

## COMPREHENSIVE SERVICES

We offer competitive repair and calibration services, as well as easily accessible documentation and free downloadable resources.

## SELL YOUR SURPLUS

We buy new, used, decommissioned, and surplus parts from every NI series. We work out the best solution to suit your individual needs.

 Sell For Cash  Get Credit  Receive a Trade-In Deal

## OBSOLETE NI HARDWARE IN STOCK & READY TO SHIP

We stock **New**, **New Surplus**, **Refurbished**, and **Reconditioned** NI Hardware.



*Bridging the gap between the manufacturer and your legacy test system.*

 1-800-915-6216

 [www.apexwaves.com](http://www.apexwaves.com)

 [sales@apexwaves.com](mailto:sales@apexwaves.com)

*All trademarks, brands, and brand names are the property of their respective owners.*

**Request a Quote**

 **CLICK HERE**

**SCB-100**

# DAQ

## NI 651x 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*

## Worldwide Technical Support and Product Information

[ni.com](http://ni.com)

## Worldwide Offices

Visit [ni.com/niglobal](http://ni.com/niglobal) to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

## National Instruments Corporate Headquarters

11500 North Mopac Expressway Austin, Texas 78759-3504 USA Tel: 512 683 0100

For further support information, refer to the [NI Services](#) appendix. To comment on NI documentation, refer to the NI website at [ni.com/info](http://ni.com/info) and enter the Info Code feedback.

# Legal Information

---

## Limited Warranty

This document is provided 'as is' and is subject to being changed, without notice, in future editions. For the latest version, refer to [ni.com/manuals](http://ni.com/manuals). NI reviews this document carefully for technical accuracy; however, NI MAKES NO EXPRESS OR IMPLIED WARRANTIES AS TO THE ACCURACY OF THE INFORMATION CONTAINED HEREIN AND SHALL NOT BE LIABLE FOR ANY ERRORS.

NI warrants that its hardware products will be free of defects in materials and workmanship that cause the product to fail to substantially conform to the applicable NI published specifications for one (1) year from the date of invoice.

For a period of ninety (90) days from the date of invoice, NI warrants that (i) its software products will perform substantially in accordance with the applicable documentation provided with the software and (ii) the software media will be free from defects in materials and workmanship.

If NI receives notice of a defect or non-conformance during the applicable warranty period, NI will, in its discretion: (i) repair or replace the affected product, or (ii) refund the fees paid for the affected product. Repaired or replaced Hardware will be warranted for the remainder of the original warranty period or ninety (90) days, whichever is longer. If NI elects to repair or replace the product, NI may use new or refurbished parts or products that are equivalent to new in performance and reliability and are at least functionally equivalent to the original part or product.

You must obtain an RMA number from NI before returning any product to NI. NI reserves the right to charge a fee for examining and testing Hardware not covered by the Limited Warranty.

This Limited Warranty does not apply if the defect of the product resulted from improper or inadequate maintenance, installation, repair, or calibration (performed by a party other than NI); unauthorized modification; improper environment; use of an improper hardware or software key; improper use or operation outside of the specification for the product; improper voltages; accident, abuse, or neglect; or a hazard such as lightning, flood, or other act of nature.

THE REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND THE CUSTOMER'S SOLE REMEDIES, AND SHALL APPLY EVEN IF SUCH REMEDIES FAIL OF THEIR ESSENTIAL PURPOSE.

EXCEPT AS EXPRESSLY SET FORTH HEREIN, PRODUCTS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND AND NI DISCLAIMS ALL WARRANTIES, EXPRESSED OR IMPLIED, WITH RESPECT TO THE PRODUCTS, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE OR NON-INFRINGEMENT, AND ANY WARRANTIES THAT MAY ARISE FROM USAGE OF TRADE OR COURSE OF DEALING. NI DOES NOT WARRANT, GUARANTEE, OR MAKE ANY REPRESENTATIONS REGARDING THE USE OF OR THE RESULTS OF THE USE OF THE PRODUCTS IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE. NI DOES NOT WARRANT THAT THE OPERATION OF THE PRODUCTS WILL BE UNINTERRUPTED OR ERROR FREE.

In the event that you and NI have a separate signed written agreement with warranty terms covering the products, then the warranty terms in the separate agreement shall control.

## Copyright

Under the copyright laws, this publication may not be reproduced or transmitted in any form, electronic or mechanical, including photocopying, recording, storing in an information retrieval system, or translating, in whole or in part, without the prior written consent of National Instruments Corporation.

National Instruments respects the intellectual property of others, and we ask our users to do the same. NI software is protected by copyright and other intellectual property laws. Where NI software may be used to reproduce software or other materials belonging to others, you may use NI software only to reproduce materials that you may reproduce in accordance with the terms of any applicable license or other legal restriction.

## End-User License Agreements and Third-Party Legal Notices

You can find end-user license agreements (EULAs) and third-party legal notices in the following locations:

- Notices are located in the <National Instruments>\\_Legal Information and <National Instruments> directories.
- EULAs are located in the <National Instruments>\Shared\MDF\Legal\license directory.
- Review <National Instruments>\\_Legal Information.txt for information on including legal information in installers built with NI products.

## U.S. Government Restricted Rights

If you are an agency, department, or other entity of the United States Government ("Government"), the use, duplication, reproduction, release, modification, disclosure or transfer of the technical data included in this manual is governed by the Restricted Rights provisions under Federal Acquisition Regulation 52.227-14 for civilian agencies and Defense Federal Acquisition Regulation Supplement Section 252.227-7014 and 252.227-7015 for military agencies.

## Trademarks

Refer to the *NI Trademarks and Logo Guidelines* at [ni.com/trademarks](http://ni.com/trademarks) for more information on NI trademarks.

ARM, Keil, and  $\mu$ Vision are trademarks or registered of ARM Ltd or its subsidiaries.

LEGO, the LEGO logo, WEDO, and MINDSTORMS are trademarks of the LEGO Group.

TETRIX by Pitsco is a trademark of Pitsco, Inc.

FIELDBUS FOUNDATION™ and FOUNDATION™ are trademarks of the Fieldbus Foundation.

EtherCAT® is a registered trademark of and licensed by Beckhoff Automation GmbH.

CANopen® is a registered Community Trademark of CAN in Automation e.V.

DeviceNet™ and EtherNet/IP™ are trademarks of ODVA.

Go!, SensorDAQ, and Vernier are registered trademarks of Vernier Software & Technology. Vernier Software & Technology and [vernier.com](http://vernier.com) are trademarks or trade dress.

Xilinx is the registered trademark of Xilinx, Inc.

Taptite and Trilobular are registered trademarks of Research Engineering & Manufacturing Inc.

FireWire® is the registered trademark of Apple Inc.

Linux® is the registered trademark of Linus Torvalds in the U.S. and other countries.

Handle Graphics®, MATLAB®, Simulink®, Stateflow®, and xPC TargetBox® are registered trademarks, and Simulink Coder™, TargetBox™, and Target Language Compiler™ are trademarks of The MathWorks, Inc.

Tektronix®, Tek, and Tektronix, Enabling Technology are registered trademarks of Tektronix, Inc.

The Bluetooth® word mark is a registered trademark owned by the Bluetooth SIG, Inc.

The ExpressCard™ word mark and logos are owned by PCMCIA and any use of such marks by National Instruments is under license.

The mark LabWindows is used under a license from Microsoft Corporation. Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

Other product and company names mentioned herein are trademarks or trade names of their respective companies.

Members of the National Instruments Alliance Partner Program are business entities independent from NI and have no agency, partnership, or joint-venture relationship with NI.

## Patents

For patents covering NI products/technology, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your media, or the *National Instruments Patent Notice* at [ni.com/patents](http://ni.com/patents).

## Export Compliance Information

Refer to the *Export Compliance Information* at [ni.com/legal/export-compliance](http://ni.com/legal/export-compliance) for the NI global trade compliance policy and how to obtain relevant HTS codes, ECCNs, and other import/export data.

## WARNING REGARDING USE OF NATIONAL INSTRUMENTS PRODUCTS

YOU ARE ULTIMATELY RESPONSIBLE FOR VERIFYING AND VALIDATING THE SUITABILITY AND RELIABILITY OF THE PRODUCTS WHENEVER THE PRODUCTS ARE INCORPORATED IN YOUR SYSTEM OR APPLICATION, INCLUDING THE APPROPRIATE DESIGN, PROCESS, AND SAFETY LEVEL OF SUCH SYSTEM OR APPLICATION.

