NI Vision

NI CVS-1450 Series User Manual

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National Instruments Corporate Headquarters

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

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All Class A products display a simple warning statement of one paragraph in length regarding interference and undesired operation. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

Consult the FCC Web site at www.fcc.gov for more information.

FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE marking Declaration of Conformity*, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by NI could void the user's authority to operate the equipment under the FCC Rules.

Class A

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user is required to correct the interference at their own expense.

Canadian Department of Communications

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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* The CE marking Declaration of Conformity contains important supplementary information and instructions for the user or installer.

Conventions

The following conventions are used in this manual:

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

This icon denotes a tip, which alerts you to advisory information.

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

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

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

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

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

monospace bold Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

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NI CVS-1450 Series Overview

This chapter provides an overview of the features and components of the National Instruments CVS-1450 Series compact vision system.

About the NI CVS-1450 Series

NI CVS-1450 Series devices are easy-to-use, distributed, real-time imaging systems that acquire, process, and display images from IEEE 1394 cameras conforming to the *IIDC 1394-based Digital Camera Specification, Version 1.30*. The CVS-1450 Series also provides multiple digital input/output (I/O) options for communicating with external devices to configure and start an inspection and to indicate results.

An Ethernet connection between the CVS-1450 device and a development computer allows you to display measurement results and status information and to configure the CVS-1450 device settings. When configured, the CVS-1450 device can run applications without a connection to the development computer.

Each CVS-1450 device ships with documentation and the NI-IMAQ for IEEE 1394 Cameras driver software, which is licensed for one development system and one deployment system.

Hardware Overview

The CVS-1450 device front panel consists of a VGA connector, an RS-232 serial port, a 10/100 Ethernet connector, and three IEEE 1394a ports.

The CVS-1450 device also includes LEDs for communicating system status, DIP switches that specify startup options, TTL inputs and outputs for *triggering*, and isolated inputs and outputs for connecting to external devices, such as *PLCs*, sensors, LED indicators, and start/stop buttons. The isolated inputs and outputs on the CVS-1450 device provide an easy means for preventing ground loops that could degrade signal integrity.

⚠ **Caution** The isolation on the CVS-1450 device is *not* safety isolation.

Figure 1-1 shows the CVS-1450 Series front panel.

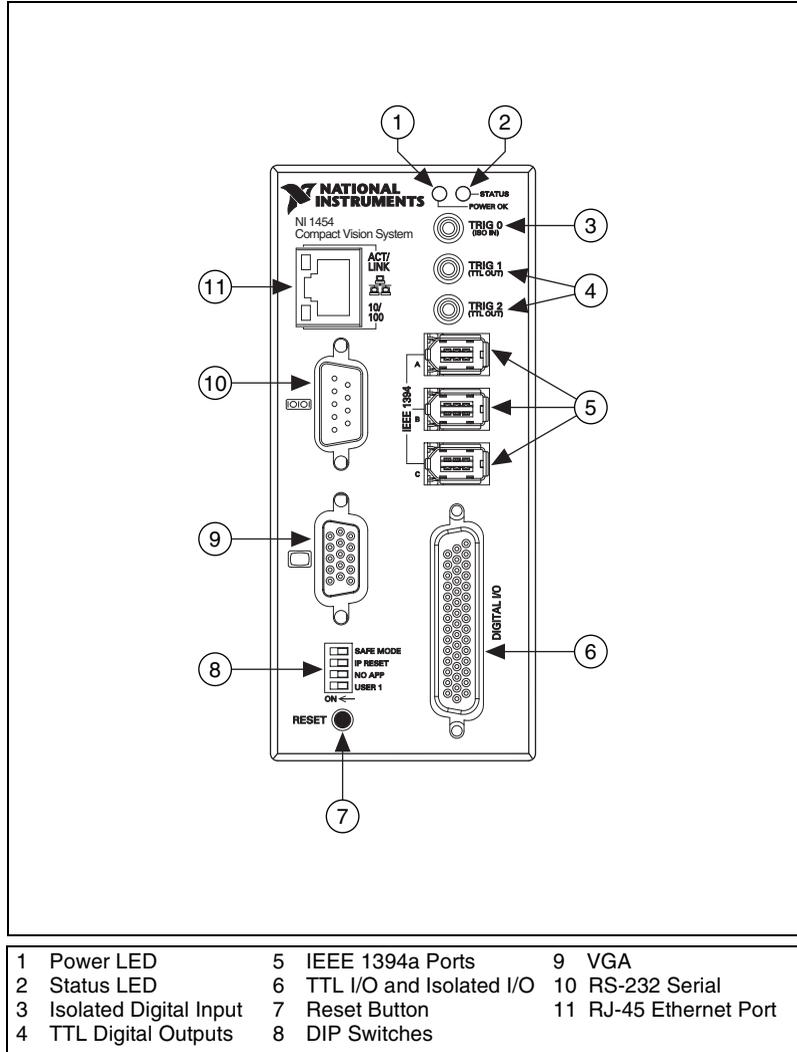| 1	Power LED	5	IEEE 1394a Ports	9	VGA
2	Status LED	6	TTL I/O and Isolated I/O	10	RS-232 Serial
3	Isolated Digital Input	7	Reset Button	11	RJ-45 Ethernet Port
4	TTL Digital Outputs	8	DIP Switches		

Figure 1-1. CVS-1450 Series Front Panel

Available Camera Bandwidth

The IEEE 1394 bus provides a fixed amount of bandwidth that is shared among the three IEEE 1394a ports on the CVS-1450 device. These ports provide direct connection for up to three DCAM-compliant IEEE 1394 cameras, depending on the amount of bandwidth each camera requires. Higher frame rates and larger image sizes require a higher data transfer rate and use more bandwidth.

Table 1-1 shows the maximum number of cameras the CVS-1450 device supports for three common video formats. Use this table as a guide when determining the combination of cameras to use in your application.

Note Bandwidth calculations described in Table 1-1 do not include software decoding of YUV images to RGB. This conversion time is dependent on processor speed.

By triggering your cameras at a frame rate slower than those rates listed in Table 1-1, you can operate more cameras simultaneously. If the camera combination exceeds the amount of available bandwidth, the software returns an Insufficient Resources error.

Table 1-1. Available Camera Bandwidth

Video Format	Frames per Second	Maximum Number of Cameras for Simultaneous Operation
640 × 480 8-bits/pixel mono	30	3
	60	1
	100	1
640 × 480 YUV (4:2:2) 16-bits/pixel color	15	3
	30	1
1024 × 768 16-bits/pixel mono	7.5	2
	15	1

Software Overview

Programming the CVS-1450 device requires NI-IMAQ for IEEE 1394 Cameras 1.5 (or later) driver software to control the hardware and one of the following application software packages to process images.

- **NI Vision Builder for Automated Inspection (AI) 2.0 or later**—Allows you to configure solutions to common inspection tasks

- **LabVIEW Real-Time Module 7.0 or later with the Vision Development Module 7.0 or later**—Provides customizable control over acquisition hardware and algorithms

The following sections provide an overview of the driver software and the application software. For detailed information about individual software packages, refer to the documentation specific to the package.

NI-IMAQ for IEEE 1394 Cameras Driver Software

The NI-IMAQ for IEEE 1394 Cameras driver software ships with the CVS-1450 device. NI-IMAQ for IEEE 1394 Cameras is the interface path between the application software and the CVS-1450 device.

NI-IMAQ for IEEE 1394 Cameras includes an extensive library of VIs you can call from LabVIEW. These VIs include routines for video configuration, continuous and single-shot image acquisition, trigger control, and register-level camera configuration.

The NI-IMAQ for IEEE 1394 Cameras driver software performs all functions necessary for acquiring and saving images but does not perform image analysis. For image analysis functionality, refer to the *National Instruments Application Software* section.

NI-IMAQ for IEEE 1394 Cameras features both high-level and low-level functions. A function that acquires images in multi-buffer, single-shot, or continuous mode is an example of a high-level function. A function that requires advanced understanding of the CVS-1450 device and image acquisition, such as configuring an image sequence, is an example of a low-level function.

The NI-IMAQ for IEEE 1394 Cameras software handles many of the complex issues between the CVS-1450 device and the camera, such as IEEE 1394 bus communication and camera control.

National Instruments Application Software

This section describes National Instruments application software packages you can use to analyze and process the images you acquire with the CVS-1450 device.

Vision Builder for Automated Inspection

NI Vision Builder for Automated Inspection (AI) is configurable machine vision software that you can use to prototype, benchmark, and deploy machine vision applications. Creating applications in Vision Builder AI does not require programming. However, Vision Builder AI applications are scalable to the LabVIEW Real-Time Module.

Vision Builder AI allows you to easily configure and benchmark a sequence of visual inspection steps, as well as deploy the visual inspection system for automated inspection. With Vision Builder AI, you can perform powerful visual inspection tasks and make decisions based on the results of individual tasks. You can also migrate your configured inspection to LabVIEW, extending the capabilities of your applications if necessary.

LabVIEW Real-Time Module with the Vision Development Module

The LabVIEW Real-Time Module combines LabVIEW graphical programming with the power of Real-Time (RT) Series hardware, such as the CVS-1450 Series, enabling you to build deterministic, real-time systems. You develop VIs in LabVIEW and embed the VIs on RT targets. The RT target runs VIs without a user interface and offers a stable platform for real-time VIs.

For more information about the LabVIEW Real-Time Module, refer to the *LabVIEW Help*.

The Vision Development Module is an image acquisition, processing, and analysis library of more than 270 functions for the following common machine vision tasks:

• Pattern matching

• Particle analysis

• Gauging

• Taking measurements

• Grayscale, color, and binary image display

You can use the Vision Development Module functions individually or in combination. With the Vision Development Module you can acquire, display, and store images as well as perform image analysis and processing. Using the Vision Development Module, imaging novices and experts can program the most basic or complicated image applications without knowledge of particular algorithm implementations.

NI Vision Assistant, which is included with the Vision Development Module, is an interactive prototyping tool for machine vision and scientific imaging developers. With Vision Assistant, you can prototype vision applications quickly and test how various vision image processing functions work. Using the Vision Assistant LabVIEW VI creation wizard, you can create LabVIEW VI block diagrams that perform the prototype you created in Vision Assistant. You can use them in LabVIEW to add functionality to the generated VI.

For information about how to use the Vision Development Module with the LabVIEW Real-Time Module, refer to the *IMAQ Vision for LabVIEW User Manual*.

2

Setup and Configuration

This chapter provides instructions for setting up the NI CVS-1450 Series hardware. This chapter also includes instructions for installing software, configuring an IP address, and acquiring an initial image using the application software.

Required Items

The following items are necessary for setting up the CVS-1450 device.

Hardware

❑ CVS-1450 device

❑ Ethernet-equipped development computer running Windows 2000/XP/Me/98

❑ DCAM-compliant IEEE 1394 camera

❑ IEEE 1394 jackscrew-to-latch cable (part number 778796-01) or any standard IEEE 1394 cable—Facilitates plug-and-play connection from the CVS-1450 device to up to three 1394 cameras. You can use a 4-pin to 6-pin converter cable with cameras that have their own external power supply and do not require power from the 1394 bus.

Note To maintain signal integrity, the IEEE 1394 cable length must be no longer than 4.5 m.

❑ NI desktop power supply (part number 778794-01) or any 24 VDC ±10%, 50 W power supply

– Power supply cord—Connects the NI desktop power supply to an outlet. Refer to `ni.com` for the part number specific to your region and ordering information.

– 4-position power connector—Required if you do not use the NI desktop power supply

❑ 10 m 10/100Base-T Ethernet cable (part number 189174-10)—Standard Category 5 (CAT-5) 10/100Base-T Ethernet cable that connects the CVS-1450 device to a network port. To connect the CVS-1450 device directly to a local development computer, use an Ethernet crossover cable.

Note To maintain signal integrity, the Ethernet cable length must be no longer than 100 m.

Software

❑ NI-IMAQ for IEEE 1394 Cameras driver software, which includes the CVS-1450 Series support software

❑ One of the following application software packages:
   – NI Vision Builder for Automated Inspection (AI) 2.0 or later
   – NI LabVIEW Real-Time Module 7.0 or later with the Vision Development Module 7.0 or later

Accessories

National Instruments offers the following accessories for use with a CVS-1450 device.

Hardware

- VGA-resolution camera (part number 778785-01)
- 12 mm fixed focal length lens (part number 778789-01)
- LED ring light (part number 778787-01)
- NI Vision I/O terminal block and prototyping accessory (part number 779166-01)
- DIN rail/panel mount kit (part number 189154-01)
- 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)
- 75 Ω SMB 111 coaxial cable (part number 763422-01)—SMB to BNC cable for connecting to triggers and light sources
- 10 m Ethernet crossover cable (part number 187375-10)—For connecting the CVS-1450 device directly to the development computer

Documentation

The following documentation resources ship with the CVS-1450 device and the application software. For more resources, including code examples and tutorials, visit the NI Developer Zone at `ni.com/zone`.

Hardware Documents

- *NI CVS-1450 Series User Manual*
- *NI 1450 Series Compact Vision System Digital I/O Help*
- *NI 1450 Series Compact Vision System Quick Start Guide*

Vision Builder AI Documents

- *NI Vision Builder for Automated Inspection Tutorial*
- *NI Vision Builder for Automated Inspection: Configuration Help*
- *NI Vision Builder for Automated Inspection: Inspection Help*

NI-IMAQ for IEEE 1394 Cameras Driver Software Documents

- *Getting Started with NI-IMAQ for IEEE 1394 Cameras*
- *NI-IMAQ for IEEE 1394 Cameras User Manual*
- *NI-IMAQ for IEEE 1394 Cameras VI Reference Help*
- *NI-IMAQ for IEEE 1394 Cameras Help*

Vision Development Module and LabVIEW Real-Time Module Documents

Vision Development Module Documents

- *NI Vision Assistant Help*
- *NI Vision Assistant Tutorial*
- *NI Vision Concepts Manual*
- *NI Vision for LabVIEW User Manual*
- *NI Vision for LabVIEW VI Reference Help*

LabVIEW Real-Time Module Documents

- *Getting Started With the LabVIEW Real-Time Module*
- *LabVIEW Real-Time Module Release Notes*

- *LabVIEW PID Control Toolset User Manual*
- *LabVIEW Help*

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.

If the device is rated for use with hazardous voltages (>30 V_{rms}, 42.4 V_{pk}, or 60 V_{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. Pollution degrees are listed below:

- 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 this device at or below the Measurement Category level specified in the hardware specifications.

Measurement Category[1]: Measurement circuits are subjected to working voltages[2] and transient stresses (overvoltage) from the circuit to which they are connected during measurement or test. Installation Category establishes standardized impulse withstand voltage levels that commonly occur in electrical distribution systems. The following is a description of Installation (Measurement[3]) Categories:

- Measurement Category I is for measurements performed on circuits *not* directly connected to the electrical distribution system referred to as MAINS[4] 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).

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[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.

Examples of Installation Category II are measurements performed on household appliances, portable tools, and similar products.

- Measurement Category III is for measurement 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.

- Measurement Category IV is for measurements performed at the primary electrical supply installation (<1,000 V). Examples include electricity meters and measurements on primary overcurrent protection devices and on ripple control units.

