

USER GUIDE

NI Camera Link I/O Extension Board

The NI Camera Link I/O Extension Board provides additional I/O capabilities for National Instruments PCI Express (PCIe) Camera Link image acquisition devices. This document describes how to install and configure the necessary components to begin using the I/O Extension Board.

The I/O Extension Board offers the following functionality:

- 8 TTL I/O. Refer to the [Configuring the TTL I/O Start Condition](#) section for information about selecting the start condition.
- 3 optically isolated inputs.
- 3 optically isolated outputs.
- Quadrature encoder input.
- Camera power (+5 V or +12 V).

What You Need to Get Started

You need the following items to set up and use the I/O Extension Board:

- NI Camera Link I/O Extension Board
- National Instruments PCIe Camera Link image acquisition device
- 50-pin ribbon cable, included in kit
- Computer running Microsoft Windows Vista/XP/2000 with at least one available PCI slot



Note Visit ni.com/info and enter `rdvisionvista` for more information about National Instruments device compatibility with Windows Vista.

- NI Vision Acquisition Software 8.2.0 or later, which includes the NI-IMAQ driver software

Optional Equipment

National Instruments offers a variety of products for use with the I/O Extension Board, including the following:

- Digital I/O cable and horizontal DIN rail terminal block (part number 778790-01)
- Digital I/O cable and vertical DIN rail terminal block (part number 778791-01)

Refer to the National Instruments catalog, visit ni.com, or call the National Instruments office nearest you for more specific information about these products.

Related Documentation

The following documents contain additional information that you may find helpful:

- *NI Vision Acquisition Software Release Notes*—Contains information about new functionality, minimum system requirements, and installation instructions for the NI-IMAQ driver software.
- *Measurement & Automation Explorer Help for NI-IMAQ*—Describes how to configure the NI-IMAQ driver software, NI image acquisition devices, and cameras using Measurement & Automation Explorer (MAX).
- *NI-IMAQ Help*—Contains fundamental programming concepts for the NI-IMAQ driver software and terminology for using NI image acquisition devices.

Safety Information



Caution The following paragraphs contain important safety information you *must* follow when installing and operating the I/O Extension Board and all devices connecting to the I/O Extension Board.

Do *not* operate the device in a manner not specified in the documentation. Misuse of the device may result in a hazard and may compromise the safety protection built into the device. If the device is damaged, turn it off and do *not* use it until service-trained personnel can check its safety. If necessary, return the device to National Instruments for repair.

Keep away from live circuits. Do *not* remove equipment covers or shields unless you are trained to do so. If signal wires are connected to the device, hazardous voltages can exist even when the equipment is turned off. To avoid a shock hazard, do *not* perform procedures involving cover or shield removal unless you are qualified to do so. Disconnect all field power prior to removing covers or shields.

If the device is rated for use with hazardous voltages ($>30 V_{\text{rms}}$, $42.4 V_{\text{pk}}$, or $60 V_{\text{dc}}$), it may require a safety earth-ground connection wire. Refer to the device specifications for maximum voltage ratings.

Because of the danger of introducing additional hazards, do *not* install unauthorized parts or modify the device. Use the device only with the chassis, modules, accessories, and cables specified in the installation instructions. All covers and filler panels *must* be installed while operating the device.

Do *not* operate the device in an explosive atmosphere or where flammable gases or fumes may be present. Operate the device only at or below the pollution degree stated in the specifications. Pollution consists of any foreign matter—solid, liquid, or gas—that may reduce dielectric strength or surface resistivity. The following is a description of pollution degrees.

- Pollution Degree 1—No pollution or only dry, nonconductive pollution occurs. The pollution has no effect.
- Pollution Degree 2—Normally only nonconductive pollution occurs. Occasionally, nonconductive pollution becomes conductive because of condensation.
- Pollution Degree 3—Conductive pollution or dry, nonconductive pollution occurs. Nonconductive pollution becomes conductive because of condensation.

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

You *must* insulate signal connections for the maximum voltage for which the device is rated. Do *not* exceed the maximum ratings for the device. Remove power from signal lines before connection to or disconnection from the device.



Caution National Instruments measurement products may be classified as either Measurement Category I or II. Operate products at or below the Measurement Category level specified in the hardware specifications.

Measurement Category¹: Measurement circuits are subjected to working voltages² and transient stresses (overvoltage) from the circuit to which they are connected during measurement or test. Measurement Category establishes standardized impulse withstand voltage levels that commonly occur in electrical distribution systems. The following is a description of Measurement (Installation³) Categories:

- Measurement Category I is for measurements performed on circuits *not* directly connected to the electrical distribution system referred to as MAINS⁴ voltage. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.
- Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (e.g., 115 V for U.S. or 230 V for Europe). Examples of Measurement Category II are measurements performed on household appliances, portable tools, and similar products.
- Measurement Category III is for measurements performed in the building installation at the distribution level. This category refers to measurements on hard-wired equipment such as equipment in fixed installations, distribution boards, and circuit breakers. Other examples are wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and stationary motors with permanent connections to fixed installations.

Unpacking

The I/O Extension Board ships in an antistatic package to prevent electrostatic discharge from damaging device components. To avoid such damage in handling your device, take the following precautions:

1. Ground yourself using a grounding strap or by touching a grounded object, such as the computer chassis.
2. Touch the antistatic package to a metal part of the computer chassis before removing the device from the package.



Caution *Never* touch the exposed pins of connectors.

3. Remove the device from the package and inspect it for loose components or any other signs of damage. Notify National Instruments if the device appears damaged in any way. Do *not* install a damaged device in the computer.

Store the I/O Extension Board in the antistatic package when not in use.

¹ Measurement Categories as defined in electrical safety standard IEC 61010-1.

