

GETTING STARTED GUIDE

NI CVS-1459RT

USB3 Vision Compact Vision System with Reconfigurable I/O

The NI CVS-1459RT is a real-time, compact vision system that acquires, processes, and displays images from USB3 Vision cameras. This document explains how to install and configure the NI CVS-1459RT.

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Required Components

The following items are necessary to set up and use the NI CVS-1459RT:

- NI CVS-1459RT device
- One or two USB3 Vision cameras
- One USB 3.0 cable per USB3 Vision camera
- One CAT 5 10/100Base-TX, CAT 5e, or CAT 6 1000Base-T Ethernet cable to connect the device to the development computer or to a network.



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

- Development computer running Microsoft Windows. Refer to the driver or application development software readme for specific Windows version compatibility.
- A compatible power supply, such as the NI PS-15 Power Supply (part number 781093-01)

Optional Equipment

National Instruments offers the following products for use with the NI CVS-1459RT:

- 24 VDC, 1.25 A Desktop Power Supply (part number 782032-01)
- 44-pin D-SUB cable for digital I/O
 - 44-pin D-SUB male to pigtail cable (part number 156083-03 for 3 meter cable)
 - 44-pin D-SUB male to 44-position D-SUB female cable (part number 156084-03 for 3 meter cable or part number 156084-0R5 for 0.5 meter cable)
- NI CVS I/O Accessory



Note This accessory is unshielded.

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

- DIN Rail Kit (part number 781740-01)
- Serial cable (part number 182845-01 for 1 meter cable, part number 182845-02 for 2 meter cable, or part number 182845-03 for 3 meter cable)

Software Options

Use the following software to develop applications with the NI CVS-1459RT.

- NI-IMAQdx 14.0 or later driver software, included with NI Vision Acquisition Software August 2014
- One of the following options for developing machine vision applications:
 - NI Vision Builder for Automated Inspection (Vision Builder AI) 2014 or later
 - LabVIEW 2014 or later, LabVIEW Real-Time 2014 or later, and the NI Vision Development Module 2014 or later
- Software for using and reconfiguring the NI CVS-1459RT FPGA I/O. Different configurations are referred to as hardware personalities, and are defined by bitfiles.
 - LabVIEW FPGA Module 2014 or later—You must install the LabVIEW FPGA Module to reconfigure the default personality of the NI CVS-1459RT FPGA.
 - NI-IMAQ I/O 14.0 or later driver software, included with NI Vision Acquisition Software August 2014—NI-IMAQ I/O is required to use the default personality of the NI CVS-1459RT in LabVIEW, or to reconfigure the default personality of the NI CVS-1459RT I/O in the LabVIEW FPGA Module.

Safety Information



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

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

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

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

This is a Pollution Degree 2 device. Do *not* operate the device in an explosive atmosphere or where flammable gases or fumes may be present. Operate the device only at or below the pollution degree stated in the specifications. Pollution consists of any foreign matter—solid, liquid, or gas—that may reduce dielectric strength or surface resistivity. The following is a description of pollution degrees.

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

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

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

Electromagnetic Compatibility Guidelines

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

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

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



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

Installing the Software

Before using the NI CVS-1459RT, you must install the application software and device drivers on the development computer. National Instruments provides two options for developing machine vision applications.

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

Installing Vision Builder AI

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

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

Vision Builder AI does not require additional software. Proceed to [Configuring the Hardware](#).

Installing the Vision Development Module

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

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

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

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

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

3. **LabVIEW FPGA Module**—It is only necessary to install the LabVIEW FPGA Module if you want to reconfigure the default personality of the NI CVS-1459RT I/O. Refer to the *LabVIEW FPGA Module Release and Upgrade Notes* for installation instructions and information about getting started with the LabVIEW FPGA Module.

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

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

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

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

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

6. **NI-IMAQ I/O**—NI-IMAQ I/O is required to use the default personality of the NI CVS-1459RT in LabVIEW, or to reconfigure the default personality of the NI CVS-1459RT I/O in the LabVIEW FPGA Module. Refer to the *NI Vision Acquisition Software Release Notes* on the NI Vision Acquisition Software installation media for system requirements and installation instructions for the NI-IMAQ I/O driver.

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

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

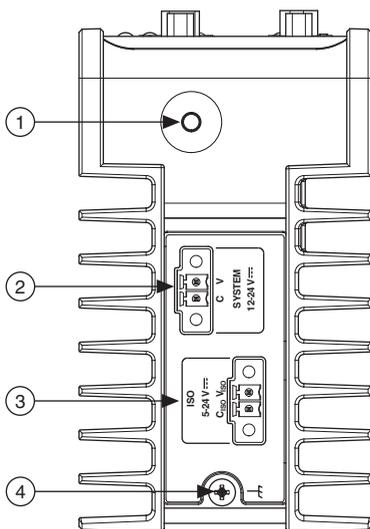
Configuring the Hardware

Remove the NI CVS-1459RT from the package and inspect the system for damage. Notify National Instruments if the system appears damaged in any way. Do not use a damaged system.