Setup Overview

Figure 2-1 illustrates the sequence for setting up and getting started with the CVS-1450 device.
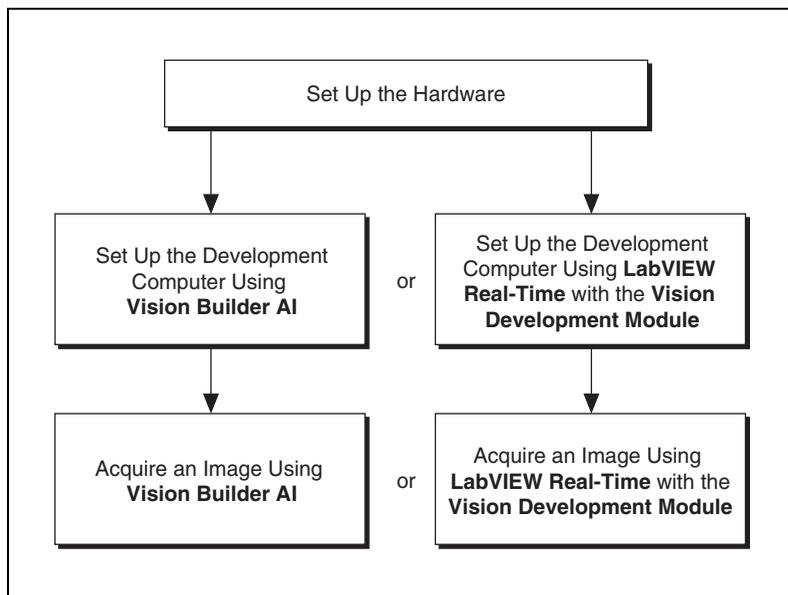
Figure 2-1. Setup Sequence

- **Setting Up the Hardware**—This section explains how to connect a camera, monitor, and power supply to a CVS-1450 device.

- **Setting Up the Development Computer**—This section explains how to use either Vision Builder AI or the LabVIEW Real-Time Module with the Vision Development Module to perform the following tasks:

  – Connect the CVS-1450 device to the development computer

  – Install application and driver software

  – Obtain an IP address

- **Acquiring an Image**—This section explains how to use either Vision Builder AI or the LabVIEW Real-Time Module with the Vision Development Module to acquire an image.

Before Getting Started: Connecting the CVS-1450 Device to a Network

Use a standard CAT-5 or CAT-6 Ethernet cable to connect the CVS-1450 device to an Ethernet network.

If the development computer is already configured on a network, you must configure the CVS-1450 device on the same network. If the development computer is not connected to a network, you can connect the two directly using a CAT-5 or CAT-6 Ethernet crossover cable.

⚠ **Caution**   To prevent data loss and to maintain the integrity of your Ethernet installation, do *not* use a cable longer than 100 m. If you are using a 100 Mbps Ethernet, National Instruments recommends using a CAT-5 or CAT-6 shielded twisted-pair Ethernet cable.

Subnet Considerations

To configure the CVS-1450 device, it must reside on the same subnet as the development computer. Once the CVS-1450 device is configured, other subnets can access and use it.

To use the CVS-1450 device on a subnet other than the one on which the development computer resides, first connect and configure the CVS-1450 device on the same subnet as the development computer. Next, physically move the CVS-1450 device to the other subnet and reassign an IP address. Contact your network administrator for assistance in setting up the development computer and CVS-1450 device on the same subnet.

Setting Up the Hardware

This section describes how to connect the basic hardware components of the CVS-1450 device. When these basic components are connected for the first time, the CVS-1450 device runs a program that acquires images. This program verifies that all hardware components are properly connected and functioning.

The following items are necessary for hardware setup.

❑ CVS-1450 device

❑ 24 VDC ±10%, 50 W power supply

❑ DCAM-compliant IEEE 1394 camera

❑ IEEE 1394 cable

❑ Ethernet cable

❑ Monitor

Connecting a Camera and Monitor to the CVS-1450 Device

Before connecting a camera and monitor to the CVS-1450 device, make sure that all CVS-1450 device DIP switches are in the **OFF** position.

To connect an IEEE 1394 camera and a monitor to the CVS-1450 device, refer to Figure 2-2 while completing the following steps:

1. Connect the VGA cable from the monitor to the VGA port on the CVS-1450 device.

2. Plug the IEEE 1394 cable into one of the IEEE 1394a ports on the CVS-1450 device. Plug the other end of the cable into the IEEE 1394 port on the camera.

   If your camera requires an external power supply, connect it to the camera, and verify that the camera is powered on.
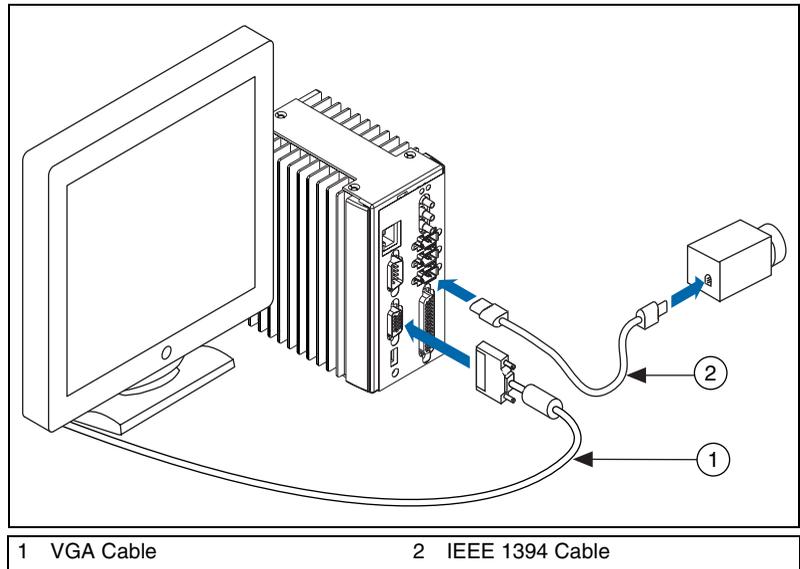
3. Plug in and power on the monitor.

| 1 | VGA Cable | 2 | IEEE 1394 Cable |

Figure 2-2. Basic Hardware Setup

Wiring Power to the CVS-1450 Device

This section describes how to connect the NI desktop power supply. For instructions on how to connect a separate main supply, refer to the *Connecting to a Separate Main Supply* section.

⚠ **Caution**   Do *not* connect the CVS-1450 device main power to a source other than 24 VDC ±10%. Do *not* connect the CVS-1450 device isolated power to a source less than 5 VDC or greater than 30 VDC. Doing so could damage the CVS-1450 device.

To connect power to the CVS-1450 device, refer to Figure 2-3 while completing the following steps:

1. Plug the 4-position connector from the power supply into the power receptacle on the CVS-1450 device.

2. Plug the power cord into the power supply.

3. Plug the power cord into an outlet.

The CVS-1450 device ships with a factory-installed startup program that, when the CVS-1450 device is connected to a camera and powered on, acquires images and displays them on the monitor. If the images from the camera display on the monitor, continue to the *Connecting the CVS-1450 Device to the Development Computer* section. If the images from the

camera are not displayed on the monitor, refer to Appendix A,
Troubleshooting.

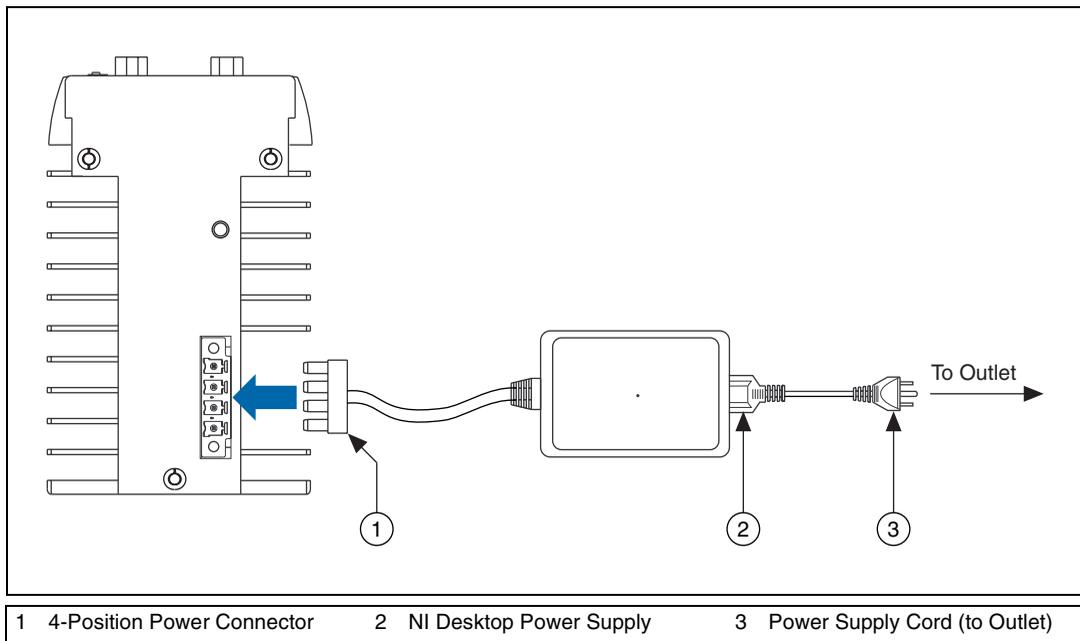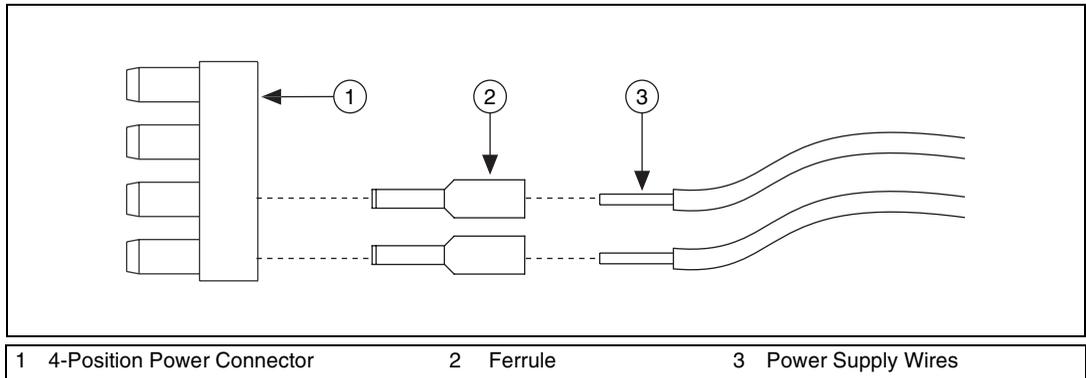| 1	4-Position Power Connector	2	NI Desktop Power Supply	3	Power Supply Cord (to Outlet)

Figure 2-3. Wiring Power to the CVS-1450 Device

Connecting to a Separate Main Supply

If you use a power supply other than the NI desktop power supply, follow
the instructions in this section to connect power to the CVS-1450 device.

Note   If you are not using the NI desktop power supply, use 0.75 mm^2, 18 AWG ferrules
according to manufacturer specifications to terminate the wires leading to the 4-position
power connector, shown in Figure 2-4. Ferrules are available from Phoenix Contact
(part number 3200519).

1	4-Position Power Connector	2	Ferrule	3	Power Supply Wires

Figure 2-4. Wiring a Third-Party Power Supply to the 4-Position Power Connector

⚠️ **Caution**   Do *not* connect the CVS-1450 device main power to a source other than 24 VDC ±10%. Do *not* connect the CVS-1450 device isolated power to a source less than 5 VDC or greater than 30 VDC. Doing so could damage the CVS-1450 device.

The CVS-1450 device ships with a 4-position power connector that plugs directly into the power input connector on the CVS-1450 device. To wire power to the 4-position connector, complete the following steps:

1. Wire the voltage output of the 24 VDC ±10% power supply to the main voltage input, labeled **V**, on the 4-position connector.

2. Wire the common-mode signal (ground) output of the power supply to the common-mode signal input, labeled **C**, on the 4-position connector.

If you are using a separate power supply for the CVS-1450 device isolated outputs, connect the voltage output on the power supply to the isolated power (**Viso**) on the 4-position connector. Connect the common-mode signal (ground) on the power supply to the isolated common-mode signal (**Ciso**) on the connector.

📝 **Note**   If you do not require a separate power supply for the CVS-1450 device isolated outputs, you can daisy-chain the **V** to the **Viso** and the **C** to the **Ciso** on the connector.

For information about grounding the CVS-1450 device chassis to earth ground, refer to the *Earth Ground Connection* section of Chapter 3, *LEDs, DIP Switches, and Connectors*.

Connecting the CVS-1450 Device to the Development Computer

The development computer communicates with the CVS-1450 device over an Ethernet connection. Use a standard Ethernet cable to connect from the network port to the CVS-1450 device.

✎ **Note** If you are *not* connecting through a network, use an Ethernet crossover cable to connect the CVS-1450 device directly to the development computer.

To connect the CVS-1450 device to the development computer, refer to Figure 2-5 while completing the following steps:

1. Verify that the development computer is connected to the network and is powered on.

2. Using a standard CAT-5 Ethernet cable, connect from the network port to the Ethernet port on the CVS-1450 device.

3. Using a standard CAT-5 Ethernet cable, connect from the network port to the Ethernet port on the development computer.

1   Standard Ethernet Cable Connecting from the CVS-1450 Device to an Ethernet Hub
2   Standard Ethernet Cable Connecting from an Ethernet Hub to the Development Computer
3   Ethernet Hub or Other Network Port
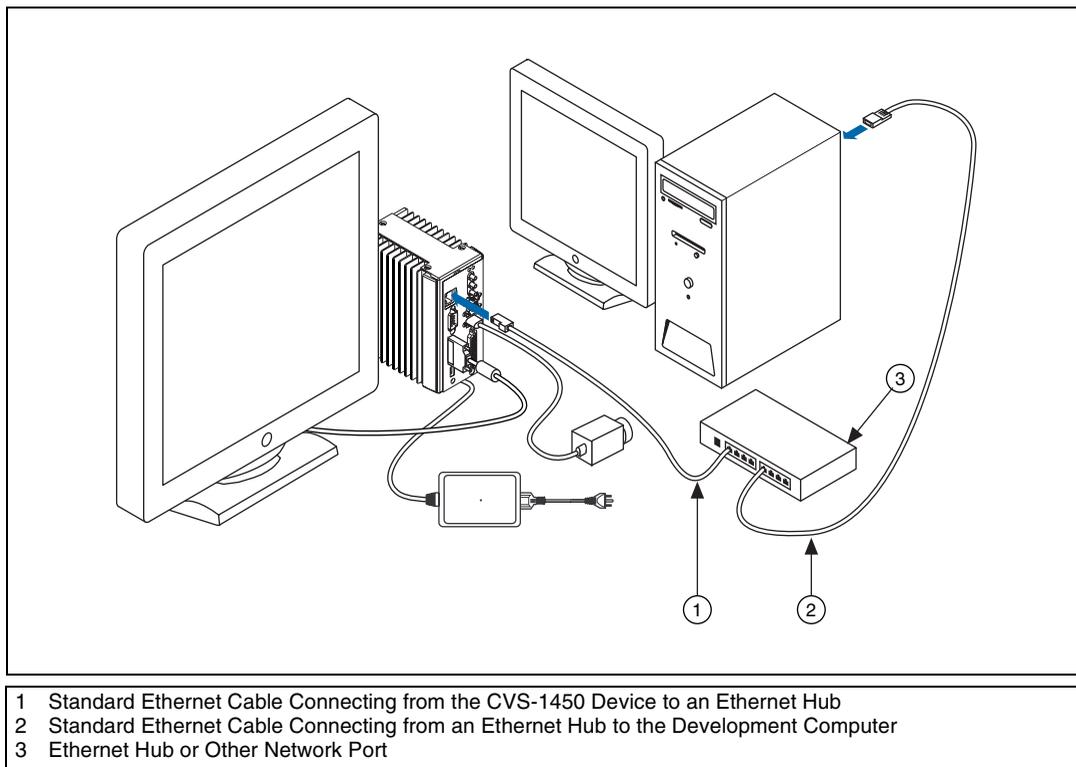
Figure 2-5. Ethernet Connection

Vision Builder AI: Setting up the Development Computer

This section describes the sequence for installing Vision Builder AI and the NI-IMAQ for IEEE 1394 Cameras software on the development computer, obtaining an IP address, installing software on the CVS-1450 device, and configuring the CVS-1450 device to acquire an image using Vision Builder AI.

