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# NI FlexRIO™ FPGA Module Installation Guide and Specifications

This document explains how to install your NI FlexRIO system, comprised of an NI FlexRIO FPGA module (NI PXI/PXIe-79xxR) and an NI FlexRIO adapter module. This document also contains the specifications for your NI FlexRIO FPGA module.

## Contents

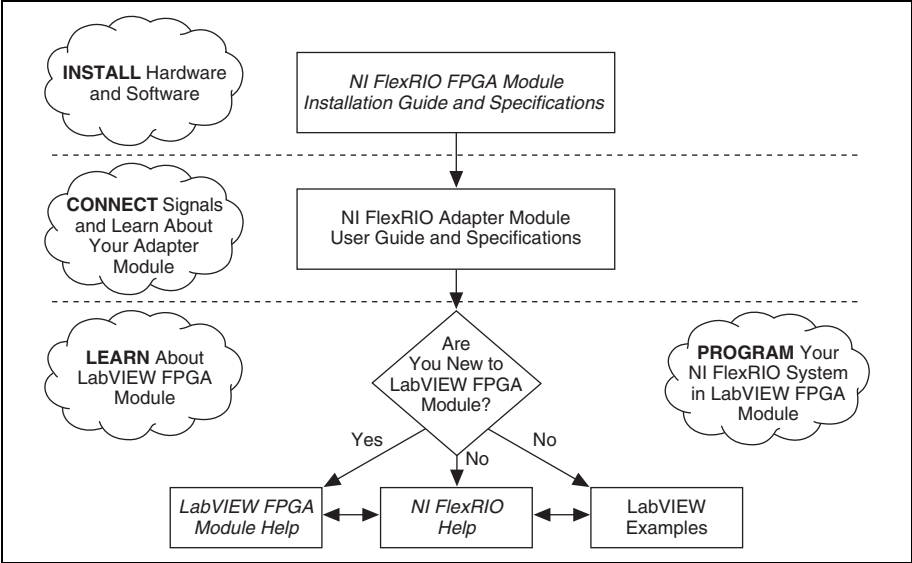
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## How to Use Your NI FlexRIO Documentation Set

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Refer to the Figure 1 and Table 1- for information about how to use your NI FlexRIO documentation set.



**Figure 1.** How to Use Your NI FlexRIO Documentation Set

**Table 1.** NI FlexRIO Documentation Locations and Descriptions

| Document   | Location   | Description  |
|--|--|--|
| <i>NI FlexRIO FPGA Module Installation Guide and Specifications*</i>                         | Available in your FPGA module hardware kit and from the Start Menu.  | Contains installation instructions for your NI FlexRIO system and specifications for your FPGA module. |
| <i>NI FlexRIO Adapter Module User Guide and Specifications*</i>                              | Available from the Start Menu.                                       | Contains signal information, examples, and specifications for your adapter module.                     |
| <i>LabVIEW FPGA Module Help*</i>   | Embedded in <i>LabVIEW Help</i> .                                    | Contains information about the basic functionality of LabVIEW FPGA Module.                             |
| <i>NI FlexRIO Help*</i>  | Available from the Start Menu.                                       | Contains FPGA module, adapter module, and CLIP configuration information.                              |
| LabVIEW Examples   | Available in LabVIEW Example Finder.                                 | Contains examples of how to run FPGA VIs and Host VIs on your device.                                  |
| Other Useful Information on <a href="http://ni.com">ni.com</a>                               |  |  |
| <a href="http://ni.com/ipnet">ni.com/ipnet</a>   | Contains LabVIEW FPGA functions and intellectual property to share.  |  |
| <a href="http://ni.com/flexrio">ni.com/flexrio</a>   | Contains product information and data sheets for NI FlexRIO devices. |  |
| * These documents are also available at <a href="http://ni.com/manuals">ni.com/manuals</a> . |  |  |

