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SHC68-C68-D4

GETTING STARTED GUIDE

NI 6581/6581B

NI FlexRIO High-Speed Digital I/O Adapter Module

The NI 6581/6581B is a high-speed digital I/O adapter module designed to work in conjunction with your NI FlexRIO™ FPGA module. The NI 6581/6581B features 54 single-ended digital I/O channels and sample rates up to 100 Mb/s per channel.

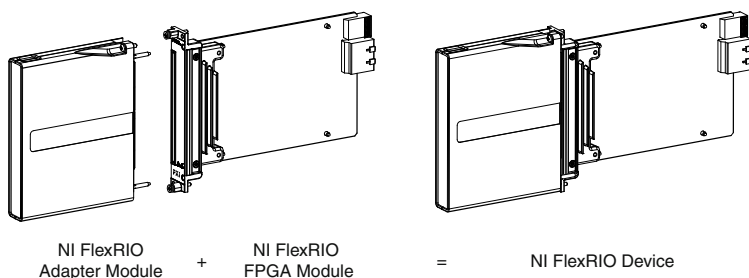
This document contains installation instructions and signal information for the NI 6581/6581B.



Note The *NI 6581B* is compatible with all NI FlexRIO FPGA modules. The *NI 6581* variant is compatible with the NI PXI-795xR and NI PXIe-796xR FPGA modules only.

The following figure shows an example of a properly connected NI FlexRIO device.

Figure 1. NI FlexRIO Device



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Electromagnetic Compatibility Guidelines

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

This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any 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.



Caution To ensure the specified EMC performance, the length of all I/O cables must be no longer than 3 m (10 ft).

How to Use Your NI FlexRIO Documentation Set

Refer to the following flowchart for information about how to use FlexRIO documentation.

Figure 2. How to Use Your NI FlexRIO Documentation Set.

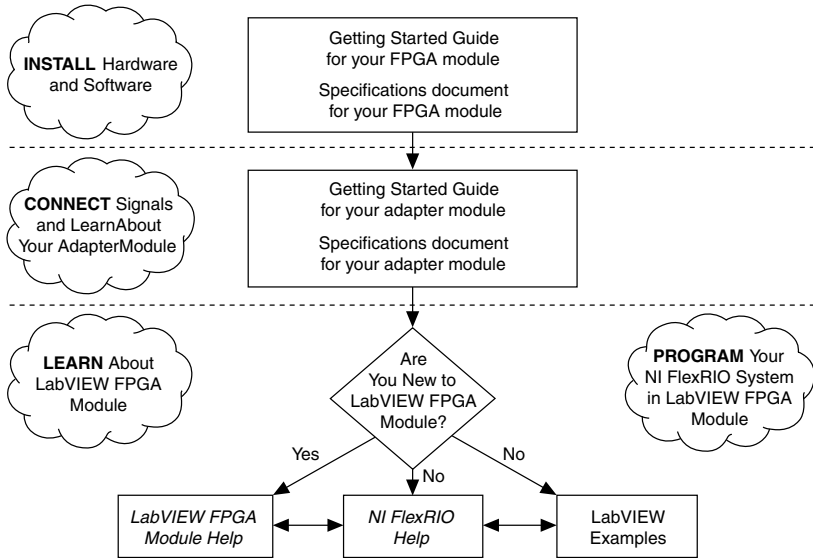


Table 1. NI FlexRIO Documentation Locations and Descriptions

Document	Location	Description
Getting started guide for your FPGA module	Available from the Start menu and at ni.com/manuals .	Contains installation instructions for your NI FlexRIO system.
Specifications document for your FPGA module	Available from the Start menu and at ni.com/manuals .	Contains specifications for your FPGA module.
Getting started guide for your adapter module	Available from the Start menu and at ni.com/manuals .	Contains signal information, examples, and CLIP details for your adapter module.
Specifications document for your adapter module	Available from the Start menu and at ni.com/manuals .	Contains specifications for your adapter module.
<i>LabVIEW FPGA Module Help</i>	Embedded in <i>LabVIEW Help</i> and at ni.com/manuals .	Contains information about the basic functionality of the LabVIEW FPGA Module.