Note This section applies *only* to Vision Builder AI users. If you are using the LabVIEW Real-Time Module with the Vision Development Module, refer to the *LabVIEW Real-Time Module with the Vision Development Module: Setting up the Development Computer* section.

The following items are necessary for setting up the development computer.

❑ Vision Builder AI, version 2.0 or later

❑ NI-IMAQ for IEEE 1394 Cameras driver, version 1.5 or later

Installing Vision Builder AI and NI-IMAQ for IEEE 1394 Cameras

This section describes how to install the Vision Builder AI software and the NI-IMAQ for IEEE 1394 Cameras driver software onto the development computer.

Note You must install Vision Builder AI *before* installing NI-IMAQ for IEEE 1394 Cameras.

Complete the following steps to install Vision Builder AI and NI-IMAQ for IEEE 1394 Cameras onto the development computer.

1. Insert the Vision Builder AI CD into the CD-ROM drive.

2. When the installation splash screen appears, click **Install NI Vision Builder AI** and follow the setup instructions.

3. Insert the NI-IMAQ for IEEE 1394 Cameras CD into the CD-ROM drive.

Note When installing NI-IMAQ for IEEE 1394 Cameras, make sure to install the support files for the LabVIEW Real-Time Module.

4. When the installation splash screen appears, click **Install NI-IMAQ for IEEE 1394 Cameras**, and follow the setup instructions.

5. Restart the development computer.

Configuring the IP Address on the CVS-1450 Device

Complete the following steps to set up an IP address and download software onto the CVS-1450 device.

1. Launch Vision Builder AI on the development computer by navigating to **Start»Programs»National Instruments»Vision Builder AI**.

2. Expand the **Execution Target** drop-down listbox, and click **Select Network Target**. This process takes several seconds.

3. In the Select Remote Target window, click **192.168.10.12** to highlight the row. This IP address is assigned to all unconfigured CVS-1450 devices.

Tip To uniquely identify unconfigured CVS-1450 devices, connect and configure one CVS-1450 device at a time.

4. Click **Configure** to launch the Vision Builder AI Remote Target Configuration Wizard.

5. In the Identification window, enter a name for the CVS-1450 device in the **Name** field and a description of the CVS-1450 device in the **Description** field.

Note Device names are limited to 15 characters with no spaces or special characters. The first and last characters must be alphanumeric.

6. Click **Next**.

7. If the network is configured to issue IP addresses using DHCP, select **Obtain IP address from DHCP server**. Otherwise, set the IP address manually by selecting **Edit IP Settings**, **Suggest Values**, and **OK**.

8. Click **Next**. This window shows the status of the software installed on the CVS-1450 device.

9. Select the **Update Target Software** checkbox.

10. Click **OK** to begin configuring the IP address and downloading software onto the CVS-1450 device. This initialization process takes several minutes.

Acquiring an Image in Vision Builder AI

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

1. Launch Vision Builder AI on the development computer.

2. In the Vision Builder AI Welcome screen, expand the **Execution Target** drop-down listbox and click **Select Network Target**.

3. Select the CVS-1450 device you configured and click **OK**.

4. In the Vision Builder AI Welcome screen, click **Configure Inspection**.

5. From the Acquire Images palette, click **Acquire Image (IEEE 1394)**.

6. Click the Snap button to acquire a single image, or click the Grab button to acquire continuous images.

7. When you have configured your acquisition, click **OK** to add the step. You can now add inspection steps as documented in the *NI Vision Builder for Automated Inspection Tutorial*.
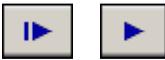
LabVIEW Real-Time Module with the Vision Development Module: Setting up the Development Computer

This section describes the sequence for installing the application and driver software on the development computer, obtaining an IP address, installing software on the CVS-1450 device, and configuring the CVS-1450 device to acquire an image using the LabVIEW Real-Time Module.

✎ **Note** This section applies *only* to LabVIEW Real-Time Module users. If you are using the Vision Builder AI software, refer to the *Vision Builder AI: Setting up the Development Computer* section.

The following items are necessary for setting up the development computer.

❑ LabVIEW and LabVIEW Real-Time Module software

❑ Vision Development Module software

❑ NI-IMAQ for IEEE 1394 Cameras driver software

Installing the LabVIEW Real-Time Module, Vision Development Module, and NI-IMAQ for IEEE 1394 Cameras

Note   You must install LabVIEW, the LabVIEW Real-Time Module, and the Vision Development Module software *before* installing the NI-IMAQ for IEEE 1394 Cameras driver software.

Complete the following steps to install LabVIEW, the LabVIEW Real-Time Module, the Vision Development Module, and NI-IMAQ for IEEE 1394 Cameras onto the development computer.

1. Insert the LabVIEW CD into the CD-ROM drive.
2. When the installation splash screen appears, click **Install LabVIEW**, and follow the setup instructions.
3. Insert the LabVIEW Real-Time Module CD into the CD-ROM drive.
4. When the installation splash screen appears, click **Install LabVIEW Real-Time Module**, and follow the setup instructions.
5. Insert the Vision Development Module CD into the CD-ROM drive.
6. When the splash screen appears, click **Install Vision Development Module**, and follow the setup instructions.
7. Insert the NI-IMAQ for IEEE 1394 Cameras CD into the CD-ROM drive.

Note   If you select the custom software installation, make sure to install the support for the CVS-1450 Series.

8. When the splash screen appears, click **Install NI-IMAQ for IEEE 1394 Cameras**, and follow the setup instructions.
9. When prompted, click **Yes** to restart the development computer.

Configuring the IP Address using the LabVIEW Real-Time Module

To set up an IP address for the CVS-1450 device, complete the following steps:

1. Open the Measurement & Automation Explorer (MAX) configuration software by double-clicking the MAX icon on the desktop, or navigate to MAX by selecting **Start»Programs»National Instruments» Measurement & Automation**.
2. Expand the **Remote Systems** branch of the configuration tree, and click **192.168.10.12** to display the Network Settings window. This IP address is assigned to all unconfigured CVS-1450 devices.

Tip   To uniquely identify unconfigured CVS-1450 devices, connect and configure one CVS-1450 device at a time.

3. In the Network Settings window, enter a name for the device in the **Name** field and a description of the device in the **Comment** field.

Note   Device names are limited to 15 characters with no spaces or special characters. The first and last characters must be alphanumeric.

4. If the network is configured to issue IP addresses using DHCP, select **Obtain IP address from DHCP server**. Otherwise, set the IP address manually by selecting **Edit the IP settings**, **Suggest Values**, and **OK**.

5. Click **Apply**.

6. When prompted, click **Yes** to restart the CVS-1450 device. This initialization process takes several minutes.

While the CVS-1450 device is restarting, an icon appears next to the device name to indicate that the CVS-1450 device is disconnected. The MAX status bar also indicates the connection status of the CVS-1450 device.

Downloading Software onto the CVS-1450 Device

1. In the MAX configuration window, click the **Software** tab. This window displays the status of the software on the CVS-1450 device.

2. Click the **Install Software** button.

3. Select the software to download. For initial installation, make sure all checkboxes are selected.

4. Click **OK**.

5. When prompted, click **Yes** to restart the CVS-1450 device. This process takes several seconds.

Acquiring an Image Using the LabVIEW Real-Time Module

Complete the following steps to acquire an image using the LabVIEW Real-Time Module.

1. Launch LabVIEW by navigating to **Start»Programs»National Instruments LabVIEW**.

2. Expand the **Execution Target** drop-down listbox, and click **Select Target with Options**.

3. Enter the new IP address in the **Machine Name/IP** field, and click **OK**.

4. Click the **Open** button.

5. Navigate to <*LabVIEW*>\examples\IMAQ.

6. Double-click IMAQ1394 examples.llb and select Grab.vi.

7. Click the **Run** button to begin acquiring images.

Now that you are acquiring images in LabVIEW, you can use the Vision Development Module and the installed CVS-1450 device drivers to process images and control inputs and outputs.

LEDs, DIP Switches, and Connectors

This chapter provides information about the location and functionality of the LED indicators, DIP switches, and connectors on the NI CVS-1450 device. The *Connectors* section provides signal names and descriptions for each connector.

LED Indicators

Figure 3-1 shows the location of the **POWER OK** and **STATUS** LEDs on the CVS-1450 device.
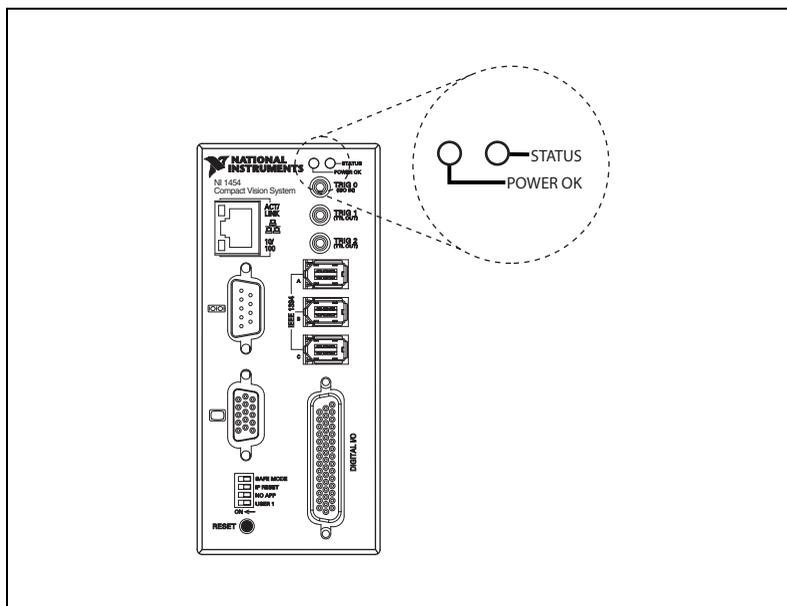
Figure 3-1. POWER OK and STATUS LEDs

Refer to Appendix A, *Troubleshooting*, for information about troubleshooting LEDs.

POWER OK LED

Under normal operating conditions, the **POWER OK** LED remains green while the CVS-1450 device is powered on. A green **POWER OK** LED indicates that CVS-1450 device main power is receiving power and that the CVS-1450 device is not in a fault state. A red **POWER OK** LED indicates that the CVS-1450 device has shut down because of a fault state. A fault state occurs when the user shutdown input is asserted, the processor overheats, or the watchdog timer expires.

✎ **Note** The **POWER OK** LED does *not* indicate the status of the isolated power, Viso.

STATUS LED

The orange **STATUS** LED remains off under normal operating conditions and flashes a specific number of times to indicate error conditions or certain DIP switch settings. The **STATUS** LED remains lit if the CVS-1450 device detects an internal error.

Refer to the *Hardware Errors* section of Appendix A, *Troubleshooting*, for information about LED error indications.

ACT/LINK LED

The orange **ACT/LINK** LED blinks when the CVS-1450 device receives data from or transmits data to the network through the Ethernet connection. Unrelated network activity causes this LED to blink occasionally even when the CVS-1450 device is inactive.

Figure 3-2 shows the location of the **ACT/LINK** LED on the CVS-1450 device.

100 Mbps LED

The green **100 Mbps** LED is lit when the network provides 100 Mbps support and the CVS-1450 device is communicating at 100 Mbps. If the **100 Mbps** LED is not lit, the CVS-1450 device is not operating at 100 Mbps.

Figure 3-2 shows the location of the **100 Mbps** LED on the CVS-1450 device.
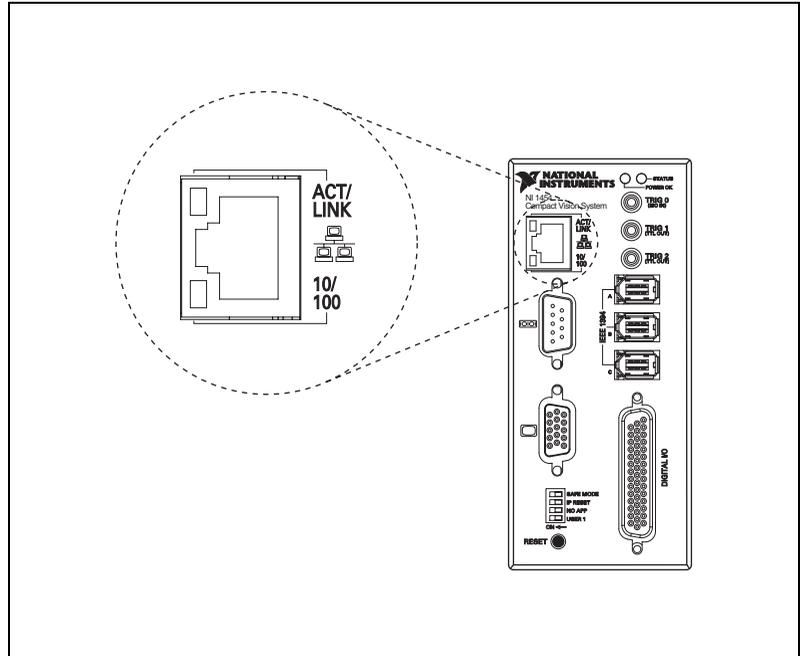
Figure 3-2. ACT/LINK and 100 Mbps LEDs

DIP Switches

This section describes the **SAFE MODE**, **IP RESET**, **NO APP**, and **USER 1** DIP switches on the CVS-1450 device.

To enable a DIP switch, move it to the **ON** (left) position and then reset the CVS-1450 device by pressing the **RESET** button for at least two seconds.

Note You must reset the CVS-1450 device in order for the setting change to occur.

Figure 3-3 shows the location of the DIP switches on the CVS-1450 device.
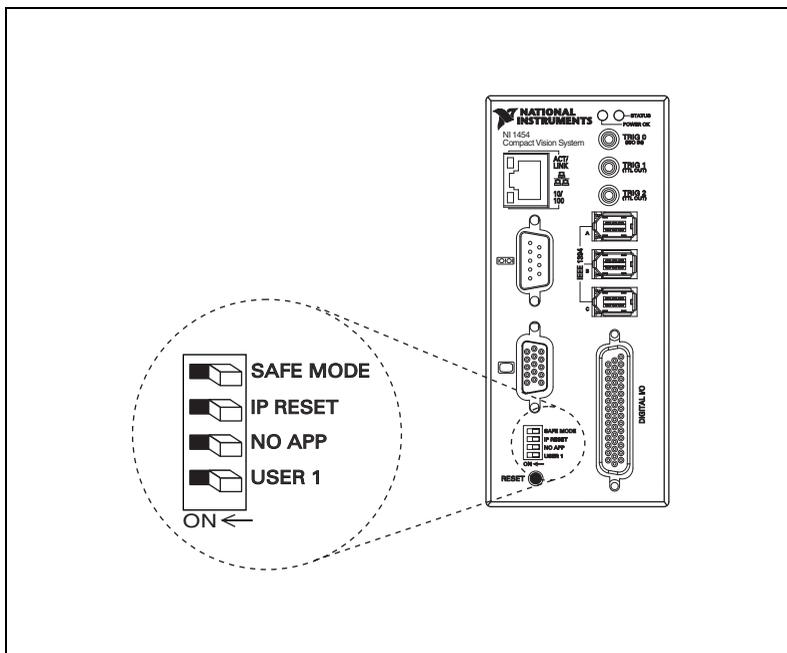
Figure 3-3. DIP Switches

SAFE MODE Switch
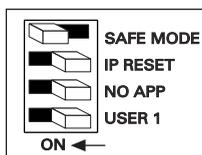
To start the CVS-1450 device in Safe mode, move the **SAFE MODE** switch to the **ON** position and reset the CVS-1450 device. Use Safe mode to reconfigure TCP/IP settings and to download or update software from the development computer.

Downloading incorrect software to the CVS-1450 device may cause it to hang during restart or become inaccessible over the network. Powering on or resetting the CVS-1450 device in Safe mode starts the CVS-1450 device but does not start the embedded LabVIEW RT engine. To resume normal operations, restart the CVS-1450 device with the **SAFE MODE** switch in the **OFF** position.