PRODUCTS ARE NOT DESIGNED, MANUFACTURED, OR TESTED FOR USE IN LIFE OR SAFETY CRITICAL SYSTEMS, HAZARDOUS ENVIRONMENTS OR ANY OTHER ENVIRONMENTS REQUIRING FAIL-SAFE PERFORMANCE, INCLUDING IN THE OPERATION OF NUCLEAR FACILITIES; AIRCRAFT NAVIGATION; AIR TRAFFIC CONTROL SYSTEMS; LIFE SAVING OR LIFE SUSTAINING SYSTEMS OR SUCH OTHER MEDICAL DEVICES; OR ANY OTHER APPLICATION IN WHICH THE FAILURE OF THE PRODUCT OR SERVICE COULD LEAD TO DEATH, PERSONAL INJURY, SEVERE PROPERTY DAMAGE OR ENVIRONMENTAL HARM (COLLECTIVELY, "HIGH-RISK USES"). FURTHER, PRUDENT STEPS MUST BE TAKEN TO PROTECT AGAINST FAILURES, INCLUDING PROVIDING BACK-UP AND SHUT-DOWN MECHANISMS. NI EXPRESSLY DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY OF FITNESS OF THE PRODUCTS OR SERVICES FOR HIGH-RISK USES.

# Contents

---

## About This Manual

Related Documentation .....	ix
-----------------------------	----

## Chapter 1

### NI 651x Fundamentals

NI 651x Configuration .....	1-1
NI 651x Functional Overview .....	1-2

## Chapter 2

### NI 651x Features

Digital Filtering .....	2-1
Digital Filtering Example .....	2-2
Programmable Power-Up States .....	2-2
Change Detection .....	2-3
Change Detection Example .....	2-3
Watchdog Timer .....	2-4

## Chapter 3

### Digital I/O

I/O Connector .....	3-1
NI 6510 I/O Connector .....	3-1
NI 6511 I/O Connector .....	3-1
NI 6512/6513 I/O Connector .....	3-2
NI 6514/6515 I/O Connector .....	3-2
NI 6516/6517 I/O Connector .....	3-3
NI 6518/6519 I/O Connector .....	3-3
Pin Assignments .....	3-5
NI 6510 Pin Assignments .....	3-5
NI 6511 SH100-100-F Pin Assignments .....	3-6
NI 6511 R1005050 Pin Assignments .....	3-8
NI 6512 SH100-100-F Pin Assignments .....	3-8
NI 6512 R1005050 Pin Assignments .....	3-10
NI 6513 SH100-100-F Pin Assignments .....	3-10
NI 6513 R1005050 Pin Assignments .....	3-12
NI 6514 SH100-100-F Pin Assignments .....	3-12
NI 6514 R1005050 Pin Assignments .....	3-14
NI 6515 SH100-100-F Pin Assignments .....	3-14
NI 6515 R1005050 Pin Assignments .....	3-16
NI 6516 Pin Assignments .....	3-17
NI 6517 Pin Assignments .....	3-18
NI 6518 Pin Assignments .....	3-19

NI 6519 Pin Assignments .....	3-20
Signal Descriptions .....	3-21
NI 6510 Signal Descriptions .....	3-21
NI 6511 Signal Descriptions .....	3-21
NI 6512 Signal Descriptions .....	3-22
NI 6513 Signal Descriptions .....	3-23
NI 6514 Signal Descriptions .....	3-23
NI 6515 Signal Descriptions .....	3-25
NI 6516 Signal Descriptions .....	3-26
NI 6517 Signal Descriptions .....	3-26
NI 6518 Signal Descriptions .....	3-27
NI 6519 Signal Descriptions .....	3-27

## Chapter 4

### Power Connections

Isolation .....	4-1
NI 6510 .....	4-1
NI 6511 .....	4-1
NI 6512/6513 .....	4-1
NI 6514/6515 .....	4-1
NI 6516/6517 .....	4-1
NI 6518/6519 .....	4-1
Optically Isolated Inputs (NI 6510/6511/6514/6515/6518/6519) .....	4-2
Sensing DC Voltages .....	4-2
Input Signal Connection Example .....	4-2
Optically Isolated Outputs with Darlington Arrays (NI 6512/6513/6514/6515/6516/6517/6518/6519) .....	4-4
Power-On and Power-Off Conditions .....	4-4
Output Signal Connection Example (Sourcing Current) .....	4-5
Distributing Current (NI 6516/6518 Only) .....	4-6
Output Signal Connection Example (Sinking Current) .....	4-7
Distributing Current (NI 6517/6519 Only) .....	4-9

## Chapter 5

### Cables and Accessories

Accessories for 37-Pin Devices .....	5-1
NI SH37F-37M Cable .....	5-2
Accessories for 100-Pin Devices .....	5-2
SH100-100-F Cable .....	5-2
R1005050 Ribbon Cable .....	5-2

Appendix A  
NI Services

Glossary

Index



# 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.

## 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](http://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](http://ni.com/manuals).

---

# NI 651x 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.

## NI 651x Configuration

---

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

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

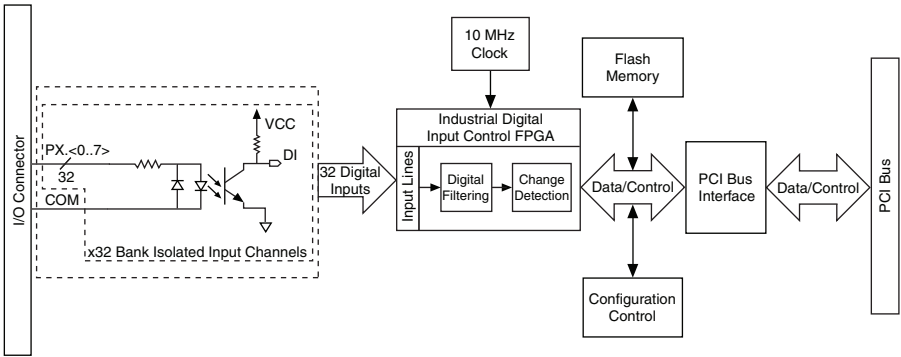
If the DAQ device does not appear in MAX, use the following troubleshooting guidelines.

- 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](http://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.

