

GETTING STARTED GUIDE

PCIe-6593

PCIe, 16 Gbps, 8-Channel High-Speed Serial Instrument

This document explains how to install, configure, test, and use the PCIe-6593. You can program the PCIe-6593 with the following software options.

- FlexRIO driver software
- NI LabVIEW Instrument Design Libraries for FlexRIO (instrument design libraries)



Note Adapter modules are not installable or interchangeable on the PCIe-6593.

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FlexRIO Documentation and Resources

Use the following resources to find more information about the PCIe-6593.

All documentation can be found at ni.com/manuals or in LabVIEW by clicking **Help**.



Table 1. FlexRIO Documentation and Resources

Document	Contents
<i>PCIe-6593 Getting Started Guide</i> (this document)	<ul style="list-style-type: none"> • Installation instructions • Basic programming information
<i>PCIe-6593 Specifications</i>	<ul style="list-style-type: none"> • Operating environment requirements • DIO specifications • Clocking specifications • Physical and mechanical specifications
<i>PCIe-6593 Safety, Environmental, and Regulatory Information</i>	<ul style="list-style-type: none"> • Safety and compliance information • Environmental information
<i>LabVIEW FPGA Module Help</i>	<ul style="list-style-type: none"> • Basic functionality of the FPGA module • Instructions for developing and debugging custom hardware logic
<i>FlexRIO Readme</i>	<ul style="list-style-type: none"> • Minimum system requirements • Supported Application Development Environments (ADEs) • Known issues and bug fixes • Recent updates
<i>FlexRIO Help</i>	<ul style="list-style-type: none"> • FlexRIO driver API and programming information • I/O Component Level IP (CLIP) development information
LabVIEW Examples	<ul style="list-style-type: none"> • Examples showing how to run FPGA VIs on your device • Examples showing how to run host VIs on your device

Unpacking the Kit



Notice To prevent electrostatic discharge (ESD) from damaging the device, ground yourself using a grounding strap or by holding a grounded object, such as your computer chassis.

1. Touch the antistatic package to a metal part of the computer chassis.
2. Remove the device from the package and inspect the device for loose components or any other sign of damage.



Notice Never touch the exposed pins of connectors.



Note Do not install a device if it appears damaged in any way.

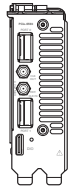
3. Unpack any other items and documentation from the kit.

Store the device in the antistatic package when the device is not in use.

Verifying the Kit Contents

Verify that the following items are included in the PCIe-6593 kit.

Figure 1. PCIe-6593 Kit Contents



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-
1. PCIe-6593
 2. PCIe-6593 Safety, Environmental, and Regulatory Information
 3. PCIe-6593 Getting Started Guide
-

Recommended Cables (Not Included)

Choose from the following cables to make your high-speed serial connection.

- QSFP28 Active Optical Cable
 - 10 m: NI part number 788257-10
- QSFP28 Passive Cable
 - 0.5 m: NI part number 788256-0R5
 - 1 m: NI part number 788256-01
 - 2 m: NI part number 788256-02



Notice When the system is deployed at the upper environmental specification of the PCIe-6593, standard rated QSFP28 active optical cables may exceed their operating case temperature range. To ensure the cable case temperature remains within its operating temperature range, monitor the built-in temperature sensor of the cable throughout deployment.



Note To convert a QSFP28 signal to a Molex Nano-Pitch signal compatible with other NI modules, use the SCB-12, NI part number 787419-01.

To purchase high-speed serial cables and the SCB-12, search the NI part number at ni.com.

Installing the Software

You must be an Administrator to install NI software on your computer.

1. Install an ADE, such as LabVIEW or LabWindows™/CVI™.
2. Download the driver software installer from ni.com/downloads.

NI Package Manager downloads with the driver software to handle the installation. Refer to the [NI Package Manager Manual](#) for more information about installing, removing, and upgrading NI software using NI Package Manager.

3. Follow the instructions in the installation prompts.



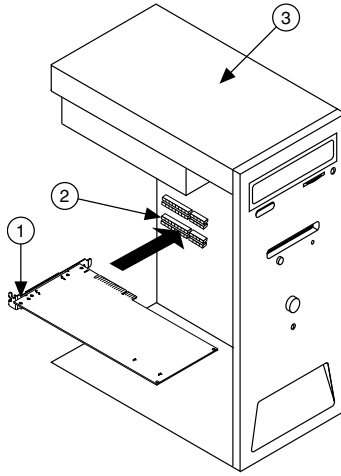
Note Windows users may see access and security messages during installation. Accept the prompts to complete the installation.

