GETTING STARTED GUIDE
NI CVS-1457RT

GigE Vision Compact Vision System
with Reconfigurable I/O and Power over Ethernet

The NI CVS-1457RT is a real-time, compact vision system that acquires, processes, and displays images from GigE Vision cameras. This document explains how to install and configure the NI CVS-1457RT.

Contents

NATIONAL INSTRUMENTS™

Required Components

The following items are necessary to set up and use the NI CVS-1457RT:

☐ NI CVS-1457RT device

☐ One or two GigE Vision cameras

☐ One CAT 5e or CAT 6 1000Base-T Ethernet cable per GigE Vision camera

☐ One CAT 5 10/100Base-TX or CAT 5e or CAT 6 1000Base-T Ethernet cable to connect the
device to the development computer or to a network.

✎ **Note** A CAT 5e or CAT 6 1000Base-T Ethernet cable is required to achieve
maximum 1,000 Mbps (Gigabit) Ethernet performance. CAT 5e and CAT 6 Ethernet
cables adhere to higher electrical standards required for Gigabit Ethernet
communication. CAT 5 cables are not guaranteed to meet the necessary electrical
requirements. While CAT 5 cables may appear to work at 1,000 Mbps in some
installations, CAT 5 cables are likely to cause increased bit errors resulting in
degraded or unreliable network performance.

☐ Development computer running Microsoft Windows 8 (32-bit or 64-bit)/7 (32-bit or
64-bit)/Vista (32-bit or 64-bit)/XP (32-bit)

☐ 24 VDC, 1.25 A Desktop Power Supply (part number 782032-01)

Optional Equipment

National Instruments offers the following products for use with the NI CVS-1457RT:

☐ NI PS-15 Power Supply to power the isolated outputs (part number 781093-01)

☐ NI PoE Power Supply to power the Power over Ethernet (PoE) ports (part number
783307-01 for DIN rail version or part number 783308-01 for desktop version)

☐ 44-pin D-SUB cable for digital I/O
  • 44-pin D-SUB male to pigtail cable (part number 156083-03 for 3 meter cable)
  • 44-pin D-SUB male to 44-position D-SUB female cable (part number 156084-03 for
    3 meter cable or part number 156084-0R5 for 0.5 meter cable)

☐ NI CVS I/O Accessory
  • CVS I/O Accessory and 3 meter 44-pin D-SUB male to 44-position D-SUB female
    cable (part number 783327-01)
  • CVS I/O Accessory and 0.5 meter 44-pin D-SUB male to 44-position D-SUB female
    cable (part number 783328-01)

☐ DIN Rail Kit (part number 781740-01)

☐ Serial cable (part number 182845-01 for 1 meter cable, part number 182845-02 for 2 meter cable, or part number 182845-03 for 3 meter cable)

Software Options

Use the following software to develop applications with the NI CVS-1457RT.

☐ NI-IMAQdx 4.3 or later driver software, included with NI Vision Acquisition Software September 2013

☐ One of the following options for developing machine vision applications:
- NI Vision Builder for Automated Inspection (Vision Builder AI) 2013 or later
- LabVIEW 2010 or later, LabVIEW Real-Time 2010 or later, and the NI Vision Development Module 2010 or later

☐ Software for using and reconfiguring the FPGA I/O. The NI CVS-1457RT has a user-reconfigurable FPGA that allows the I/O to be configured for particular applications. Different configurations are referred to as hardware personalities, and are defined by bitfiles.
- LabVIEW FPGA Module 2010 or later—You must install the LabVIEW FPGA Module to reconfigure the default personality of the NI CVS-1457RT FPGA.
- NI-IMAQ I/O 2.8 or later driver software, included with NI Vision Acquisition Software September 2013—NI-IMAQ I/O is required to use the default personality of the NI CVS-1457RT in LabVIEW, or to reconfigure the default personality of the NI CVS-1457RT I/O in the LabVIEW FPGA Module.

Safety Information

⚠️ **Caution** The following paragraphs contain important safety information you *must* follow when installing and operating the device.