## NI 651x Functional Overview

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

**Figure 1-1. NI 6510 Block Diagram**



**Figure 1-2. NI 6511 Block Diagram**

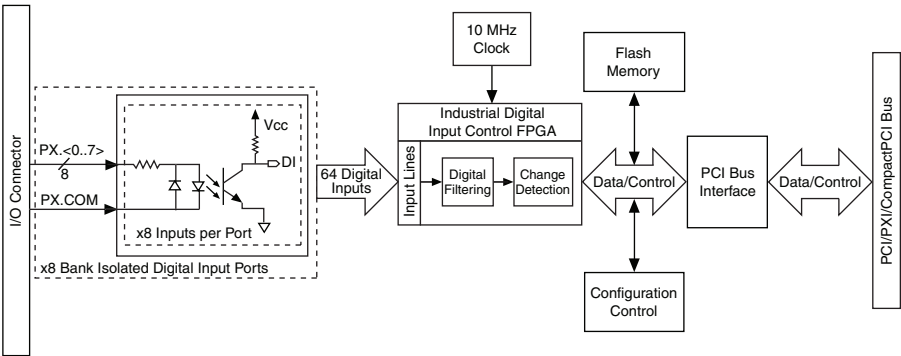


Figure 1-3. NI 6512 Block Diagram

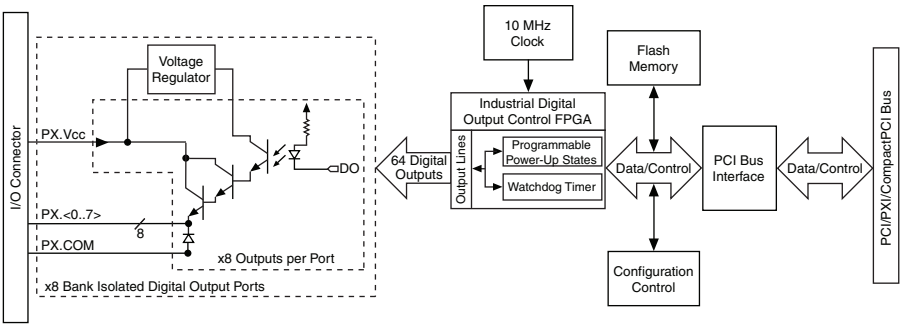


Figure 1-4. NI 6513 Block Diagram

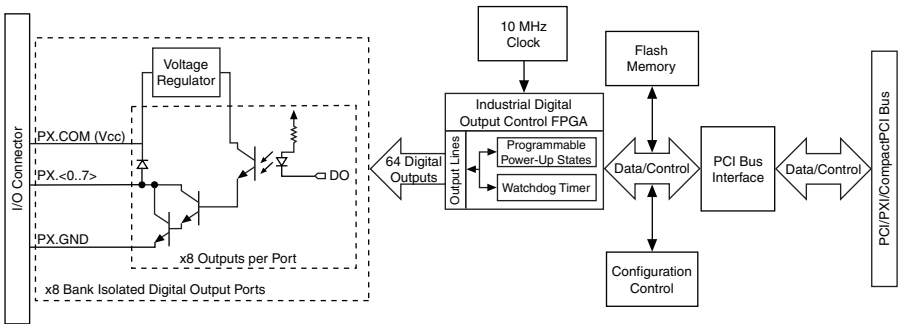


Figure 1-5. NI 6514 Block Diagram

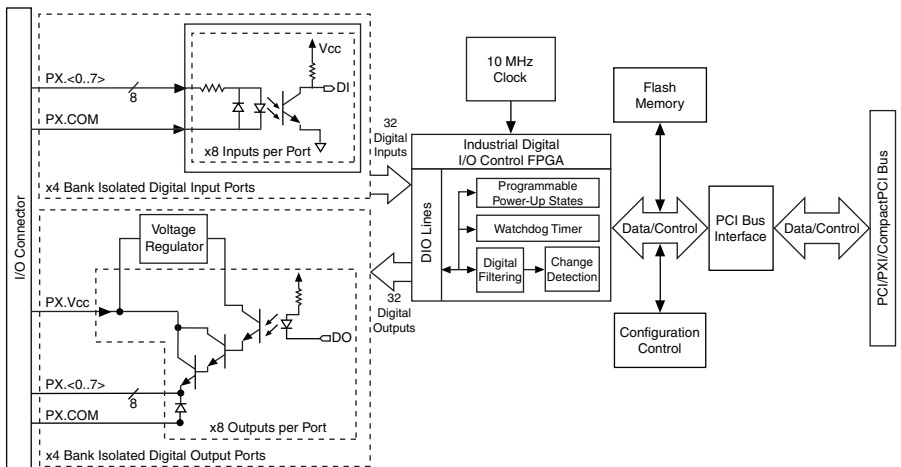


Figure 1-6. NI 6515 Block Diagram

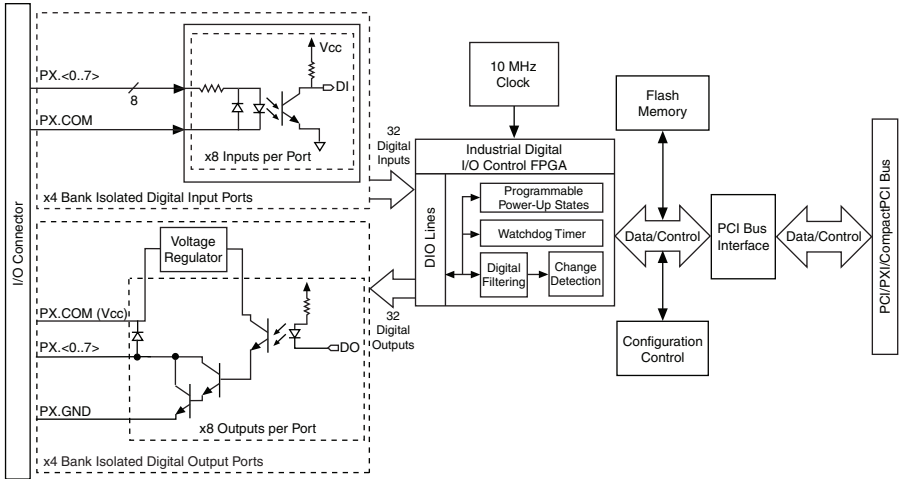


Figure 1-7. NI 6516 Block Diagram

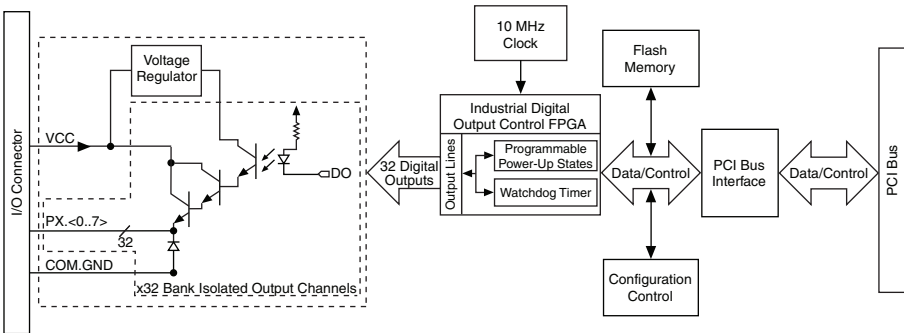


Figure 1-8. NI 6517 Block Diagram

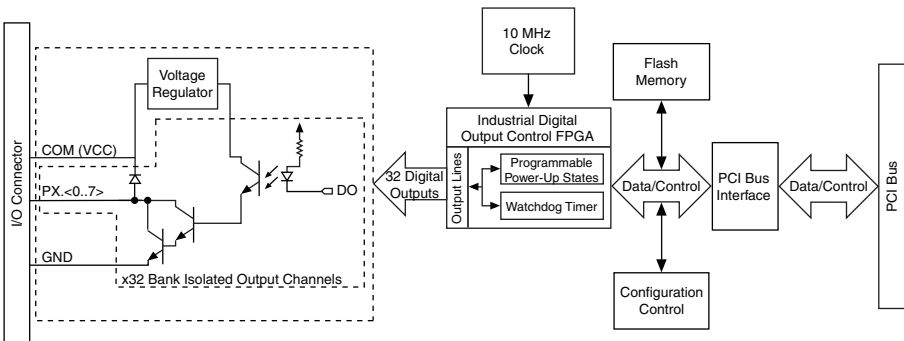


Figure 1-9. NI 6518 Block Diagram

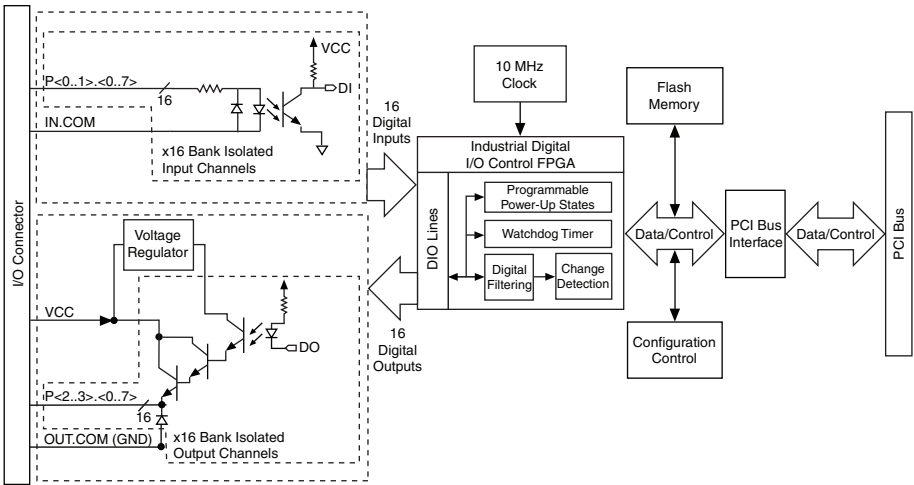
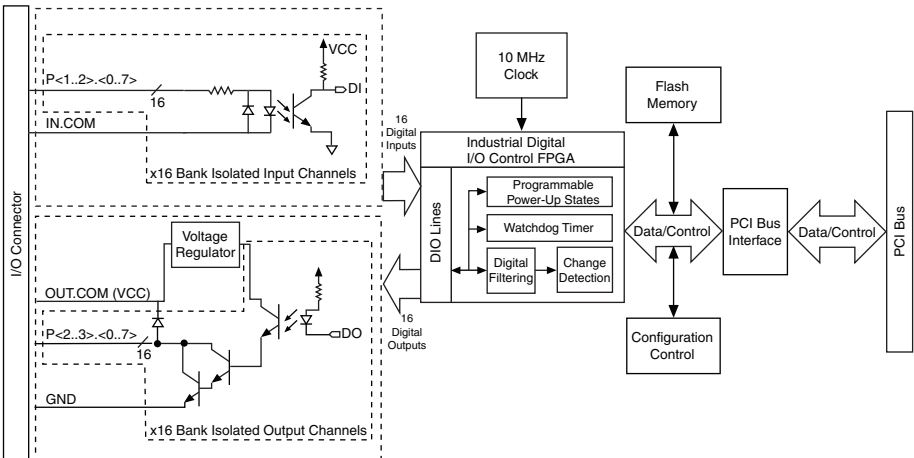


Figure 1-10. NI 6519 Block Diagram



# NI 651x Features

This chapter describes the National Instruments digital I/O features available for NI 651x 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](http://ni.com/info) and enter the code `rdcidi`.