IP RESET Switch
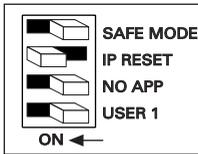
To clear the CVS-1450 device IP settings, move the **IP RESET** switch to the **ON** position and reset the CVS-1450 device. Use **IP RESET** to reset the TCP/IP settings when moving the system from one subnet to another or when the current TCP/IP settings are invalid.

Resetting the CVS-1450 device with the **IP RESET** switch in the **ON** position resets the IP address to **0.0.0.0**. You can then set up a new network configuration for the CVS-1450 device from a development machine on the same subnet, or you can use an Ethernet crossover cable to connect the CVS-1450 device directly to the development computer.

NO APP Switch
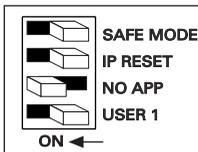
To prevent the CVS-1450 device from automatically running VIs at startup, move the **NO APP** switch to the **ON** position and reset the CVS-1450 device. If the CVS-1450 device becomes inaccessible because of a startup program, enable the **NO APP** switch and reset the CVS-1450 device.

Enable this switch to prevent the CVS-1450 device default startup program or Vision Builder AI from running at startup.

USER 1 Switch (LabVIEW Real-Time Module Users)
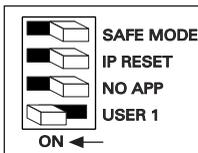
The **USER 1** switch is user-configurable and has no default functionality. You can use the RT Read Switch VI to read the **USER 1** switch state and perform a custom action based on the current switch state position.

Connectors

This section describes the connectors on the CVS-1450 device and includes pinouts and signal descriptions for each connector.

Table 3-1 summarizes the functions of the connectors on the CVS-1450 device.

Table 3-1. CVS-1450 Device Connectors Overview

| Peripheral	External Connectors	Function
Power	4-position power connector	Main power and power for isolated outputs
IEEE 1394a	6-pin IEEE 1394	Power and data connection to IEEE 1394 cameras
VGA	15-pin female DSUB (standard VGA)	Video output
Serial	9-pin male DSUB (standard RS-232 serial port)	COM1
10/100 Ethernet	RJ-45 (standard Ethernet port)	Ethernet network connection
TRIG 0	SMB receptacle	External isolated trigger input
TRIG 1 and TRIG 2	SMB receptacle	External TTL output
Digital Input/Output	44-pin female high-density DSUB	External TTL I/O; External isolated I/O

Power Connector

The power connector on the CVS-1450 device accommodates two power supplies. The terminals labeled **V** and **C** provide the voltage and common-mode signal for the main power of the CVS-1450 device. The terminals labeled **Viso** and **Ciso** provide the voltage and common-mode signal to power the isolated output circuitry.

⚠️ **Caution**   The isolation provided by the CVS-1450 device is intended to prevent ground loops that could introduce noise into the system. This isolation does *not* provide safety isolation.

Figure 3-4 shows the power connector on the CVS-1450 device. Table 3-2 lists and describes each terminal on the power connector.
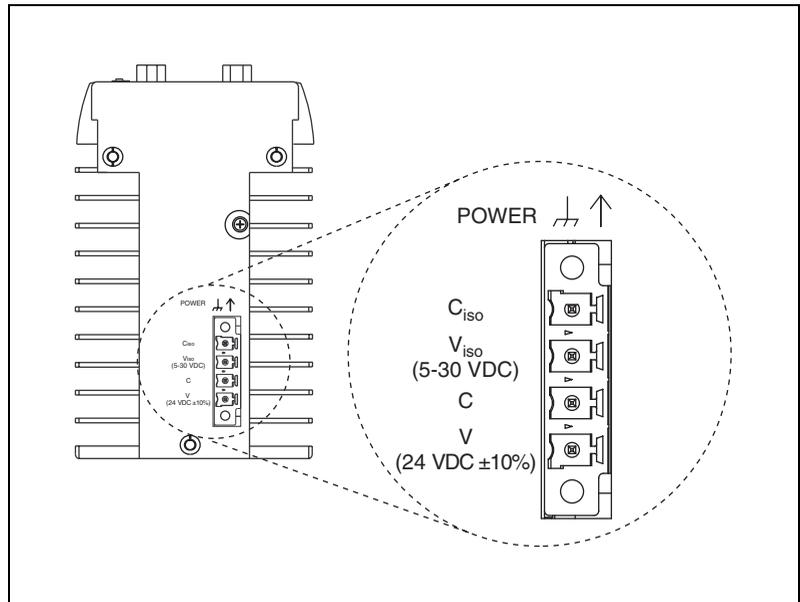
Figure 3-4. Power Connector

**Table 3-2.** Power Connector Terminals

Terminal	Description
V	Main power (24 VDC ±10%)
C	Common-mode signal
Viso	Isolated power (5 to 30 VDC)
Ciso	Isolated common-mode signal

Earth Ground Connection

Some system setups may require using the grounding lug on the CVS-1450 device to connect the chassis to earth ground. Connecting the grounding lug, shown in Figure 3-5, to earth ground connects the common-mode signal of the main power to earth ground through the CVS-1450 device chassis.

✎ **Note** An earth ground connection does *not* connect Ciso to earth ground.

| 1 | Grounding Lug | 2 | Power Connector |
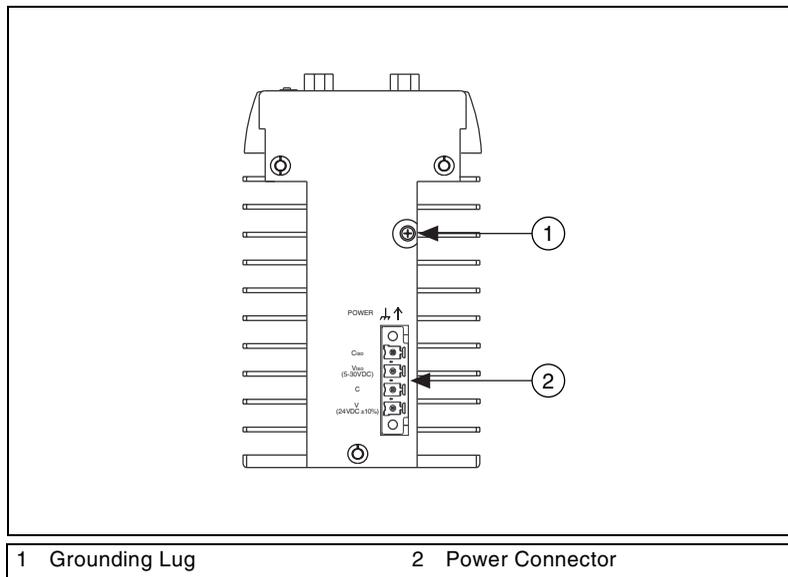
Figure 3-5. Grounding Lug on the CVS-1450 Device

IEEE 1394

The IEEE 1394 connectors on the CVS-1450 device provide a reliable, high-frequency connection between the CVS-1450 device and up to three DCAM-compliant IEEE 1394 cameras. For information about the amount of bandwidth available for connecting cameras, refer to the *Available Camera Bandwidth* section of Chapter 1, *NI CVS-1450 Series Overview*.

To access the IEEE 1394 connectors on the CVS-1450 device, use any standard 6-pin IEEE 1394 cable.

✎ **Note** You can use a 4-pin to 6-pin converter cable with cameras that have their own external power supply and do not require power from the IEEE 1394 bus.

VGA

The VGA connector on the CVS-1450 device provides connection between the CVS-1450 device and a VGA monitor. Use any standard 15-pin VGA cable to access the VGA connector. Figure 3-6 shows the location and pinout of the VGA connector. Table 3-3 lists and describes the VGA connector signals.
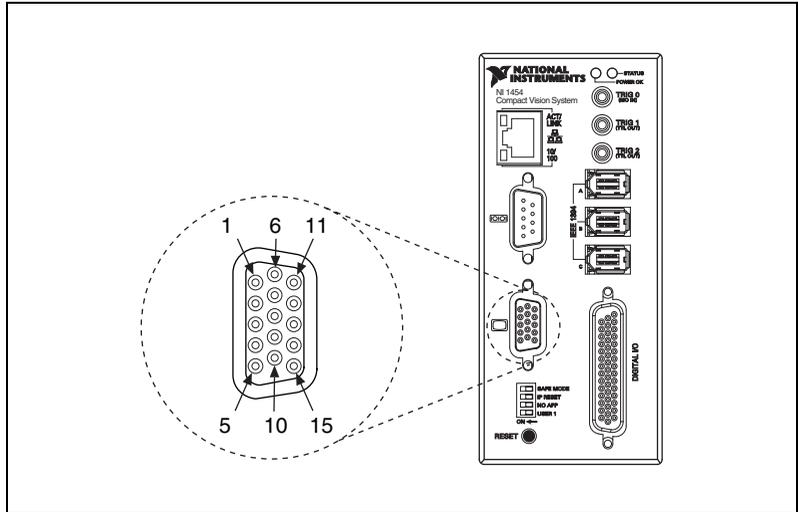
Figure 3-6. VGA Connector

Table 3-3 lists pin numbers, signal names, and signal descriptions for the 15-pin VGA connector on the CVS-1450 device.

Table 3-3. VGA Connector Signals

Pin Number	Signal Name	Signal Description
1	R	Red
2	G	Green
3	B	Blue
4	NC	No Connect
5	C	Common-mode signal of the CVS-1450 device main power
6	C	Common-mode signal of the CVS-1450 device main power
7	C	Common-mode signal of the CVS-1450 device main power
8	C	Common-mode signal of the CVS-1450 device main power
9	+5 V	+5 V

Table 3-3. VGA Connector Signals (Continued)

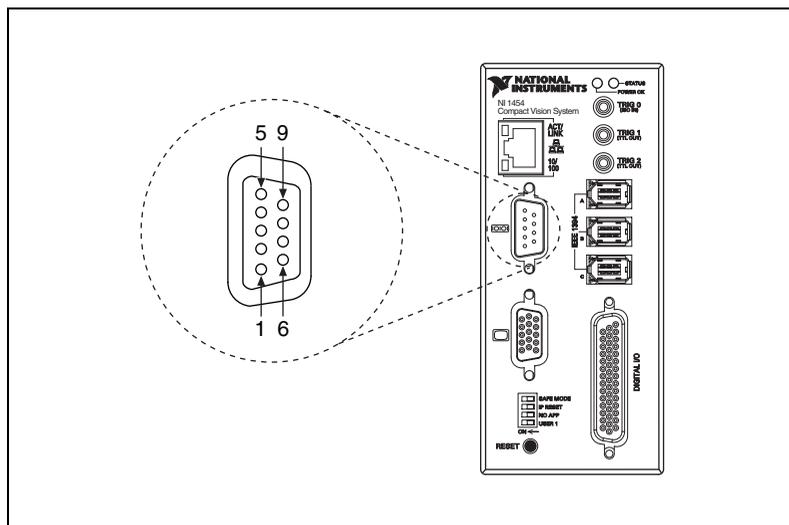| Pin Number	Signal Name	Signal Description
10	C	Common-mode signal of the CVS-1450 device main power
11	NC	No Connect
12	SD	Serial Data
13	HSync	Horizontal Sync
14	VSync	Vertical Sync
15	SC	Serial Clock

COM1

COM1 is a high-speed RS-232 (DTE) serial port used for connecting to serial devices, such as PLCs, scanners, and lighting devices.

✎ **Note** The Serial Port VIs access COM1 as Port 0.

Figure 3-7 shows the location and pinout of the COM1 DSUB 9-pin connector. Table 3-4 lists and describes the COM1 signals.

Figure 3-7. COM1 DSUB 9-Pin Connector

Table 3-4 lists pin numbers, signal names, and signal descriptions for the 9-pin COM1 connector on the CVS-1450 device.

Table 3-4. COM1 Connector Signals

Pin Number	Signal Name	Signal Description
1	DCD	Data Carrier Detect
2	RXD	Receive Data
3	TXD	Transmit Data
4	DTR	Data Terminal Ready
5	C	Common-mode signal of the CVS-1450 device main power
6	DSR	Data Set Ready
7	RTS	Ready to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

Ethernet

The Ethernet port on the CVS-1450 device provides connection between the CVS-1450 device and the development computer, either directly or through a network port. The CVS-1450 device automatically detects the speed of the connection and configures itself accordingly.

If you are connecting the CVS-1450 device to the development computer through a network port, use a standard Ethernet cable. To connect the CVS-1450 device directly to the development computer, use an Ethernet crossover cable.

TRIG 0

The TRIG 0 isolated input on the CVS-1450 device provides connection to external devices, such as proximity sensors and start/stop buttons. For easy connection to the TRIG 0 input, use the National Instruments SMB 111 coaxial cable (part number 763422-01).

Note   Additional isolated inputs are available on the 44-pin DSUB connector.

Caution   These isolated inputs are compatible with 5 V logic if the external circuit meets the voltage and current requirements listed in Appendix B, *Specifications*.

TRIG 1 and TRIG 2

You can use the two TTL outputs available on the SMB connectors for triggering cameras and external interfaces, such as lighting control units. For easy connection to the TTL outputs, use the National Instruments SMB 111 coaxial cable (part number 763422-01).

Note   Additional TTL outputs are available on the 44-pin DSUB connector.

Caution   Do *not* connect voltage or current sources to TTL outputs. Doing so could damage the CVS-1450 device.

General-Purpose Digital I/O

The 44-pin DSUB connector, shown in Figure 3-8, provides access to the general-purpose digital inputs and outputs. The general-purpose digital I/O available on this connector includes 2 TTL inputs, 8 TTL outputs, 12 isolated inputs, and 4 isolated outputs. For easy connection to the digital I/O connector, use the National Instruments digital I/O cable and terminal block.

For detailed information about digital I/O functionality and recommended use cases, refer to Chapter 4, *Digital I/O Functionality*.

Note   Isolated inputs are compatible with 5 V logic if the external circuit meets the voltage and current requirements listed in Appendix B, *Specifications*.
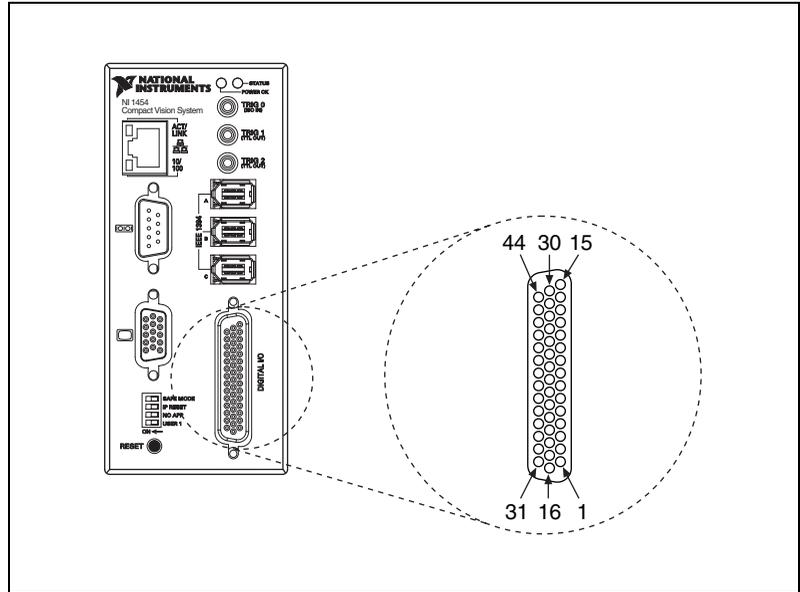
Figure 3-8. 44-Pin DSUB Connector

Table 3-5 lists pin numbers, signal names, and signal descriptions for the 44-pin connector on the CVS-1450 device and the 37-pin terminal block.

