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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-79*xx*R) and an NI FlexRIO adapter module. This document also contains the specifications for your NI FlexRIO FPGA module.

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How to Use Your NI FlexRIO Documentation Set

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

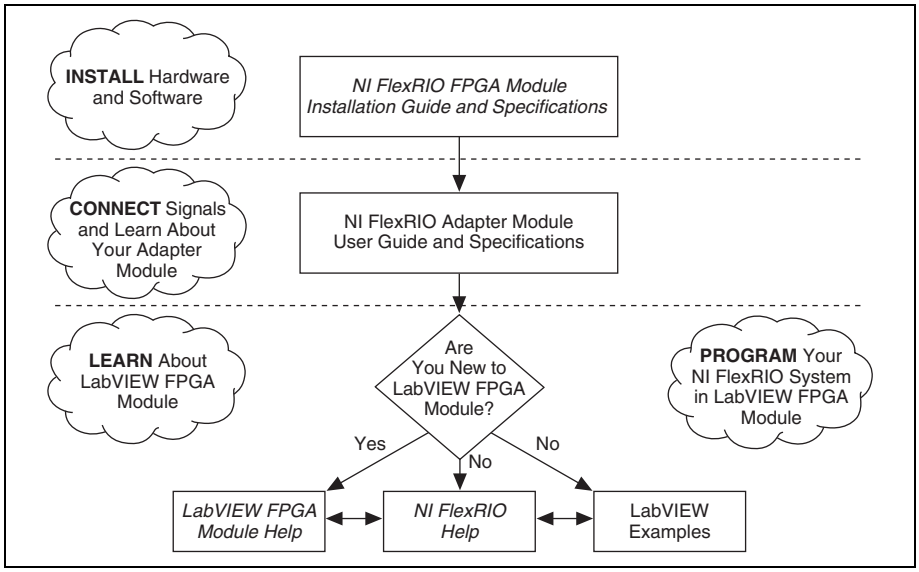


Figure 1. How to Use Your NI FlexRIO Documentation Set

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Table 1. NI FlexRIO Documentation Locations and Descriptions

Document	Location	Description
NI FlexRIO FPGA Module Installation Guide and Specifications[*]	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.
NI FlexRIO Adapter Module User Guide and Specifications[*]	Available from the Start Menu.	Contains signal information, examples, and specifications for your adapter module.
LabVIEW FPGA Module Help[*]	Embedded in *LabVIEW Help*.	Contains information about the basic functionality of LabVIEW FPGA Module.
NI FlexRIO Help[*]	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 `ni.com`		
`ni.com/ipnet`	Contains LabVIEW FPGA functions and intellectual property to share.	
`ni.com/flexrio`	Contains product information and data sheets for NI FlexRIO devices.	
[*] These documents are also available at `ni.com/manuals`.		

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-79*xx*R)
  - 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.

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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.