Table 1. NI FlexRIO Documentation Locations and Descriptions (Continued)

Document	Location	Description
<i>NI FlexRIO Help</i>	Available from the Start menu and at ni.com/manuals .	Contains information about the FPGA module, adapter module, and CLIP configuration information.
LabVIEW Examples	Available in NI Example Finder. In LabVIEW, click Help»Find Examples»Hardware Input and Output»FlexRIO .	Contains examples of how to run FPGA VIs and Host VIs on your device.
IPNet	ni.com/ipnet	Contains LabVIEW FPGA functions and intellectual property to share.
NI FlexRIO product page	ni.com/flexrio	Contains product information and data sheets for NI FlexRIO devices.

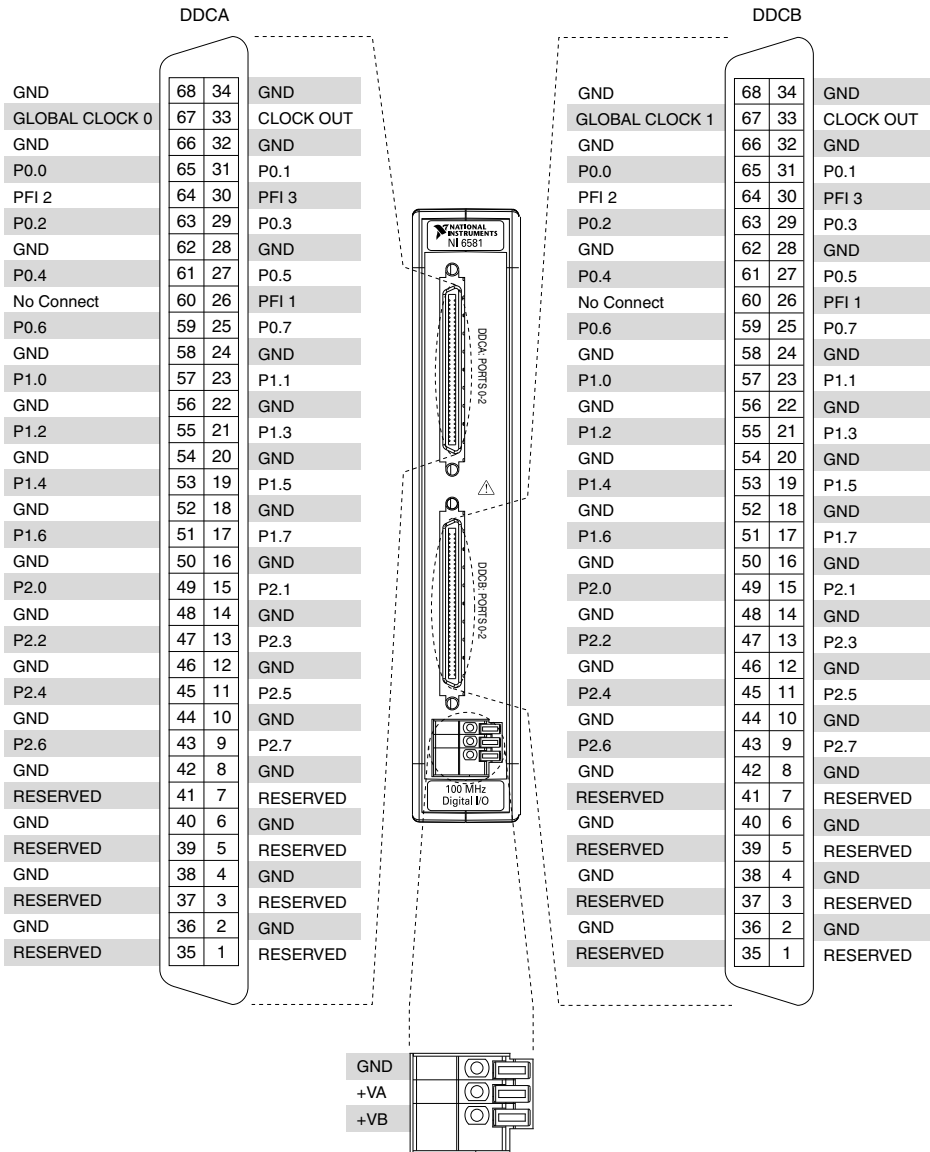
Verifying the System Requirements

To use the NI FlexRIO Adapter Module Support instrument driver, your system must meet certain requirements. For more information about minimum system requirements, recommended system, and supported application development environments (ADEs), refer to the *NI FlexRIO Adapter Module Support Readme*, which is available on the NI FlexRIO Adapter Module Support software DVD or online at ni.com/updates.