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

³ Measurement Category is also referred to as Installation Category.

⁴ MAINS is defined as the (hazardous live) electrical supply system to which equipment is designed to be connected for the purpose of powering the equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

Installation

The following instructions are for general installation. Refer to the documentation provided by your computer manufacturer for specific instructions and warnings. Refer to the [Specifications](#) section for a list of the typical power requirements for the I/O Extension Board.

1. Install the NI Vision Acquisition Software before installing the I/O Extension Board. Refer to the *NI Vision Acquisition Software Release Notes* for specific installation instructions.
2. Power off and unplug the computer.



Caution To protect yourself and the computer from electrical hazards, the computer *must* remain unplugged until the installation is complete.

3. Remove the computer cover to expose the expansion slots.
4. Choose an unused PCI slot, and remove the corresponding expansion slot cover on the back panel of the computer.
5. Touch a metal part on the computer case to discharge any static electricity that might be on your clothes or body. Static electricity can damage the device.
6. Remove the device from the antistatic package and gently rock the device into the slot. The connection may be tight, but do *not* force the device into place.
7. Secure the device mounting bracket to the back panel rail of the computer.
8. To provide power to your camera, connect an unused power connector from the ATX power supply on your computer to the camera power ATX connector on the I/O Extension Board. Figure 1 shows how to connect the power cable from your PC power supply to the ATX power supply connector on the I/O Extension Board.

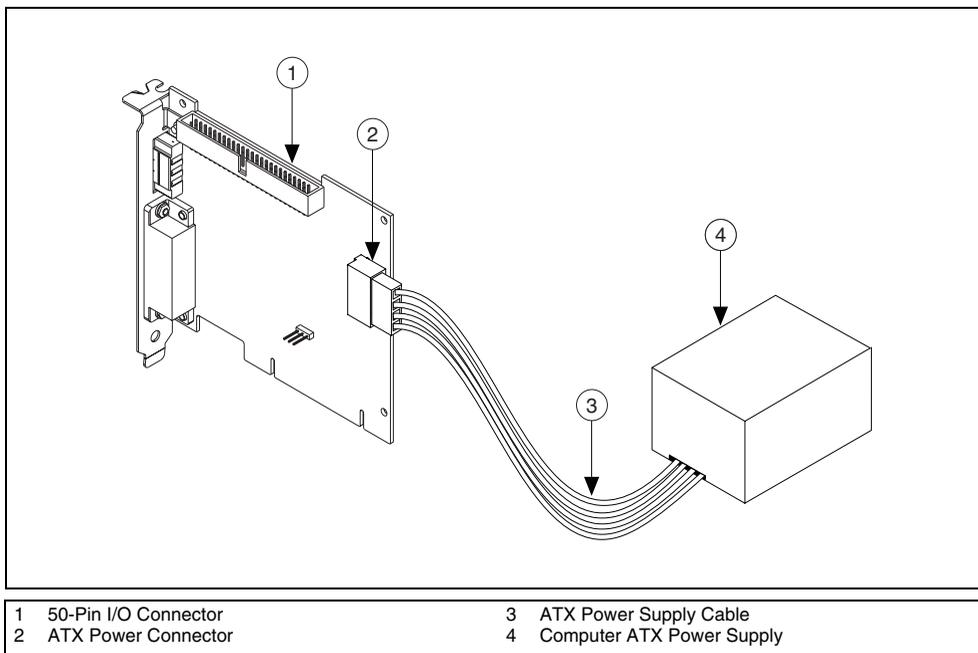


Figure 1. Connecting the Power Supply

9. Connect the 50-pin ribbon cable from the I/O Extension Board to your image acquisition device. Figure 2 shows how to connect the 50-pin ribbon cable from the I/O Extension Board to an image acquisition device that supports the I/O Extension Board.