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

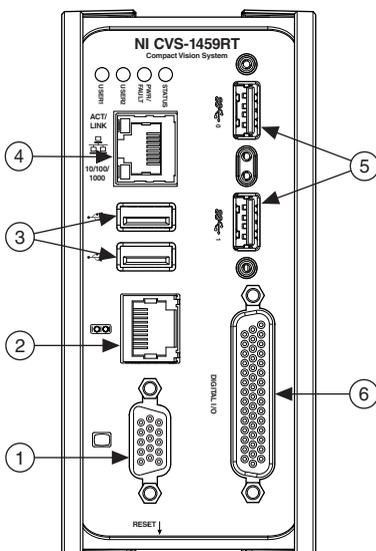
Complete the following sections to wire power to the NI CVS-1459RT, connect cameras, and connect the NI CVS-1459RT to a development computer or network. Figure 1 and Figure 2 show the features on the device.

Figure 1. NI CVS-1459RT Power Connectors and Reset Button



- | | | | |
|---|------------------------|---|----------------------------------|
| 1 | Reset Button | 3 | Isolated Outputs Power Connector |
| 2 | System Power Connector | 4 | Chassis Grounding Screw |

Figure 2. NI CVS-1459RT Front Panel Connectors



- | | | | |
|---|------------------|---|------------------------------|
| 1 | VGA Connector | 4 | RJ45 Network Port |
| 2 | RJ50 Serial Port | 5 | USB3 Vision Ports |
| 3 | USB 2.0 Ports | 6 | 44-pin Digital I/O Connector |

Wiring Power to the NI CVS-1459RT

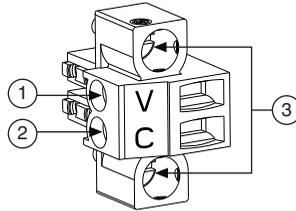
Refer to Figure 1 while connecting the NI CVS-1459RT power supplies.

Connecting the System Power Supply

Complete the following steps to supply power to the NI CVS-1459RT.

1. Make sure the power source is turned off.
2. If the power connector plug is connected to the chassis, disconnect it from the device.
Figure 3 shows the terminal screws, which secure the wires in the screw terminals, and the connector screws, which secure the connector plug on the chassis.

Figure 3. Power Screw Terminal Connector Plug



1 V (Positive) Terminal Screw 2 C (Negative) Terminal Screw 3 Connector Screws



Caution Do *not* tighten or loosen the terminal screws on the power connector while the power is on.

3. Connect the positive lead of the power source to the V terminal of the power connector plug and tighten the terminal screw to 0.2 to 0.25 N · m (1.8 to 2.2 lb · in.) of torque.
4. Connect the negative lead of the power source to the C terminal of the power connector plug and tighten the terminal screw to 0.2 to 0.25 N · m (1.8 to 2.2 lb · in.) of torque.
5. Install the power connector plug into the SYSTEM power receptacle on the NI CVS-1459RT chassis and tighten the connector screws to 0.4 N · m (3.5 lb · in.) of torque.
6. Turn on the external power source. Verify the PWR/FAULT LED is lit green.

Connecting the Isolated Outputs Power Supply

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

1. Make sure the power source is turned off.
2. If the power connector plug is connected to the chassis, disconnect it from the device.
Figure 3 shows the terminal screws, which secure the wires in the screw terminals, and the connector screws, which secure the connector plug on the chassis.



Caution Do *not* tighten or loosen the terminal screws on the power connector while the power is on.

3. Connect the positive lead of the power source to the V terminal of the power connector plug and tighten the terminal screw to 0.2 to 0.25 N · m (1.8 to 2.2 lb · in.) of torque.
4. Connect the negative lead of the power source to the C terminal of the power connector plug and tighten the terminal screw to 0.2 to 0.25 N · m (1.8 to 2.2 lb · in.) of torque.
5. Install the power connector plug into the ISO power receptacle on the NI CVS-1459RT chassis and tighten the connector screws to 0.4 N · m (3.5 lb · in.) of torque.
6. Turn on the external power source.

Connecting USB3 Vision Cameras

The NI CVS-1459RT supports two USB3 Vision cameras. Complete the following steps to connect cameras to the NI CVS-1459RT.

1. Connect a USB3 Vision cable to a USB3 Vision camera.
2. Connect the other end of the cable to the NI CVS-1459RT Port 0. Repeat these steps for Port 1 if you are connecting two cameras.

Connecting to the Development Computer

The NI CVS-1459RT can connect to the development computer directly or through a network. To connect over a network, the device must be on the same subnet as the development computer.

Direct Connection

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

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

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

Network Connection

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

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

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

Installing Software on the NI CVS-1459RT

Configure the NI CVS-1459RT in NI Vision Builder AI or NI MAX. If you use LabVIEW as your application development environment, you must use MAX to configure the device.