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.

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.

This is a Pollution Degree 2 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.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) as stated in the product specifications. These requirements and limits are designed to provide reasonable protection against harmful interference when the product is operated in its intended operational electromagnetic environment.

This product is intended for use in industrial locations. There is no guarantee that harmful interference will not occur in a particular installation, when the product is connected to a test object, or if the product is used in residential areas. To minimize the potential for the product to cause interference to radio and television reception or to experience unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any changes or modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

⚠ **Caution** To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

⚠ **Caution** To ensure the specified EMC performance, product installation requires either special considerations or user-installed, add-on devices. See the product installation instructions for further information.

Installing the Software

Before using the NI CVS-1457RT, you must install the application software and device drivers on the development computer. National Instruments provides two options for developing machine vision applications.

- **NI Vision Builder AI**—Interactive, menu-driven configuration software for developing, benchmarking, and deploying machine vision applications.
- **NI Vision Development Module**—Programming library for developing machine vision and scientific imaging applications. The NI Vision Development Module requires LabVIEW, LabVIEW Real-Time, and NI-IMAQdx driver software.

Installing Vision Builder AI

Install Vision Builder AI from the Vision Builder AI installation media. Refer to the *NI Vision Builder for Automated Inspection Readme* for installation instructions.

After installation, documentation for Vision Builder AI is available by selecting **Start» All Programs»National Instruments»Vision Builder AI»Documentation**.

Vision Builder AI does not require additional software. Proceed to *Configuring the Hardware*.

Installing the Vision Development Module

Install the following software to use the Vision Development Module to develop applications and LabVIEW FPGA to reconfigure the I/O. The software must be installed in this order.

1. **LabVIEW**—Refer to the *LabVIEW Installation Guide* for installation instructions and system requirements for the LabVIEW software. Refer to the *LabVIEW Upgrade Notes* for additional information about upgrading to the most recent version of LabVIEW.

   Documentation for LabVIEW is available by selecting **Start»All Programs»National Instruments»LabVIEW**.

2. **LabVIEW Real-Time Module**—Refer to the *LabVIEW Real-Time Module Release and Upgrade Notes* for installation instructions and information about getting started with the LabVIEW Real-Time Module.

   Documentation for the LabVIEW Real-Time Module is available by selecting **Start» All Programs»National Instruments»LabVIEW**.

3. **LabVIEW FPGA Module**—It is only necessary to install the LabVIEW FPGA Module if you want to reconfigure the default personality of the NI CVS-1457RT I/O. Refer to the *LabVIEW FPGA Module Release and Upgrade Notes* for installation instructions and information about getting started with the LabVIEW FPGA Module.

   Documentation for the LabVIEW FPGA Module is available by selecting **Start» All Programs»National Instruments»LabVIEW**.

4. **NI Vision Development Module**—Refer to the *NI Vision Development Module Readme* on the NI Vision Development Module installation media for system requirements and installation instructions.

Documentation for the NI Vision Development Module is available by selecting **Start»All Programs»National Instruments»Vision»Documentation»NI Vision**.

5. **NI-IMAQdx**—Refer to the *NI Vision Acquisition Software Release Notes* on the NI Vision Acquisition Software installation media for system requirements and installation instructions for the NI-IMAQdx driver.

   Documentation for the NI-IMAQdx driver software is available by selecting **Start» All Programs»National Instruments»Vision»Documentation»NI-IMAQdx**.

6. **NI-IMAQ I/O**—NI-IMAQ I/O is required to use the default personality of the NI CVS-1457RT in LabVIEW, or to reconfigure the default personality of the NI CVS-1457RT I/O in the LabVIEW FPGA Module. Refer to the *NI Vision Acquisition Software Release Notes* on the NI Vision Acquisition Software installation media for system requirements and installation instructions for the NI-IMAQ I/O driver.

   Documentation for the NI-IMAQ I/O driver software is available by selecting **Start» All Programs»National Instruments»Vision»Documentation»NI-IMAQ I/O**.