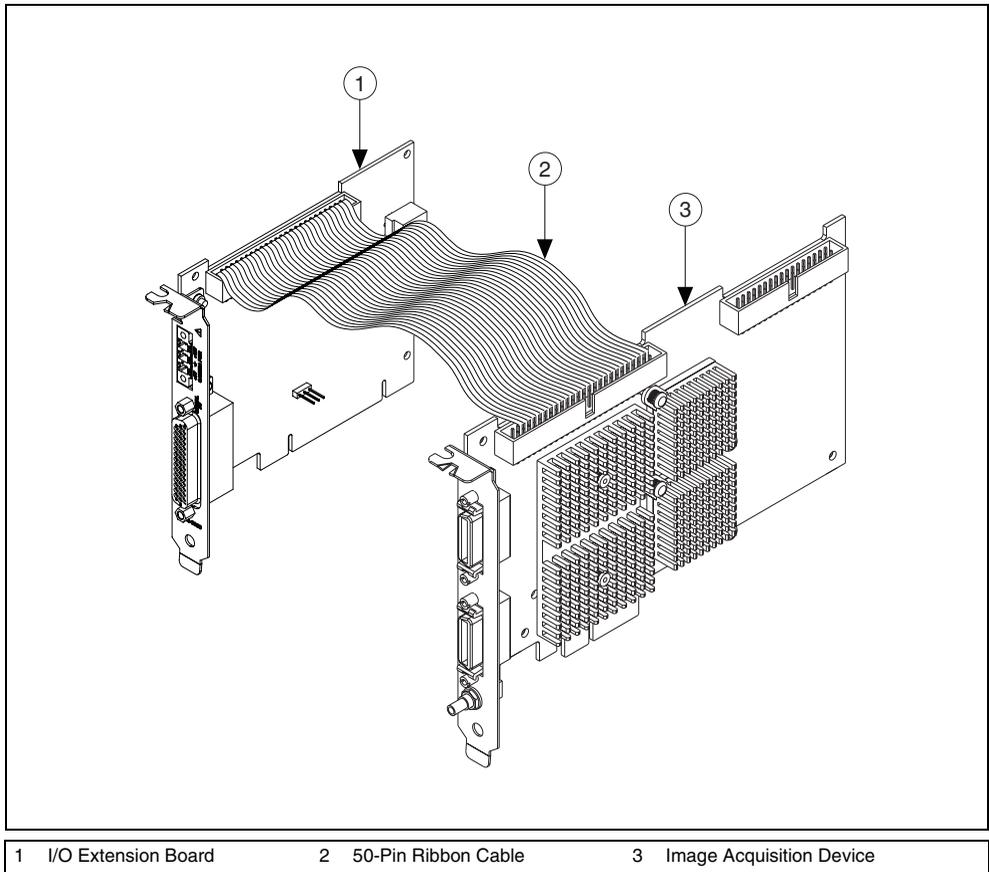


Figure 2. Connecting the I/O Extension Board to an Image Acquisition Device

10. Replace the computer cover.
11. Plug in and power on the computer.

The I/O Extension Board is now installed and connected to the image acquisition device.

Configuring the I/O Extension Board

After you have installed the I/O Extension Board and powered on the computer, the computer will recognize the device and assign resources to it. Use Measurement & Automation Explorer (MAX), the National Instruments configuration utility, to configure the I/O Extension Board. Refer to the *Measurement & Automation Explorer Help for NI-IMAQ* for additional information about configuring the I/O Extension Board.



Note Before configuring the device in MAX, ensure that you installed the NI-IMAQ driver software.

Configuring the TTL I/O Start Condition

The start condition for the TTL I/O is user-selectable. The TTL I/O can either be pulled high, pulled low, or tri-stated.

- To pull the TTL I/O lines high, connect the jumper to Signal and +5V.
- To pull the TTL I/O lines low, connect the jumper to Signal and GND.
- To tri-state the TTL I/O lines, remove the jumper.

Figure 3 shows how to use the jumper setting to connect the start condition for the TTL I/O to be pulled high, pulled low, or tri-stated.

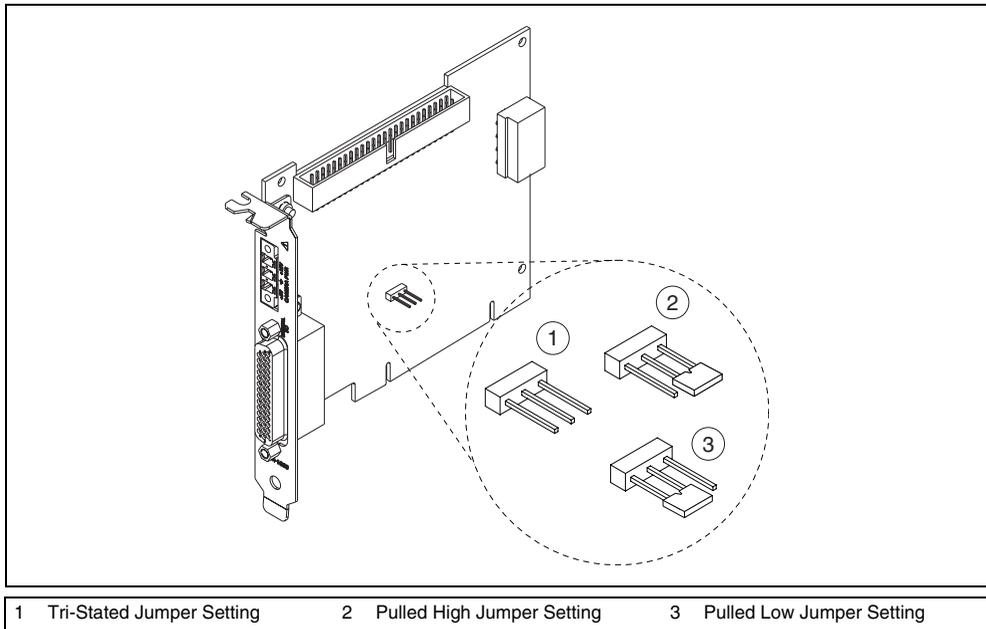


Figure 3. Configuring the TTL I/O

Signal Connections

The following sections describes the signal connections for the I/O Extension Board.

Wiring Recommendations



Caution Failure to follow these precautions may result in system instability and may cause permanent damage to system components.

National Instruments recommends the following guidelines for connecting to the I/O Extension Board.

- Keep high-voltage lines, such as AC power cables, away from low-level signals, such as encoders.
- Use twisted pair cable for differential signals, such as encoders.
- Ensure that all cables connected to the I/O Extension Board include a braided shield.
- Use hoods with internal metallic shielding for D-SUB connectors.
- Ensure that all power supplies in the system are powered down when connecting them to the I/O Extension Board.

44-Pin D-SUB Connections

Figure 4 shows the pinout of the 44-pin D-SUB connector on the front panel of the I/O Extension Board.