4. When the installer completes, select **Restart** in the dialog box that prompts you to restart, shut down, or restart later.

Installing the PCIe-6593 Module into PCIe Chassis

1. Power off and unplug the computer.
2. Access the computer system expansion slots. This step might require you to remove one or more access panels on the computer case.
3. Locate a compatible slot and remove the corresponding slot cover on the computer back panel.
4. Touch any metal part of the computer to discharge any static electricity.
5. Insert the module into the slot you selected. Gently rock the module into place without forcing it.

Figure 2. Module Installation



1. Module
2. System Expansion Slot
3. PC

6. Secure the PCI Express mounting bracket of the module to the computer chassis with two bracket screws.



Note Because of the high mass of the PCI Express FlexRIO devices, installing the bracket screws is recommended. Installing the bracket screws increases mechanical stability and electrically connects the front panel to the chassis, which can improve signal quality and electromagnetic performance.

7. Connect the 6-pin PCI Express power connector from the power supply to the PCI Express FlexRIO device.
8. Reinstall any access panels on the computer case.
9. Power on your computer.

Configuring the PCIe-6593 in MAX

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

1. Launch MAX.
2. In the configuration tree, expand **Devices and Interfaces** to see the list of installed NI hardware.



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

3. Record the identifier MAX assigns to the hardware. Use this identifier when programming the PCIe-6593.
4. Self-test the hardware by selecting the item in the configuration tree and clicking **Self-Test** in the MAX toolbar.

The MAX self-test performs a basic verification of hardware resources.

PCIe-6593 Front Panel and Pinouts

Figure 3. PCIe-6593 Front Panel

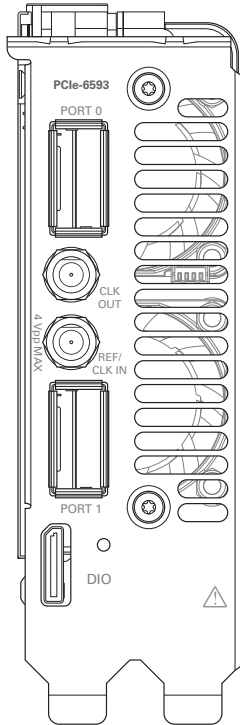


Table 2. Signal Connectors for the PCIe-6593

Connector	Description	Function
DIO	Molex Nano-Pitch DIO connector	Multi-signal DIO connector that provides access to FPGA multi-gigabit transceivers (MGTs) and general-purpose LVC MOS signals
PORT 0	QSFP, SFF-8436 compliant	High-speed serial interfacing ports
PORT 1		
CLK OUT	Standard SMA female connector	Output for exported clock
REF/CLK IN	Standard SMA female connector	Input for an external Reference Clock

Figure 4. Digital I/O Connector Pinout

Reserved	A1	B1	5 V
GND	A2	B2	GND
MGT Rx+ 0	A3	B3	MGT Tx+ 0
MGT Rx- 0	A4	B4	MGT Tx- 0
GND	A5	B5	GND
MGT Rx+ 1	A6	B6	MGT Tx+ 1
MGT Rx- 1	A7	B7	MGT Tx- 1
GND	A8	B8	GND
DIO 4	A9	B9	DIO 6
DIO 5	A10	B10	DIO 7
GND	A11	B11	GND
DIO 0	A12	B12	DIO 2
DIO 1	A13	B13	DIO 3
GND	A14	B14	GND
MGT Rx+ 2	A15	B15	MGT Tx+ 2
MGT Rx- 2	A16	B16	MGT Tx- 2
GND	A17	B17	GND
MGT Rx+ 3	A18	B18	MGT Tx+ 3
MGT Rx- 3	A19	B19	MGT Tx- 3
GND	A20	B20	GND
5.0 V	A21	B21	Reserved

Table 3. Available Pins on the DIO connector.