## Digital Filtering

Use the digital filter option available on the NI 651x 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 651x Digital Filter Timing Intervals

Filter Interval	Pulse Width Passed		Pulse Width Blocked	
	Low Pulse	High Pulse	Low Pulse	High Pulse
$t_{\text{interval}}$	$t_{\text{interval}} + 200 \mu\text{s}$	$t_{\text{interval}}$	$t_{\text{interval}}/2$	$(t_{\text{interval}}/2) - 200 \mu\text{s}$

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  $\mu\text{s}$  to 200 ms.

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.

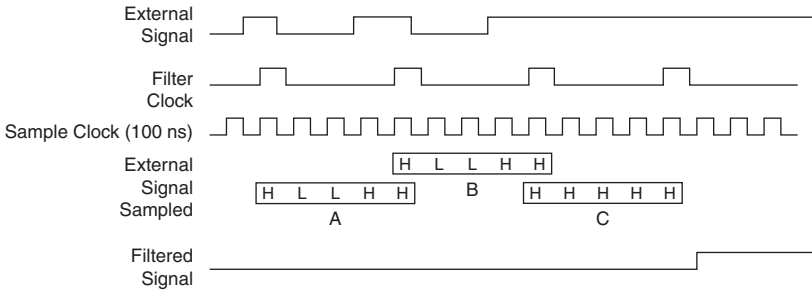


The filter clock is programmable and allows you to control how long a pulse must last to be recognized. The sample clock provides a fast sample rate to ensure that input pulses remain constant between filter clocks.

## Digital Filtering Example

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

## Programmable Power-Up States

At power-up, the output drives on the NI 651x 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 651x 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 651x 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.

## 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
<b>Changes to detect</b>	↕	↕	↕	↕	—	—	↑	↓
<b>Enable rising-edge detection</b>	yes	yes	yes	yes	no	no	yes	no
<b>Enable falling-edge detection</b>	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.

## 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 651x device.



**Note** The NI-DAQmx Watchdog feature is meant to protect a system from software errors and hangs. In the case of a PXI system with remote control through MXI, a lost MXI connection could result in unexpected Watchdog behavior and therefore improperly implemented Watchdog states.

When the watchdog timer is enabled, if the NI 651x 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 651x 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 651x 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.

---

# 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](http://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*.



**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](http://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<sub>X</sub>.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<sub>X</sub>.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](http://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 (GND) to ground, and cross a load between digital output and COM (GND).

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 (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 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](http://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 PX.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 PX.COM.

The output lines on the NI 6514 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 6515 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 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](http://ni.com/manuals), for information about maximum input ratings.

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](http://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 consist of photocouplers and Darlington arrays. To connect to these signals, connect a 5 V to 30 V power supply to VCC, connect OUT.COM (GND) to ground, and cross a load between digital output and OUT.COM (GND).

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

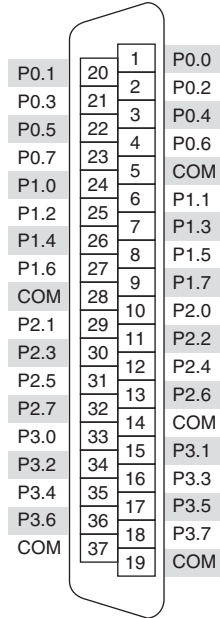
For more information, refer to the [Pin Assignments](#) section.

# 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  $PX.Y$ , 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  $PX.Y$ , where  $X$  is the port (P) number, and  $Y$  is the line number or name.

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

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

NC = No Connect

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 *PX.Y*, where *X* is the port (P) number, and *Y* is the line number or name.

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

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	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

For more information on the NI 6511 signals, refer to the [Signal Descriptions](#) section.

## 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 *PX.Y*, where *X* is the port (P) number, and *Y* is the line number or name.

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

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

NC = No Connect

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 *PX.Y*, where *X* is the port (P) number, and *Y* is the line number or name.

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

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

NC = No Connect

For more information on the NI 6512 signals, refer to the [Signal Descriptions](#) section.

## 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 *PX.Y*, where *X* is the port (P) number, and *Y* is the line number or name.

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

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

NC = No Connect

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.

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

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

For more information on the NI 6513 signals, refer to the [Signal Descriptions](#) section.

## 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.

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

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

NC = No Connect



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 *PX.Y*, where *X* is the port (P) number, and *Y* is the line number or name.

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

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

For more information on the NI 6514 signals, refer to the [Signal Descriptions](#) section.

## 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 *PX.Y*, where *X* is the port (P) number, and *Y* is the line number or name.

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

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

NC = No Connect

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 *PX.Y*, where *X* is the port (P) number, and *Y* is the line number or name.

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

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

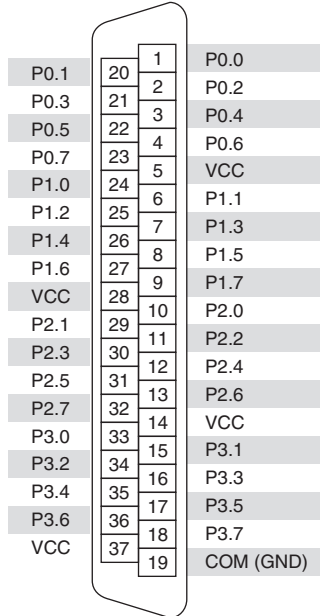
NC = No Connect

For more information on the NI 6515 signals, refer to the [Signal Descriptions](#) section.

## 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  $PX.Y$ , where  $X$  is the port (P) number, and  $Y$  is the line number or name.

**Figure 3-12.** NI 6516 Pin Assignments

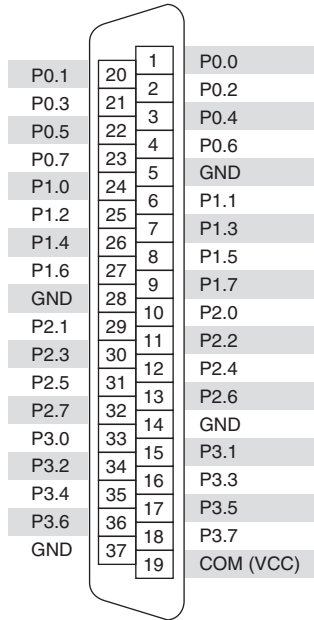


For more information on the NI 6516 signals, refer to the [Signal Descriptions](#) section.

## 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  $PX.Y$ , where  $X$  is the port (P) number, and  $Y$  is the line number or name.

**Figure 3-13.** NI 6517 Pin Assignments

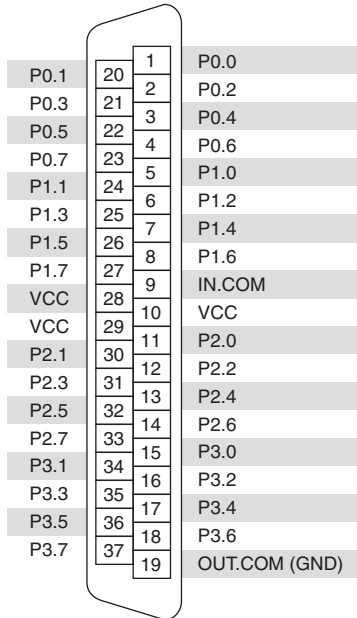


For more information on the NI 6517 signals, refer to the [Signal Descriptions](#) section.

## 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  $PX.Y$ , where  $X$  is the port (P) number, and  $Y$  is the line number or name.

**Figure 3-14.** NI 6518 Pin Assignments

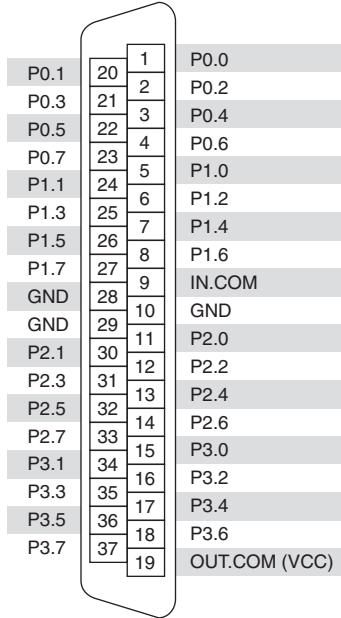


For more information on the NI 6518 signals, refer to the [Signal Descriptions](#) section.