Front Panel and Connector Pinouts

The following figure shows the digital data connector (DDC) pin assignments for the NI 6581/6581B. Refer to the *NI 6581/NI 6581B Specifications* for signal information.

Figure 3. NI 6581/6581B Connector Pin Assignments



Caution Connections that exceed any of the maximum ratings of input or output signals on the NI 6581/6581B can damage the device and the chassis. NI is not liable for any damage resulting from such signal connections. For the maximum input and

output ratings for each signal, refer to the *NI 6581/NI 6581B Specifications*, available from ni.com/manuals.

Table 2. NI 6581 DDC Connector Pins

Signal Name	Pin(s)	Signal Type	Signal Description
GLOBAL CLOCK 0	67 on DDCA	Control	Input terminal for the external Sample Clock source, which can be used for dynamic acquisition.
GLOBAL CLOCK 1	67 on DDCB		
P0.<0..7>	25, 27, 29, 31, 59, 61, 63, 65	Data/Control	Bidirectional Port 0 digital I/O data channels 0 through 7.
P1.<0..7>	17, 19, 21, 23, 51, 53, 55, 57	Data/Control	Bidirectional Port 1 digital I/O data channels 0 through 7.
P0.<0..7>	9, 11, 13, 15, 43, 45, 47, 49	Data/Control	Bidirectional Port 2 digital I/O data channels 0 through 7.
CLOCK OUT	33	Control	Output terminal for the exported Sample Clock.
PFI <1..3>	26, 30, 64	Control/Data	Bidirectional digital I/O channels 1 through 3.
GND	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 28, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 62, 66	Ground	Ground reference for signals.
RESERVED	1, 3, 5, 7, 35, 37, 39, 41	N/A	These terminals are reserved for future use. Do not connect to these pins.
No Connect	60	N/A	Do not connect to this pin.

The following table contains external power connector terminal information for the NI 6581.

Table 3. NI 6581 Power Connector Terminals

External Power Terminal Name	Terminal Description
GND	Ground reference for external power
+VA	External power terminal for DDCA connector.
+VB	External power terminal for DDCB connector.

The following table lists the NI 6581/6581B power supply control signals and the corresponding NI FlexRIO FPGA module signals.

Table 4. NI 6581/6581B Power Supply Control Signals and NI FlexRIO FPGA Module Signals

NI 6581/6581B Supply Control Signal Name	NI FlexRIO FPGA Module GPIO Out
BANK0_SUPPLY_SELECT	GPIO_32
BANK1_SUPPLY_SELECT	GPIO_32_n
PWR_SUPPLY_SEL_0	GPIO_65
PWR_SUPPLY_SEL_1	GPIO_65_n

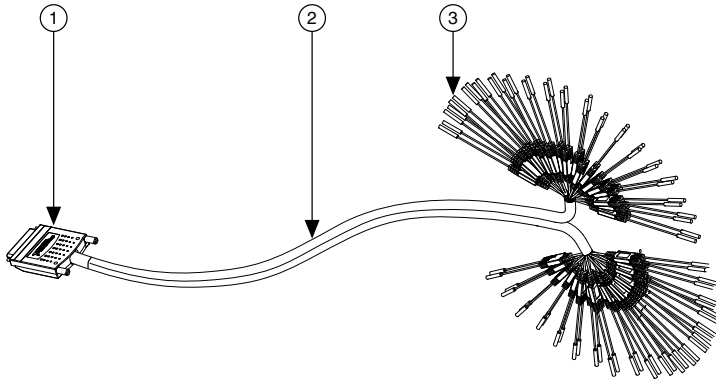
Connectivity Options

NI recommends that you use the following cables with the NI 6581/6581B:

- NI SHC68-C68-D4 cable (part number 196275-01)—Shielded cable designed for single-ended, high-speed digital signal transmission. This cable has individual microcoaxial 50 Ω lines for each signal.
- NI C68-C68-D4 cable (part number 195949-01)—Unshielded, single-ended 50 Ω cable.
- NI SHC68-H1X38 cable (part number 192681-1R5)—Single-ended, 50 Ω cable that breaks out each single-ended signal into two 0.1 inch header receptacles, one receptacle each for the signal and ground. It provides an easy way to connect the NI 6581/6581B to various types of devices and circuits for interfacing, testing, or analysis.