## Required Components

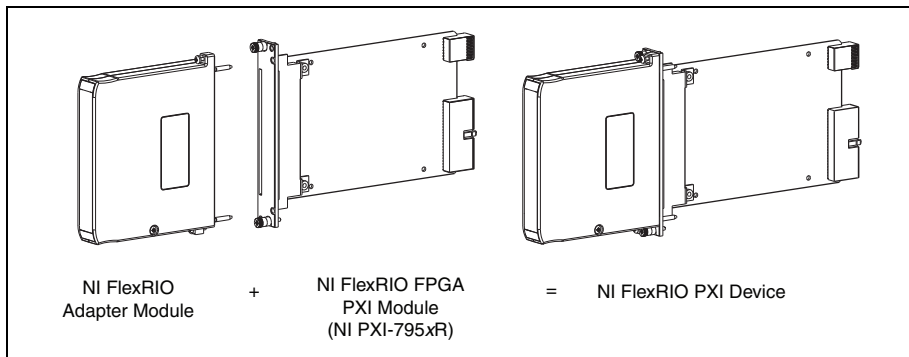
The following items are necessary to set up and use your NI FlexRIO system:

- The NI FlexRIO hardware device, comprised of the following items:
  - NI FlexRIO FPGA module (PXI/PXIe-79xxR)
  - NI FlexRIO adapter module

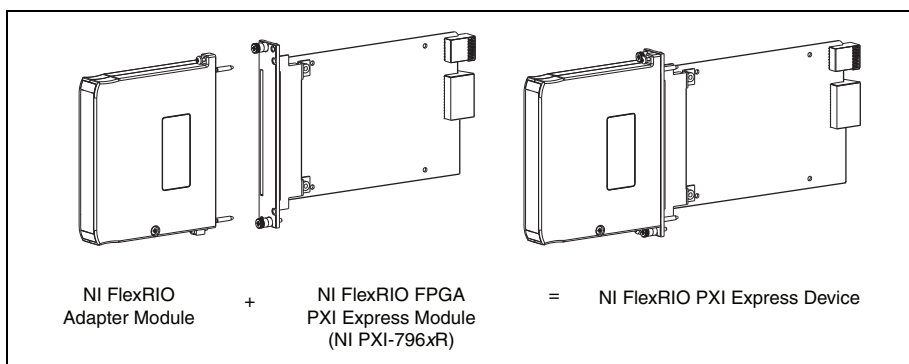


**Note** You can use the NI FlexRIO FPGA module without an adapter module for coprocessing or peer-to-peer streaming. The adapter module installation instructions in this document do not apply to these circumstances.

The form factor of the FPGA module (PXI or PXI Express) determines the form factor of the combined module, as shown in Figures 2 and 3.



**Figure 2.** NI FlexRIO PXI Device



**Figure 3.** NI FlexRIO PXI Express Device

- The following software packages:
  - LabVIEW
  - LabVIEW FPGA Module
  - NI-RIO driver
  - NI FlexRIO Adapter Module Support<sup>1</sup>



**Note** The most recent version of NI FlexRIO Adapter Module Support is available at [ni.com](http://ni.com). Visit [ni.com/info](http://ni.com/info) and enter `famsoftware` as the Info Code to download the latest version of NI FlexRIO Adapter Module Support. You do not need this software if you are not using an adapter module.

- (Optional) LabVIEW Real-Time Module

<sup>1</sup> The NI 1483 adapter module requires the NI-IMAQ instrument driver instead of NI FlexRIO Adapter Module Support.

Refer to *Step 1. Install the Application Software and Driver* for more information about NI FlexRIO software support.

- One of the following chassis:
  - PXI/CompactPCI chassis
  - PXI Express/CompactPCI Express chassis
- One of the following controllers:
  - PXI/CompactPCI embedded controller
  - PXI Express/CompactPCI Express embedded controller
  - MXI kit and a PC
- One of the following operating systems:
  - Windows 7
  - Windows Vista
  - Windows XP Pro x32 Service Pack 1 or 2
- At least one cable for connecting signals to the NI FlexRIO device. Refer to your adapter module documentation for a list of applicable cables and accessories for your NI FlexRIO system.

## Step 1. Install the Application Software and Driver

---

Before installing your hardware, you must install the application software and instrument driver. Visit [ni.com/info](http://ni.com/info) and enter `rdsoftwareversion` as the Info Code to determine which minimum software versions you need for your device. Install the software in the following order:

1. **LabVIEW**—Refer to the *LabVIEW Release Notes* for installation instructions for LabVIEW 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 for Windows.

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

2. **LabVIEW FPGA Module**—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»LabVIEW Manuals**.

