

# Getting Started with the NI 7831R

This document explains how to set up the National Instruments 7831R device.

## Introduction

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The NI 7831 is an R Series reconfigurable I/O (RIO) device with 96 digital I/O (DIO) lines, eight independent 16-bit analog output (AO) channels, and eight independent 16-bit analog input (AI) channels.

Traditional I/O devices have a fixed functionality provided by an application-specific integrated circuit (ASIC), but the NI 7831R has a field-programmable gate array (FPGA) that allows you to define device functionality and timing.

You can use the LabVIEW FPGA Module to graphically design the NI 7831R timing and functionality without having to learn a low-level programming language or a hardware description language (HDL) traditionally used for FPGA design. With the LabVIEW FPGA Module, you create or download a custom virtual instrument (VI) to the FPGA. You can reconfigure the NI 7831R device with a new VI at any time.

You can use the LabVIEW Real-Time Module to communicate and control the NI 7831R device while performing additional tasks, such as real-time floating-point processing and data logging.



**Note** If you are using LabVIEW but not the LabVIEW FPGA Module, you can create VIs that run in LabVIEW to control existing FPGA VIs, but you cannot create new FPGA VIs.

The NI 7831R device has Flash memory that you can use to store VIs. You can configure VIs to load to the FPGA and to run when the device powers up.

# Required Items

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This section provides lists of the items necessary for getting started using the PXI-7831R and the PCI-7831R device with Windows 2000/XP and the LabVIEW Real-Time Module.

## Documentation

The *NI 7831R User Manual* describes the electrical and mechanical aspects of the NI 7831R device and contains information about device operation and programming. This document is included on the NI-RIO CD and is also available at [ni.com/manuals](http://ni.com/manuals).

*LabVIEW Help* is available in LabVIEW by selecting **Help»VI, Function, & How-To Help**.

## PXI-7831R with Windows 2000/XP

Use the following items to set up and use the PXI-7831R with Windows 2000/XP.

- PXI-7831R device
- The following software packages:
  - LabVIEW 7.0 or later
  - LabVIEW FPGA Module 1.0 or later—required to develop custom FPGA VIs for the PXI-7831R device
  - NI-RIO 1.1 or later—included with the PXI-7831R
- PXI/CompactPCI chassis and a PXI/CompactPCI embedded controller running Windows 2000/XP or any computer running Windows 2000/XP and a MXI-3 link to a PXI/CompactPCI chassis
- At least one cable and device for connecting signals to the PXI-7831R

## PCI-7831R with Windows 2000/XP

Use the following items to set up and use the PCI-7831R with Windows 2000/XP.

- PCI-7831R device
- The following software packages:
  - LabVIEW 7.1 or later
  - LabVIEW FPGA Module 1.1 or later—required to develop custom FPGA VIs for the PCI-7831R device
  - NI-RIO 1.1 or later—included with the PCI-7831R
- Pentium-based PCI computer running Windows 2000/XP
- At least one cable and device for connecting signals to the PCI-7831R

## PXI-7831R with the LabVIEW Real-Time Module for ETS

Use the following items to set up and use the PXI-7831R with the LabVIEW FPGA Module and the LabVIEW Real-Time Module.

- PXI-7831R device
- The following software packages:
  - LabVIEW 7.0 or later
  - LabVIEW Real-Time Module for ETS 7.0 or later
  - LabVIEW FPGA Module 1.0 or later—required to develop custom FPGA VIs for the PXI-7831R device
  - NI-RIO 1.0 or later—included with the PXI-7831R
- PXI/CompactPCI chassis and real-time PXI controller
- One of the following host computers, depending upon your application, running Windows 2000/XP:
  - PC
  - Laptop computer
  - PXI/CompactPCI embedded controller
- At least one cable and device for connecting signals to the PXI-7831R
- CAT 5 Ethernet crossover cable if the real-time PXI system is not configured on a network. To connect the PXI system to a network port, use a standard CAT 5 10/100Base-T Ethernet cable.

## PCI-7831R with the LabVIEW Real-Time Module for ETS

Use the following items to set up and use the PCI-7831R with the LabVIEW FPGA Module and the LabVIEW Real-Time Module for ETS.