This cable offers connectivity similar to that found on a typical logic analyzer, so you can use it in logic analyzer-type applications. Unlike a typical logic analyzer, however, this cable also allows for simultaneous pattern generation and acquisition so that you can use it in stimulus/response applications as well. The following figure shows the parts locator diagram for the single-ended digital flying lead cable.

Figure 4. NI SHC68-H1X38 Cable Parts Locator Diagram



1. 68-pin VHDCI Connector
2. Removable Sleeving
3. Lead Pairs

You can use the SHC68-C68-D4 or C68-C68-D4 cable with the following accessories:

- NI CB-2162—Single-ended digital I/O (DIO) accessory that can access the signals on the 68-pin DDC connector, terminate the DIO channels, and provide a platform for circuit prototyping and DUT testing.
- NI SMB-2163—Breakout box that offers coaxial SMB connectors for each channel on the DDC connector, providing an easy way to connect to other devices for testing and debugging.



Note When connecting to the CB-2162 or SMB-2163 accessories, NI 6581/6581B signals map in the following ways:

- P0.<0..7> map to DIO <0..7>
- P1.<0..7> map to DIO <8..15>
- P2.<0..7> map to DIO <16..23>
- GLOBAL CLOCK <0..1> map to STROBE

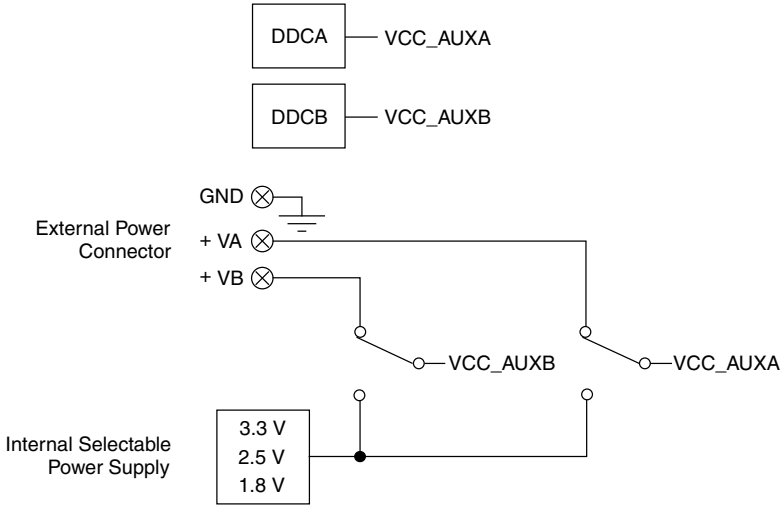
For information about connecting I/O signals, refer to the *NI FlexRIO Help*, available from the Start menu and at ni.com/manuals.

Power Options

You can power the NI 6581/6581B internally, or externally through a variable power supply.

The following diagram illustrates a power circuitry diagram with an external variable power supply.

Figure 5. NI 6581/6581B Power Circuitry Diagram



Internal Power Options

You can use one of the internal power options shown in the following table to power one or both DDC connectors.

Table 5. Internal Power Supply Voltage Settings

Voltage	Setting in LabVIEW
3.3 V	0
2.5 V	1
1.8 V	2

Using External Power

Use the power connector to externally power the NI 6581/6581B. If you do not want to use the predefined internal voltages, you can select external power in software for one or both DDC connectors. Complete the following steps to wire a variable power supply to the power connector with 20–26 AWG wires.

- Using wire strippers, carefully remove 11 mm (0.43 in.) of insulation from the signal wires.
- Wire the voltage output of the power supply to the +VA terminal and/or +VB terminal, depending which DDC connector(s) you want to power. Press a small flathead screwdriver on the spring terminal lever to open the terminal, and insert the wire into the spring terminal opening.

- Wire the ground of the power supply to the GND terminal of the power connector.

The NI 6581/6581B external power connector ground connection references an external power supply to the PXI system. The external power connector does not provide any means of isolation; therefore, use care when connecting a non-isolated supply to the external power connector.

Using a grounded power supply as the external power source may cause ground loops that increase noise on the power rails. NI recommends that you use a floating source that is ground referenced to the PXI chassis using the ground connection provided by the external power ground connector on the NI 6581/6581B.

For the maximum external power supply limit, refer to the *NI 6581/6581B Specifications*, available from the Start menu and at ni.com/manuals.

Power Supply Control Signals

The following table lists the NI 6581/6581B power supply control signals and the corresponding NI FlexRIO FPGA module signals.