# 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.

# 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 ports 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 ports 0 through 7
25, 50, 75, 100	NC	—	No connection



# 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 ports 0 through 7
9, 21, 34, 46, 59, 71, 84, 96	P<0..7>.COM (GND)	Input	Ground for ports 0 through 7; isolated from the computer power supply
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 ports 0 through 7
25, 75	NC	—	No connection
50, 100	P<6..7>.+5V	Output	+5 V for ports 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 ports 0 through 7
9, 21, 34, 46, 59, 71, 84, 96	P<0..7>.COM (VCC)	Input	Power lines for ports 0 through 7
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 ports 0 through 7; isolated from the computer power supply
25, 75	NC	—	No connection
50, 100	P<6..7>.+5V	Output	+5 V for ports 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 port 0
9, 10, 11, 12	P0.COM	Input	Common lines for port 0
51, 52, 53, 54, 55, 56, 57, 58	P1.<0..7>	Input	Data lines for port 1
59, 60, 61, 62	P1.COM	Input	Common lines for port 1
13, 14, 15, 16, 17, 18, 19, 20	P2.<0..7>	Input	Data lines for port 2
21, 22, 23, 24	P2.COM	Input	Common lines for port 2

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

Pin Number	Signal Name	Input or Output	Signal Description
63, 64, 65, 66, 67, 68, 69, 70	P3.<0..7>	Input	Data lines for port 3
71, 72, 73, 74	P3.COM	Input	Common lines for port 3
25, 75	NC	—	No connection
26, 27, 28, 29, 30, 31, 32, 33	P4.<0..7>	Output	Data lines for port 4
34	P4.COM (GND)	Input	Ground for port 4; isolated from the computer power supply
35, 36, 37	P4.VCC	Input	Power lines for port 4
76, 77, 78, 79, 80, 81, 82, 83	P5.<0..7>	Output	Data lines for port 5
84	P5.COM (GND)	Input	Ground for port 5; isolated from the computer power supply
85, 86, 87	P5.VCC	Input	Power lines for port 5
38, 39, 40, 41, 42, 43, 44, 45	P6.<0..7>	Output	Data lines for port 6
46	P6.COM (GND)	Input	Ground for port 6; isolated from the computer power supply
47, 48, 49	P6.VCC	Input	Power lines for port 6
50	P6.+5V	Output	+5 V for port 6
88, 89, 90, 91, 92, 93, 94, 95	P7.<0..7>	Output	Data lines for port 7
96	P7.COM (GND)	Input	Ground for port 7; isolated from the computer power supply
97, 98, 99	P7.VCC	Input	Power lines for port 7
100	P7.+5V	Output	+5 V for port 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 port 0
9, 10, 11, 12	P0.COM	Input	Common lines for port 0
51, 52, 53, 54, 55, 56, 57, 58	P1.<0..7>	Input	Data lines for port 1
59, 60, 61, 62	P1.COM	Input	Common lines for port 1
13, 14, 15, 16, 17, 18, 19, 20	P2.<0..7>	Input	Data lines for port 2
21, 22, 23, 24	P2.COM	Input	Common lines for port 2
63, 64, 65, 66, 67, 68, 69, 70	P3.<0..7>	Input	Data lines for port 3
71, 72, 73, 74	P3.COM	Input	Common lines for port 3
25, 75	NC	—	No connection
26, 27, 28, 29, 30, 31, 32, 33	P4.<0..7>	Output	Data lines for port 4
34	P4.COM (VCC)	Input	Power line for port 4
35, 36, 37	P4.GND	Input	Ground for port 4; isolated from the computer power supply
76, 77, 78, 79, 80, 81, 82, 83	P5.<0..7>	Output	Data lines for port 5
84	P5.COM (VCC)	Input	Power line for port 5
85, 86, 87	P5.GND	Input	Ground for port 5; isolated from the computer power supply
38, 39, 40, 41, 42, 43, 44, 45	P6.<0..7>	Output	Data lines for port 6
46	P6.COM (VCC)	Input	Power line for port 6
47, 48, 49	P6.GND	Input	Ground for port 6; isolated from the computer power supply
50	P6.+5V	Output	+5 V for port 6
88, 89, 90, 91, 92, 93, 94, 95	P7.<0..7>	Output	Data lines for port 7

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

Pin Number	Signal Name	Input or Output	Signal Description
96	P7.COM (VCC)	Input	Power line for port 7
97, 98, 99	P7.GND	Input	Ground for port 7; isolated from the computer power supply
100	P7.+5V	Output	+5 V for port 7

## 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

**Table 3-8.** NI 6517 Signal Descriptions (Continued)

Pin Number	Signal Name	Input or Output	Signal Description
19	COM (VCC)	Input	Power line for all ports
5, 14, 28, 37	GND	Input	Ground for all ports

## 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

**Table 3-10.** NI 6519 Signal Descriptions (Continued)

<b>Pin Number</b>	<b>Signal Name</b>	<b>Input or Output*</b>	<b>Signal Description</b>
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.			

---

# 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<sub>X</sub>.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<sub>X</sub>.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<sub>X</sub>.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.

### 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 V DC.

### Sensing DC Voltages

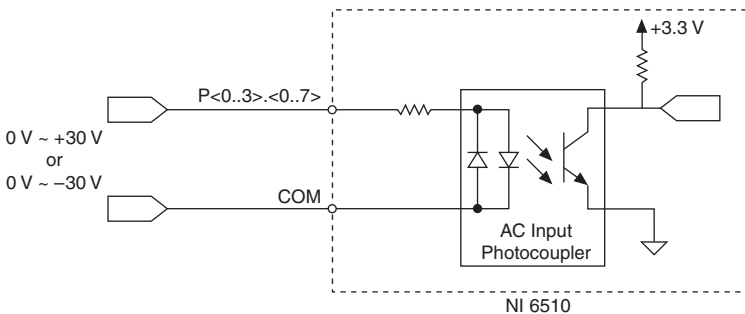
**(NI 6510/6511/6514/6515/6518/6519 only)** These devices can sense DC signals from 11 V to DC power supply levels up to 30 V.

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.

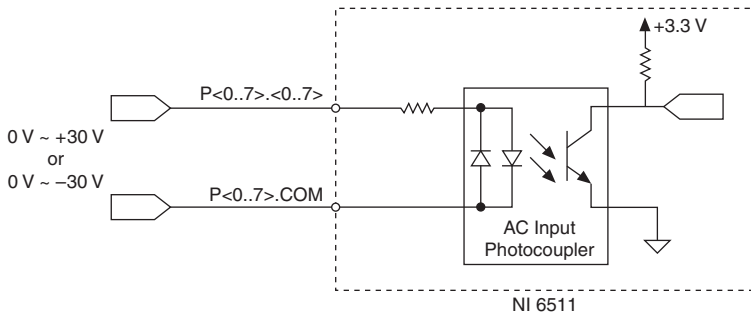
### Input Signal Connection Example

**(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](http://ni.com/manuals), for information about voltage ranges.

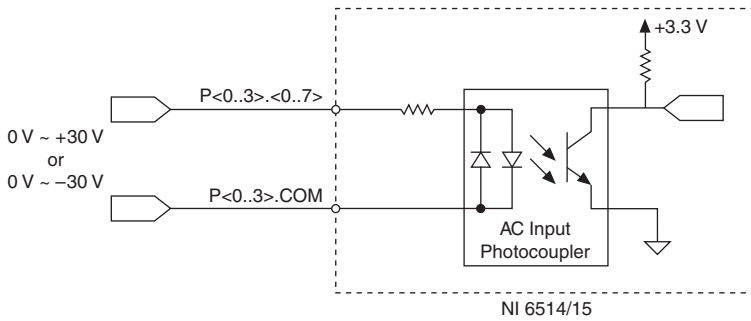
**Figure 4-1.** NI 6510 Signal Connection Example



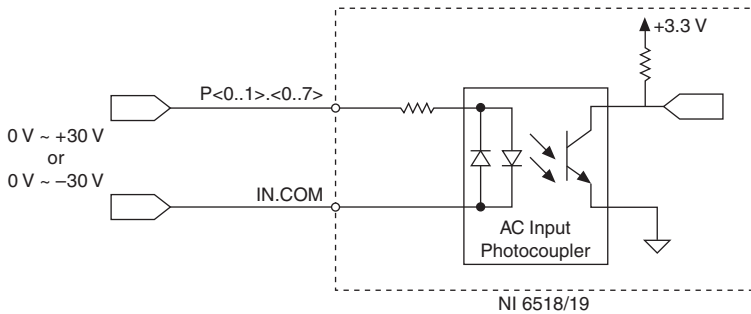
**Figure 4-2. NI 6511 Input Signal Connection Example**



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



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



# 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)** In order to use the +5 V isolated power lines on Bank 6 or Bank 7, you must connect an external power supply over +8 V on Bank 6 or 7 respectively.