Signal	Type	Direction
MGT Tx± <0..3>	Xilinx UltraScale GTH	Output
MGT Rx± <0..3>	Xilinx UltraScale GTH	Input
DIO <0..7>	Single-ended	Bidirectional
5.0 V	DC	Output
GND	Ground	—

Figure 5. QSFP+ Connector Pinout

GND	20	19	GND
Rx2n	21	18	Rx1n
Rx2p	22	17	Rx1p
GND	23	16	GND
Rx4n	24	15	Rx3n
Rx4p	25	14	Rx3p
GND	26	13	GND
ModPrsL	27	12	SDA
IntL	28	11	SCL
Vcc Tx	29	10	Vcc Rx
Vcc1	30	9	ResetL
LPMODE	31	8	ModSelL
GND	32	7	GND
Tx3p	33	6	Tx4p
Tx3n	34	5	Rx4n
GND	35	4	GND
Tx1p	36	3	Tx2p
Tx1n	37	2	Tx2n
GND	38	1	GND

Table 4. Available Pins on the QSFP+ Connectors

Pin	Symbol	Name/Description
1	GND	Ground
2	Tx2n	Transmitter Inverted Data Input
3	Tx2p	Transmitter Non-Inverted Data Input
4	GND	Ground
5	Tx4n	Transmitter Inverted Data Input
6	Tx4p	Transmitter Non-Inverted Data Input

Table 4. Available Pins on the QSFP+ Connectors (Continued)

Pin	Symbol	Name/Description
7	GND	Ground
8	ModSelL	Module Select
9	ResetL	Module Reset
10	Vcc Rx	+3.3V Power Supply Receiver
11	SCL	2-Wire Serial Interface Clock
12	SDA	2-Wire Serial Interface Data
13	GND	Ground
14	Rx3p	Receiver Non-Inverted Data Output
15	Rx3n	Receiver Inverted Data Output
16	GND	Ground
17	Rx1p	Receiver Non-Inverted Data Output
18	Rx1n	Receiver Inverted Data Output
19	GND	Ground
20	GND	Ground
21	Rx2n	Receiver Inverted Data Output
22	Rx2p	Receiver Non-Inverted Data Output
23	GND	Ground
24	Rx4n	Receiver Inverted Data Output
25	Rx4p	Receiver Non-Inverted Data Output
26	GND	Ground
27	ModPrsL	Module Present
28	IntL	Interrupt
29	Vcc Tx	+3.3V Power Supply Transmitter
30	Vcc1	+3.3V Power Supply
31	LPMoDe	Low Power Mode

Table 4. Available Pins on the QSFP+ Connectors (Continued)

Pin	Symbol	Name/Description
32	GND	Ground
33	Tx3p	Transmitter Non-Inverted Data Input
34	Tx3n	Transmitter Inverted Data Input
35	GND	Ground
36	Tx1p	Transmitter Non-Inverted Data Input
37	Tx1n	Transmitter Inverted Data Input
38	GND	Ground