⚠ **Caution**   Do *not* draw more than 500 mA combined from the Viso pins on the 44-pin DSUB connector. Do *not* draw more than 100 mA from 24 V or 30 V isolated outputs. Do *not* draw more than 50 mA from 5 V isolated outputs.

Table 3-5. 44-Pin DSUB and 37-Pin Terminal Block Connector Signals

44-Pin DSUB on CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number	Signal Name	Primary Function	Alternate Function
1	1	TTL Input 0	Pulse generator trigger input	General-purpose input
2	3	C	Common-mode signal of the CVS-1450 device main power	—
3	4	TTL Output 0	Watchdog timer output	General-purpose output
4	5	TTL Output 1	Pulse generator output	General-purpose output

Table 3-5. 44-Pin DSUB and 37-Pin Terminal Block Connector Signals (Continued)

44-Pin DSUB on CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number	Signal Name	Primary Function	Alternate Function
5	6	C	Common-mode signal of the CVS-1450 device main power	—
6	7	TTL Output 2	Pulse generator output	General-purpose output
7	8	TTL Output 3	Pulse generator output	General-purpose output
8	6	C	Common-mode signal of the CVS-1450 device main power	—
9	NC	NC	No connect	—
10	17	Viso	Isolated power	—
11	18	Ciso	Isolated common-mode signal	—
12	19	ISO Output 0	General-purpose output	—
13	35	ISO Output 1	General-purpose output	—
14	34	Ciso	Isolated common-mode signal	—
15	9	ISO Input 0	Input port, Data(0)	—
16	2	TTL Input 1	Pulse generator trigger input	General-purpose input
17	3	C	Common-mode signal of the CVS-1450 device main power	—
18	20	TTL Output 4	Pulse generator output	General-purpose output
19	21	TTL Output 5	General-purpose output	—
20	22	C	Common-mode signal of the CVS-1450 device main power	—
21	23	TTL Output 6	General-purpose output	—
22	24	TTL Output 7	General-purpose output	—

Table 3-5. 44-Pin DSUB and 37-Pin Terminal Block Connector Signals (Continued)

44-Pin DSUB on CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number	Signal Name	Primary Function	Alternate Function
23	22	C	Common-mode signal of the CVS-1450 device main power	—
24	NC	NC	No connect	—
25	33	Viso	Isolated power	—
26	34	Ciso	Isolated common-mode signal	—
27	36	ISO Output 2	General-purpose output	—
28	37	ISO Output 3	General-purpose output	—
29	12	Ciso	Isolated common-mode signal	—
30	10	ISO Input 1	Input port, Data(1)	—
31	11	ISO Input 2	Input port, Data(2)	—
32	13	ISO Input 3	Input port, Data(3)	—
33	16	Ciso	Isolated common-mode signal	—
34	14	ISO Input 4	Input Port, Data(4)	—
35	15	ISO Input 5	Input port latch, Data(5)	Pulse generator trigger input
36	28	Ciso	Isolated common-mode signal	—
37	25	ISO Input 6	Quadrature encoder Phase A	General-purpose input
38	26	ISO Input 7	Quadrature encoder Phase B	General-purpose input
39	28	Ciso	Isolated common-mode signal	—
40	27	ISO Input 8	Pulse generator trigger input	General-purpose input
41	29	ISO Input 9	General-purpose input	General-purpose input

Table 3-5. 44-Pin DSUB and 37-Pin Terminal Block Connector Signals (Continued)

44-Pin DSUB on CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number	Signal Name	Primary Function	Alternate Function
42	32	Ciso	Isolated common-mode signal	—
43	30	ISO Input 10	General-purpose input	General-purpose input
44	31	ISO Input 11	User shutdown	General-purpose input

4

Digital I/O Functionality

This chapter describes the primary functions of the digital inputs and outputs on the NI CVS-1450 device. This chapter also includes guidelines for connecting the digital I/O and for setting up a typical CVS-1450 device.

Overview

The digital I/O functions are accessible through 2 TTL inputs, 10 TTL outputs, 13 isolated inputs, and 4 isolated outputs.

You can use input signals as triggers, product selection ports, or to read quadrature encoders. Uses for output signals include controlling camera reset and exposure, controlling strobe lighting, outputting inspection results, or communicating with PLCs. You can also define the functions of digital input and output signals.

For information about how to use the LabVIEW Real-Time Module to implement specific digital I/O functions, refer to the application software documentation and examples in the following locations:

- `Program Files\National Instruments\NI 1450 Series\Docs`
- `<`*LabVIEW*`>\examples\NI 1450`

The *NI 1450 Series Compact Vision System Digital I/O Help* is available for each example. This help file contains digital I/O reference information and instructions for using the LabVIEW FPGA VIs.

Tip To quickly launch the digital I/O help from a LabVIEW example, press <F1>.

TTL and Isolated Inputs and Outputs

This section describes the TTL and Isolated I/O functions available on the CVS-1450 device.

TTL Inputs and Outputs

TTL is a fast-switching, 5 V, digital, signaling standard commonly used for applications that require high precision, such as camera triggering. TTL inputs and outputs do not require a separate power supply.

⚠️ **Caution** Do *not* connect voltage or current sources to TTL outputs. Doing so could damage the CVS-1450 device.

Table 4-1 summarizes the TTL inputs and outputs available on the CVS-1450 device.

Table 4-1. TTL Inputs and Outputs

Primary Function	Input or Output	Number Available	Signal Names	44-Pin DSUB on CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number
Trigger	Input	2	TTL Input 0 TTL Input 1	1 16	1 2
Timed Pulse	Output	6	TRIG 1, Pulse 5 TRIG 2, Pulse 6 TTL Output 1, Pulse 1 TTL Output 2, Pulse 2 TTL Output 3, Pulse 3 TTL Output 4, Pulse 4	— — 4 6 7 18	— — 5 7 8 20
Watchdog	Output	1	TTL Output 0	3	4
General-Purpose	Output	3	TTL Output 5 TTL Output 6 TTL Output 7	19 21 22	21 23 24

Isolated Inputs and Outputs

The isolated inputs and outputs on the CVS-1450 device have a separate ground reference from the main CVS-1450 device supply, providing an easy means to prevent ground loops that can introduce noise into a system. You can apply signals up to 30 V to the isolated inputs. The voltage swing of the isolated outputs is determined by the Viso you supply on the connector.

✎ **Note** The isolated outputs have current-limiting protection circuitry. If this circuitry is tripped, you can re-enable the outputs by restarting the CVS-1450 device or by toggling the output state in the software.

Table 4-2 summarizes the isolated inputs and outputs available on the CVS-1450 device.

Table 4-2. Isolated Inputs and Outputs

Primary Function	Input or Output	Number Available	Signal Names	44-Pin DSUB on CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number
Trigger	Input	3	TRIG 0 ISO Input 5† ISO Input 8	— 35 40	— 15 27
Quadrature Encoder	Input	1	ISO Input 6 ISO Input 7	37 38	25 26
External Shutdown Control	Input	1	ISO Input 11	44	31
Product Selection Port†	Input	1	ISO Input 0 ISO Input 1 ISO Input 2 ISO Input 3 ISO Input 4	15 30 31 32 34	9 10 11 13 14
General-Purpose	Input	2	ISO Input 9 ISO Input 10	41 43	29 30
General-Purpose	Output	4	ISO Output 0 ISO Output 1 ISO Output 2 ISO Output 3	12 13 27 28	19 35 36 37

† ISO Input 5 can also function as a latch for the product selection port.

I/O for Normal Operation

The following sections describe I/O functions that are available on the CVS-1450 device during normal operation.

Trigger Inputs

Trigger inputs are available from both TTL inputs and isolated inputs. You can use these trigger inputs to synchronize the CVS-1450 device with an external event, such as the assertion of a signal generated by a proximity sensor or a PLC to indicate that an inspection item is passing in front of the camera. The CVS-1450 device uses this input to initiate a timed pulse that can be used for camera control, lighting control, encoder pulse counting, and result output timing.

For more information about creating a timed pulse output, refer to the
Timed Pulse Output section.

TTL Input 0, TTL Input 1, TRIG 0, and ISO Input 8 can alternatively
function as general purpose inputs. ISO input 5 can alternatively function
as a latch input for the product selection port.

Timed Pulse Output

The CVS-1450 device is capable of timed pulse output on six different
digital outputs, which provides precise control over time-critical signals,
such as camera exposure. This section describes the various uses for the
timed pulse output and the parameters you can set to control these outputs.

Uses for timed pulse output include controlling camera reset and exposure,
controlling strobe lighting, operating plungers on an assembly line, and
communicating with PLCs. You can configure the start of the pulse output
generation to occur from software or from a *rising* or *falling edge* of a
trigger input.

In addition to controlling the timing of pulse output, you can also configure
the polarity of the output signal, resulting in a high-true or low-true signal.
Based on the polarity setting, the output signal asserts after the appropriate
delay time and de-asserts after the configured pulse width. You can set the
delay time in microseconds or in quadrature encoder counts from the start
signal—either a hardware trigger or a software command. Width is always
configured in microseconds.

Initiating a Timed Pulse

Each timed pulse generator has a trigger input that specifies whether to wait
on a particular trigger input to generate the pulse or to immediately
generate the pulse when software sets the pulse mode to **Start**.

When the pulse generator is configured for a particular trigger input, after
generating a pulse, it waits for another trigger before generating another
pulse. When the pulse generator is configured to immediately generate the
pulse on a software start, after generating a pulse, it immediately generates
another pulse.

If the trigger input is set to **Immediate**, the pulse generation occurs as soon
as the pulse mode is set to **Start**. If the trigger input is set to one of the
hardware trigger inputs, the timed pulse output waits for an assertion edge
on the appropriate trigger input. The assertion edge is configurable based
on the trigger polarity parameter. It then generates one pulse and rearms to

wait for the next trigger. In either case, the pulse output generation stops and resets if the pulse mode parameter is set to **Stop**.

Figure 4-1 shows an output pulse when a trigger is selected.
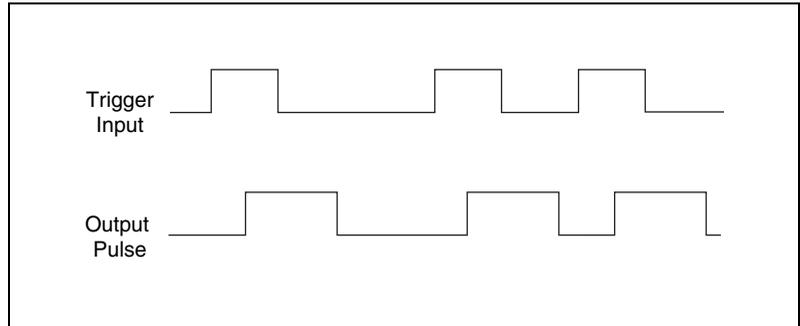
Figure 4-1. Output Pulse When Trigger Is Selected

Pulse Modes

Each pulse generator has a Start and a Stop mode. Configure the pulse generator when in Stop mode and then set it to Start mode.

Pulse Delay

Pulse delay is the amount of time between a trigger and the first (assertion) edge of an output pulse. The pulse delay is configurable in units of microseconds or quadrature encoder counts. If configured for microseconds, available values are between 10 µs and 4,294,967,295 µs, which is 4,294 seconds, or approximately 71 minutes. If the delay is configured for quadrature encoder counts, the range of choices is 0 counts to 4,294,967,295 counts.

Pulse Width

Pulse width is the amount of time between the first (assertion) edge of a pulse and the second (deassertion) edge. Pulse width is configurable only in microseconds from 10 µs to 4,294,967,295 µs.

Trigger Polarity

Each pulse generator can be individually configured for rising or falling edge triggering. Even if multiple pulse generators are using the same trigger, each can have different polarities.

Figure 4-2 shows the output of a pulse generator configured to look for a rising edge trigger and output a high pulse with a microsecond width and delay.
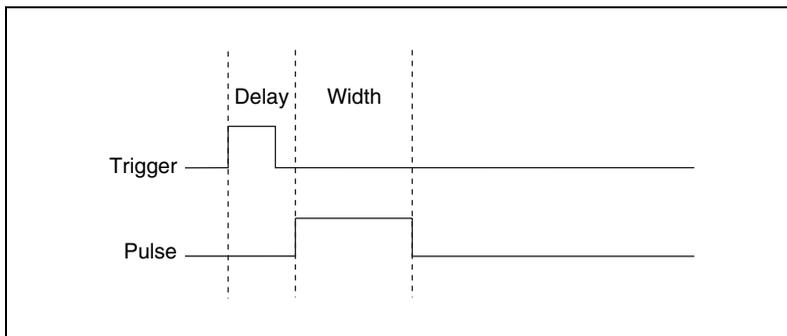
Figure 4-2. High Pulse with Rising Edge Trigger

Figure 4-3 shows how to create a high and low *pulse train* with a microsecond delay and width.
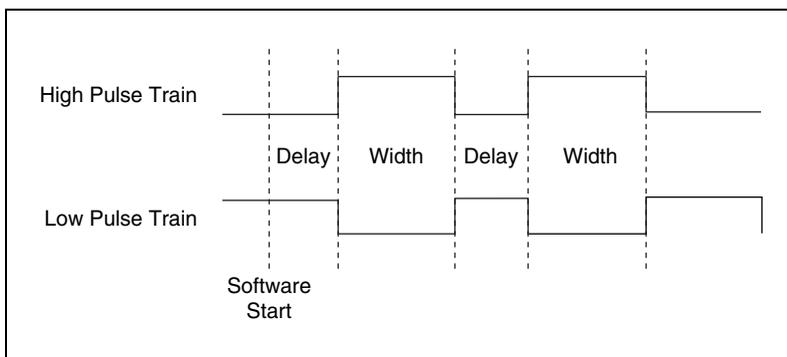
Figure 4-3. High and Low Pulse Trains

Quadrature Encoder

The quadrature encoder uses ISO Input 6 for its Phase A input and ISO Input 7 for its Phase B input. Encoder speed is limited by the speed of the isolated inputs. Each isolated input can change at a maximum rate of 100 kHz, making the maximum encoder rate 400,000 counts/s.

The quadrature encoder can also be used as a timebase for the pulse generation delay.

Figure 4-4 shows a rising edge trigger and a low pulse with a quadrature encoder delay and a microsecond width.
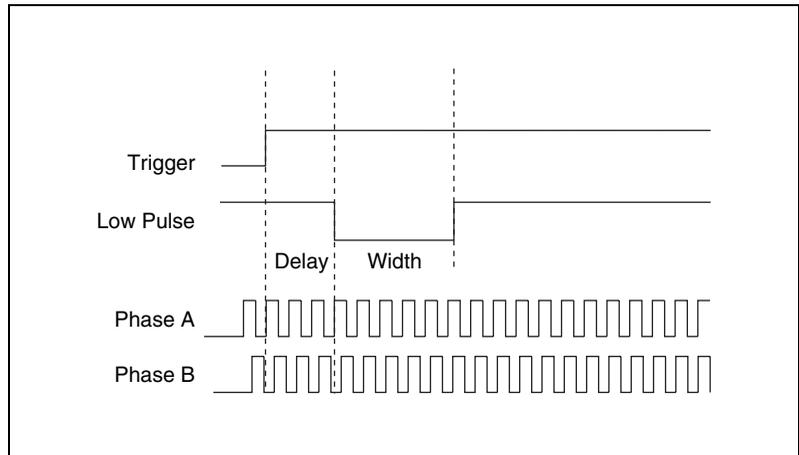
Figure 4-4. Rising Edge Trigger, Low Pulse with a Quadrature Encoder Delay

Product Selection Port

The product selection port consists of a group of five isolated digital inputs that the software running on the CVS-1450 device reads simultaneously. You can program the CVS-1450 device to switch between up to 32 (2^5) inspection sequences for different parts on an assembly line.