**Note** The maximum external voltage on these lines is 30 V DC.



**Note** The power at the I/O connector is derived from the output Vcc (user-provided). The output Vcc must be greater than 10 V DC to ensure that the output voltage is in the range of +4.3 V DC to +6.3 V DC



**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.

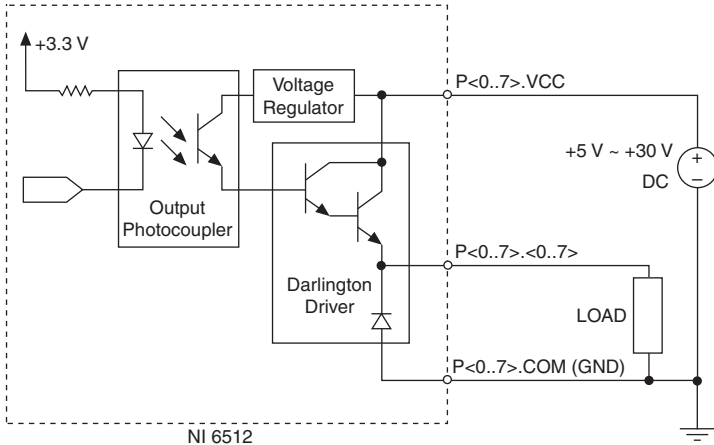
## Power-On and Power-Off Conditions

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

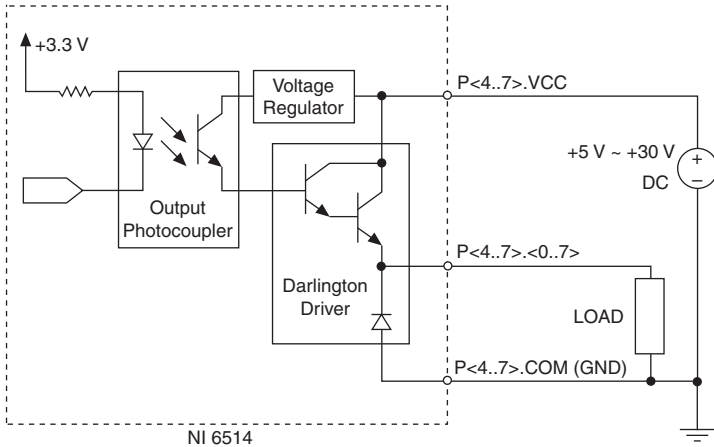
# Output Signal Connection Example (Sourcing Current)

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

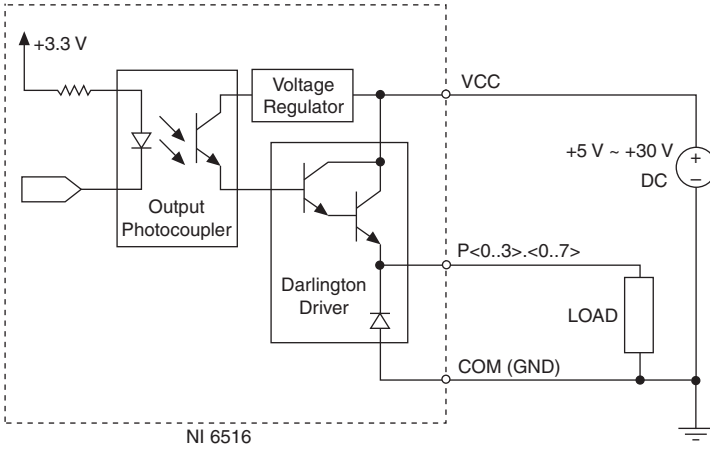
**Figure 4-5.** NI 6512 Output Signal Connection Example



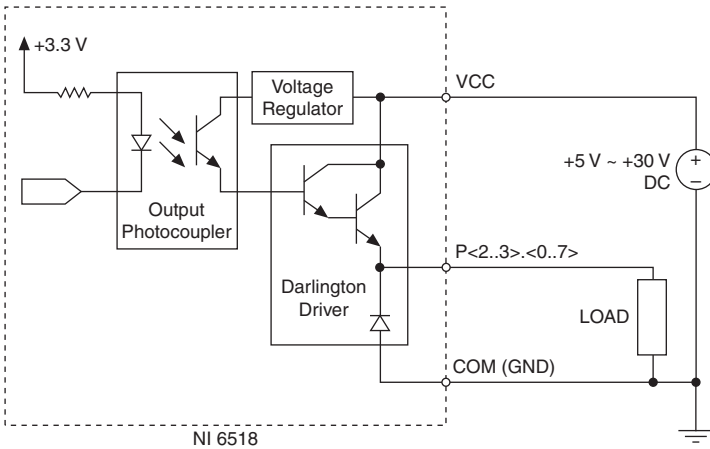
**Figure 4-6.** NI 6514 Output Signal Connection Example



**Figure 4-7. NI 6516 Output Signal Connection Example**



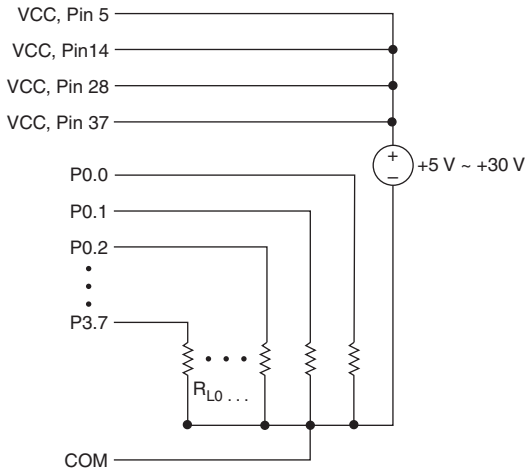
**Figure 4-8. NI 6518 Output Signal Connection Example**



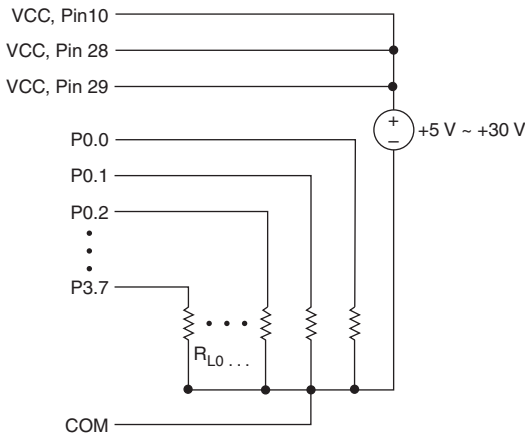
### Distributing Current (NI 6516/6518 Only)

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



**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)

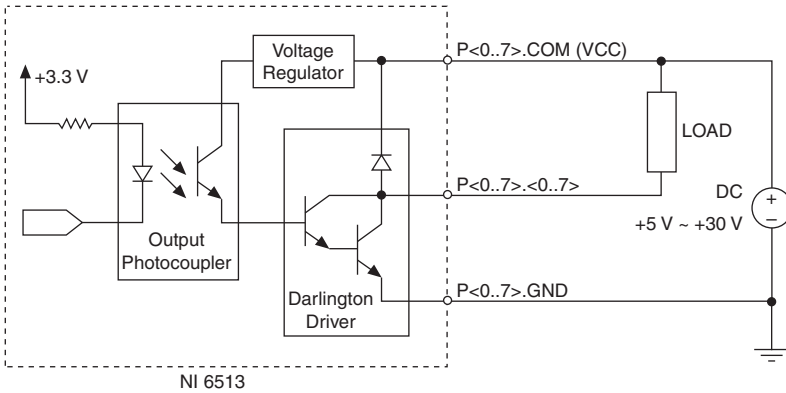
The following figures show examples of driving a load with the photocouplers and Darlington arrays (sinking current).



**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

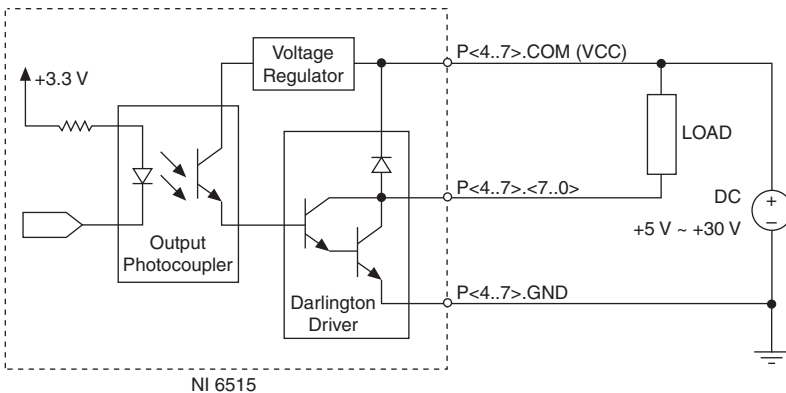
power supply. Failure to do so could permanently damage the NI 6513 device and the power supply if it is not protected.