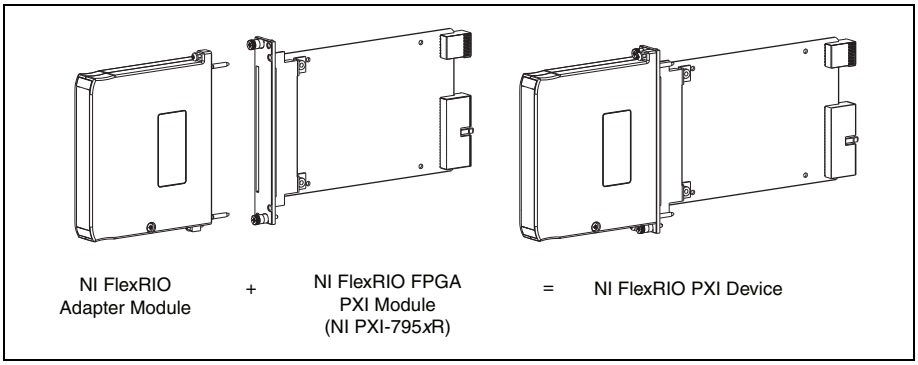


Figure 2. NI FlexRIO PXI Device

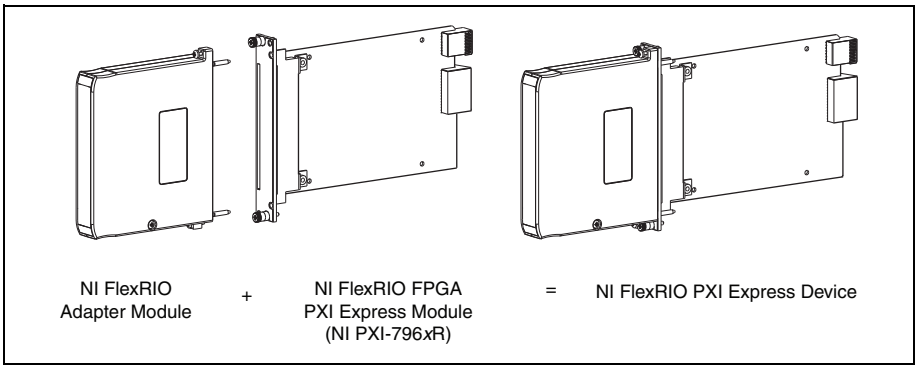


Figure 3. NI FlexRIO PXI Express Device

- ❑ The following software packages:
  - LabVIEW
  - LabVIEW FPGA Module
  - NI-RIO driver
  - NI FlexRIO Adapter Module Support[1]

Note The most recent version of NI FlexRIO Adapter Module Support is available at `ni.com`. Visit `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

[1] The NI 1483 adapter module requires the NI-IMAQ instrument driver instead of NI FlexRIO Adapter Module Support.

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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` 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**.

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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`. 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

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.

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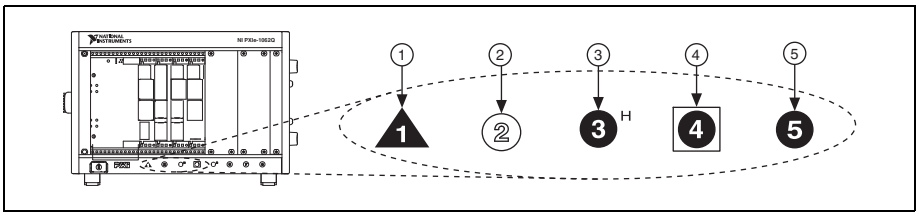
Installing the NI FlexRIO FPGA Module

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.



1	PXI Express System Controller Slot	4	PXI Express System Timing Slot
2	PXI Peripheral Slot	5	PXI Express Peripheral Slot
3	PXI Express Hybrid Peripheral Slot		

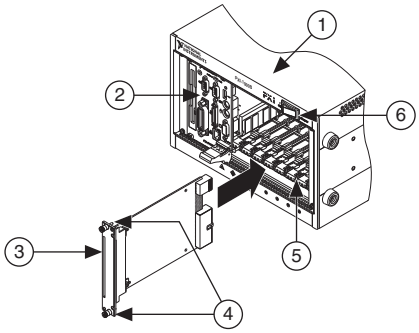
Figure 4. Symbols for PXI Express/PXI Express Hybrid/PXI Slots

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.

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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.



1	PXI/PXI Express Chassis	4	Front-Panel Mounting Screws
2	PXI/PXI Express System Controller	5	Module Guides
3	NI FlexRIO FPGA Module (PXI shown)	6	Power Switch

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

5. Secure the device front panel to the chassis front panel mounting rail using the front panel mounting screws.
6. 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:

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



Figure 6. Confirming That the Device is Recognized

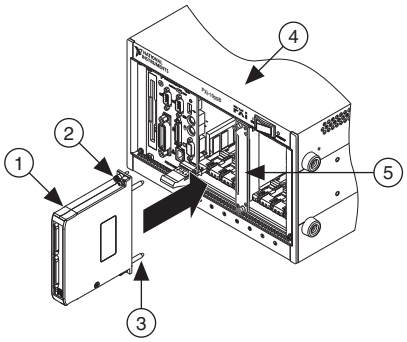
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Installing the NI FlexRIO Adapter Module

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.