Block Diagrams

Figure 6. FPGA Carrier Block Diagram

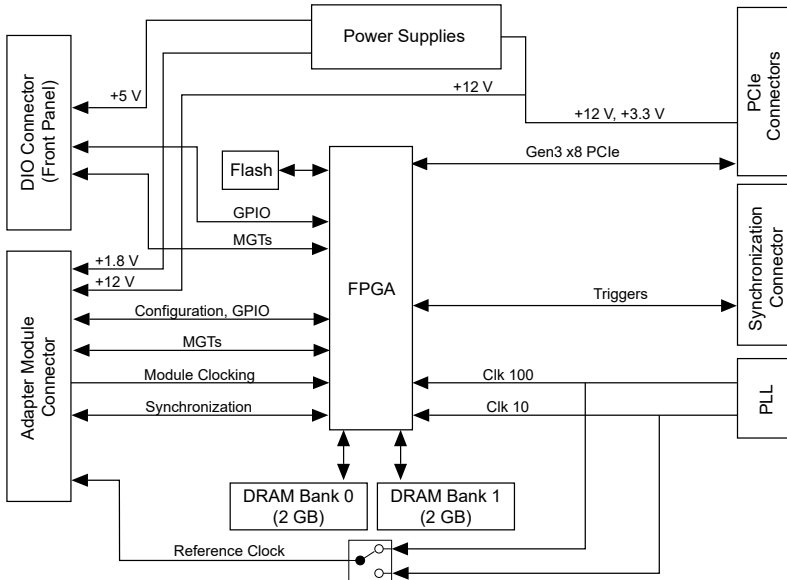
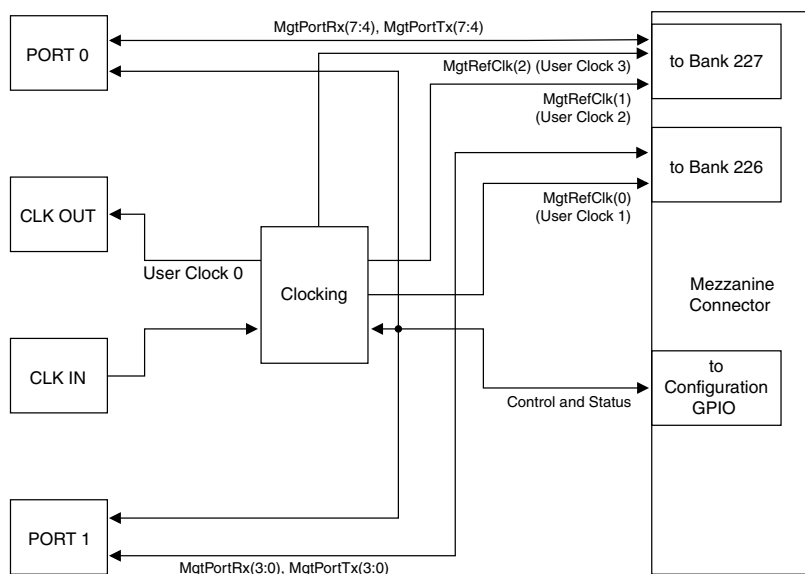


Figure 7. PCIe-6593 Block Diagram



Accessing FlexRIO with Integrated I/O Examples

The FlexRIO driver includes several example applications for LabVIEW. These examples serve as interactive tools, programming models, and as building blocks in your own applications. To access all FlexRIO with Integrated I/O getting started examples, complete the following steps.

1. In LabVIEW, click **Help »Find Examples** .
2. In the **NI Example Finder** window that opens, click **Hardware Input and Output » FlexRIO »Integrated IO »Getting Started** .
3. Double click Getting Started with FlexRIO Integrated IO.vi.

The **FlexRIO with Integrated IO Project Creator** window opens.

4. Select the example that corresponds to the name of your FlexRIO module. The **Description** window includes a short description of the getting started example for your device. Rename the project, select a location for the project, and click **OK**.

The **Project Explorer** window for your new project opens.

Online examples are also available to demonstrate FlexRIO basics, such as using DRAM, acquiring data, and performing high throughput streaming. To access these examples, search FlexRIO examples in the **Search the community** field at ni.com/examples.

Common FlexRIO with Integrated I/O Examples

In addition to the examples within the FlexRIO with Integrated IO Project Creator, NI provides several examples that apply to all FlexRIO with Integrated I/O modules to help you perform common tasks.

The following examples can be found in the NI Example Finder:

- `Show All FlexRIO with Integrated IO Hardware.vi` queries and displays a set of hardware properties from all FlexRIO with Integrated I/O devices in a chassis.
- `Vivado Export Getting Started Ultrascale.lvproj` demonstrates how to export your LabVIEW FPGA project into Vivado in order to develop your FPGA design in the Vivado ADE.
- `Read-Write Calibration Data.vi` demonstrates how to read and write calibration data and metadata into the storage space of FlexRIO with Integrated I/O devices.

Component-Level Intellectual Property (CLIP)

The LabVIEW FPGA Module includes component-level intellectual property (CLIP) for HDL IP integration. 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 it 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 PCIe-6593 ships with socketed CLIP items that add module I/O to the LabVIEW project.

Synchronizing FlexRIO PCI Express Devices Using Compact Synchronization and RTSI (Real-Time System Integration)

You can synchronize the Reference Clocks and triggers of two or more FlexRIO PCI Express devices and up to five other types of RTSI-supported PCI Express devices.