**Figure 4-11.** NI 6513 Output Signal Connection Example



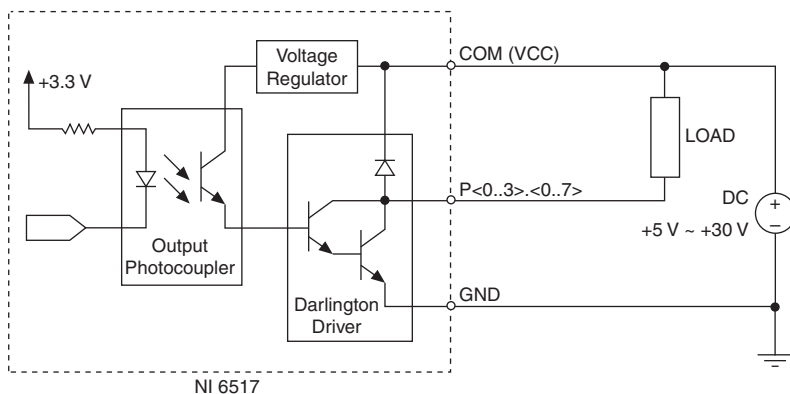
**Caution** Make sure that **P<4..7>.COM (VCC)** is connected to the positive pole of the power supply and that **P<4..7>.GND** is connected to the negative pole of the power supply. Failure to do so could permanently damage the NI 6515 device and the power supply if it is not protected.

**Figure 4-12.** NI 6515 Output Signal Connection Example



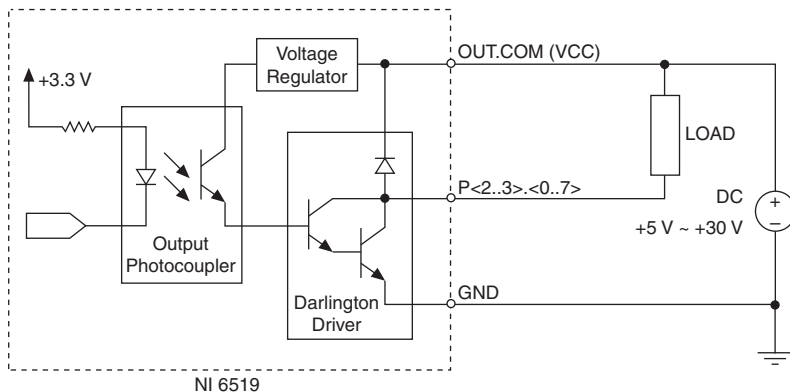
**Caution** Make sure that **COM (VCC)** is connected to the positive pole of the power supply and that **GND** is connected to the negative pole of the power supply. Failure to do so could permanently damage the NI 6517 device and the power supply if it is not protected.

Figure 4-13. NI 6517 Output Signal Connection Example



**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

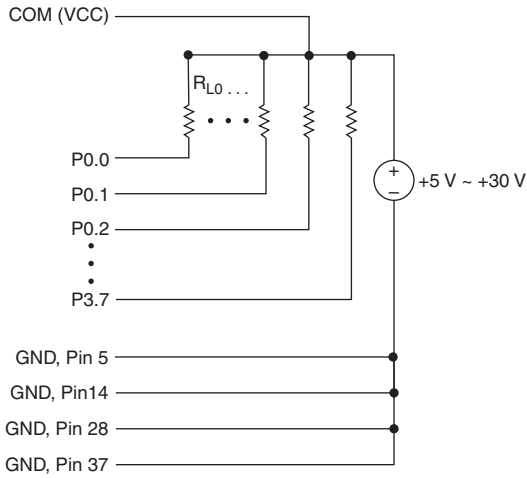


## Distributing Current (NI 6517/6519 Only)

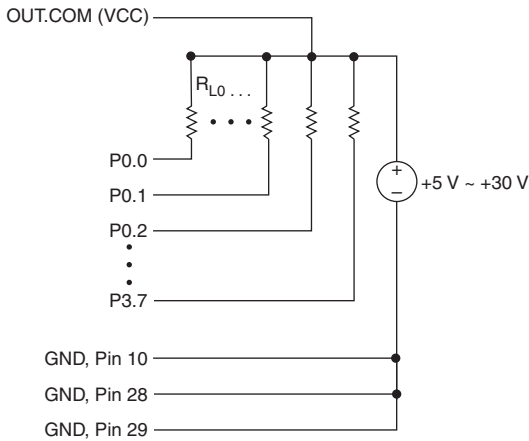
In applications that drive many high-current loads, a large amount of current must be returned on the GND pins. When connecting the NI 6517/6519 to multiple loads, physically connect to all GND pins on the device, as shown in Figure 4-15 and Figure 4-16. Connecting to all GND pins distributes the current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



**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.

---

# Cables and Accessories

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



**Caution** For compliance with Electromagnetic Compatibility (EMC) requirements, this product must be operated with shielded cables and accessories. If unshielded cables or accessories are used, the EMC specifications are no longer guaranteed unless all unshielded cables and/or accessories are installed in a shielded enclosure with properly designed and shielded input/output ports.

---

## Accessories for 37-Pin Devices

National Instruments offers the following connectivity options for use with 37-pin safety low voltage ( $\leq 60$  V DC/42.4 V peak/30 V RMS) 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](http://ni.com).

## NI SH37F-37M Cable

The NI SH37F-37M cable is a 37-pin shielded cable that provides direct connection to 37-pin 651x 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 V DC, 42.4 V peak, or 30 V RMS).

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](http://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.

### 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.



---

# NI Services

NI provides global services and support as part of our commitment to your success. Take advantage of product services in addition to training and certification programs that meet your needs during each phase of the application life cycle; from planning and development through deployment and ongoing maintenance.

To get started, register your product at [ni.com/myproducts](https://ni.com/myproducts).

As a registered NI product user, you are entitled to the following benefits:

- Access to applicable product services.
- Easier product management with an online account.
- Receive critical part notifications, software updates, and service expirations.

Log in to your MyNI user profile to get personalized access to your services.

## Services and Resources

---

- **Maintenance and Hardware Services**—NI helps you identify your systems' accuracy and reliability requirements and provides warranty, sparing, and calibration services to help you maintain accuracy and minimize downtime over the life of your system. Visit [ni.com/services](https://ni.com/services) for more information.
  - **Warranty and Repair**—All NI hardware features a one-year standard warranty that is extendable up to five years. NI offers repair services performed in a timely manner by highly trained factory technicians using only original parts at an NI service center.
  - **Calibration**—Through regular calibration, you can quantify and improve the measurement performance of an instrument. NI provides state-of-the-art calibration services. If your product supports calibration, you can obtain the calibration certificate for your product at [ni.com/calibration](https://ni.com/calibration).
- **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](https://ni.com/alliance).

- **Training and Certification**—The NI training and certification program is the most effective way to increase application development proficiency and productivity. Visit [ni.com/training](https://ni.com/training) for more information.
  - The Skills Guide assists you in identifying the proficiency requirements of your current application and gives you options for obtaining those skills consistent with your time and budget constraints and personal learning preferences. Visit [ni.com/skills-guide](https://ni.com/skills-guide) to see these custom paths.
  - NI offers courses in several languages and formats including instructor-led classes at facilities worldwide, courses on-site at your facility, and online courses to serve your individual needs.
- **Technical Support**—Support at [ni.com/support](https://ni.com/support) includes the following resources:
  - **Self-Help Technical Resources**—Visit [ni.com/support](https://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](https://ni.com/forums). NI Applications Engineers make sure every question submitted online receives an answer.
  - **Software Support Service Membership**—The Standard Service Program (SSP) is a renewable one-year subscription included with almost every NI software product, including NI Developer Suite. This program entitles members to direct access to NI Applications Engineers through phone and email for one-to-one technical support, as well as exclusive access to online training modules at [ni.com/self-paced-training](https://ni.com/self-paced-training). NI also offers flexible extended contract options that guarantee your SSP benefits are available without interruption for as long as you need them. Visit [ni.com/ssp](https://ni.com/ssp) for more information.
- **Declaration of Conformity (DoC)**—A DoC is our claim of compliance with the Council of the European Communities using the manufacturer’s declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting [ni.com/certification](https://ni.com/certification).

For information about other technical support options in your area, visit [ni.com/services](https://ni.com/services), or contact your local office at [ni.com/contact](https://ni.com/contact).

You also can visit the Worldwide Offices section of [ni.com/niglobal](https://ni.com/niglobal) to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

# Glossary

---

Symbol	Prefix	Value
n	nano	$10^{-9}$
$\mu$	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

## 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
-----	----------------------

## 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.

V DC                     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.