NI-IMAQ and NI-IMAQdx integrate with Measurement and Automation Explorer (MAX), the National Instruments utility for configuring and testing your measurement and automation system. The NI MAX icon appears on your desktop after you install one of the device drivers.

Configuring the Hardware

Remove the NI CVS-1457RT from the package and inspect the system for any sign of damage. Notify National Instruments if the system appears damaged in any way. Do not use a damaged system.

Ensure that the AC input to the external power supply is disconnected before plugging in or unplugging any connector. Ground the unit to minimize the possibility of static electricity damage.

Complete the following sections to wire power to the NI CVS-1457RT, connect cameras, and connect the NI CVS-1457RT to a development computer or network. Figure 1 shows the power connectors on the device. Figure 2 shows the connectors on the device.

Figure 1. NI CVS-1457RT Power Connectors and Reset Button
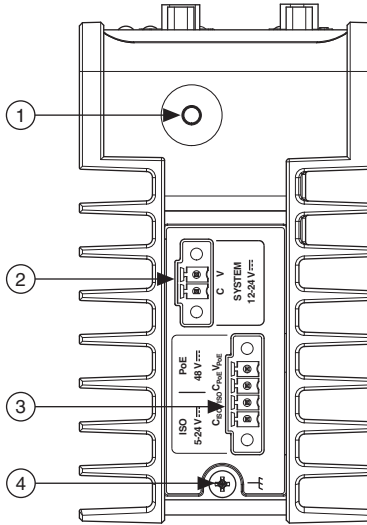
1	Reset Button	3	Isolated Output and PoE Power Connector
2	System Power Connector	4	External Ground

Figure 2. NI CVS-1457RT Connectors
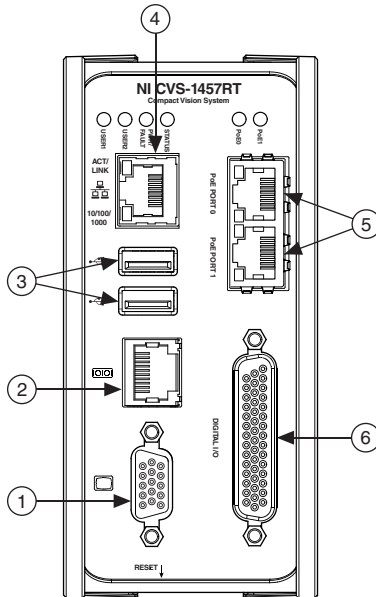
1	VGA Connector	4	RJ-45 Network Port
2	RJ50 Serial Port	5	Gigabit Ethernet PoE Ports
3	USB Ports	6	44-pin Digital I/O Connector

Wiring Power to the NI CVS-1457RT

Refer to Figure 1 while connecting the NI CVS-1457RT power supplies.

Connecting the System Power Supply

Complete the following steps to connect power to the NI CVS-1457RT.

1. Plug the 2-position connector from the power supply into the SYSTEM power receptacle on the NI CVS-1457RT.
2. Plug the power cord into the power supply.
3. Plug the power supply into an outlet.
4. Verify the POWER LED is lit.

Connecting the PoE Power Supply

Complete the following steps to supply power to the PoE ports.

1. Wire the voltage output of the PoE power supply to the PoE voltage input on the 4-position connector.
2. Wire the common-mode signal (ground) output of the PoE power supply to the common-mode input on the 4-position connector.
3. Plug the 4-position connector into the ISO/PoE power receptacle on the NI CVS-1457RT.

Connecting the Isolated Outputs Power Supply

Complete the following steps to supply power to the isolated outputs.

1. Wire the voltage output of the Isolated Outputs power supply to the ISO voltage input on the 4-position connector.
2. Wire the common-mode signal (ground) output of the Isolated Outputs power supply to the ISO common-mode input on the 4-position connector.
3. Plug the 4-position connector into the ISO/PoE power receptacle on the NI CVS-1457RT.