Table 6. NI 6581/6581B Power Supply Control Signals and NI FlexRIO FPGA Module Signals

NI 6581/6581B Supply Control Signal Name	NI FlexRIO FPGA Module GPIO Out
BANK0_SUPPLY_SELECT	GPIO_32
BANK1_SUPPLY_SELECT	GPIO_32_n
PWR_SUPPLY_SEL_0	GPIO_65
PWR_SUPPLY_SEL_1	GPIO_65_n

Block Diagrams

Figure 6. P0.<0..7>, P1.<0..7>, P2<0..7> Data Port

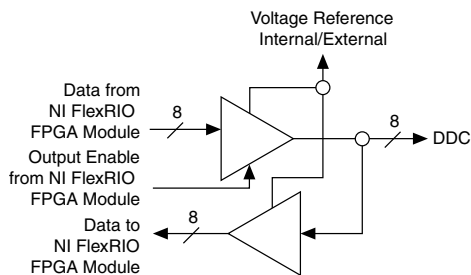
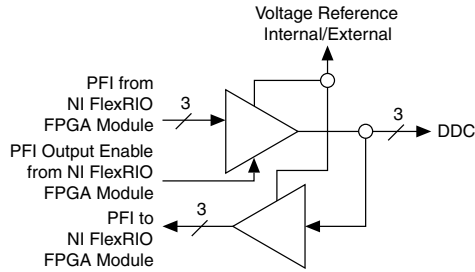
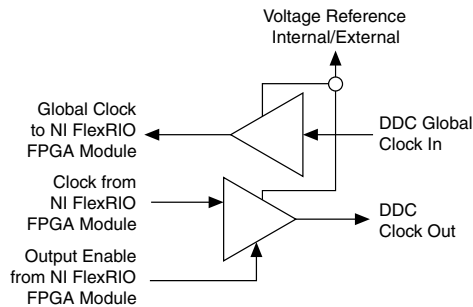


Figure 7. PFI <1..3> Port



Note Digital I/O signals, P0 <0..7>, P1 <0..7>, P2 <0..7>, and PFI <1..3>, appear on both connectors, DDCA and DDCB.

Figure 8. Clock Input and Output



Note Refer to Tables 3 and 4 for information about buffer mapping to the NI FlexRIO FPGA module.

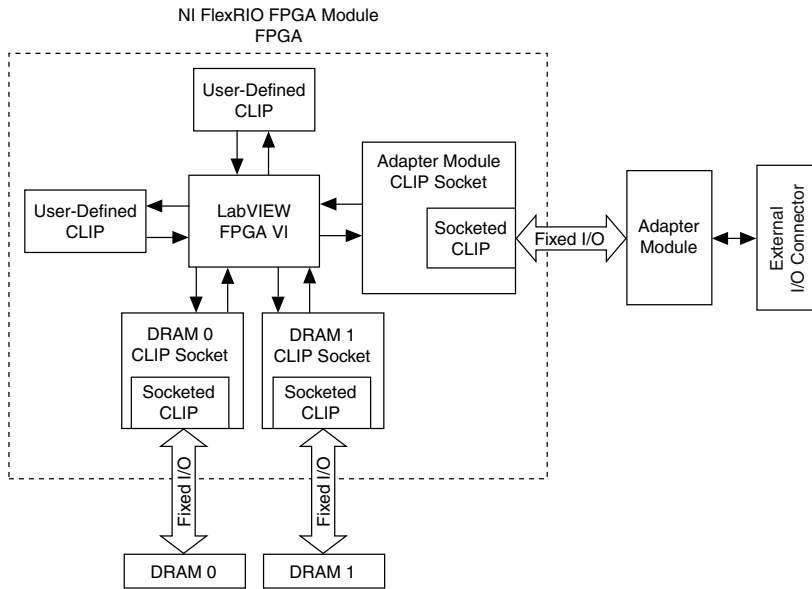
NI 6581/6581B Component-Level Intellectual Property (CLIP)

The LabVIEW FPGA Module includes component-level intellectual property (CLIP) for HDL IP integration. NI FlexRIO devices support two types of CLIP: user-defined and socketed.

- *User-defined CLIP* allows you to insert HDL IP into an FPGA target, enabling VHDL code to communicate directly with an FPGA VI.
- *Socketed CLIP* provides the same IP integration of the user-defined CLIP, but also allows the CLIP to communicate directly with circuitry external to the FPGA. Adapter module socketed CLIP allows your IP to communicate directly with both the FPGA VI and the external adapter module connector interface.