VI                        input voltage

## W

W                        watts

# Index

---

## A

### accessories

- for 100-pin devices, 5-2
- for 37-pin devices, 5-1

## B

block diagrams. *See* functional overview

## C

change detection, 2-3

    example, 2-3

components. *See* functional overview

configuration, 1-1

## D

digital filtering, 2-1

    example, 2-2

digital I/O

    NI 6510, 3-1

    NI 6511, 3-1

    NI 6512/6513, 3-2

    NI 6514/6515, 3-2

    NI 6516/6517, 3-3

    NI 6518/6519, 3-3

distributing current

    NI 6516, 4-6

    NI 6517, 4-9

    NI 6518, 4-6

    NI 6519, 4-9

## F

functional overview

    NI 6510 (figure), 1-2

    NI 6511 (figure), 1-2

    NI 6512 (figure), 1-3

    NI 6513 (figure), 1-3

    NI 6514 (figure), 1-3

    NI 6515 (figure), 1-4

    NI 6516 (figure), 1-4

    NI 6517 (figure), 1-4

    NI 6518 (figure), 1-5

    NI 6519 (figure), 1-5

fundamentals

    NI 6510, 1-1

    NI 6511, 1-1

    NI 6512/6513, 1-1

    NI 6514/6515, 1-1

    NI 6516/6517, 1-1

    NI 6518/6519, 1-1

## I

I/O connector

    NI 6510, 3-1

    NI 6511, 3-1

    NI 6512/6513, 3-2

    NI 6514/6515, 3-2

    NI 6516/6517, 3-3

    NI 6518/6519, 3-3

input signal connection example, 4-2

    NI 6510 (figure), 4-2

    NI 6511 (figure), 4-3

    NI 6514/6515 (figure), 4-3

    NI 6518/6519 (figure), 4-3

isolation

    NI 6510, 4-1

    NI 6511, 4-1

    NI 6512/6513, 4-1

    NI 6514/6515, 4-1

    NI 6516/6517, 4-1

    NI 6518/6519, 4-1

## N

NI 6510

    change detection, 2-3

    digital filtering, 2-1

    functional overview (figure), 1-2

    fundamentals, 1-1

    optically isolated inputs, 4-2

    pin assignments, 3-5

    signal descriptions, 3-21

NI 6511

    change detection, 2-3

    digital filtering, 2-1

- functional overview (figure), 1-2
- optically isolated inputs, 4-2
- pin assignments
  - for the R1005050 cable, 3-8
  - for the SH100-100-F cable, 3-6
- signal descriptions, 3-21
- NI 6512
  - functional overview (figure), 1-3
  - optically isolated outputs with
    - Darlington arrays, 4-4
  - pin assignments
    - for the R1005050 cable, 3-10
    - for the SH100-100-F cable, 3-8
  - programmable power-up states, 2-2
  - signal descriptions, 3-22
  - watchdog timer, 2-4
- NI 6513
  - functional overview (figure), 1-3
  - optically isolated outputs with
    - Darlington arrays, 4-4
  - pin assignments
    - for the R1005050 cable, 3-12
    - for the SH100-100-F cable, 3-10
  - programmable power-up states, 2-2
  - signal descriptions, 3-23
  - watchdog timer, 2-4
- NI 6514
  - change detection, 2-3
  - digital filtering, 2-1
  - functional overview (figure), 1-3
  - optically isolated inputs, 4-2
  - optically isolated outputs with
    - Darlington arrays, 4-4
  - pin assignments
    - for the R1005050 cable, 3-14
    - for the SH100-100-F cable, 3-12
  - programmable power-up states, 2-2
  - signal descriptions, 3-23
  - watchdog timer, 2-4
- NI 6515
  - change detection, 2-3
  - digital filtering, 2-1
  - functional overview (figure), 1-4
  - optically isolated inputs, 4-2
  - optically isolated outputs with
    - Darlington arrays, 4-4
  - pin assignments, 3-17
  - programmable power-up states, 2-2
  - signal descriptions, 3-26
  - watchdog timer, 2-4
- NI 6516
  - functional overview (figure), 1-4
  - optically isolated outputs with
    - Darlington arrays, 4-4
  - pin assignments, 3-17
  - programmable power-up states, 2-2
  - signal descriptions, 3-25
  - watchdog timer, 2-4
- NI 6517
  - functional overview (figure), 1-4
  - optically isolated outputs with
    - Darlington arrays, 4-4
  - pin assignments, 3-18
  - programmable power-up states, 2-2
  - signal descriptions, 3-26
  - watchdog timer, 2-4
- NI 6518
  - change detection, 2-3
  - digital filtering, 2-1
  - functional overview (figure), 1-5
  - optically isolated inputs, 4-2
  - optically isolated outputs with
    - Darlington arrays, 4-4
  - pin assignments, 3-19
  - programmable power-up states, 2-2
  - signal descriptions, 3-27
  - watchdog timer, 2-4
- NI 6519
  - change detection, 2-3
  - digital filtering, 2-1
  - functional overview (figure), 1-5
  - optically isolated inputs, 4-2
  - optically isolated outputs with
    - Darlington arrays, 4-4
  - pin assignments, 3-20
  - programmable power-up states, 2-2
  - signal descriptions, 3-27

- watchdog timer, 2-4
- NI 651x features
  - change detection, 2-3
    - example, 2-3
  - digital filtering, 2-1
    - example, 2-2
  - programmable power-up states, 2-2
    - watchdog timer, 2-4
- NI SH37F-37M cable, 5-2

## O

- optically isolated inputs, 4-2
- optically isolated outputs with Darlington arrays, 4-4
  - distributing current
    - NI 6516, 4-6
    - NI 6517, 4-9
    - NI 6518, 4-6
    - NI 6519, 4-9
  - output signal connection example
    - sinking current, 4-7
    - sourcing current, 4-5
  - power-on and power-off conditions, 4-4
- output signal connection example
  - sinking current, 4-7
    - NI 6513 (figure), 4-8
    - NI 6515 (figure), 4-8
    - NI 6517 (figure), 4-9
    - NI 6519 (figure), 4-9
  - sourcing current, 4-5
    - NI 6512 (figure), 4-5
    - NI 6514 (figure), 4-5
    - NI 6516 (figure), 4-6
    - NI 6518 (figure), 4-6

## P

- pin assignments
  - NI 6510, 3-5
  - NI 6511
    - for the R1005050 cable, 3-8
    - for the SH100-100-F cable, 3-6
  - NI 6512
    - for the R1005050 cable, 3-10
    - for the SH100-100-F cable, 3-8
  - NI 6513

- for the R1005050 cable, 3-12
- for the SH100-100-F cable, 3-10
- NI 6514
  - for the R1005050 cable, 3-14
  - for the SH100-100-F cable, 3-12
- NI 6515
  - for the R1005050 cable, 3-16
  - for the SH100-100-F cable, 3-14
- NI 6516, 3-17
- NI 6517, 3-18
- NI 6518, 3-19
- NI 6519, 3-20

- power connections, 4-1
- power-on and power-off conditions, 4-4
- programmable power-up states, 2-2

## R

- related documentation, ix

## S

- sensing DC voltages, 4-2
- SH100-100-F cable, 5-2
- signal connection example
  - input signal connection example, 4-2
    - NI 6510 (figure), 4-2
    - NI 6511 (figure), 4-3
    - NI 6514/6515 (figure), 4-3
    - NI 6518/6519 (figure), 4-3
  - output signal connection example
    - sinking current, 4-7
      - NI 6513 (figure), 4-8
      - NI 6515 (figure), 4-8
      - NI 6517 (figure), 4-9
      - NI 6519 (figure), 4-9
    - sourcing current, 4-5
      - NI 6512 (figure), 4-5
      - NI 6514 (figure), 4-5
      - NI 6516 (figure), 4-6
      - NI 6518 (figure), 4-6
- signal descriptions
  - NI 6510, 3-21
  - NI 6511, 3-21
  - NI 6512, 3-22
  - NI 6513, 3-23
  - NI 6514, 3-23

## Index

NI 6515, 3-25

NI 6516, 3-26

NI 6517, 3-26

NI 6518, 3-27

NI 6519, 3-27

### signals

#### connection examples (input)

NI 6510, 4-2

NI 6511, 4-3

NI 6514/6515, 4-3

NI 6518/6519, 4-3

#### connection examples (output)

##### sinking current

NI 6513, 4-8

NI 6515, 4-8

NI 6517, 4-9

NI 6519, 4-9

##### sourcing current

NI 6512, 4-5

NI 6514, 4-5

NI 6516, 4-6

NI 6518, 4-6

### sinking current

#### output signal connection example, 4-7

NI 6513, 4-8

NI 6515, 4-8

NI 6517, 4-9

NI 6519, 4-9

### sourcing current

#### output signal connection example, 4-5

NI 6512, 4-5

NI 6514, 4-5

NI 6516, 4-6

NI 6518, 4-6