- PCI-7831R device
- The following software packages:
  - LabVIEW 7.1 or later
  - LabVIEW Real-Time Module for ETS 7.1 or later
  - LabVIEW FPGA Module 1.1 or later
  - NI-RIO 1.1 or later—included with the PXI-7831R
- Pentium-based PCI computer. For information about the desktop PC models that National Instruments recommends, refer to the NI Web site at [ni.com/info](http://ni.com/info) and enter `etspc`.
- One of the following host computers running Windows 2000/XP:
  - PC
  - Laptop computer
  - PXI/CompactPCI embedded controller
- At least one cable and device for connecting signals to the PXI-7831R

## PCI-7831R with the LabVIEW Real-Time Module 7.1 for RTX

Use the following items to set up and use the PCI-7831R with the LabVIEW Real-Time Module 7.1 for RTX.

- PCI-7831R device
- The following software packages:
  - LabVIEW Real-Time Module for RTX 7.1 or later
  - LabVIEW FPGA Module 1.1 or later
  - NI-RIO CD—included with the PCI-7831R
- Pentium-based PCI computer running Windows 2000/XP
- A host PC running Windows 2000/XP
- At least one cable and device for connecting signals to the PCI-7831R

# Installing Software

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The following instructions describe how to install the NI-RIO device drivers and LabVIEW.

## Installing LabVIEW, the LabVIEW Real-Time Module for ETS, and the LabVIEW FPGA Module

Use the following sequence when installing LabVIEW, the LabVIEW Real-Time Module, and the LabVIEW FPGA Module. For more detailed information about software requirements, refer to the *LabVIEW FPGA Release Notes*.

If you are using NI-RIO without LabVIEW, skip these steps and complete the steps in the [Installing NI-RIO Device Drivers](#) section.



**Note** You must install LabVIEW (version 7.1 or later for PCI, and version 7.0 or later for PXI) and the LabVIEW modules you will use with the NI 7831R *before* installing the NI-RIO device drivers. For LabVIEW installation instructions, refer to the *LabVIEW Release Notes*.

1. Install LabVIEW for Windows from the LabVIEW CD.
2. If you are using the LabVIEW Real-Time Module for ETS, install the LabVIEW Real-Time Module for ETS from the LabVIEW Real-Time CD.

If you are using the PCI-7831R device with the LabVIEW Real-Time Module for RTX, install the LabVIEW Real-Time module for RTX from the LabVIEW Real-Time CD.



**Note** If you are using the NI 7831R with Windows only, it is not necessary to install the LabVIEW Real-Time Module.

3. Install LabVIEW FPGA from the LabVIEW FPGA CD.
4. Install the NI-RIO device drivers. Refer to the [Installing NI-RIO Device Drivers](#) section for driver installation instructions.

## Installing NI-RIO Device Drivers

Complete the following steps to install the NI-RIO device drivers that are included with the NI 7831R device. If you are using LabVIEW, complete the installation instructions in the [Installing LabVIEW, the LabVIEW Real-Time Module for ETS, and the LabVIEW FPGA Module](#) section before installing the NI-RIO device drivers.

1. Run `setup.exe` from the NI-RIO CD and follow the setup instructions.
2. Follow the onscreen instructions until the Feature Tree window appears.
3. In the Feature Tree window, select the components to install. You must install NI-VISA, NI-RIO, and NI Measurement & Automation Explorer (MAX).
4. Follow the onscreen instructions to complete the driver installation.
5. Reboot your computer.

## Installing Hardware

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This section describes how to unpack and install the PXI-7831R and the PCI-7831R devices.



**Note** You must install the NI-RIO device drivers before installing the NI 7831R device.

## Unpacking

The NI 7831R device ships in an antistatic package to prevent electrostatic discharge from damaging device components. To prevent such damage when handling the device, take the following precautions:

- Ground yourself using a grounding strap or by holding a grounded object, such as your computer chassis.
- Touch the antistatic package to a metal part of the computer chassis before removing the devices from the package.



**Caution** *Never* touch the exposed pins of connectors.

Remove the devices from the package and inspect the devices for loose components or any other sign of damage. Notify NI if the devices appear damaged in any way. Do *not* install damaged devices into the computer.

Store the NI 7831R in the antistatic envelope when not in use.

## PXI-7831R Installation

You can install the PXI-7831R in any available peripheral slot in the PXI or CompactPCI chassis. Complete the following instructions to install the PXI-7831R device.