The following figure shows the relationship between an FPGA VI and the CLIP.

Figure 9. CLIP and FPGA VI Relationship



The NI 6581/6581B ships with socketed CLIP items that add module I/O to the LabVIEW project.

NI 6581 CLIP

This CLIP provides read/write access to all digital I/O (DIO) channels using a single channel-based interface. Each grouping of eight I/O channels has a write enable signal. In the LabVIEW FPGA Module, each DIO channel is accessed using a Boolean signal.

Refer to Knowledge Base 6NND5NOA for a list of pin assignments to use when modifying the socketed CLIP used by an NI 6581/6581B.

Installing 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. Install LabVIEW.

Refer to the *LabVIEW Installation Guide* 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 at ni.com/manuals and by selecting **Start»All Programs»National Instruments»LabVIEW»LabVIEW Manuals**.

2. Install the 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 at ni.com/manuals and by selecting **Start»All Programs»National Instruments»LabVIEW»LabVIEW Manuals**.

3. (Optional) Install the 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. Install NI FlexRIO.

Refer to the *NI FlexRIO Readme* on the NI FlexRIO installation media for system requirements and installation instructions for NI FlexRIO Support. Documentation for NI FlexRIO Support is available at ni.com/manuals and by selecting **Start»All Programs»National Instruments»NI FlexRIO**.



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

5. Install 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. Documentation for NI FlexRIO Adapter Module Support is available at ni.com/manuals and by selecting **Start»All Programs»National Instruments»NI FlexRIO»NI FlexRIO Adapter Module Documentation**.

Installing the NI FlexRIO Devices



Note You must install the software before installing the hardware.

Unpacking

The NI 6581/6581B modules ship in antistatic packages to prevent electrostatic discharge from damaging module components. To prevent such damage when handling the modules, ground yourself using a grounding strap or by holding a grounded object, such as your computer chassis, and complete the following steps:

1. Touch the antistatic package to a metal part of the computer chassis before removing the module from the package.



Caution Never touch the exposed pins of connectors.

2. Remove each module from the package and inspect it for loose components or any other sign of damage.

Notify NI if the modules appear damaged in any way. Do not install a damaged module into the chassis.

Preparing the Environment

Ensure that the environment you are using the NI 6581/6581B in meets the following specifications.

Operating temperature (IEC.....0 °C to 55 °C
60068-2-1, IEC60068-2-2)

Operating humidity.....10% to 90% RH, noncondensing
(IEC 60068-2-56)

Pollution Degree.....2

Maximum altitude.....2,000 m at 25 °C ambient temperature

Indoor use only.



Note Refer to the *NI 6581/NI 6581B Specifications* at ni.com/manuals for complete specifications.

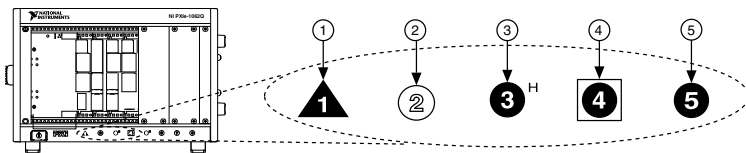
Installing the NI FlexRIO FPGA Module



Note You must install the software before you install the hardware.

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

Figure 10. Symbols for PXI Express/PXI Express HybridSlots

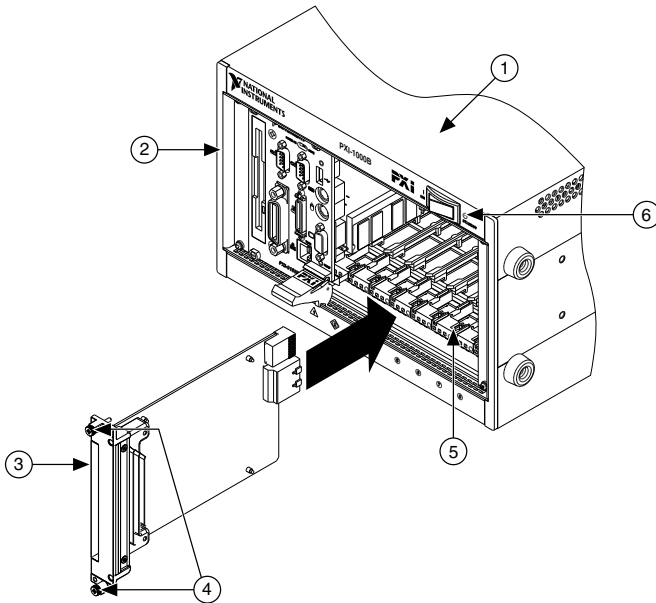


- | | |
|---------------------------------------|-----------------------------------|
| 1. PXI Express System Controller Slot | 4. PXI Express System Timing Slot |
| 2. PXI Peripheral Slot | 5. PXI Express Peripheral Slot |
| 3. PXI Express Hybrid Peripheral Slot | |

Refer to the chassis documentation for specifications.