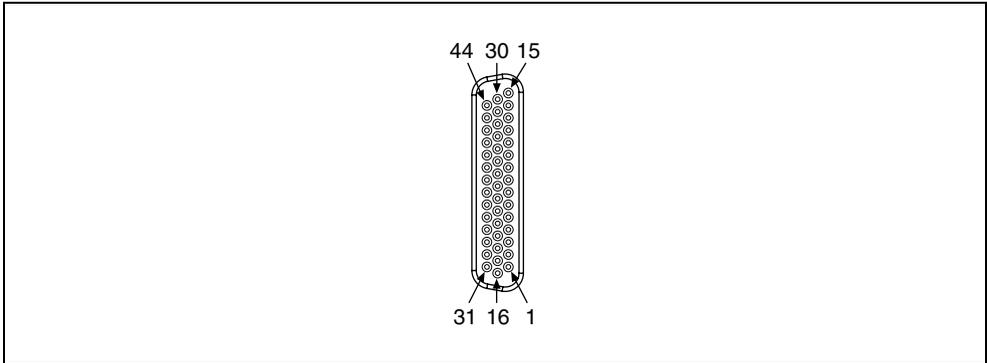


Figure 4. 44-Pin D-SUB Connector

Table 1 lists pin numbers, signal names, and signal descriptions for the 44-pin D-SUB connector.

Table 1. D-SUB Connector Signals

Pin Number	Signal Name	Signal Description
1	+12 V Camera	+12 V Camera Power
2	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
3	TTL I/O 1	General Purpose TTL Input/Output Line
4	TTL I/O 2	General Purpose TTL Input/Output Line
5	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
6	TTL I/O 3	General Purpose TTL Input/Output Line
7	TTL I/O 4	General Purpose TTL Input/Output Line
8	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
9	NC	No Connect
10	V _{iso}	Isolated Power
11	C _{iso}	Isolated Power Common
12	Iso Output 0	General Purpose Isolated Output
13	Iso Output 1	General Purpose Isolated Output
14	C _{iso}	Isolated Power Common
15	Iso Input 1+	Isolated Input Positive Connection
16	+12 V Camera	+12 V Camera Power

Table 1. D-SUB Connector Signals (Continued)

Pin Number	Signal Name	Signal Description
17	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
18	TTL I/O 5	General Purpose TTL Input/Output Line
19	TTL I/O 6	General Purpose TTL Input/Output Line
20	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
21	TTL I/O 7	General Purpose TTL Input/Output Line
22	TTL I/O 8	General Purpose TTL Input/Output Line
23	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
24	NC	No Connect
25	V _{iso}	Isolated Power
26	C _{iso}	Isolated Power Common
27	Iso Input 2+	Isolated Input Positive Connection
28	Iso Input 2-	Isolated Input Negative Connection
29	C _{iso}	Isolated Power Common
30	Iso Input 1-	Isolated Input Negative Connection
31	+5 V Camera	+5 V Camera Power
32	+5 V Camera	+5 V Camera Power
33	C _{iso}	Isolated Power Common
34	Phase A+	Quadrature Encoder Phase A Positive Connection
35	Phase A-	Quadrature Encoder Phase A Negative Connection
36	C _{iso}	Isolated Power Common
37	NC	No Connect
38	Phase B+	Quadrature Encoder Phase B Positive Connection
39	C _{iso}	Isolated Power Common
40	Phase B-	Quadrature Encoder Phase B Negative Connection
41	Iso Output 2	General Purpose Isolated Output
42	C _{iso}	Isolated Power Common
43	Iso Input 0+	Isolated Input Positive Connection
44	Iso Input 0-	Isolated Input Negative Connection

Figure 5 shows the pinout of the 3-pin screw terminal connector.

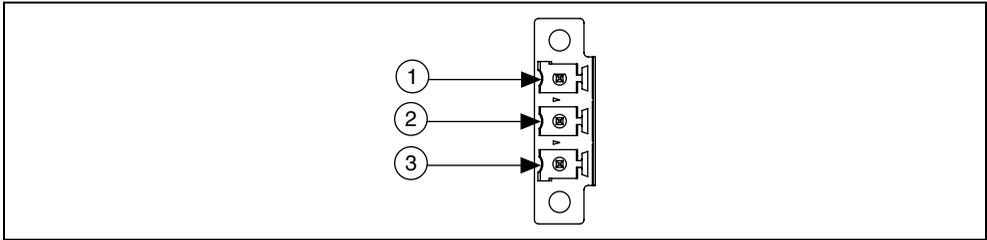


Figure 5. 3-Pin Screw Terminal Connector

Table 2 lists pin numbers, signal names, and signal descriptions for the 3-pin screw terminal connector on the I/O Extension Board.

Table 2. 3-Pin Screw Terminal Connector Signals

Pin Number	Signal Name	Signal Description
1	+12 V	+12 V Camera Power
2	Ground	Ground Reference for Camera Power
3	+5 V	+5 V Camera Power

Connecting an Isolated Input to Output Devices

You can wire an isolated input to both sourcing and sinking output devices. Refer to Figures 6 and 7 for wiring examples by output type. Refer to the [Specifications](#) section for information about switching thresholds and current requirements.



Caution Do *not* apply a voltage greater than 30 VDC to the isolated inputs. Voltages greater than 30 VDC may damage the I/O Extension Board.



Note Isolated inputs are compatible with 5 V logic if the external circuit meets the voltage and current requirements listed in the [Specifications](#) section.