Connecting GigE Vision Cameras

The NI CVS-1457RT supports 2 GigE Vision cameras. The system is capable of supplying Power over Ethernet (PoE) to 2 cameras simultaneously. Complete the following steps to connect cameras to the NI CVS-1457RT.

1. Connect an Ethernet cable to a GigE Vision camera, then connect the other end to the NI CVS-1457RT PoE PORT 0. Repeat this step for PoE PORT 1 if you are connecting two cameras.
2. If the cameras support PoE, verify that the corresponding PoE LEDs are lit.
3. Verify the ACTIVITY/LINK LED is lit.

Connecting to the Development Computer

The NI CVS-1457RT can connect to the development computer directly or through a network. To connect over a network, the device must be on the same subnet as the development computer.

Direct Connection

Complete the following steps to connect the device directly to the development computer.

1. Connect one end of an Ethernet cable to the network port on the device.
2. Connect the free end of the cable to an Ethernet port on the development computer.
3. Verify the ACTIVITY/LINK LED on the port is on or blinking.

The device will use a link-local IP address when connected directly to the development computer.

Network Connection

Complete the following steps to connect the device to the development computer over a network.

1. Verify the that the development computer is powered on and connected to the network.
2. Connect one end of an Ethernet cable to the network port on the device.
3. Connect the free end of the cable to an Ethernet hub or other network device.
4. Verify the ACTIVITY/LINK LED on the port is on or blinking.

The device will negotiate an IP address when connected to a network with a DHCP server or comparable network device.

Installing Software on the NI CVS-1457RT

The NI CVS-1457RT can be configured in Vision Builder AI or MAX. If you choose LabVIEW as your application development environment, you must use MAX to configure the device.

Configuring the Device in Vision Builder AI

Complete the following steps to configure the device in Vision Builder AI.

1. Launch Vision Builder AI by navigating to **Start»All Programs»National Instruments» Vision Builder AI**.
2. Select the NI CVS-1457RT from the list of available targets.
3. Select the **Configure Target** icon.
4. Complete the configuration wizard. At step 3, select **Update Target Software** to install Vision Builder AI on the device.

Configuring the Device in MAX

Complete the following steps to configure the device in MAX.

1. Launch MAX by navigating to **Start»All Programs»National Instruments»NI MAX** or by clicking the NI MAX desktop icon.

2. In the Configuration pane, expand **Remote Systems** to see a list of all devices on the same subnet.

3. Expand the **NI CVS-1457RT.** Right-click **Add/Remove Software**. Complete the installation wizard.

Acquiring an Image

To ensure the NI CVS-1457RT is functioning properly, acquire a test image.

Acquiring an Image in Vision Builder AI

Complete the following steps to acquire an image in Vision Builder AI.

1. Launch Vision Builder AI.

2. Select the NI CVS-1457RT from the list of available targets.

3. In the Configure Inspection section, select **New Inspection from Template**.

4. Select **Acquire Image Template** from the Compact Vision System tree.

5. Click the **Run Inspection Once** icon to acquire an image.

Acquiring an Image in MAX

Complete the following steps to acquire an image in MAX.

1. Launch MAX.

2. In the Configuration Pane, expand **Remote Systems** and locate the **NI CVS-1457RT**.

3. Expand **NI CVS-1457RT»Devices and Interfaces»NI-IMAQdx Devices**.

4. Select the camera you want to test.
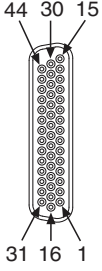
5. Click **Snap** to acquire an image.

Connections

The following sections describe connections available on the NI CVS-1457RT. Refer to Figure 2 for the location of connectors and indicators on the device.
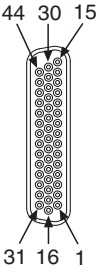
Digital I/O

The 44-pin Digital I/O port on the NI CVS-1457RT offers 8 isolated inputs, 8 isolated outputs with external power supply input, 2 bidirectional differential inputs (RS-422) or single-ended lines which can be used with a quadrature encoder, and 8 bidirectional TTL lines. The Digital I/O port can be connected to any appropriate shielded device or connector block using a shielded cable. Refer to Table 1 for pin locations and functions.