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

Figure 11. Installing an NI FlexRIO FPGA Module in the PXI Express Chassis



- | | |
|----------------------------------|--------------------------------|
| 1. PXI Express Chassis | 4. Front-Panel Mounting Screws |
| 2. PXI Express System Controller | 5. Module Guides |
| 3. NI FlexRIO FPGA Module | 6. Power Switch |

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 Express chassis.

Confirming that Measurement & Automation Explorer (MAX) Recognizes the Device

Use Measurement & Automation Explorer (MAX) to configure your National Instruments hardware. MAX informs other programs about which devices reside in the system and how they are configured. MAX is automatically installed with NI FlexRIO Support.

1. Launch MAX by navigating to **Start»All Programs»National Instruments»NI MAX** or by clicking the NI MAX desktop icon.
2. In the Configuration pane, double-click **Devices and Interfaces** to see the list of installed devices. Installed devices appear under the name of their associated chassis.
3. Expand your **Chassis** tree item. MAX lists all devices installed in the chassis. Your default device names may vary.



Note If you do not see your hardware listed, press <F5> to refresh the list of installed devices. If the device is still not listed, power off the system, ensure the device is correctly installed, and restart.

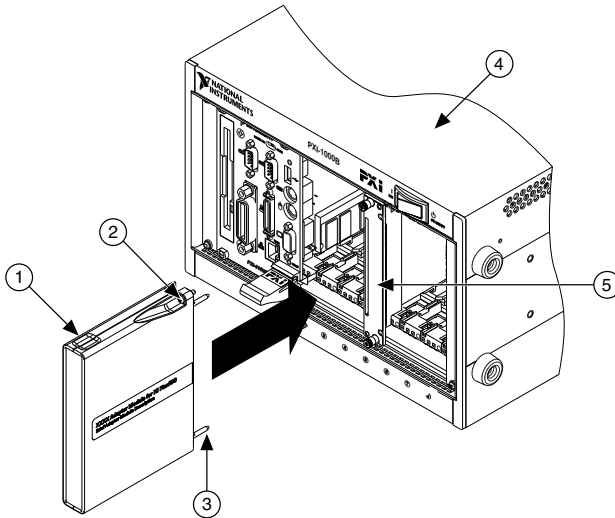
Installing the NI FlexRIO Adapter Module



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 the figure below.

Figure 12. Installing the NI FlexRIO Adapter Module



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

The connection may be tight, but do not force the adapter module into place.

2. Tighten the captive screws on the NI FlexRIO adapter module to secure it to the NI FlexRIO FPGA module. NI recommends using the laser-tipped screwdriver (part number 748677-01) included in the NI 6581/NI 6581B packaging.
3. Launch LabVIEW to begin configuring your NI FlexRIO system.



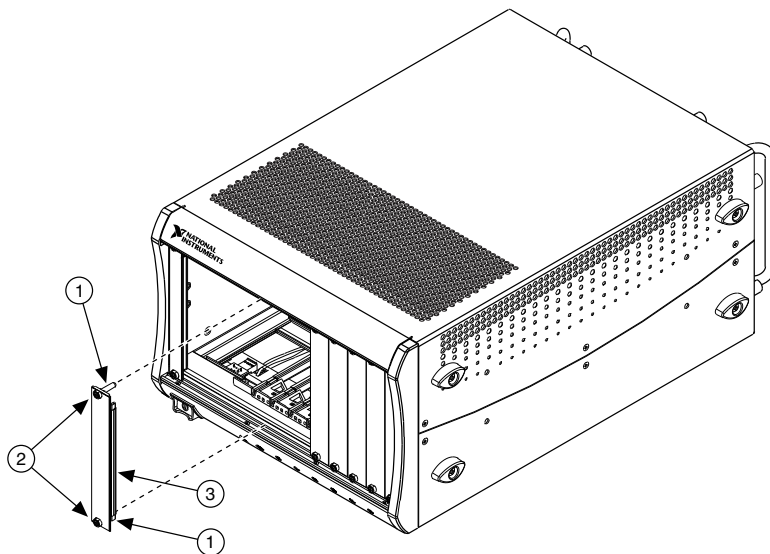
Note MAX only recognizes FPGA modules that are in the chassis. Your adapter module will not appear in MAX.