1	NI FlexRIO Adapter Module	4	PXI/PXI Express Chassis
2	Captive Screw	5	NI FlexRIO FPGA Module
3	Guide Pin		

Figure 7. Installing the NI FlexRIO Adapter Module

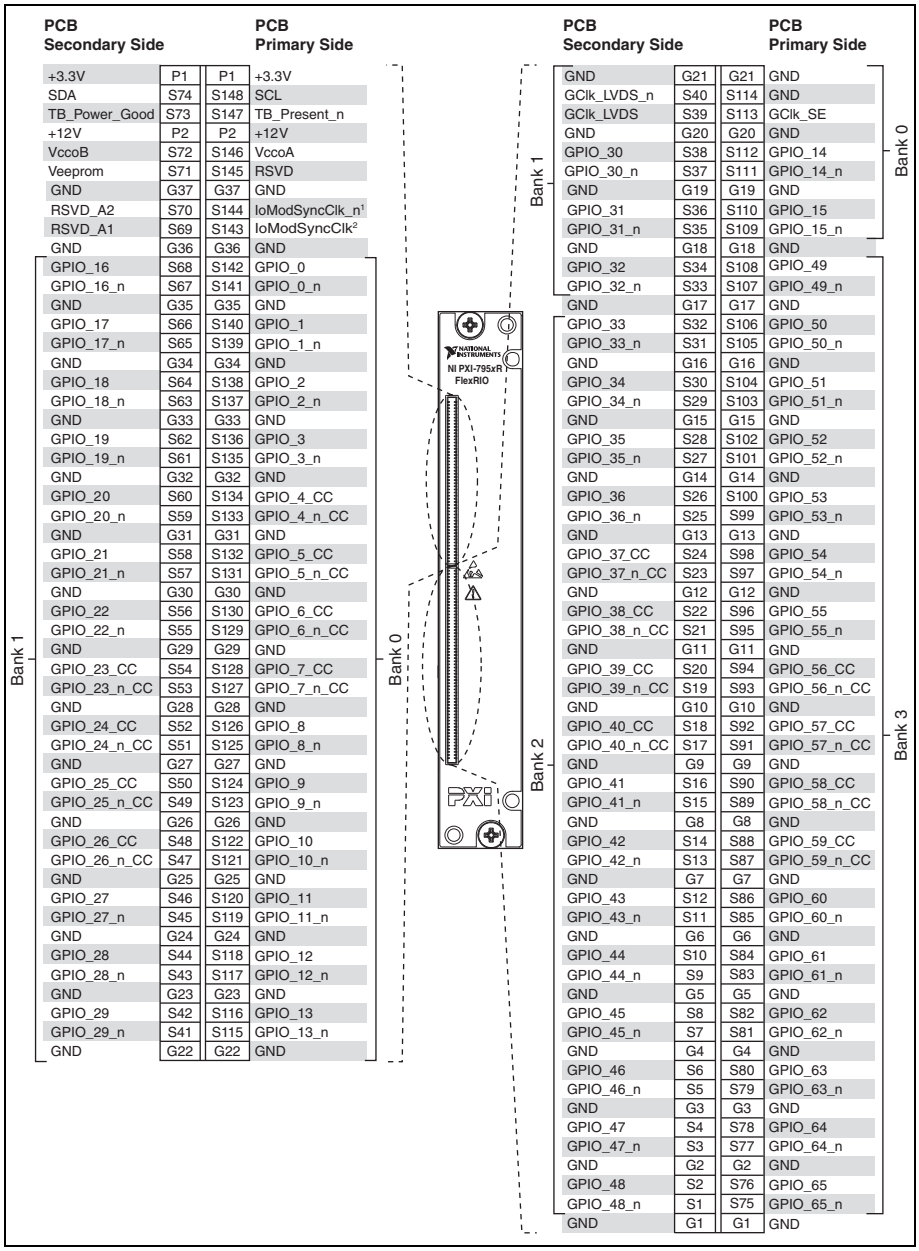
2. Tighten the captive screws on the NI FlexRIO adapter module to secure it to the NI FlexRIO FPGA module.
3. Launch LabVIEW to begin configuring your NI FlexRIO system.

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.