3. **(Optional) LabVIEW Real-Time Module**—Refer to the *LabVIEW Real-Time Module Release and Upgrade Notes* for system requirements, installation instructions, and additional information about using the LabVIEW Real-Time Module.

4. **NI-RIO**—Refer to the *NI-RIO Readme* on the NI-RIO installation media for system requirements and installation instructions for the NI-RIO driver.

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



**Note** If you are not using an adapter module, skip step 5.

5. **NI FlexRIO Adapter Module Support**—Refer to the *NI FlexRIO Adapter Module Support Readme* on the NI FlexRIO Adapter Module Support installation media for system requirements and installation instructions.

The LabVIEW documents are available from [ni.com/manuals](http://ni.com/manuals). You can also view the LabVIEW Manuals directory that contains these documents by selecting **Start»All Programs»National Instruments»LabVIEW»LabVIEW Manuals**.

## Step 2. Install the NI FlexRIO devices

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This section describes how to unpack and install the NI FlexRIO FPGA module and the NI FlexRIO adapter module.



**Note** You must install the software before installing the hardware. For software installation information, refer to [Step 1. Install the Application Software and Driver](#).

### Unpacking

The NI FlexRIO FPGA module and the NI FlexRIO adapter module are shipped in antistatic packages 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 device from the package.



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

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

Store the NI FlexRIO FPGA module and NI FlexRIO adapter module in the antistatic envelopes when not in use.

# Installing the NI FlexRIO FPGA Module

Complete the following steps to install an NI FlexRIO FPGA module:

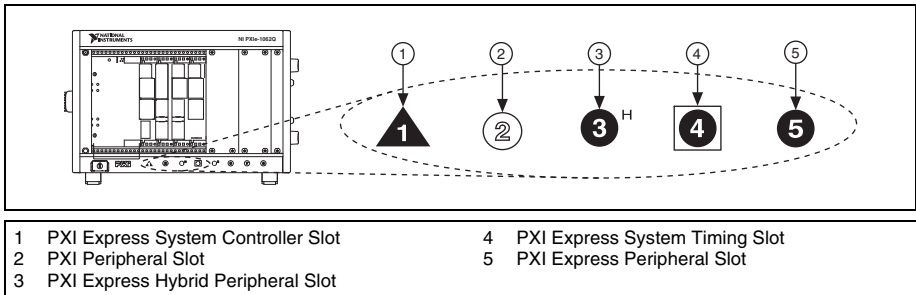


**Note** You must install the software before installing the hardware. For software installation information, refer to [Step 1. Install the Application Software and Driver](#).



**Caution** Refer to the *Read Me First: Safety and Electromagnetic Compatibility* document packaged with your PXI/PXI Express chassis or device before removing equipment covers or connecting or disconnecting any signal wires.

1. Power off and unplug the PXI/PXI Express chassis. Refer to your chassis manual to install or configure the chassis.
2. Identify a supported PXI/PXI Express slot in the chassis. Figure 4 shows the symbols that indicate the slot types in a PXI/PXI Express chassis.



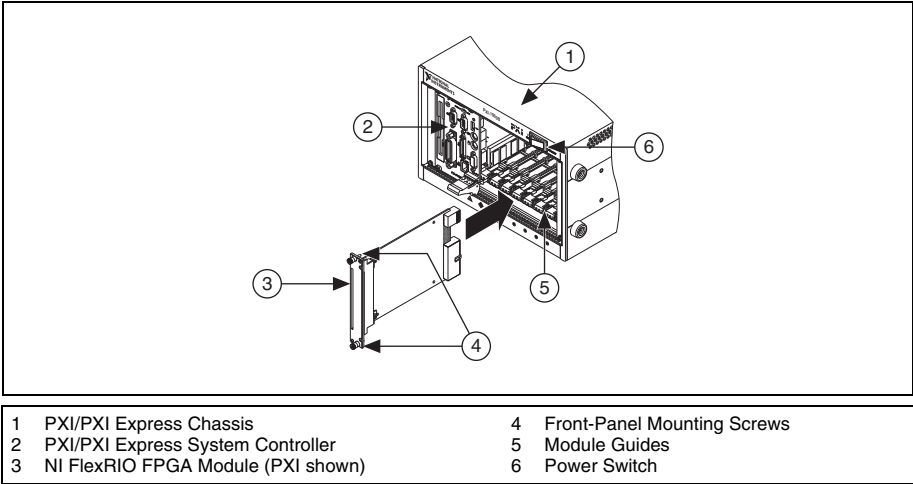
**Figure 4.** Symbols for PXI Express/PXI Express Hybrid/PXI Slots