Table 1. Pin Location and Definition for the NI CVS-1457RT Digital I/O

Pin Location	Pin Number	Signal	Description
	1	Diff 0+	Bidirectional RS-422 I/O (positive side), or quadrature encoder phase A+
	2	GND	Digital ground reference for TTL and differential I/O
	3	TTL 0	Bidirectional TTL I/O
	4	TTL 1	Bidirectional TTL I/O
	5	GND	Digital ground reference for TTL and differential I/O
	6	TTL 2	Bidirectional TTL I/O
	7	TTL 3	Bidirectional TTL I/O
	8	GND	Digital ground reference for TTL and differential I/O
	9	Diff 1+	Bidirectional RS-422 I/O (positive side), or quadrature encoder phase B+
	10	V_{ISO}	Isolated power voltage reference output
	11	C_{ISO}	Common ground reference for isolated inputs and outputs
	12	Iso Out 0	General purpose isolated output
	13	Iso Out 1	General purpose isolated output
	14	C_{ISO}	Common ground reference for isolated inputs and outputs
	15	Iso Out 4	General purpose isolated output
	16	Diff 0-	Bidirectional RS-422 I/O (negative side), or quadrature encoder phase A-
	17	GND	Digital ground reference for TTL and differential I/O
	18	TTL 4	Bidirectional TTL I/O
	19	TTL 5	Bidirectional TTL I/O
	20	GND	Digital ground reference for TTL and differential I/O
	21	TTL 6	Bidirectional TTL I/O
	22	TTL 7	Bidirectional TTL I/O
	23	GND	Digital ground reference for TTL and differential I/O
	24	Diff 1-	Bidirectional RS-422 I/O (negative side), or quadrature encoder phase B-
	25	V_{ISO}	Isolated power voltage reference output
	26	C_{ISO}	Common ground reference for isolated inputs and outputs

The Pin Location column shows a connector diagram labeled with: 44 30 15 (top) and 31 16 1 (bottom).

Table 1. Pin Location and Definition for the NI CVS-1457RT Digital I/O (Continued)

Pin Location	Pin Number	Signal	Description
44 30 15 31 16 1	27	Iso Out 2	General purpose isolated output
	28	Iso Out 3	General purpose isolated output
	29	C_{ISO}	Common ground reference for isolated inputs and outputs
	30	Iso Out 5	General purpose isolated output
	31	Iso In 0	General purpose isolated input
	32	Iso In 1	General purpose isolated input
	33	C_{ISO}	Common ground reference for isolated inputs and outputs
	34	Iso In 2	General purpose isolated input
	35	Iso In 3	General purpose isolated input
	36	C_{ISO}	Common ground reference for isolated inputs and outputs
	37	Iso In 4	General purpose isolated input
	38	Iso In 5	General purpose isolated input
	39	C_{ISO}	Common ground reference for isolated inputs and outputs
	40	Iso In 6	General purpose isolated input
	41	Iso In 7	General purpose isolated input
	42	C_{ISO}	Common ground reference for isolated inputs and outputs
	43	Iso Out 6	General purpose isolated output
	44	Iso Out 7	General purpose isolated output

Wiring an Isolated Input

You can wire an isolated input to a sourcing output device, as shown in the Figure 3.

⚠️ **Caution** Do *not* apply a voltage greater than 24 VDC to the isolated inputs. Voltage greater than 24 VDC may damage the NI CVS-1457RT.