Configuring the Device in NI Vision Builder AI

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

1. Launch Vision Builder AI by navigating to **Start»All Programs»National Instruments»Vision Builder AI**.
2. Select the NI CVS-1459RT from the list of available targets.
3. Select the **Configure Target** icon.
4. Complete the configuration wizard. At step 3, select **Update Target Software** to install Vision Builder AI on the device.

Configuring the Device in NI MAX

Complete the following steps to configure the device in MAX.

1. Launch MAX by navigating to **Start»All Programs»National Instruments»NI MAX** or by double-clicking the NI MAX desktop icon.
2. In the Configuration pane, expand **Remote Systems** to see a list of devices on the same subnet.
3. Expand the **NI CVS-1459RT**. Right-click **Software** and select **Add/Remove Software**.
4. Select **NI-IMAQdx**, **NI Vision-RIO**, **NI Vision RT**, **LabVIEW Real-Time**, and **NI-RIO**. Some features will automatically select required dependencies.
5. Complete the installation wizard.

Acquiring an Image

To ensure the NI CVS-1459RT is functioning properly, acquire a test image.

Acquiring an Image in Vision Builder AI

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

1. Launch Vision Builder AI.
2. Select the NI CVS-1459RT from the list of available targets.
3. In the Configure Inspection section, select **New Inspection from Template**.
4. Select **Acquire Image Template** from the Compact Vision System tree.
5. Click the **Run Inspection Once** icon to acquire an image.

Acquiring an Image in MAX

Complete the following steps to acquire an image in MAX.

1. Launch MAX.
2. In the Configuration Pane, expand **Remote Systems** and locate the **NI CVS-1459RT**.
3. Expand **NI CVS-1459RT»Devices and Interfaces»NI-IMAQdx Devices**.
4. Select the camera you want to test.
5. Click **Snap** to acquire an image.

Digital I/O

The 44-pin Digital I/O port on the NI CVS-1459RT offers 8 isolated inputs, 8 isolated outputs, 2 bidirectional differential I/O (RS-422) or single-ended input lines which can be used with a quadrature encoder, and 8 bidirectional TTL lines. The Digital I/O port can be connected to any appropriate shielded device or connector block using a shielded cable. Refer to Table 1 for pin locations and functions.

Table 1. Pin Location and Definition for the NI CVS-1459RT Digital I/O

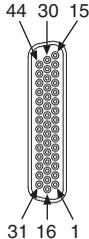
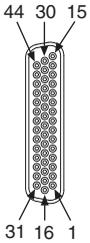
Pin Location	Pin Number	Signal	Description
	1	Diff 0+	Bidirectional RS-422 I/O (positive side), or quadrature encoder phase A+
	2	GND	Digital ground reference for TTL and differential I/O
	3	TTL 0	Bidirectional TTL I/O
	4	TTL 1	Bidirectional TTL I/O
	5	GND	Digital ground reference for TTL and differential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

Table 1. Pin Location and Definition for the NI CVS-1459RT Digital I/O (Continued)

Pin Location	Pin Number	Signal	Description
	23	GND	Digital ground reference for TTL and differential I/O
	24	Diff 1-	Bidirectional RS-422 I/O (negative side), or quadrature encoder phase B-
	25	V _{ISO}	Isolated power voltage reference output
	26	C _{ISO}	Common ground reference for isolated inputs and outputs
	27	Iso Out 2	General purpose isolated output
	28	Iso Out 3	General purpose isolated output
	29	C _{ISO}	Common ground reference for isolated inputs and outputs
	30	Iso Out 5	General purpose isolated output
	31	Iso In 0	General purpose isolated input
	32	Iso In 1	General purpose isolated input
	33	C _{ISO}	Common ground reference for isolated inputs and outputs
	34	Iso In 2	General purpose isolated input
	35	Iso In 3	General purpose isolated input
	36	C _{ISO}	Common ground reference for isolated inputs and outputs
	37	Iso In 4	General purpose isolated input
	38	Iso In 5	General purpose isolated input
	39	C _{ISO}	Common ground reference for isolated inputs and outputs
	40	Iso In 6	General purpose isolated input
	41	Iso In 7	General purpose isolated input
	42	C _{ISO}	Common ground reference for isolated inputs and outputs
43	Iso Out 6	General purpose isolated output	
44	Iso Out 7	General purpose isolated output	

Where to Go Next

The following documents and resources contain information you may find helpful as you use the NI CVS-1459RT in an application. Refer to the National Instruments Product Manuals Library at ni.com/manuals for the most recent versions of product documentation.

- *NI CVS-1459RT Specifications*—Contains detailed specifications for the NI CVS-1459RT.
- *NI CVS-1459RT User Manual*—Contains connector pinouts, configuration information, mounting information, and answers to common troubleshooting questions.
- *NI CVS I/O Accessory User Manual*—Contains installation and operation instructions for the CVS I/O Accessory.

Additional Resources for Vision Builder AI Users

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

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

Additional Resources for LabVIEW Users

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

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

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

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

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

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

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