Based on the input to the product selection port, you can configure the application software to run the appropriate inspection sequence. For example, an upstream CVS-1450 device programmed for part classification might drive the product selection port of a downstream CVS-1450 device. Alternatively, a PLC with information about which part is being inspected can drive the product selection port of the CVS-1450 device.

Using ISO Input 5 as a Latch

You can configure the product selection port to use ISO Input 5 as a latch. A rising edge on ISO Input 5 can latch the data into a data register on the CVS-1450 device. Before each inspection, the software checks the status of the product select inputs and reads the most recent value latched into the register.

Note In Vision Builder AI, ISO Input 5 is always designated as a latch.

Table 4-3 lists the product selection ports.

Table 4-3. Product Selection Port

Function	External Connection
Data(5), rising edge latch	ISO Input 5
Data(4)	ISO Input 4
Data(3)	ISO Input 3
Data(2)	ISO Input 2
Data(1)	ISO Input 1
Data(0)	ISO Input 0

General-Purpose I/O

General-purpose inputs and outputs are available as both TTL and isolated connections. At any time, the software running on the CVS-1450 device can read the inputs and drive the outputs high or low.

General-Purpose Inputs

The primary difference between general-purpose inputs and trigger inputs is that you cannot use general-purpose inputs to initiate a timed pulse generator. In an application, use the general-purpose inputs to get the status of the inputs at a given point and not to synchronize the CVS-1450 device with an external event.

An example of how to use general-purpose inputs is reading the status of a general-purpose input as the first step in your inspection sequence and recording that value as part of your inspection.

General-Purpose Outputs

The primary difference between general-purpose outputs and timed pulse outputs is that the timing of general-purpose outputs is controlled by software rather than hardware. As a result, timing of general-purpose outputs changes as the inspection algorithm changes, which makes general-purpose outputs less appropriate than timed outputs for camera control, strobe light control, and other applications that require precise timing.

An example of using general-purpose outputs is driving a relay that turns on an Inspection in Progress light for an operator to see while the inspection sequence is running.

I/O for Fault Conditions

The CVS-1450 device recognizes the following fault conditions:

- External shutdown, when Shutdown mode is enabled
- Watchdog timer expiration
- Overheat

The behavior of the CVS-1450 device in the event of a fault condition is dependent on configuration settings of the **SAFE MODE** DIP switch and the software-enabled Shutdown mode. Table 4-4 summarizes how user configuration affects the behavior of the CVS-1450 device in the event of a fault condition. To resume operation, address the fault condition and reset the CVS-1450 device. The following sections describe each fault condition.

Table 4-4. Configuration Settings and Effects

Fault Condition	Configuration Settings		Configuration Effects	
	Safe Mode DIP	**Shutdown Enabled**	**Processing Halts**	**Outputs Change to User-Defined States**
External Shutdown	On	N/A	N/A	No
	Off	On	Yes	Yes
	Off	Off	No	No
Watchdog	On	N/A	N/A	No
	Off	On	Yes	Yes
	Off	Off	Yes	No
Overheat	On	N/A	Yes	No
	Off	On	Yes	Yes
	Off	Off	Yes	No

Shutdown

Shutdown mode is a software-enabled feature, that when activated, allows an external device to halt the CVS-1450 device processing operations. Additionally, Shutdown mode allows you to specify user-defined shutdown states for all fault conditions.

When Shutdown mode is enabled and the shutdown input signal, ISO Input 11, turns off, the CVS-1450 device registers an external shutdown condition. When this fault occurs, the **POWER OK** LED turns red and all system operation halts. To resume operation, you must reset the CVS-1450 device.

For all fault conditions, outputs operate according to user-defined shutdown states. Each TTL output is configurable to drive high, drive low, or 3-state, and each isolated output is on/off configurable.

Shutdown mode is unavailable when the **SAFE MODE** DIP switch is turned on.

Refer to Table 4-4 for a summary of how user configuration affects the shutdown condition.

Disabling Shutdown Mode

To disable Shutdown mode once it is enabled, remove Shutdown mode from the software script and reset the CVS-1450 device. To reset the system, press the **RESET** button on the CVS-1450 device front panel for at least two seconds.

Note For prototyping when equipment is unavailable, you can wire from Viso to ISO Input 11 to simulate external equipment that indicates to the CVS-1450 device to operate normally.

Watchdog Timer

The watchdog timer is a software configurable feature that can monitor software on the CVS-1450 device and take action if the software is unresponsive. The millisecond counter on the watchdog timer is configurable up to 65,534 ms, in 1 ms increments, before it expires.

Configure the watchdog timer to take one of the following actions when it expires:

⚠ **Caution**   Use the **Indicator Only** option *only* to test the watchdog timer. If software becomes unresponsive, it cannot be relied upon to send notification to the host.

- **Indicator Only**—This option sends the expiration signal back to the development machine through software. **True** indicates an expired watchdog timer. **False** indicates an unexpired watchdog timer. The expiration signal that indicates an expired watchdog timer continues to assert until the watchdog timer is disarmed. Disarming the watchdog timer resets the I/O.

- **TTL Output 0**—This option outputs a signal on TTL Output 0. A **High** on TTL Output 0 indicates that the watchdog timer has expired. **Low** indicates that it has not expired. If the watchdog timer has expired, the expiration signal continues to assert until the watchdog timer is disarmed.

- **System Shutdown**—This option halts the CVS-1450 device operation and turns the **POWER OK** LED red. If Shutdown mode is enabled, the outputs go to the user-defined shutdown states.

Table 4-4 summarizes how user configuration affects the shutdown condition.

Overheat

Operating the CVS-1450 device outside of its temperature specifications may cause the CVS-1450 device to overheat. Refer to Appendix B, *Specifications*, for temperature specifications.

In the event of an overheat, all CVS-1450 device operation halts and the **POWER OK** LED turns red. If Shutdown mode is enabled, the outputs go to the user-defined shutdown states.

Considerations When Connecting the Digital I/O

The isolated trigger inputs on the CVS-1450 device are current sinking and optically isolated. Figure 4-6 shows the trigger input interface circuit.

Wiring an Isolated Input to a Sourcing Output Device

You can wire an isolated input to a sourcing output device, as shown in the example in Figure 4-5. Refer to Appendix B, *Specifications*, for switching thresholds and current requirements.

⚠️ **Caution**   Do *not* apply a voltage greater than 30 VDC to the isolated inputs. Doing so could damage CVS-1450 device.
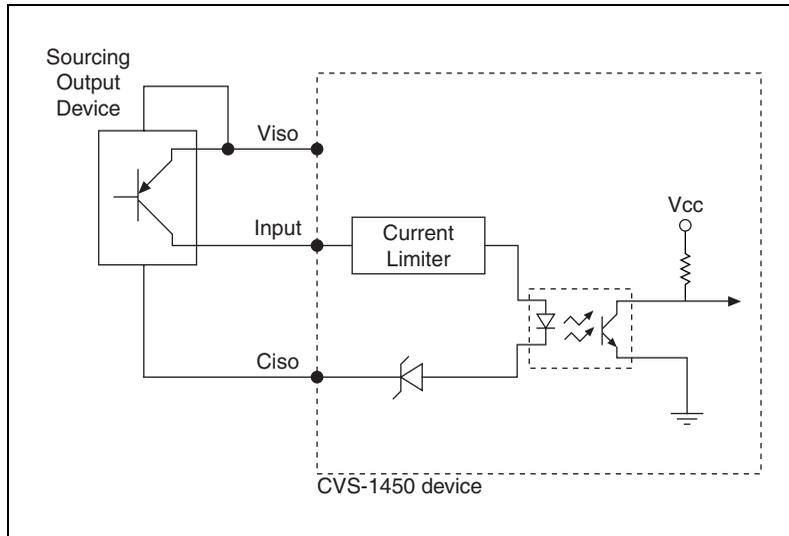
Figure 4-5. Example of Connecting an Isolated Input to a Sourcing Output Device

Wiring an Isolated Output to an External Load

The digital output circuit sources current to external loads, as shown in the example in Figure 4-6.

⚠️ **Caution**   Do *not* draw more than 100 mA from 24 V or 30 V isolated outputs. Do *not* draw more than 50 mA from 5 V isolated outputs.
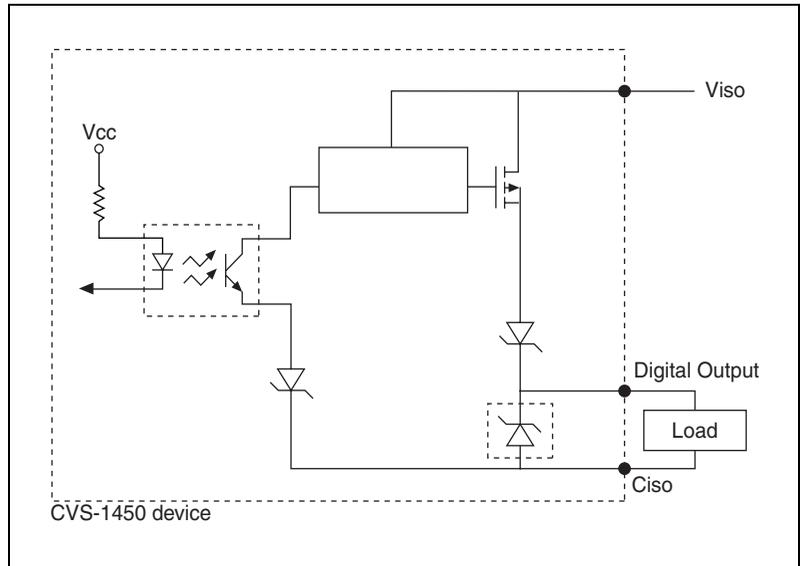
Figure 4-6. Example of Connecting an Isolated Output to an External Load

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 CVS-1450 device to an inductive load.

Figure 4-7 shows an example of using an external flyback diode to protect inductive loads.
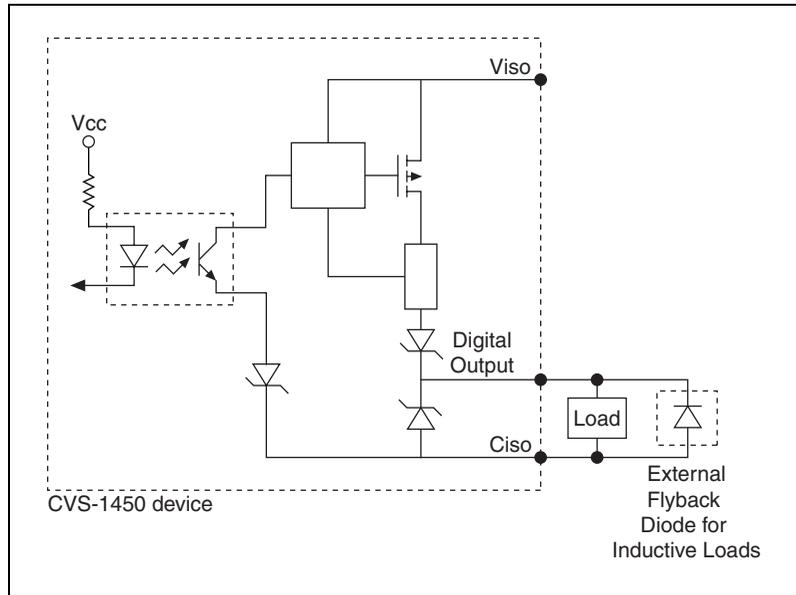
Figure 4-7. Example of Using an External Flyback Diode for Inductive Loads

Transmission Line Effects

Transmission line effects can degrade the signals on the I/O cables and cause instability. To minimize transmission line effects, use twisted-pair wires with a characteristic impedance of 118 Ω to connect external signals to the 44-pin I/O DSUB connector. Use a 75 Ω coaxial cable, such as RG-179, to connect to the SMB connectors.

Figure 4-8 shows connections to the 44-pin DSUB connector and the TRIG 0 SMB connector that minimize transmission line effects.
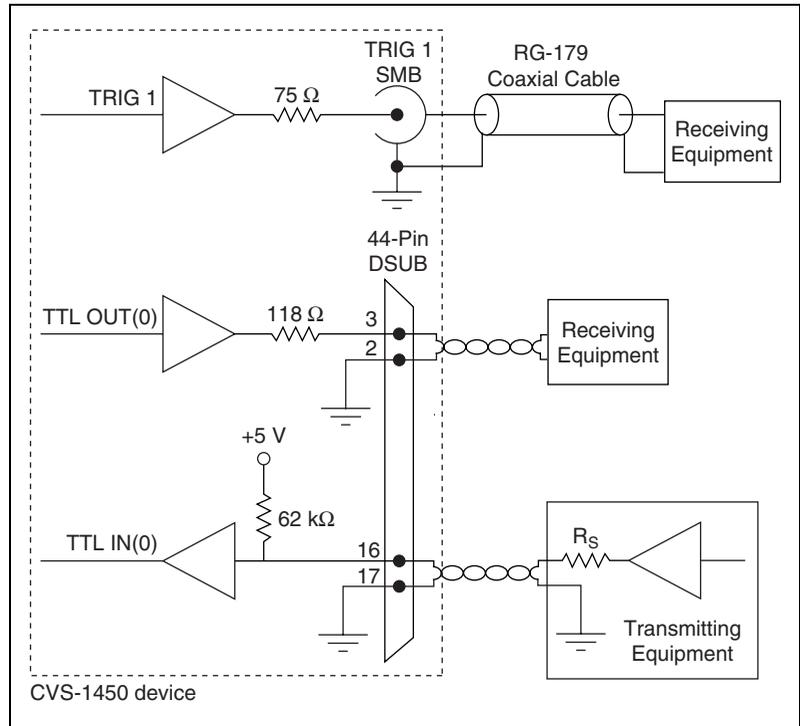
Figure 4-8. Example Connections

When connecting to TTL inputs on the CVS-1450 device, match the output impedance of the transmitting device to the characteristic impedance of the cable. For example, if the cable characteristic impedance is 118 Ω, make R_s equal to 118 Ω, as shown in Figure 4-8.

Typical System Setup

Digital I/O configuration varies depending on the number of cameras your system setup requires. You can access the digital I/O through the 44-pin DSUB connector or through the three SMB connectors.

The digital I/O capabilities of the SMB connectors on the CVS-1450 device are ideal for typical single-camera applications. The SMB connectors are labeled **TRIG 0**, **TRIG 1**, and **TRIG 2**.

Table 4-5 summarizes a typical single-camera configuration.

Table 4-5. Typical Single-Camera System Setup

Signal Name	Signal Type	Purpose
TRIG 0	Isolated input	Trigger input from proximity sensor or external device
TRIG 1	Timed pulse TTL output	Exposure start and control signal to camera
TRIG 2	Timed pulse TTL output	Strobe light control

Figure 4-9 shows a typical single-camera setup.

1	Lighting Control Unit	3	Inspection Items
2	Lighting Ring	4	Proximity Sensor
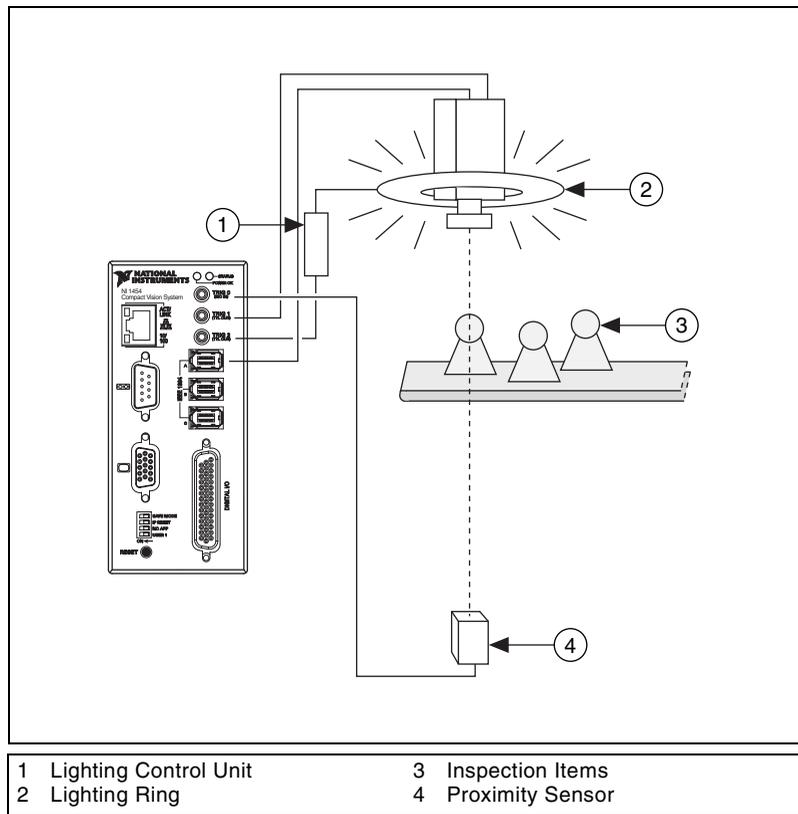
Figure 4-9. Typical Single-Camera Setup

5

Deployment

This chapter provides guidelines for connecting the NI CVS-1450 device to a network.