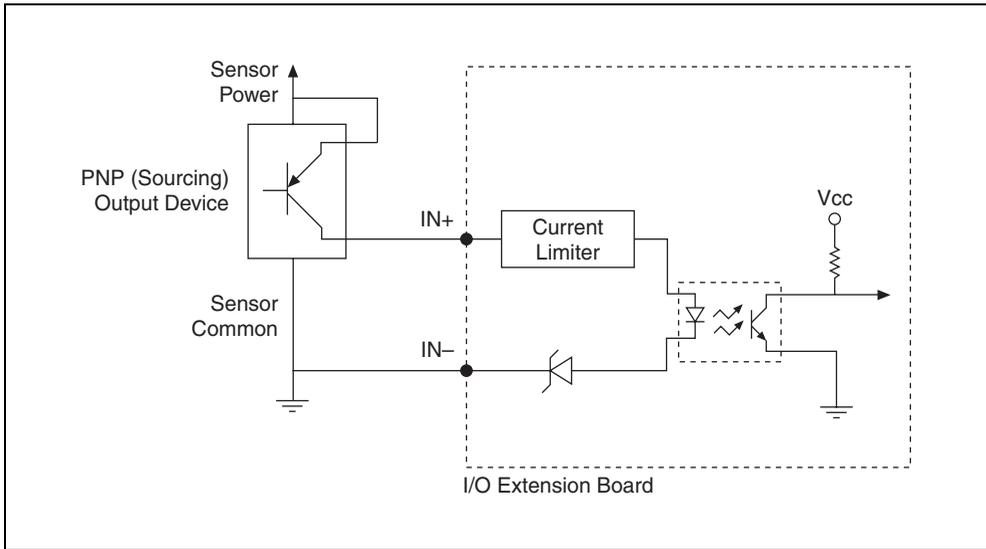


Figure 6. Example of Connecting an Isolated Input to a Sourcing Output Device

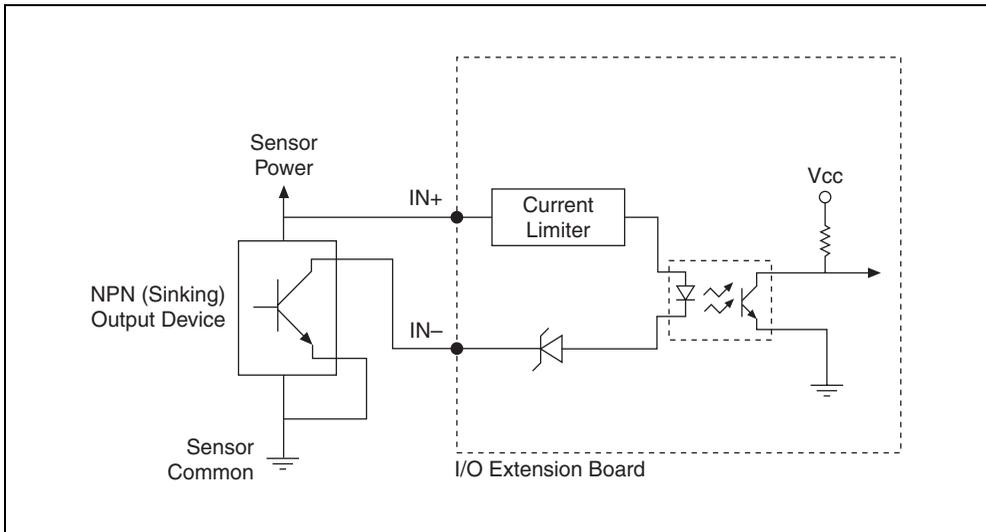


Figure 7. Example of Connecting an Isolated Input to a Sinking Output Device

Connecting an Isolated Output to an External Load

The digital output circuit sources current to external loads, as shown in the example in Figure 8.



Note The isolated outputs have current-limiting protection circuitry. If this circuitry is tripped, you can re-enable the outputs by cycling power on the I/O Extension Board or by toggling the output state in the software.

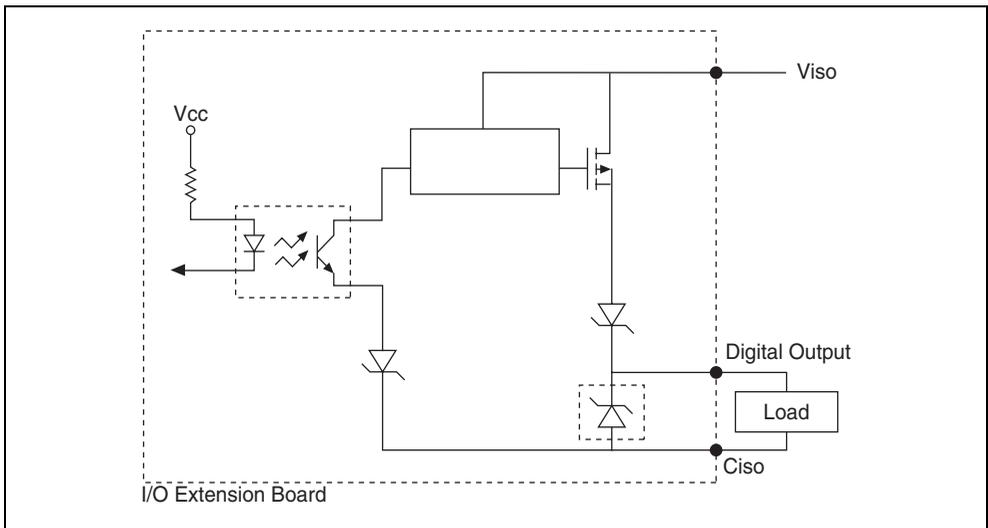


Figure 8. Example of Connecting an Isolated Output to an External Load

Protecting Inductive Loads

When an inductive load, such as a relay or solenoid, is connected to an output, a large counter-electromotive force may occur at switching time due to energy stored in the inductive load. This flyback voltage can damage the outputs and the power supply.

To limit flyback voltages at the inductive load, install a flyback diode across the load. Mount the flyback diode as close to the load as possible. Use this protection method if you connect any of the isolated outputs on the I/O Extension Board to an inductive load.

Figure 9 shows an example of using an external flyback diode to protect inductive loads.