Figure 3. Example of Connecting an Isolated Input to a Sourcing Output Device
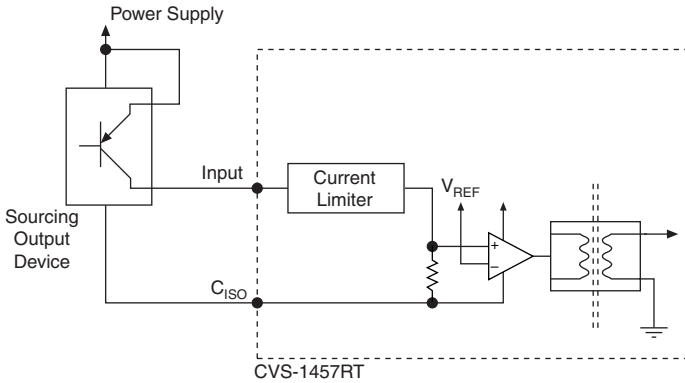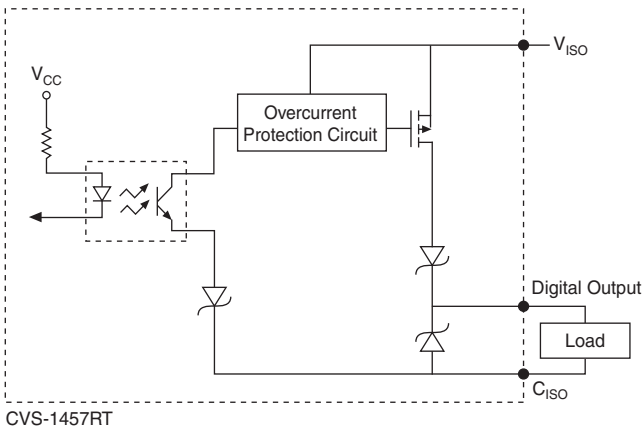

Wiring an Isolated Output

The digital output circuit sources current to external loads, as shown in Figure 4.

⚠️ **Caution** Do *not* draw more than 35 mA from 5 V isolated outputs. Do *not* draw more than 80 mA from 24 V isolated outputs.

Figure 4. Example of Connecting an Isolated Output to an External Load

Connecting to Differential I/O

The NI CVS-1457RT accepts differential (RS-422) line driver inputs. Each of the 2 differential I/O can be configured as an output. Shielded cables are recommended for all applications. Unshielded cables are more susceptible to noise and can corrupt signals. Figure 5 shows the differential input/quadrature encoder input circuit. Figure 6 and Figure 7 show differential and single-ended line driver connections. Figure 8 shows how to connect a differential output. Figure 9 shows how to connect TTL lines.