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PCB Secondary Side			PCB Primary Side
+3.3V	P1	P1	+3.3V
SDA	S74	S148	SCL
TB_Power_Good	S73	S147	TB_Present_n
+12V	P2	P2	+12V
VccoB	S72	S146	VccoA
Veeprom	S71	S145	RSVD
GND	G37	G37	GND
RSVD_A2	S70	S144	IoModSyncClk_n[1]
RSVD_A1	S69	S143	IoModSyncClk[2]
GND	G36	G36	GND
GPIO_16	S68	S142	GPIO_0
GPIO_16_n	S67	S141	GPIO_0_n
GND	G35	G35	GND
GPIO_17	S66	S140	GPIO_1
GPIO_17_n	S65	S139	GPIO_1_n
GND	G34	G34	GND
GPIO_18	S64	S138	GPIO_2
GPIO_18_n	S63	S137	GPIO_2_n
GND	G33	G33	GND
GPIO_19	S62	S136	GPIO_3
GPIO_19_n	S61	S135	GPIO_3_n
GND	G32	G32	GND
GPIO_20	S60	S134	GPIO_4_CC
GPIO_20_n	S59	S133	GPIO_4_n_CC
GND	G31	G31	GND
GPIO_21	S58	S132	GPIO_5_CC
GPIO_21_n	S57	S131	GPIO_5_n_CC
GND	G30	G30	GND
GPIO_22	S56	S130	GPIO_6_CC
GPIO_22_n	S55	S129	GPIO_6_n_CC
GND	G29	G29	GND
GPIO_23_CC	S54	S128	GPIO_7_CC
GPIO_23_n_CC	S53	S127	GPIO_7_n_CC
GND	G28	G28	GND
GPIO_24_CC	S52	S126	GPIO_8
GPIO_24_n_CC	S51	S125	GPIO_8_n
GND	G27	G27	GND
GPIO_25_CC	S50	S124	GPIO_9
GPIO_25_n_CC	S49	S123	GPIO_9_n
GND	G26	G26	GND
GPIO_26_CC	S48	S122	GPIO_10
GPIO_26_n_CC	S47	S121	GPIO_10_n
GND	G25	G25	GND
GPIO_27	S46	S120	GPIO_11
GPIO_27_n	S45	S119	GPIO_11_n
GND	G24	G24	GND
GPIO_28	S44	S118	GPIO_12
GPIO_28_n	S43	S117	GPIO_12_n
GND	G23	G23	GND
GPIO_29	S42	S116	GPIO_13
GPIO_29_n	S41	S115	GPIO_13_n
GND	G22	G22	GND

PCB Secondary Side			PCB Primary Side
GND	G21	G21	GND
GClk_LVDS_n	S40	S114	GND
GClk_LVDS	S39	S113	GClk_SE
GND	G20	G20	GND
GPIO_30	S38	S112	GPIO_14
GPIO_30_n	S37	S111	GPIO_14_n
GND	G19	G19	GND
GPIO_31	S36	S110	GPIO_15
GPIO_31_n	S35	S109	GPIO_15_n
GND	G18	G18	GND
GPIO_32	S34	S108	GPIO_49
GPIO_32_n	S33	S107	GPIO_49_n
GND	G17	G17	GND
GPIO_33	S32	S106	GPIO_50
GPIO_33_n	S31	S105	GPIO_50_n
GND	G16	G16	GND
GPIO_34	S30	S104	GPIO_51
GPIO_34_n	S29	S103	GPIO_51_n
GND	G15	G15	GND
GPIO_35	S28	S102	GPIO_52
GPIO_35_n	S27	S101	GPIO_52_n
GND	G14	G14	GND
GPIO_36	S26	S100	GPIO_53
GPIO_36_n	S25	S99	GPIO_53_n
GND	G13	G13	GND
GPIO_37_CC	S24	S98	GPIO_54
GPIO_37_n_CC	S23	S97	GPIO_54_n
GND	G12	G12	GND
GPIO_38_CC	S22	S96	GPIO_55
GPIO_38_n_CC	S21	S95	GPIO_55_n
GND	G11	G11	GND
GPIO_39_CC	S20	S94	GPIO_56_CC
GPIO_39_n_CC	S19	S93	GPIO_56_n_CC
GND	G10	G10	GND
GPIO_40_CC	S18	S92	GPIO_57_CC
GPIO_40_n_CC	S17	S91	GPIO_57_n_CC
GND	G9	G9	GND
GPIO_41	S16	S90	GPIO_58_CC
GPIO_41_n	S15	S89	GPIO_58_n_CC
GND	G8	G8	GND
GPIO_42	S14	S88	GPIO_59_CC
GPIO_42_n	S13	S87	GPIO_59_n_CC
GND	G7	G7	GND
GPIO_43	S12	S86	GPIO_60
GPIO_43_n	S11	S85	GPIO_60_n
GND	G6	G6	GND
GPIO_44	S10	S84	GPIO_61
GPIO_44_n	S9	S83	GPIO_61_n
GND	G5	G5	GND
GPIO_45	S8	S82	GPIO_62
GPIO_45_n	S7	S81	GPIO_62_n
GND	G4	G4	GND
GPIO_46	S6	S80	GPIO_63
GPIO_46_n	S5	S79	GPIO_63_n
GND	G3	G3	GND
GPIO_47	S4	S78	GPIO_64
GPIO_47_n	S3	S77	GPIO_64_n
GND	G2	G2	GND
GPIO_48	S2	S76	GPIO_65
GPIO_48_n	S1	S75	GPIO_65_n
GND	G1	G1	GND