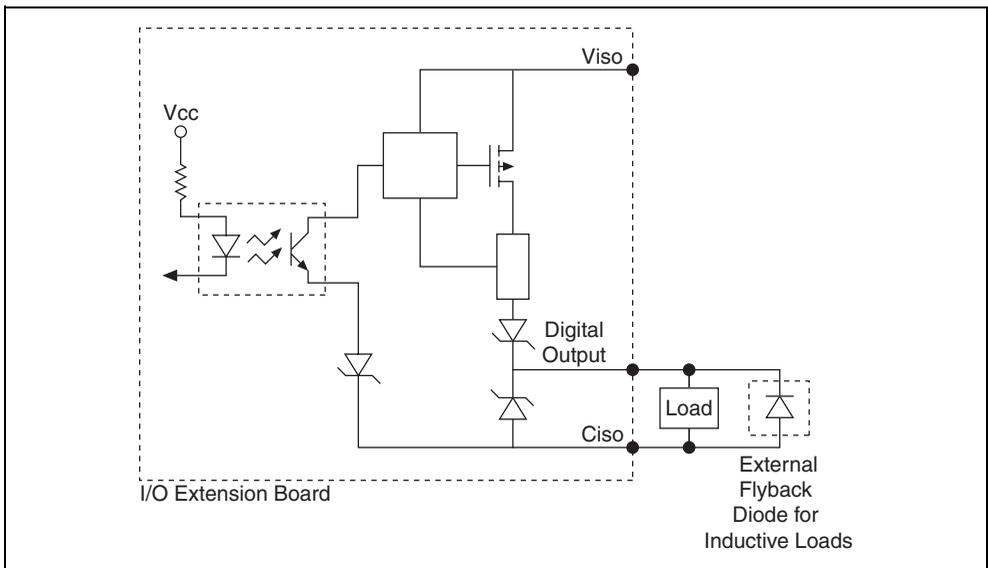


Figure 9. Example of Using an External Flyback Diode for Inductive Loads

Connecting to a Quadrature Encoder

The I/O Extension Board accepts either single-ended TTL or differential (RS-422 compatible) line driver inputs. If a single-ended encoder is used, the encoder lines must be connected to the positive connection for each phase.

Shielded encoder cables are recommended for all applications. Unshielded cables are more susceptible to noise and can corrupt the encoder signals.



Note If the encoder cable length is greater than 3.05 m (10 ft), encoders with line driver outputs are recommended.

Figure 10 shows the encoder inputs circuit.

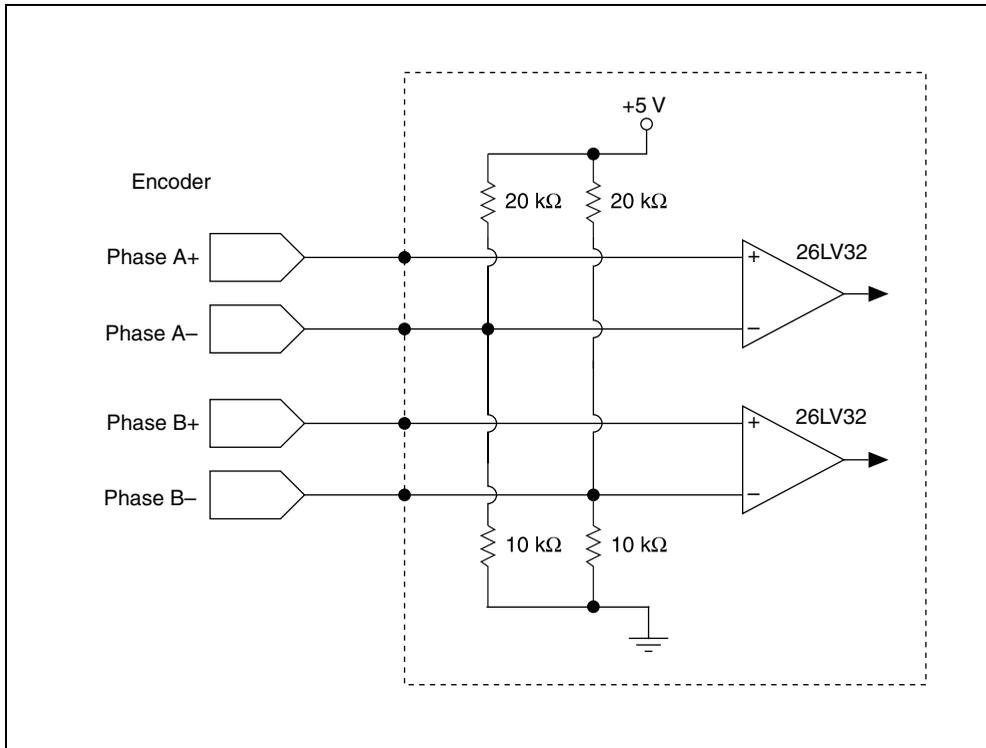


Figure 10. Encoder Inputs Circuit

Figure 11 shows an example of connecting differential line drivers.