Figure 5. NI CVS-1457RT Quadrature Encoder/RS-422 Input Circuit
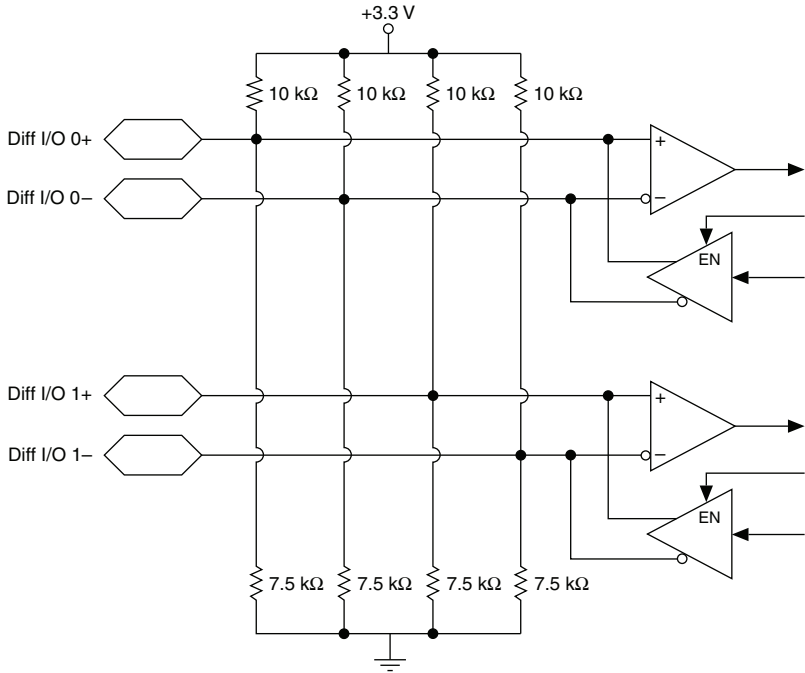
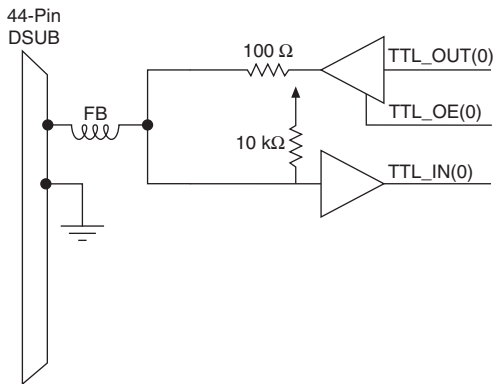**Figure 6.** Example of Connecting Differential Line Drivers
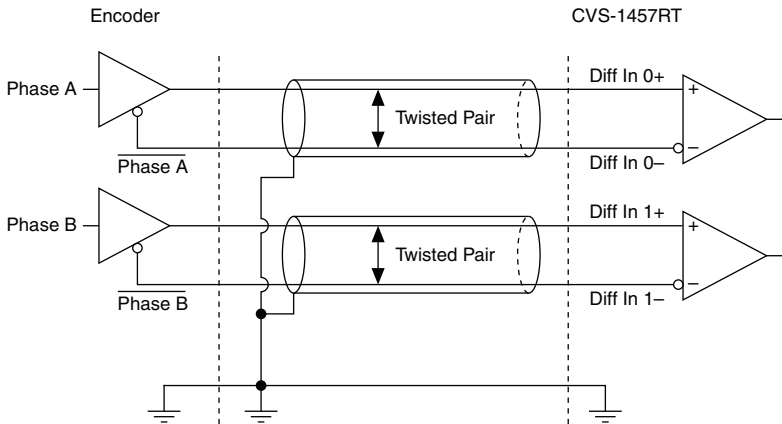
Figure 7. Example of Connecting Single-Ended Line Drivers
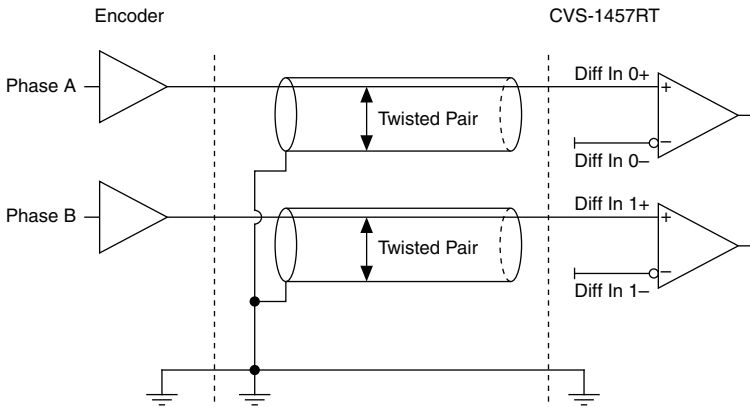
**Figure 8.** Example of Connecting Differential Output
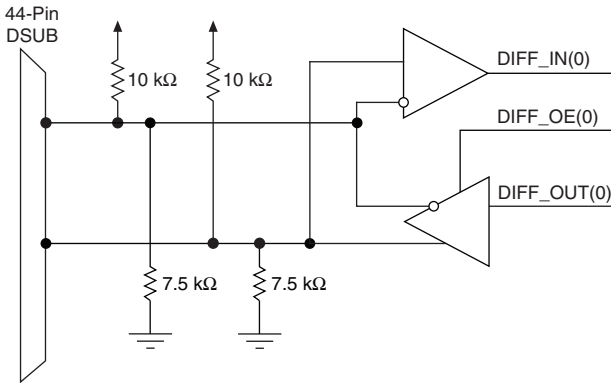
Figure 9. Example of Connecting TTL Lines