If you are using a PXI Express chassis, you can place PXI devices in the PXI slots. If a PXI device is hybrid slot compatible, you can use the PXI Express Hybrid slots. PXI Express devices can be placed only in PXI Express slots and PXI Express Hybrid slots. Refer to the chassis documentation for details.

3. Remove the filler panel of an unused PXI/PXI Express slot.
4. Touch any metal part of the chassis to discharge any static electricity.



Place the PXI/PXI Express module edges into the module guides at the top and bottom of the chassis, and slide the module into the chassis until the module is fully inserted, as shown in Figure 5.



**Figure 5.** Installing an NI FlexRIO FPGA Module in the PXI/PXI Express Chassis

- Secure the device front panel to the chassis front panel mounting rail using the front panel mounting screws.
- Plug in and power on the PXI/PXI Express chassis.

## Confirming That the Device Is Recognized in Measurement & Automation Explorer (MAX)

To confirm that your device is recognized, complete the following additional steps:

- Select **Start»All Programs»National Instruments»Measurement & Automation**.
- Expand **Devices and Interfaces**.
- Verify that the device appears under **Devices and Interfaces»RIO Devices**, as shown in Figure 6.



**Figure 6.** Confirming That the Device is Recognized

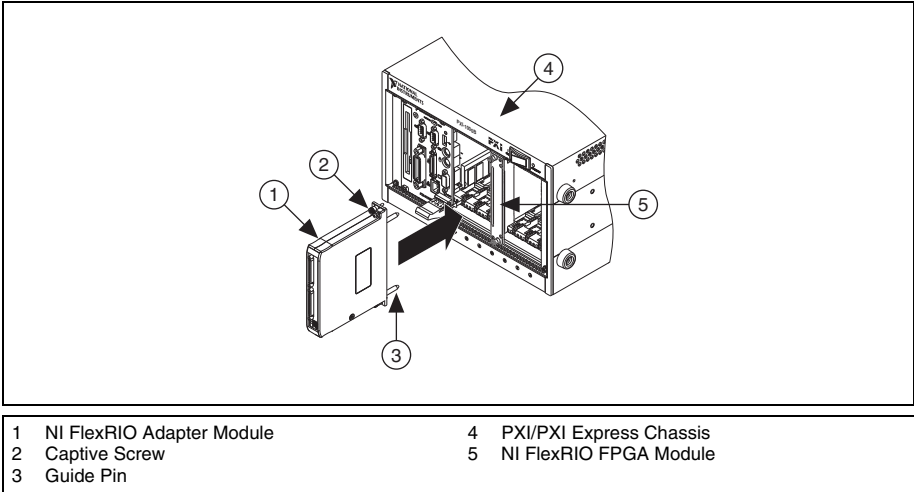
# Installing the NI FlexRIO Adapter Module

Complete the following steps to connect the NI FlexRIO adapter module to the NI FlexRIO FPGA module.



**Note** Skip this step if you are not using an adapter module.

1. Gently insert the guide pins and the high-density card edge of the NI FlexRIO adapter module into the corresponding connectors of the NI FlexRIO FPGA module, as shown in Figure 7. The connection may be tight, but do *not* force the adapter module into place.