**Note** You must install the software before installing the hardware. For software installation instructions, refer to the *Installing Software* section.

1. Power off and unplug the PXI or CompactPCI chassis.
2. Make sure there are no lit LEDs on the chassis. Wait for any lit LEDs to go out before continuing the installation.
3. Remove the filler panel for the peripheral slot.
4. Ground yourself using a grounding strap or by touching a grounded object, such as the PXI or CompactPCI chassis.
5. Insert the PXI-7831R into the slot. Use the injector/ejector handle to fully inject the PXI-7831R into place.
6. Screw the front panel of the PXI-7831R to the front panel mounting rails of the chassis.
7. Visually verify the installation. Make sure the PXI-7831R is not touching other devices or components and that the PXI-7831R is fully inserted into the slot.
8. Plug in and power on the PXI or CompactPCI chassis.

## PCI-7831R Installation

You can install the PCI-7831R in any available PCI expansion slot in the computer. To achieve the best noise performance, leave as much room as possible between the PCI-7831R and other boards.

Complete the following instructions to install the PCI-7831R.



**Note** You must install the software before installing the hardware. For software installation instructions, refer to the *Installing Software* section.

1. Power off and unplug the computer.



**Caution** To protect both yourself and the computer from electrical hazards, the computer must remain off and unplugged until the PCI-7831R device is completely installed.

2. Remove the computer cover. Make sure there are no lit LEDs on the motherboard. Wait for any lit LEDs to go out before continuing the installation.

3. Touch the metal part of the power supply case inside the computer to discharge any static electricity that might be on your clothes or body.
4. Locate the metal bracket that covers the cut-out in the back panel of the chassis for the slot you have selected. Remove and save the bracket-retaining screw and the bracket cover.
5. Line up the PCI-7831R card-edge connector with the expansion slot receptacle. Using slow, evenly distributed pressure, press the PCI-7831R straight down until it seats in the expansion slot.
6. Reinstall the bracket-retaining screw to secure the PCI-7831R to the back panel rail.
7. Visually verify the installation.
8. Replace the computer cover, and plug the computer in.

## Using the NI PCI-7831R with the LabVIEW Real-Time Module for RTX

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You can use the LabVIEW Real-Time Module for RTX with the PCI-7831R. After you have installed Venturcom RTX Runtime, the LabVIEW Real-Time Module for RTX, and RTX support from the NI-RIO 1.1 Driver CD, complete the following steps.



**Note** Before adding RTX support for the R Series device, close all NI software.

1. Select **Start»Program Files»Venturcom RTX»RTX»RTX Properties**.
2. On the **Plug and Play** tab, right-click **NI-7831R** and select **Add RTX INF Support**.
3. Click the **Apply** button. RTX Properties returns a Warning dialog box. Click **OK**.
4. In the RTX Properties window, click **OK**.
5. Right-click **My Computer** and select **Properties**.
6. Select the **Hardware** tab and click **Device Manager**.
7. For Windows XP, expand NI-RIO Devices, right-click **NI-7831R** and select **Update Driver**. In the Hardware Update Wizard window, select **Install the software automatically** and click **Next**. When the wizard finishes installing the software, click **Finish**. The NI PCI-7831R appears under RTX Drivers as **NI-7831R RTX Supported**.

For Windows 2000, expand NI-RIO Devices, right-click **NI 7831R** and select **Properties**. On the **Driver** tab, click **Update Driver**. In the **Upgrade Device Driver Wizard** window, click **Next**. Select **Search for a suitable driver for my device** and click **Next** three times. When



Windows finishes installing the software, click **Finish**. The NI PCI-7831R appears under RTX Drivers as **NI-7831R RTX Supported**.

8. In the Device Manager window, select **View»Resources by connection**.
9. In the Device Manager window, expand **Interrupt Request (IRQ)**. Make sure that the NI PCI-7831R is not sharing an IRQ with any other devices. Refer to the *Venturcom RTX Runtime Help* for information about modifying a PCI device.
10. Reboot your computer.
11. Select **Start»Run**. In the Run window, enter `net start nirtx` and click **OK**.