Ethernet

The NI CVS-1457RT provides two standard Gigabit Ethernet ports (PoE Port 0 and PoE Port 1) to acquire images from GigE Vision cameras. The NI CVS-1457RT can power PoE-capable cameras when the PoE power supply is connected. When the NI CVS-1457RT is providing PoE, the LED that corresponds to the port will be lit. Figure 10 depicts the PoE LEDs on the NI CVS-1457RT.
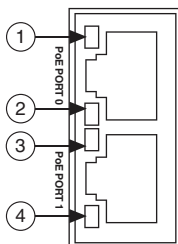
Figure 10. PoE LEDs on the NI CVS-1457RT
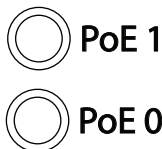
Each Ethernet port on the NI CVS-1457RT has two Ethernet LEDs that indicate the connectivity status of the port. See Figure 11 for the location of these LEDs.

Figure 11. Ethernet LEDs on the NI CVS-1457RT

1	Port 0 Activity/Link LED	3	Port 1 Activity/Link LED
2	Port 0 Speed LED	4	Port 1 Speed LED

Refer to Table 2 for information on what the status of an Ethernet LED indicates.

Table 2. Ethernet LED Status Definitions on the NI CVS-1457RT

LED	Status	Definition
Activity/Link	Unlit	No link has been established
	Solid	A link has been negotiated
	Blinking	Activity on the link
Speed	Unlit	No link, or 10 Mbps link
	Green	100 Mbps link
	Amber	1,000 Mbps link

Where to Go Next

The following documents and resources contain information you may find helpful as you use the NI CVS-1457RT in an application. Refer to the National Instruments Product Manuals Library at ni.com/manuals for the most recent versions of product documentation.

- *NI CVS-1457RT Specifications*—Contains detailed specifications for the NI CVS-1457RT.
- *NI CVS-1457RT User Manual*—Contains connector pinouts, configuration information, mounting information, and answers to common troubleshooting questions.
- *NI CVS I/O Accessory User Manual*—Contains installation and operation instructions for the CVS I/O Accessory.

Additional Resources for Vision Builder AI Users

Refer to the *NI Vision Builder for Automated Inspection Tutorial* to learn how to perform basic machine vision techniques using Vision Builder AI. You can access the *NI Vision Builder for Automated Inspection Tutorial* and other documentation by selecting **Start»All Programs» National Instruments»Vision Builder AI»Documentation**. You can also access context help within Vision Builder AI by clicking the **Show Context Help** button on the Vision Builder AI toolbar.

Examples of common Vision Builder AI inspections are installed to the `<Vision Builder AI>\Examples` directory, where `<Vision Builder AI>` is the location Vision Builder AI is installed.

Additional Resources for LabVIEW Users

Documentation for LabVIEW, the LabVIEW Real-Time Module, and the LabVIEW FPGA Module is available from the **Help** menu on the LabVIEW toolbar. You can access documentation for the NI Vision Development Module by selecting **Start»All Programs» National Instruments»Vision»Documentation»NI Vision**.

Documentation for the NI-IMAQdx driver software is available by selecting **Start» All Programs»National Instruments»Vision»Documentation»NI-IMAQdx**.

Documentation for the NI-IMAQ I/O driver software is available by selecting **Start» All Programs»National Instruments»Vision»Documentation»NI-IMAQ IO**.

Documentation for the MAX configuration software is available from the **Help** menu on the MAX toolbar. Specific information about using MAX with NI Vision hardware is available by selecting **Help»Help Topics»NI Vision»NI-IMAQdx**.

National Instruments Example Finder—LabVIEW contains an extensive library of VIs and example programs. To access the NI Example Finder, open LabVIEW and select **Help»Find Examples**.

Visit the NI Developer Zone at `ni.com/zone` for the latest example programs, tutorials, technical presentations, and a community area where you can share ideas, questions, and source code with developers around the world.

Where to Go for Support

The National Instruments website 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.

A Declaration of Conformity (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`. If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

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