**Figure 7.** Installing the NI FlexRIO Adapter Module

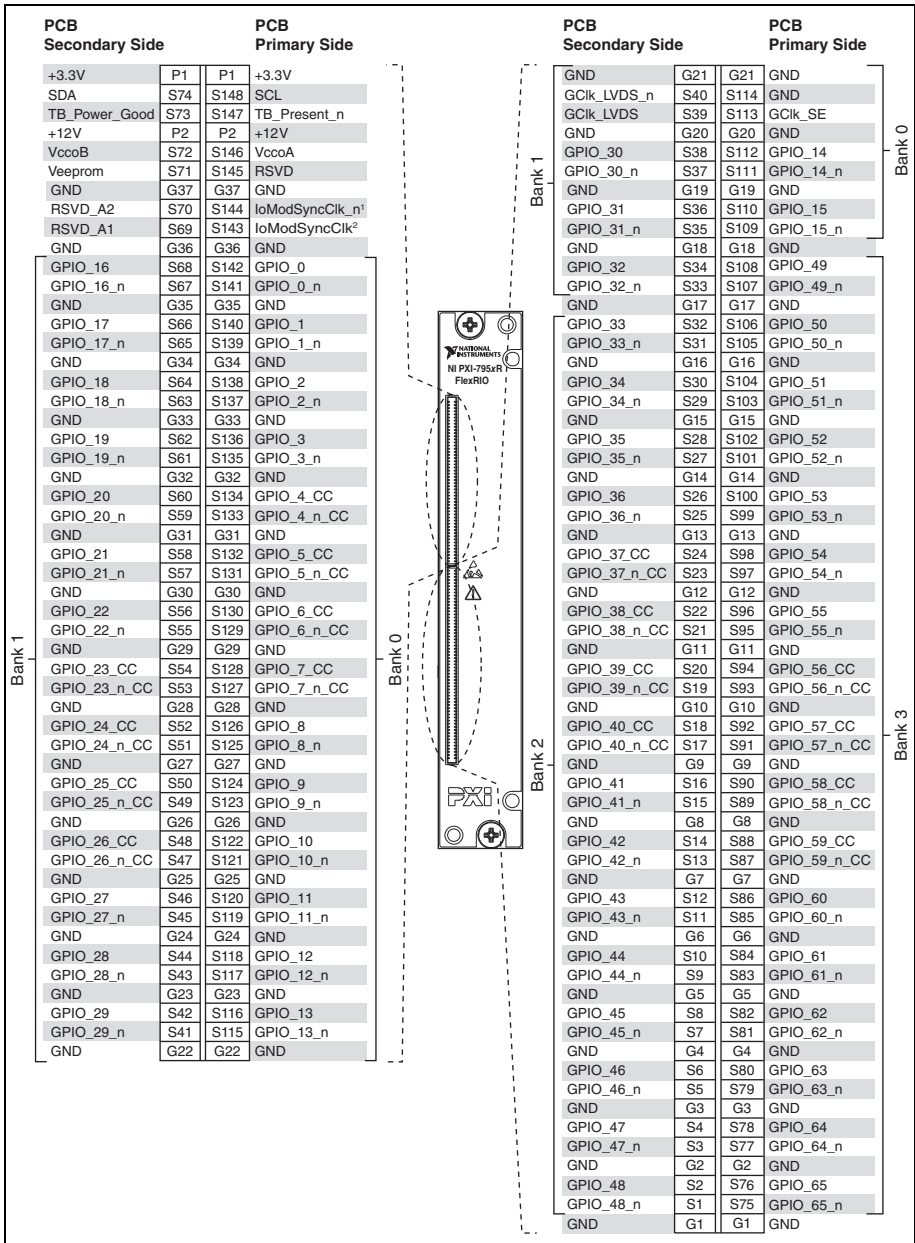
2. Tighten the captive screws on the NI FlexRIO adapter module to secure it to the NI FlexRIO FPGA module.
3. Launch LabVIEW to begin configuring your NI FlexRIO system.



**Note** MAX only recognizes which FPGA modules are in the chassis. Your adapter module will not appear in MAX.

## NI FlexRIO FPGA Module Signals

Figure 8 shows the available signals on the NI FlexRIO FPGA module. With the exception of the two footnotes in the following image, the PXI and PXI Express FPGA modules have the same pinouts. Refer to your adapter module specifications for your adapter module pinout.



1 RSVD\_B2 on the NI PXI-795xR

2 RSVD\_B1 on the NI PXI-795xR

**Figure 8.** NI FlexRIO FPGA Module Front Connector Pin Assignments and Locations

# Specifications

This section lists the specifications for your NI FlexRIO FPGA module. Refer to your adapter module documentation for the adapter module specifications. NI FlexRIO FPGA modules include the following devices:

- NI PXI-7951R
- NI PXI-7952R
- NI PXI-7953R
- NI PXI-7954R
- NI PXIe-7961R
- NI PXIe-7962R
- NI PXIe-7965R
- NI PXIe-7966R



**Note** Typical values are representative of an average unit operating at room temperature. These specifications are typical at 25 °C unless otherwise noted.