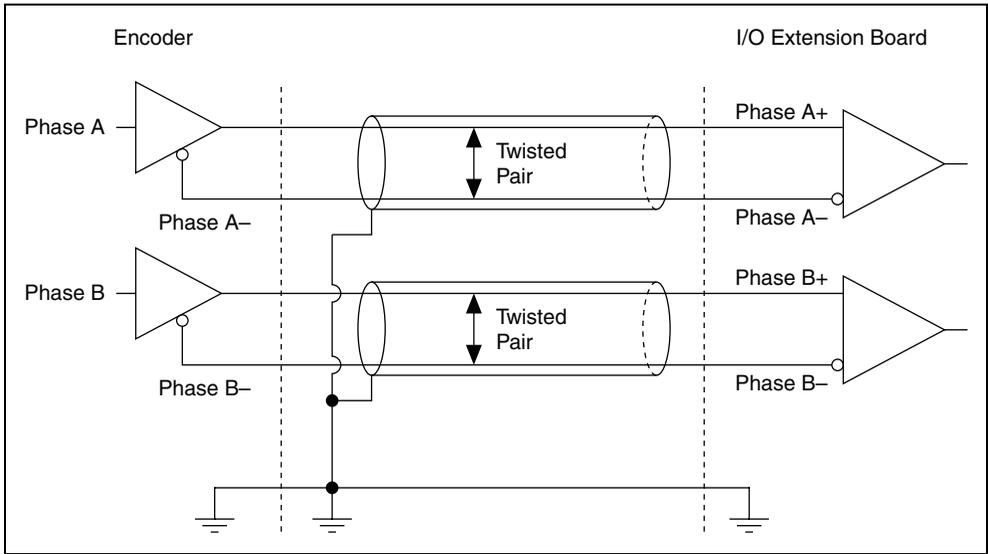


Figure 11. Example of Connecting Differential Line Drivers

Figure 12 shows an example of connecting single-ended drivers.

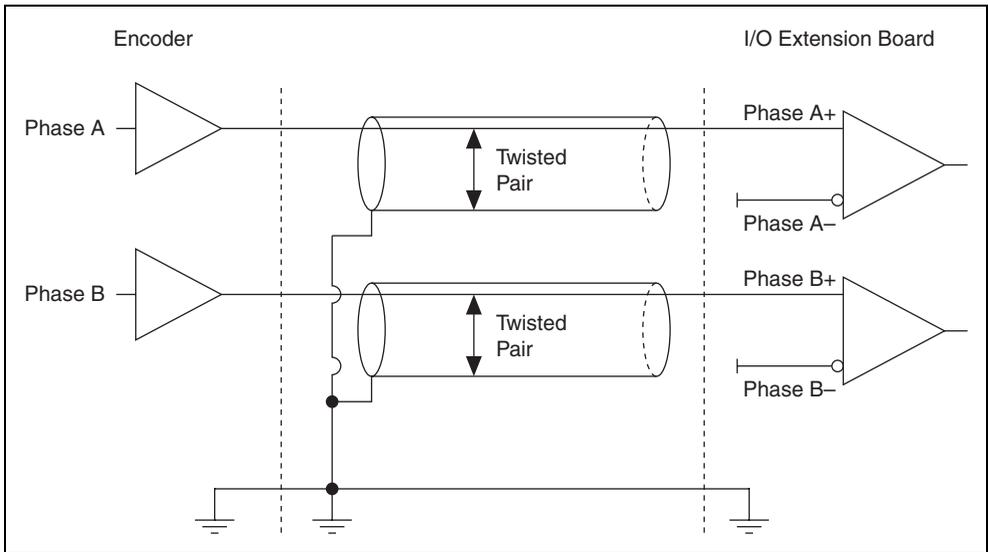


Figure 12. Example of Connecting Single-Ended Drivers

Optional 37-Pin Terminal Block

Use the 37-pin Terminal Block to convert the 44-pin D-SUB connection to a 37-pin D-SUB connection.

Figure 13 shows the pinout of the 37-pin Terminal Block.

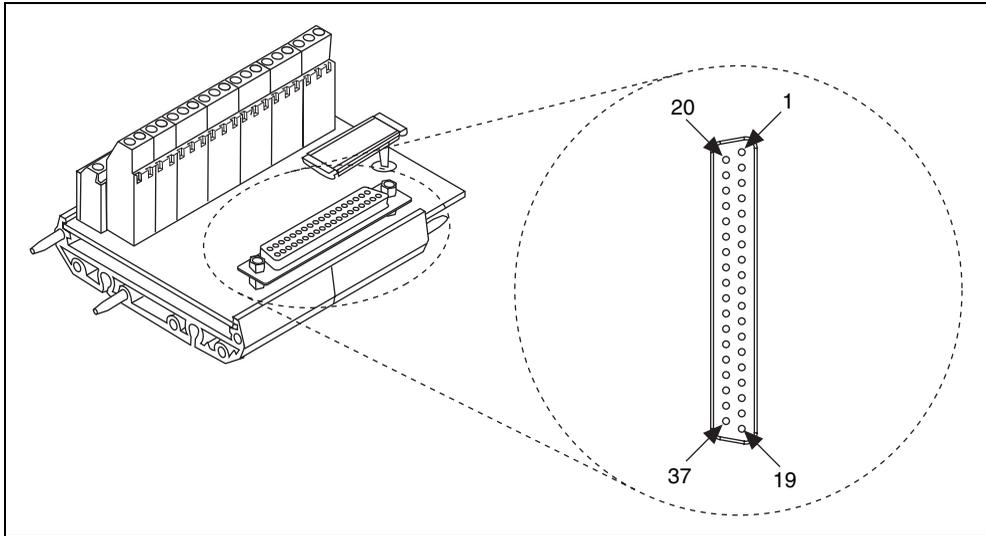


Figure 13. 37-Pin Terminal Block

Table 3 lists pin numbers, signal names, and signal descriptions for the 37-pin Terminal Block.