Connecting Multiple CVS-1450 Devices

An Ethernet connection between the development computer and the CVS-1450 device allows you to assign an IP address, configure the CVS-1450 device, download inspection tasks, and remotely monitor an ongoing inspection.

As with all Ethernet devices, you can connect multiple CVS-1450 devices to the same network, as shown in Figure 5-1.
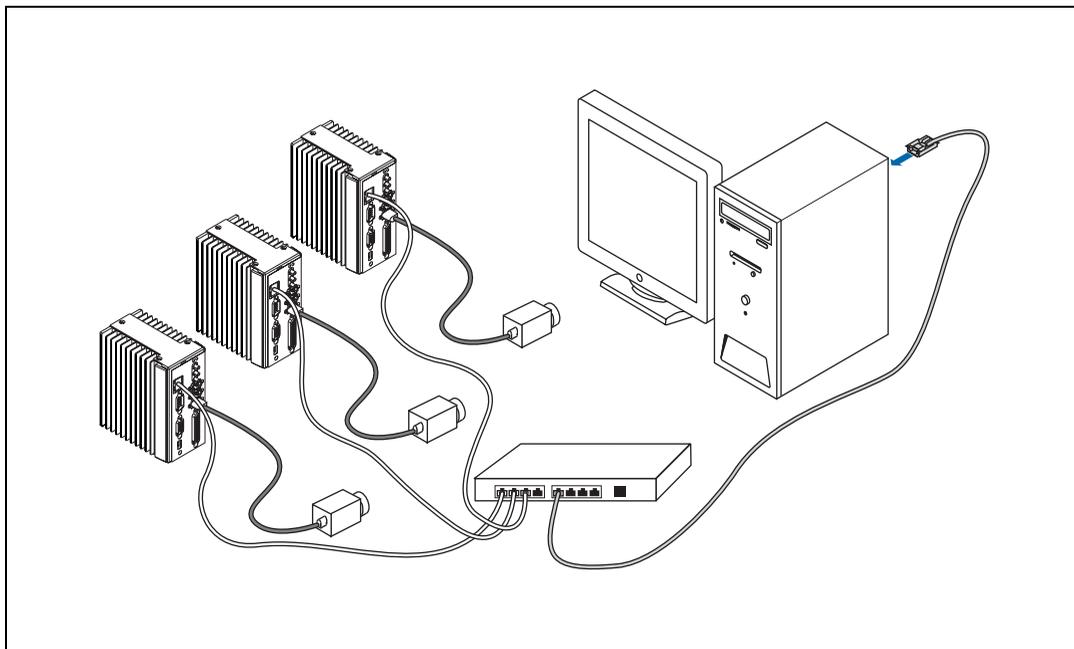
Figure 5-1. Multiple CVS-1450 Devices Connected to the Same Network

To connect multiple CVS-1450 devices to the same network, each CVS-1450 device must have a unique IP address. By default, the configuration utility running on the development computer displays each CVS-1450 device that exists on the subnet. To add entries for CVS-1450 devices that exist on other subnets, you must know the IP address assigned to each CVS-1450 device. This feature allows remote configuration, programming, and monitoring of any CVS-1450 device not protected by a firewall or user password.

Use the CVS-1450 device serial number and media access control (MAC) address to uniquely identify each unit. The serial number and MAC address are printed on the top side of each CVS-1450 device unit, as shown in Figure 5-2.
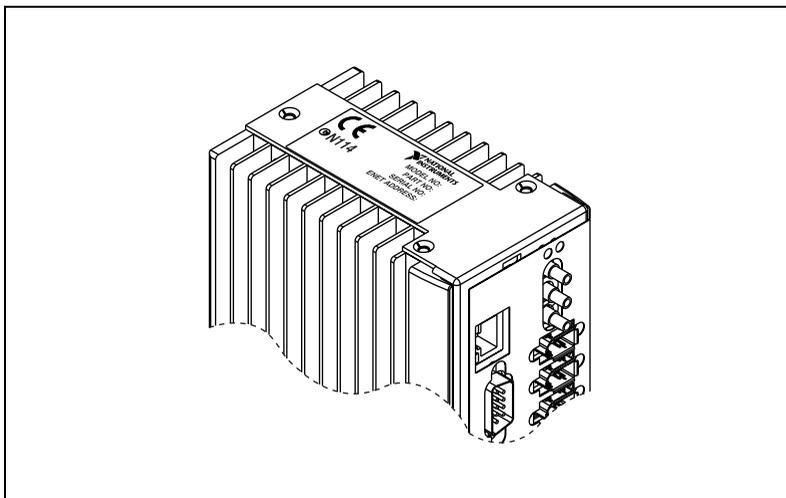
Figure 5-2. Serial Number and MAC Address Label on the CVS-1450 Device

The configuration environment on the host machine displays these values in order to distinguish one CVS-1450 device from another. In addition to distinguishing units based on serial number and MAC address, you can also assign each CVS-1450 device a descriptive name in the configuration environment.

When configured to run an inspection, the CVS-1450 device can run autonomously without connection to the host machine. All image acquisition, inspection, decision making, and I/O occurs on the CVS-1450 device itself. For local monitoring of the inspection, you can connect a monitor directly to the **Video Out** connector on the CVS-1450 device, as shown in Figure 5-3.
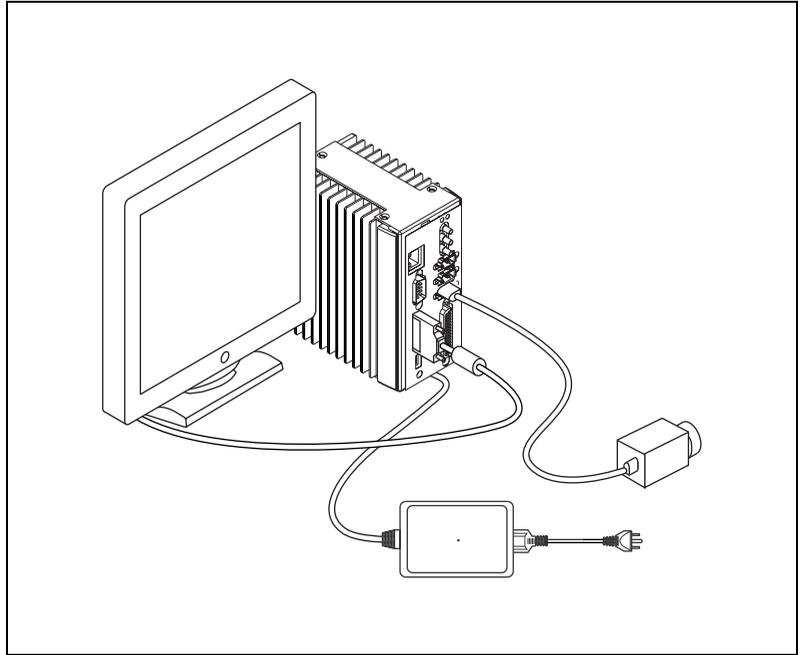
Figure 5-3. CVS-1450 Device Connected to a Monitor

At any time, you can reconnect the host machine to the CVS-1450 device and remotely monitor progress.

A

Troubleshooting

This appendix provides instructions for troubleshooting the NI CVS-1450 device.

Software Configuration Problems

CVS-1450 Device Does Not Appear in MAX or in Vision Builder AI

Possible causes and solutions:

- Verify that there is power to the CVS-1450 device and that both the CVS-1450 device and the development computer are properly connected to the network. The **POWER OK** LED should be lit. When you click **Browse**, the **ACT/LINK** LED on the CVS-1450 device should flash to indicate that communications are taking place.

- Certain network devices, such as switches and routers, may filter out the directed UDP broadcast packets the development computer uses to communicate with unconfigured CVS-1450 devices, even if these devices are on the same subnet. You can test this by connecting the development computer and the CVS-1450 device directly to a network port or by using a crossover cable between the CVS-1450 device and the development computer. If the CVS-1450 device appears in the software using this configuration, but not when connected to the larger network, the network is not properly communicating with the CVS-1450 device. Consult your network administrator.

- The CVS-1450 device may have been configured on another network and then moved to the current network. Reconfigure the CVS-1450 device on the current network.

- The grade of cable you are using may be insufficient for the speed of your network, or you may be using the wrong type of Ethernet cable. Use a straight-through cable when connecting to network hardware. Use a crossover cable to connect directly to the development computer.

- Another device on the network is using the IP address assigned to the CVS-1450 device. Either remove or reconfigure the other device, or reconfigure the CVS-1450 device IP address.

- The DIP switch settings on the CVS-1450 device may be invalid, such as all switches set to the **ON** position. Change the DIP switch settings and reset the CVS-1450 device by pressing the **RESET** button on the CVS-1450 device for at least two seconds.

Error When Configuring IP Settings for the CVS-1450 Device

The CVS-1450 device cannot be configured if the subnet mask or IP address is incompatible with the network settings. Verify that the values entered for all network parameters are valid.

Status of CVS-1450 Device in MAX and Vision Builder AI is `No Software Installed`

Install application and driver software on the CVS-1450 device. Refer to Chapter 2, *Setup and Configuration*, for installation instructions.

No Camera Found

Verify that the total power requirements of the cameras do not exceed the power the CVS-1450 device provides on the IEEE 1394 bus. Verify that the cameras comply with the *IIDC Digital 1394-based Camera Specification, Version 1.30*.

Formatting the CVS-1450 Device Compact Flash Memory

Complete the following steps to format the Compact Flash memory and restore the CVS-1450 device to its original state.

⚠ **Caution**   Formatting the Compact Flash memory overwrites all of the files on the CVS-1450 device. Back-up any user data files you want to preserve to another computer before formatting the Compact Flash memory.

1. Start the CVS-1450 device in Safe mode. To start in Safe mode, enable the **SAFE MODE** DIP switch on the front of the CVS-1450 device and restart the device.

2. Launch MAX.

3. In the MAX configuration tree, expand **Remote Systems**.

4. Right-click the name of the device you want to reformat and select **Format Disk**.

    The video output connected to the CVS-1450 device displays the status of the format.

5. After the format completes, disable the **SAFE MODE** switch, and restart the device.

6. Refer to the *NI 1450 Series Compact Vision System Quick Start Guide*, or Chapter 2, *Setup and Configuration*, of this manual for information about configuring the CVS-1450 device for your application.

Hardware Errors

POWER OK LED is Red

The CVS-1450 device is in one of the following fault conditions:

*   Shutdown enabled in software, but ISO Input 11 is not turned on

    –   ISO Input 11 is used to indicate to the CVS-1450 device that all external devices are ready for operation. When ISO Input 11 turns off, the NI 1450 shuts down. Either turn on ISO Input 11 with an external source and reset the CVS-1450 device, or disable Shutdown in the software.

✎ **Note**   For prototyping when external equipment is unavailable, Viso can be wired to ISO Input 11 to turn on the CVS-1450 device.

*   Watchdog timer expired while configured for the system shutdown option

    –   Determine if the interval between watchdog timer resets is insufficient for the processing time. Check the software to determine if it could monopolize the processor.

*   Processor overheat

    –   Make sure you are operating the CVS-1450 device in compliance with the temperature specifications in Appendix B, *Specifications*.

Refer to Table 4-4, *Configuration Settings and Effects*, for more information about fault conditions.

Cannot Drive Isolated Outputs

Verify that you have power connected to Viso and Ciso inputs on the CVS-1450 device power connector and that the contact at the screw terminals is solid. Because these outputs are electrically isolated from the CVS-1450 device main supply, they require power in addition to the CVS-1450 device main supply.

Runaway Startup Application

If a runaway startup application causes the CVS-1450 device to become unresponsive, power off the CVS-1450 device and then restart it with either the **NO APP** switch or the **SAFE MODE** switch in the **ON** position. Restarting the CVS-1450 device with the **NO APP** switch enabled prevents any VIs from running at startup. Restarting with the **SAFE MODE** switch enabled starts the CVS-1450 device in Safe mode and does not launch the embedded LabVIEW RT engine. Refer to the *DIP Switches* section of Chapter 3, *LEDs, DIP Switches, and Connectors*, for more information about these DIP switches.

System Displays a `Missing Operating System` Error at Startup

The CVS-1450 device was powered on or reset with all DIP switches in the **ON** position. Set the DIP switches to the off position, and reset the CVS-1450 device by pressing the **RESET** button for at least two seconds.

LED Error Indications

The CVS-1450 device indicates specific error conditions by flashing the orange **STATUS** LED a specific number of times. Table A-1 describes the **STATUS** LED flashing sequences and the corresponding error condition.

Table A-1. STATUS LED Flashes and Corresponding Error Conditions

Number of Flashes	Error Condition
0 (stays lit)	The CVS-1450 device has detected an internal error. Contact National Instruments for assistance.
1	The CVS-1450 device is unconfigured.
2	The CVS-1450 device has detected an error in its software. This usually occurs when an attempt to upgrade the firmware is interrupted. Repeat the firmware upgrade process.
3	The CVS-1450 device is in Safe mode.
4 (or more)	The CVS-1450 device has detected an unrecoverable error. Contact National Instruments for assistance.

POWER OK LED Is Not Lit When the CVS-1450 Device is Powered On

If the power supply is properly connected to the CVS-1450 device, but the **POWER OK** LED does not light up, check that the power supply is 24 VDC ±10% and within the specifications outlined in Appendix B, *Specifications*. Using a power supply that is not within these specifications might result in an unresponsive or unstable system and could damage the CVS-1450 device.

B

Specifications

This appendix lists the specifications of the NI CVS-1450 Series. These specifications are typical at 25 °C, unless otherwise noted.

Power Requirements

Main supply voltage .... 24 VDC ±10%

    Power (excluding cameras) .... 12 W, typical
                                         22 W, maximum

    IEEE 1394 bus power .... 18 W, maximum
                                         (shared by all three ports)

Isolated supply[1] .... 5 to 30 VDC

Memory

SDRAM .... 128 MB

Nonvolatile storage
    CVS-1454 .... 32 MB
    CVS-1455 .... 128 MB
    CVS-1456 .... 256 MB

Processor

CVS-1454 .... Intel Celeron 400 MHz processor

CVS-1455 .... Intel Celeron 650 MHz processor

CVS-1456 .... Intel Celeron 733 MHz processor

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[1] Do *not* draw more than 500 mA combined from the Viso pins on the 44-pin DSUB connector. Do *not* draw more than 100 mA from 24V or 30V isolated outputs. Do *not* draw more than 50 mA from 5V isolated outputs.