Installing PXI EMC Filler Panels

To ensure specified EMC performance, PXI EMC filler panels must be properly installed in your NI FlexRIO system. The PXI EMC filler panels (National Instruments part number 778700-01) must be purchased separately.

1. Remove the captive screw covers.
2. Install the PXI EMC filler panels by securing the captive mounting screws to the chassis, as shown in the figure below. Make sure that the EMC gasket is on the right side of the PXI EMC filler panel.

Figure 13. PXI EMC Filler Panels and Chassis



1. Captive Screw Covers
2. Captive Mounting Screws
3. EMC Gasket




Note You must populate all slots with a module or a PXI EMC filler panel to ensure proper module cooling. Do not over tighten screws (2.5 lb · in. maximum). For additional information about the use of PXI EMC filler panels in your PXI system, visit ni.com/info and enter `emcpanels`.

Uninstalling the Hardware



Hot Surface If the module has been in use, it may exceed safe handling temperatures and cause burns. Allow the module to cool before removing it from the chassis.

1.  **Caution** Disconnect or disable any external RF, clock, or digital connections to the NI 6581/6581B front panel. Applying external signals while the device is powered off may cause damage.

Disconnect any cables from the module front panel connectors.

2. Power off the chassis.

3. Ground yourself with a grounding strap or touch a grounded metal surface.
4. Unlatch the module by pushing down on the ejector handle.
5. Hold the module by the ejector handle and remove it from the slot.

Store the module in the original antistatic packaging when not in use to avoid damage.

Environment

Maximum altitude.....2,000 m (800 mbar) (at 25 °C ambient temperature)

Pollution Degree.....2

Indoor use only.

Operating Environment

Ambient temperature range.....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.)

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.)

Shock and Vibration

Operating shock.....30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)

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.)

Compliance and Certifications

Safety

This product is designed to meet the requirements of the following electrical equipment safety standards 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 In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia, and New Zealand (per CISPR 11), Class A equipment is intended for use only in heavy-industrial locations.



Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.



Note For EMC declarations, certifications, and additional information, refer to the [Online Product Certification](#) section.

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

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.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at 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 Electrical and Electronic Equipment, visit ni.com/environment/weee.

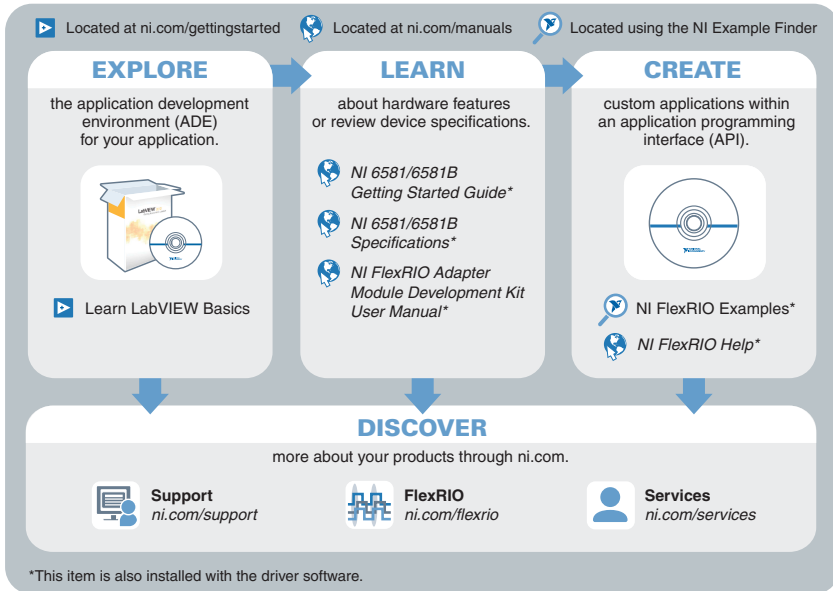
电子信息产品污染控制管理办法（中国 RoHS）



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Where to Go Next

Refer to the following figure for information about other product tasks and associated resources for those tasks.



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