The PCI-7831R now supports RTX. When you launch LabVIEW, the PCI-7831R appears in the **LabVIEW Execution Target** menu as **FPGA Device (PCI-7831R) visa://localhost::RTRTX::0/RIO0::INSTR**.

## Removing RTX Support

Complete the following steps to remove RTX support from the PCI-7831R.

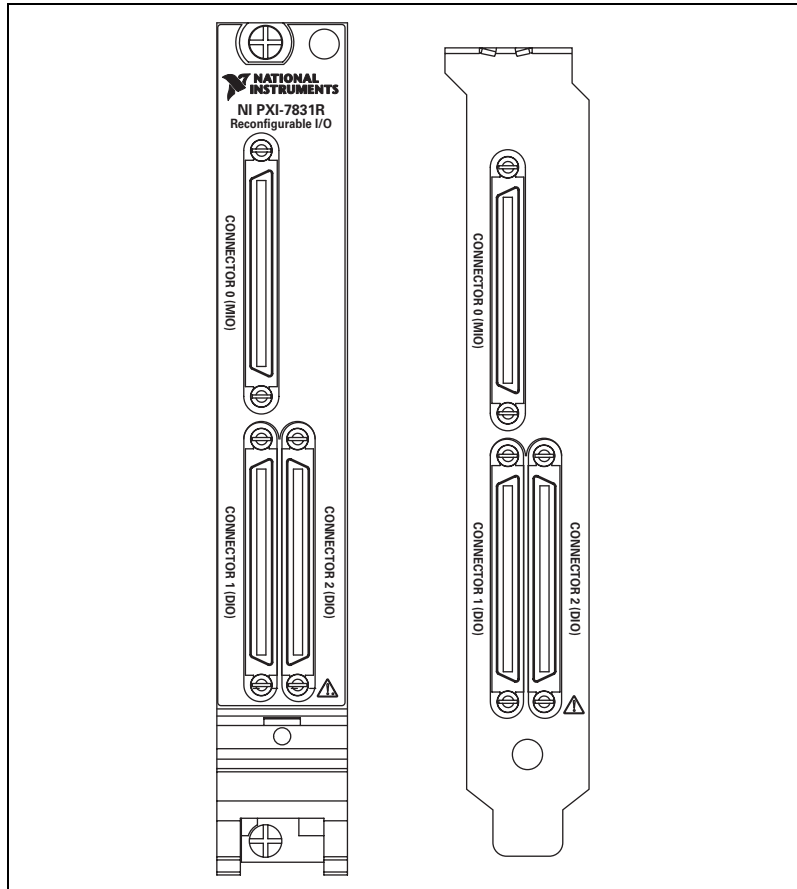
1. Close all NI software.
2. Select **Start»Program Files»Venturcom RTX»RTX»RTX Properties**.
3. On the **Plug and Play** tab, right-click **NI-7831R** and select **Remove RTX INF Support**.
4. Click **Apply**. RTX Properties returns a Warning dialog box. Click **OK**.
5. In the RTX Properties window, click **OK**.
6. Right-click **My Computer** and select **Properties**.
7. Select the **Hardware** tab and click **Device Manager**.
8. For Windows XP, expand **Rtx Drivers**, right-click **NI-7831R RTX Supported** and select **Update Driver**.

You have removed RTX support for the PCI-7831R.

# Connecting Signals

The NI 7831R has two DIO connectors with 40 DIO lines per DIO connector, and one MIO connector with eight AI lines, eight AO lines, and 16 DIO lines.

Figure 1 shows the I/O connector locations for the PXI-7831R and the PCI-7831R. The I/O connectors are numbered starting at zero.



**Figure 1.** NI 7831R Connector Locations

Figure 2 shows the pin assignments for the I/O connectors on the NI 7831R. The DIO connector pin assignment applies to both DIO connectors on the NI 7831R.