## Reconfigurable FPGA

| Device               | FPGA           | LUTs/<br>Flip-Flops | DSP48 Slices<br>(25 × 18<br>Multiplier) | Embedded<br>Block RAM<br>(kbits) |
|----------------------|----------------|---------------------|---|----------------------------------|
| NI PXI-7951R         | Virtex-5 LX30  | 19,200              | 32                                      | 1,152                            |
| NI PXI-7952R         | Virtex-5 LX50  | 28,800              | 48                                      | 1,728                            |
| NI PXI-7953R         | Virtex-5 LX85  | 51,840              | 48                                      | 3,456                            |
| NI PXI-7954R         | Virtex-5 LX110 | 69,120              | 64                                      | 4,608                            |
| NI PXIe-7961R        | Virtex-5 SX50T | 32,640              | 288                                     | 4,752                            |
| NI PXIe-7962R        | Virtex-5 SX50T | 32,640              | 288                                     | 4,752                            |
| NI PXIe-7965R/7966R* | Virtex-5 SX95T | 58,880              | 640                                     | 8,784                            |

\* These two devices have different speed grade FPGAs: -1 for the NI PXIe-7965R and -2 for the NI PXIe-7966R. For more information about Xilinx Virtex-5 FPGA speed grades, refer to the *Virtex-5 FPGA Data Sheet: DC and Switching Characteristics* available at [www.xilinx.com](http://www.xilinx.com).

Default timebase ..... 40 MHz

Timebase reference sources

NI PXI-795xR ..... PXI 10 MHz (PXI\_CLK10)

NI PXIe-796xR ..... PXI Express 100 MHz (PXIe\_CLK100)

|                        |                                      |
|------------------------|--------------------------------------|
| Timebase accuracy      |                                      |
| NI PXI-795xR .....     | ±100 ppm, 250 ps peak-to-peak jitter |
| NI PXIe-796xR .....    | ±50 ppm, 250 ps peak-to-peak jitter  |
| Data transfers .....   | DMA, interrupts, programmed I/O      |
| Number of DMA channels |                                      |
| NI PXI-795xR .....     | 3                                    |
| NI PXIe-796xR .....    | 16                                   |

## FPGA Digital Input/Output

|  |  |
|--|--|
| Number of general-purpose channels ..... | 132, configurable as 132 single-ended, 66 differential, or a combination of both <sup>1</sup>  |
| Channels per bank                        |  |
| Bank 0/Bank 2 .....                      | 32, single-ended per bank  |
| Bank 1/Bank 3 .....                      | 34, single-ended per bank  |
| Compatibility .....                      | Configured through the FPGA and based on the attached adapter module; 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V I/O standards (refer to <a href="http://www.xilinx.com">www.xilinx.com</a> ) |
| Protection .....                         | Refer to <a href="http://www.xilinx.com">www.xilinx.com</a>  |
| Current .....                            | Refer to <a href="http://www.xilinx.com">www.xilinx.com</a>  |
| Maximum I/O data rates                   |  |
| Single-ended .....                       | 400 Mb/s for LVDCI25   |
| Differential .....                       | 1 Gb/s for LVDS  |
| Global clock inputs .....                | 1 LVTTTL, 1 LVDS   |
| Connection resources                     |  |
| NI PXI-795xR .....                       | PXI triggers, PXI_CLK10, and PXI star trigger  |
| NI PXIe-796xR .....                      | PXI triggers, PXI_CLK10, PXI star trigger, PXIe_DStarA, PXIe_DStarB, PXIe_DStarC, and PXIe_Sync100   |

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<sup>1</sup> The 132 channels span across four FPGA banks. Refer to the [NI FlexRIO FPGA Module Signals](#) section for more information about banks.