Network

Network interface ....10BaseT and 100BaseTX
Ethernet

Compatibility ....IEEE 802.3

Communication rates.............................10 Mbps, 100 Mbps,
auto-negotiated

Maximum cabling distance.....................100 m/segment

TTL Inputs and Outputs

Digital logic levels

Level	Minimum	Maximum
Input low voltage (V_{IL})	0 V	0.5 V
Input high voltage (V_{IH})	2.2 V	5 V
Output low voltage (V_{OL}), at 5 mA	—	0.4 V
Output high voltage (V_{OH}), at 5 mA	2.4 V	—

TTL Inputs

Number of channels................................2

Maximum pulse rate ....2 MHz

Minimum pulse detected ....500 ns

Power-on state ....Input (high-impedance)
61.9 kΩ pull-up to 5 V

TTL Outputs

Number of channels................................10

Output voltage range ....0 V to 5 V

Maximum pulse rate ....2 MHz

Optically Isolated Inputs and Outputs

Isolated (Current Sinking) Inputs

Number of channels 13

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

Maximum pulse rate.............................. 100 kHz

Minimum pulse detected........................ 10 μs

Reverse polarity protection .... Yes, –30 V

Isolated (Current Sourcing) Outputs

Number of channels 4

On-state voltage range .... 5 V to 30 V, maximum
    Maximum on-state voltage
    drop from Viso................................ 1.2 V at 100 mA

Output current
    5 V isopower................................... 50 mA, maximum
    24 V isopower................................. 100 mA, maximum
    30 V isopower................................. 100 mA, maximum

Maximum pulse rate.............................. 10 kHz (maximum load
                                           resistance 100 kΩ)

Minimum pulse generated...................... 100 μs

Reverse polarity protection .... Yes

IEEE 1394

Number of ports......................................3

Camera Interface....................................IEEE 1394a

Speed ....100, 200, or 400 Mbps

Available bus power ....Refer to the *Power Requirements* section

Physical Characteristics

Dimensions ....102 mm × 127 mm × 64 mm (4 in. × 5 in. × 2.5 in.)

Weight ....1 kg (2.2 lb)

Refer to Appendix C, *Mounting Information*, for dimensional drawings of the CVS-1450 device.

Environmental

The CVS-1450 Series is intended for indoor use only.

Operating temperature
Vertical mounting position..............0 °C to 55 °C
All other positions ....0 °C to 45 °C

Maximum altitude...................................2,000 m

Storage temperature...............................−20 °C to 85 °C

Humidity...10% to 90% RH, noncondensing

Pollution Degree 2

Operating shock (IEC 68-2-27) ....50 g, 6 ms half sine, 3 shocks per side; 30 g 11 ms half sine, 3 shocks per side

Operating vibration
Random (IEC 60068-2-34)..............10 Hz to 500 Hz, 5 G_{rms}
Swept Sine (IEC 60068-2-6) ....10 Hz to 500 Hz, 5 g

Safety

The CVS-1450 Series meets the requirements of the following standards for safety and electrical equipment for measurement, control, and laboratory use:

•   EN 61010-1, IEC 61010-1

•   UL 61010-1

•   CAN/CSA-C22.2 No. 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 the Certification column.

Electromagnetic Compatibility

Emissions .... EN 55011 Class A at 10 m
                                                    FCC Part 15A above 1 GHz

Immunity .... EN 61326:1997 + A2:2001,
                                                    Table 1

EMC/EMI .... CE, C-Tick, and FCC Part 15
                                                    (Class A) Compliant

Note For full EMC compliance, operate this device with shielded cabling.

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.

Mounting Information

This appendix provides the information necessary to create a custom mount for the NI CVS-1450 Series.

If you do not want to create a custom mount, a panel and DIN rail mount kit for the CVS-1450 Series is available from National Instruments (part number 189154-01).

Mounting the CVS-1450 Series

If you want to create a custom mount, Figures C-1–C-4 provide dimensional drawings and clearance information for the CVS-1450 Series.

⚠ **Caution** If you choose not to mount the CVS-1450 device on a DIN rail or flat surface, do *not* position the CVS-1450 device with the heat sinks resting on any surface. Doing so may cause the CVS-1450 device to overheat. Refer to Appendix B, *Specifications*, for temperature specifications.
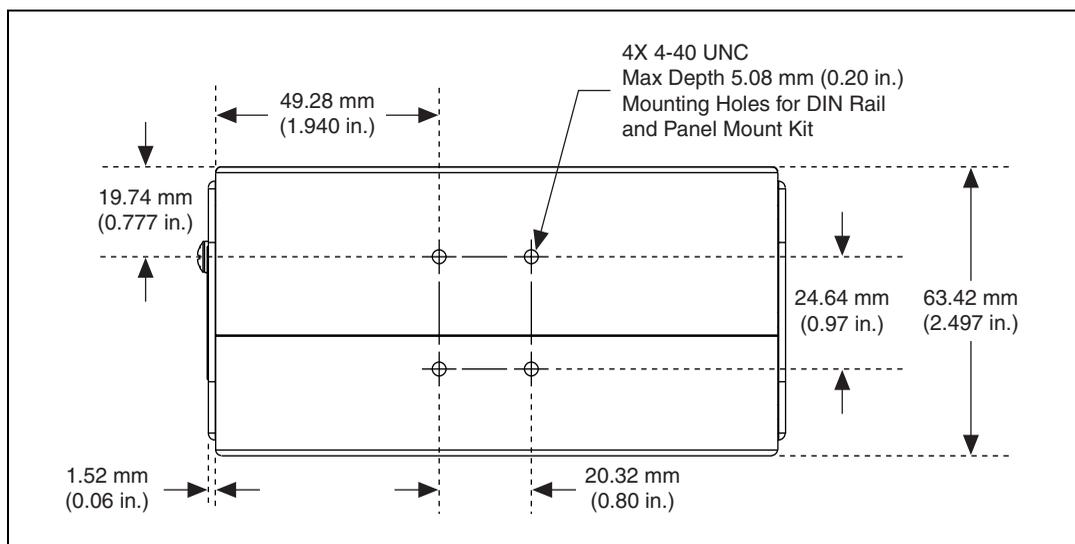
Figure C-1. Back View of the CVS-1450 Series with Dimensions
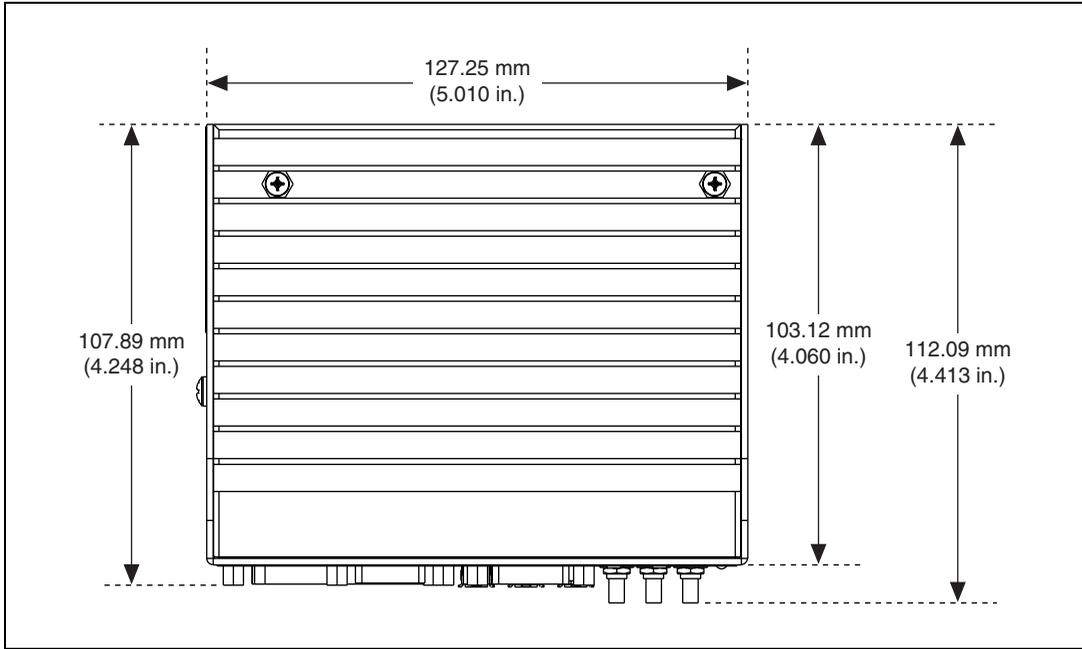
Figure C-2. Side View of the CVS-1450 Series with Dimensions
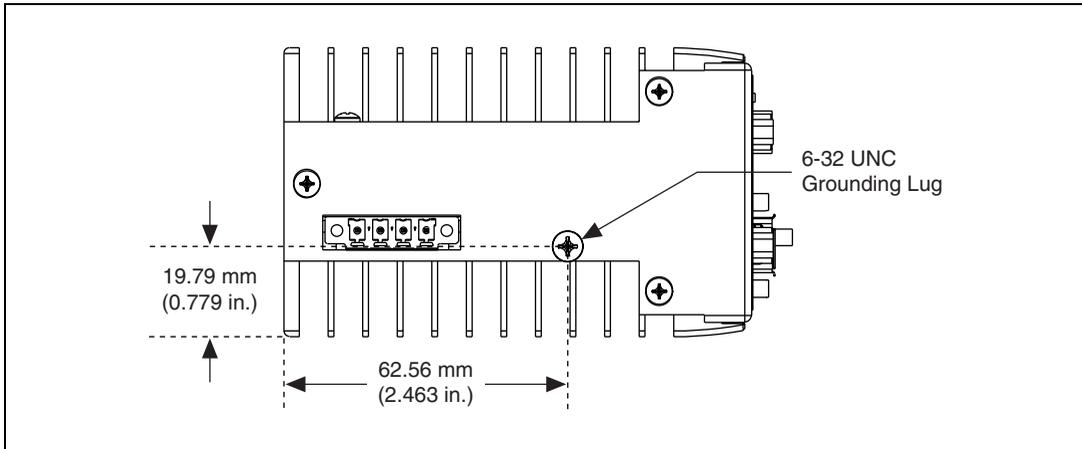
Figure C-3. Bottom View of the CVS-1450 Series with Dimensions

Note You can ground the CVS-1450 device to your mount by connecting a grounding wire to the grounding lug on the CVS-1450 device. Refer to the *Earth Ground Connection* section of Chapter 3, *LEDs, DIP Switches, and Connectors*, for more information about the grounding lug.

⚠ **Caution**   Your installation must meet the following space and cabling clearance requirements for optimum cooling:

• Allow 76.2 mm (3.0 in.) on the top and bottom of the CVS-1450 device for air circulation.

• Allow 50.8 mm (2.0 in.) on the sides of the CVS-1450 device for air circulation.

• Allow enough space in front of the CVS-1450 device to connect cables.

Refer to Figure C-4 for a illustration of the space and cabling requirements for the CVS-1450 Series.
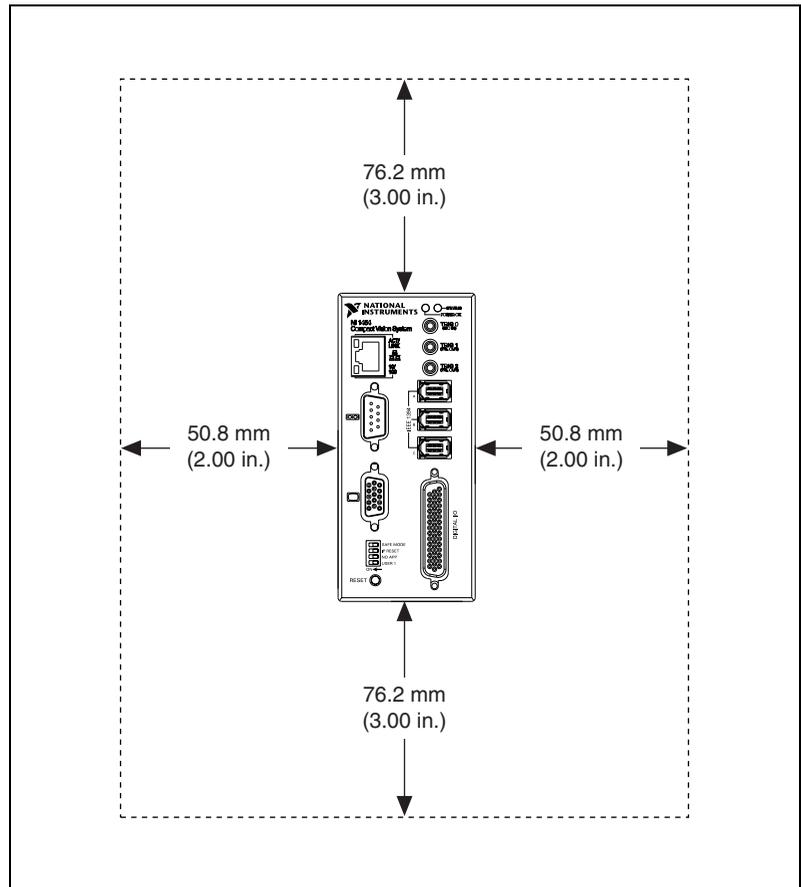
Figure C-4. Space and Cabling Clearance for the CVS-1450 Series

Complete the following steps to secure the CVS-1450 device to your mount:

1. Align the screw holes of your mounting bracket with the four holes on the back of the CVS-1450 device. Figure C-1 shows the location of the mounting holes on the CVS-1450.

2. Insert four 4-40 UNC screws and tighten them until they are secure (3.5 in.-lb). Make sure that the heads of the screws are flush with the mounting bracket.

D

Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at `ni.com` for technical support and professional services:

- **Support**—Online technical support resources at `ni.com/support` include the following:

    - **Self-Help Resources**—For answers and solutions, visit the award-winning National Instruments Web site 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.

    - **Free Technical Support**—All registered users receive free Basic Service, which includes access to hundreds of Application Engineers worldwide in the NI Developer Exchange at `ni.com/exchange`. National Instruments Application Engineers make sure every question receives an answer.

        For information about other technical support options in your area, visit `ni.com/services` or contact your local office at `ni.com/contact`.

- **Training and Certification**—Visit `ni.com/training` for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.

- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, National Instruments Alliance Partner members can help. To learn more, call your local NI office or visit `ni.com/alliance`.

- **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 electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting `ni.com/certification`.

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

If you searched `ni.com` and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Glossary

Symbol	Prefix	Value
μ	micro	10^{-6}
m	milli	10^{-3}
k	kilo	10^{3}
M	mega	10^{6}

B

buffer — Temporary storage for acquired data.

D

DCAM-compliant — Cameras that comply with the *IIDC 1394-based Digital Camera Specification, Version 1.30.*

DIP switch — Dual Inline Package switch.

E

Ethernet cable, standard — CAT-5 or CAT-6 Ethernet cable used to connect a Real-Time target to a network port.

Ethernet crossover cable — CAT-5 or CAT-6 cable used for direct connection between the development computer and the Real-Time target.

F

falling edge — The digital signal transition from the high state to the low state.

I

IEEE — Institute of Electrical and Electronics Engineers. A standard-setting body.

L

LED   Light-emitting diode.

M

MAC   Media access control. The MAC address uniquely identifies each unit
                            connected to a network.

N

NI-IMAQ   Driver software for National Instruments image acquisition (IMAQ)
                            hardware.

P

PLC   Programmable Logic Controller. An industrial computer used for factory
                            automation, process control, and manufacturing systems.

pulse train   A signal consisting of a series of continuous pulses.

R

rising edge   The digital signal transition from the low state to the high state.

RS-232   Standard electrical interface for serial data communications.

S

subnet   A set of systems whose IP addresses are configured such that they can
                            communicate directly with one another. Data will not flow through an
                            intermediate router.

T

TCP   Transmission Control Protocol. A set of standard protocols for
                            communicating across a single network or interconnected set of networks.
                            TCP is for high-reliability transmissions.

trigger   Any event that causes or starts some form of data capture.

U

UDP	User Datagram Protocol. A set of standard protocols for communicating across a single network or interconnected set of networks. UDP is for low-overhead transmissions.

V

VDC	Volts direct current.
VI	Virtual Instrument. A combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument.

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