Table 3. 37-Pin Terminal Block Signals

Pin Number	Signal Name	Signal Description
1	+12 V Camera	+12 V Camera Power
2	+12 V Camera	+12 V Camera Power
3	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
4	TTL I/O 1	General Purpose TTL Input/Output Line
5	TTL I/O 2	General Purpose TTL Input/Output Line
6	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
7	TTL I/O 3	General Purpose TTL Input/Output Line
8	TTL I/O 4	General Purpose TTL Input/Output Line
9	Iso Input 1+	Isolated Input Positive Connection
10	Iso Input 1-	Isolated Input Negative Connection
11	+5 V Camera	+5 V Camera Power
12	C _{iso}	Isolated Power Common

Table 3. 37-Pin Terminal Block Signals (Continued)

Pin Number	Signal Name	Signal Description
13	+5 V Camera	+5 V Camera Power
14	Phase A+	Quadrature Phase A Positive Connection
15	Phase A–	Quadrature Phase A Negative Connection
16	C _{iso}	Isolated Power Common
17	V _{iso}	Isolated Power
18	C _{iso}	Isolated Power Common
19	Iso Output 0	General Purpose Isolated Output
20	TTL I/O 5	General Purpose TTL Input/Output Line
21	TTL I/O 6	General Purpose TTL Input/Output Line
22	Digital Ground	Direct connection to Digital Ground on the I/O Extension Board
23	TTL I/O 7	General Purpose TTL Input/Output Line
24	TTL I/O 8	General Purpose TTL Input/Output Line
25	NC	No Connect
26	Phase B+	Quadrature Phase B Positive Connection
27	Phase B–	Quadrature Phase B Negative Connection
28	C _{iso}	Isolated Power Common
29	Iso Output 2	General Purpose Isolated Output
30	Iso Input 0+	Isolated Input Positive Connection
31	Iso Input 0–	Isolated Input Negative Connection
32	C _{iso}	Isolated Power Common
33	V _{iso}	Isolated Power
34	C _{iso}	Isolated Power Common
35	Iso Output 1	General Purpose Isolated Output
36	Iso Input 2+	Isolated Input Positive Connection
37	Iso Input 2–	Isolated Input Negative Connection

Specifications

The following specifications apply to the NI Camera Link I/O Extension Board. All specifications are typical at 0 to 40 °C, unless otherwise stated.

TTL I/O



Caution TTL I/O lines provide no short-circuit protection. Failure to protect against short-circuit conditions will result in damage to the device.

Number of external TTL I/O lines	8
Trigger input	
Voltage range	0 V to 5 V (TTL)
Input high voltage	2 V to 5 V
Input low voltage	0 V to 0.8 V
Polarity	Programmable, active high or active low
Maximum pulse rate	2 MHz
Minimum pulse detected	250 ns
Trigger output	
Voltage range	0 V to 5 V (TTL)
Output high voltage	2.4 V at 5 mA source
Output low voltage	0.55 V at 2 mA sink
Polarity	Programmable, active high or active low
Power-on state	Input (high-impedance) 22 k Ω jumper selectable pull-up to 5 V, pull-down to digital ground, or tri-state

Optically Isolated Inputs

Number of channels	3
Type	Current sinking or sourcing
Input voltage range	0 V to 30 V
Input ON voltage	3.5 V to 30 V
Input OFF voltage	0 V to 2 V
Turn-on current	7.1 mA (typical) 14 mA (maximum)
Current limiting	14 mA
Maximum pulse rate	100 kHz
Minimum pulse detected	10 μ s
Reverse polarity protection	Yes, -30 V

Optically Isolated Outputs

Number of channels	3
Type.....	Current sourcing
On-state voltage range	5 V to 30 V, maximum
Maximum on-state voltage drop from V_{iso}	1.2 V at 100 mA
Output current	
5 V_{iso}	50 mA, maximum
24 V_{iso}	100 mA, maximum
30 V_{iso}	100 mA, maximum
Maximum pulse rate	10 kHz
Minimum pulse generated	100 μ s
Reverse polarity protection	Yes, -30 V

Quadrature Encoder Inputs

Number of channels (+/- pairs)	2
Differential input threshold	\pm 0.2 V (maximum), RS-422 compatible
Voltage range	0 to 5.5 VDC
Single-ended input threshold	TTL compatible
Input high voltage	2.0 V
Input low voltage	0.8 V
Maximum quadrature count rate	5 MHz

Camera Power

+5 VDC.....	2.5 A
+12 VDC.....	1.5 A

Physical Characteristics

Dimensions	10.7 cm \times 12 cm (4.2 in. \times 4.75 in.)
Weight	92.8 g (3.27 oz)

Environment

The I/O Extension Board is intended for indoor use only.	
Operating temperature	0 $^{\circ}$ C to 40 $^{\circ}$ C
Storage temperature	-30 $^{\circ}$ C to 80 $^{\circ}$ C
Relative humidity	10% to 90%, noncondensing
Pollution Degree	2
Approved at altitudes up to 2,000 m.	

Safety

The I/O Extension Board meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1



Note For UL and other safety certifications, refer to the product label, or visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

EmissionsEN 55011 Class A at 10 m FCC Part 15A
above 1 GHz

ImmunityEN 61326:1997+ A2:2001, Table 1

CE, C-Tick, and FCC Part 15 (Class A) Compliant



Note For EMC compliance, operate this device with shielded cabling. In addition, all covers and filler panels *must* be installed.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety)73/23/EEC

Electromagnetic Compatibility

Directive (EMC)89/336/EEC



Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit ni.com/environment/weee.htm.

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At ni.com/support you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

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France 33 (0) 1 48 14 24 24, Germany 49 89 7413130, India 91 80 41190000, Israel 972 3 6393737,
Italy 39 02 413091, Japan 81 3 5472 2970, Korea 82 02 3451 3400, Lebanon 961 (0) 1 33 28 28,
Malaysia 1800 887710, Mexico 01 800 010 0793, Netherlands 31 (0) 348 433 466,
New Zealand 0800 553 322, Norway 47 (0) 66 90 76 60, Poland 48 22 3390150,
Portugal 351 210 311 210, Russia 7 495 783 6851, Singapore 1800 226 5886,
Slovenia 386 3 425 42 00, South Africa 27 0 11 805 8197, Spain 34 91 640 0085,
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