# Onboard DRAM<sup>1</sup>

## Memory size

|                     |                          |
|---------------------|--------------------------|
| NI PXI-795xR .....  | 2 banks, 64 MB per bank  |
| NI PXIe-796xR ..... | 2 banks, 256 MB per bank |

## Maximum theoretical data rate

|                     |                   |
|---------------------|-------------------|
| NI PXI-795xR .....  | 800 MB/s per bank |
| NI PXIe-796xR ..... | 1.6 GB/s per bank |

# Bus Interface

PXI.....Master, slave

## PXI Express

|                         |   |
|-------------------------|---|
| Form factor.....        | x4 PXI Express, specification v1.0 compliant            |
| Slot compatibility..... | x4, x8, and x16 PXI Express or PXI Express hybrid slots |

# Maximum Power Requirements<sup>2</sup>

## NI PXI-795xR

|                             |       |
|-----------------------------|-------|
| +5 VDC ( $\pm 5\%$ ).....   | 2 A   |
| +3.3 VDC ( $\pm 5\%$ )..... | 2 A   |
| +12 V .....                 | 0.5 A |
| -12 V.....                  | 0 A   |

## NI PXIe-796xR

|                             |     |
|-----------------------------|-----|
| +3.3 VDC ( $\pm 5\%$ )..... | 3 A |
| +12 V .....                 | 2 A |

# Physical

## Dimensions (not including connectors)

|                     |  |
|---------------------|--|
| NI PXI-795xR .....  | 18.8 cm $\times$ 12.9 cm<br>(7.4 in. $\times$ 5.1 in.) |
| NI PXIe-796xR ..... | 16.1 cm $\times$ 10.8 cm<br>(6.3 in. $\times$ 4.3 in.) |

## Weight

|                     |                |
|---------------------|----------------|
| NI PXI-795xR .....  | 190 g (6.7 oz) |
| NI PXIe-796xR ..... | 213 g (7.5 oz) |

I/O connector .....High-density card edge

<sup>1</sup> The NI PXI-7951R and NI PXIe-7961R devices do not have onboard DRAM.

<sup>2</sup> Power requirements are dependent on the adapter module and contents of the LabVIEW FPGA VI used in your application.

# Maximum Working Voltage<sup>1</sup>

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Channel-to-earth ..... 0 V to 3.3 V, Measurement Category I

Channel-to-channel..... 0 V to 3.3 V, Measurement Category I



**Caution** Do *not* use this device for connecting to signals in Measurement Categories II, III, or IV.

## Environmental

This device is intended for indoor use only.

Operating environment ..... 0 °C to 55 °C,  
tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.

Relative humidity range..... 10% to 90%, noncondensing,  
tested in accordance with IEC-60068-2-56.

Altitude ..... 2,000 m at 25 °C ambient temperature

Pollution Degree ..... 2

Storage environment

Ambient temperature range ..... -20 °C to 70 °C,  
tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.

Relative humidity range..... 5% to 95%, noncondensing,  
tested in accordance with IEC-60068-2-56.



**Note** Clean the device with a soft, non-metallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

## Shock and Vibration

Operational shock ..... 30 g peak, half-sine, 11 ms pulse,  
tested in accordance with IEC-60068-2-27.  
Test profile developed in accordance with MIL-PRF-28800F.

Random vibration

Operating ..... 5 Hz to 500 Hz, 0.3 g<sub>rms</sub>

Nonoperating ..... 5 Hz to 500 Hz, 2.4 g<sub>rms</sub>,  
tested in accordance with IEC-60068-2-64.  
Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.

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<sup>1</sup> Voltage ranges are dependent on the I/O standards available for your application. For more information on available I/O standards, refer to Xilinx documentation, available at [www.xilinx.com](http://www.xilinx.com).

# Safety

This product meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

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



**Note** For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

# Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



**Note** For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.



**Note** EMC compliance evaluated with a wrapback adapter module and general purpose I/O (GPIO) signals configured to LVTTTL I/O standard, slew rate set to slow, and drive strength set to 6 mA. EMC compliance of other I/O standards, faster slew rates, and greater drive strength is not guaranteed.

# CE Compliance

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

# Online Product Certification

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



# Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at [ni.com/environment](http://ni.com/environment). This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

## Waste Electrical and Electronic Equipment (WEEE)



**EU Customers** At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit [ni.com/environment/weee](http://ni.com/environment/weee).

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## Where to Go for Support

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

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at [ni.com/support](http://ni.com/support) and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, visit the Worldwide Offices section of [ni.com/niglobal](http://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.

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