DIO38	34	68	DIO39	AIO-	34	68	AIO+
DIO36	33	67	DIO37	AIGND1	33	67	AIGND0
DIO34	32	66	DIO35	A1-	32	66	A1+
DIO32	31	65	DIO33	A12-	31	65	A12+
DIO30	30	64	DIO31	AIGND3	30	64	AIGND2
DIO28	29	63	DIO29	A13-	29	63	A13+
+5V	28	62	DIO27	A14-	28	62	A14+
+5V	27	61	DIO26	AIGND5	27	61	AIGND4
DGND	26	60	DIO25	A15-	26	60	A15+
DGND	25	59	DIO24	A16-	25	59	A16+
DGND	24	58	DIO23	AIGND7	24	58	AIGND6
DGND	23	57	DIO22	A17-	23	57	A17+
DGND	22	56	DIO21	No Connect	22	56	AISENSE
DGND	21	55	DIO20	AOGND0	21	55	AO0
DGND	20	54	DIO19	AOGND1	20	54	AO1
DGND	19	53	DIO18	AOGND2	19	53	AO2
DGND	18	52	DIO17	AOGND3	18	52	AO3
DGND	17	51	DIO16	AOGND4	17	51	AO4
DGND	16	50	DIO15	AOGND5	16	50	AO5
DGND	15	49	DIO14	AOGND6	15	49	AO6
DGND	14	48	DIO13	AOGND7	14	48	AO7
DGND	13	47	DIO12	DIO14	13	47	DIO15
DGND	12	46	DIO11	DIO12	12	46	DIO13
DGND	11	45	DIO10	DIO10	11	45	DIO11
DGND	10	44	DIO9	DIO8	10	44	DIO9
DGND	9	43	DIO8	DGND	9	43	DIO7
DGND	8	42	DIO7	DGND	8	42	DIO6
DGND	7	41	DIO6	DGND	7	41	DIO5
DGND	6	40	DIO5	DGND	6	40	DIO4
DGND	5	39	DIO4	DGND	5	39	DIO3
DGND	4	38	DIO3	DGND	4	38	DIO2
DGND	3	37	DIO2	DGND	3	37	DIO1
DGND	2	36	DIO1	DGND	2	36	DIO0
DGND	1	35	DIO0	+5V	1	35	+5V

DIO Connector Pin Assignments

MIO Connector Pin Assignment

**Figure 2.** NI 7831R I/O Connector Pin Assignments



**Caution** Connections that exceed any of the maximum ratings of input or output signals on the NI 7831R can damage the NI 7831R and the computer. NI is *not* liable for any damage resulting from such signal connections. Refer to the *NI 7831R User Manual* for the maximum input ratings for each signal.

For detailed information about connecting I/O signals, refer to the *NI 7831R User Manual*.

## Cabling Options

Accessing the signals on the I/O connectors requires at least one cable and one signal accessory. Table 1 summarizes the National Instruments cables available for use with the NI 7831R device.

**Table 1.** Cabling Options

Cable	Connector	Description
SH68-C68-S	MIO/DIO	For connecting signals from the MIO or DIO connector to the NI SCB-68 terminal block.
SHC68-68-RMIO	MIO	For connecting signals from the MIO connector to the SCB-68 terminal block.  Improves signal integrity and noise immunity. Provides shielding on all AI channels and an overall analog shield to reduce digital-to-analog crosstalk.
NSC68-262650	MIO	For direct connection of the NI 7831R to 5B and SSR analog and digital signal conditioning backplanes.  Routes signals to connectors that attach directly to 5B backplanes (for analog signals) and SSR backplanes (for digital signals).
NSC68-5050	DIO	For direct connection of the NI 7831R and SSR backplanes.  Routes signals to connectors that attach directly to SSR backplanes.

## Documentation Resources

Refer to the following documentation for information about the LabVIEW FPGA Module, R Series hardware, and VIs necessary for your application.

- *LabVIEW FPGA Module Release Notes*—describes the software installation and other known software issues
- *LabVIEW FPGA Module User Manual*—describes the LabVIEW FPGA Module software and techniques for building applications in LabVIEW with the LabVIEW FPGA Module
- *NI 7831R User Manual*—describes the electrical and mechanical aspects of the PXI-7811R device and contains information concerning its operation and programming

- *LabVIEW Help*—describes the VIs and function reference information
- *CompactRIO R Series Expansion System Installation Instructions*—describes how to install the CompactRIO R Series Expansion chassis and CompactRIO I/O modules

## Where to Go from Here

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Refer to the *LabVIEW FPGA Module Release Notes* for information about getting started with LabVIEW FPGA VIs and host VIs. This document also provides examples for verifying that your software and hardware are properly installed. To access this document, select **Start»Programs»National Instruments»LabVIEW»Module Documents**.

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