1 RSVD_B2 on the NI PXI-795*x*R

2 RSVD_B1 on the NI PXI-795*x*R

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

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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/ Flip-Flops	DSP48 Slices (25 × 18 Multiplier)	Embedded Block RAM (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`.

Default timebase ..... 40 MHz

Timebase reference sources

NI PXI-795*x*R ..... PXI 10 MHz (PXI_CLK10)

NI PXIe-796*x*R ..... PXI Express 100 MHz (PXIe_CLK100)

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Timebase accuracy
- NI PXI-795*x*R ..... ±100 ppm, 250 ps peak-to-peak jitter
- NI PXIe-796*x*R ..... ±50 ppm, 250 ps peak-to-peak jitter

Data transfers ..... DMA, interrupts, programmed I/O

Number of DMA channels
- NI PXI-795*x*R 3
- NI PXIe-796*x*R 16

FPGA Digital Input/Output

Number of general-purpose channels ..... 132, configurable as 132 single-ended, 66 differential, or a combination of both[1]

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 `www.xilinx.com`)

Protection ..... Refer to `www.xilinx.com`

Current ..... Refer to `www.xilinx.com`

Maximum I/O data rates
- Single-ended ..... 400 Mb/s for LVDCI25
- Differential ..... 1 Gb/s for LVDS

Global clock inputs ..... 1 LVTTL, 1 LVDS

Connection resources
- NI PXI-795*x*R ..... PXI triggers, PXI_CLK10, and PXI star trigger
- NI PXIe-796*x*R ..... PXI triggers, PXI_CLK10, PXI star trigger, PXIe_DStarA, PXIe_DStarB, PXIe_DStarC, and PXIe_Sync100

[1] The 132 channels span across four FPGA banks. Refer to the *NI FlexRIO FPGA Module Signals* section for more information about banks.

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Onboard DRAM[1]

Memory size

- NI PXI-795*x*R ..... 2 banks, 64 MB per bank
- NI PXIe-796*x*R ..... 2 banks, 256 MB per bank

Maximum theoretical data rate

- NI PXI-795*x*R ..... 800 MB/s per bank
- NI PXIe-796*x*R ..... 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[2]

NI PXI-795*x*R

- +5 VDC (±5%) ..... 2 A
- +3.3 VDC (±5%) ..... 2 A
- +12 V ..... 0.5 A
- –12 V ..... 0 A

NI PXIe-796*x*R

- +3.3 VDC (±5%) ..... 3 A
- +12 V ..... 2 A

Physical

Dimensions (not including connectors)

- NI PXI-795*x*R ..... 18.8 cm × 12.9 cm (7.4 in. × 5.1 in.)
- NI PXIe-796*x*R ..... 16.1 cm × 10.8 cm (6.3 in. × 4.3 in.)

Weight

- NI PXI-795*x*R ..... 190 g (6.7 oz)
- NI PXIe-796*x*R ..... 213 g (7.5 oz)

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

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[1] The NI PXI-7951R and NI PXIe-7961R devices do not have onboard DRAM.

[2] Power requirements are dependent on the adapter module and contents of the LabVIEW FPGA VI used in your application.

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Maximum Working Voltage[1]

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_{rms}
- Nonoperating ..... 5 Hz to 500 Hz, 2.4 g_{rms},
  tested in accordance with IEC-60068-2-64.
  Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.

[1] 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`.

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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 LVTTL 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 CE

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`, search by model number or product line, and click the appropriate link in the Certification column.

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