Sharing Reference Clocks and Triggers with Another FlexRIO PCI Express Device

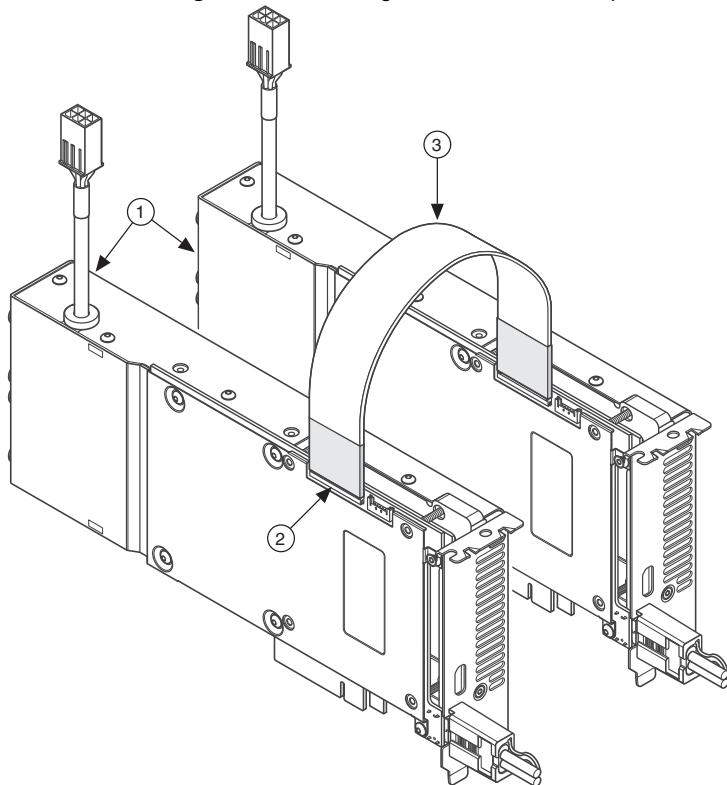


Note To synchronize the PCIe-6593 with another FlexRIO PCI Express device, you need the Compact Synchronization Interface Cable, NI part number 787213-01.

1. Install the PCIe-6593 and another PCI Express FlexRIO device into one PCI Express backplane.

2. Insert one end of the Compact Synchronization Interface Cable into the synchronization connector on each PCI Express FlexRIO device. Ensure the contacts on the cable are facing the FlexRIO device.

Figure 8. Connecting Two FlexRIO PCI Express Devices



1. FlexRIO PCI Express devices
2. Compact synchronization cable connector
3. Compact Synchronization Interface Cable

Sharing Reference Clocks and Triggers with PCI Express Devices Using RTSI

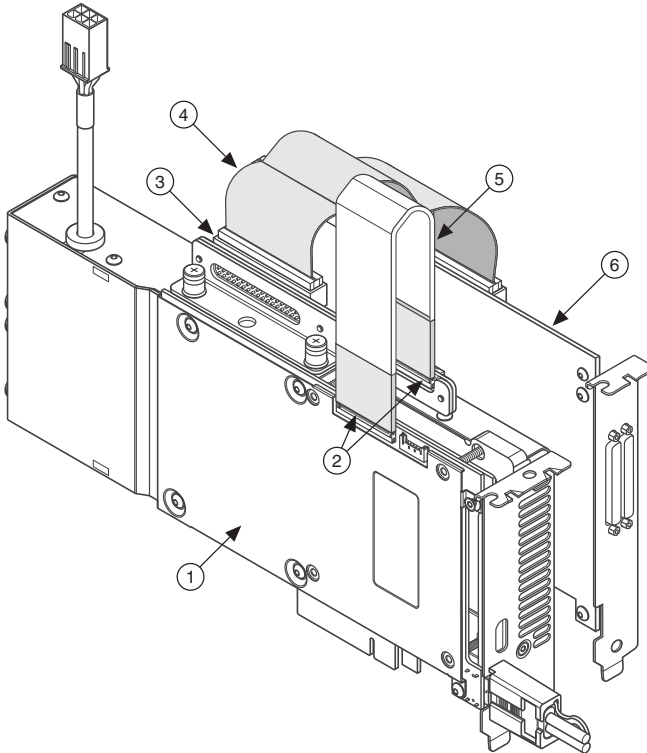


Note To synchronize the PCIe-6593 with a RTSI-supported PCI Express device, you need the Compact Synchronization Interface to RTSI Adapter, NI part number 787214-01, and a RTSI cable, NI part number 776249-02.

1. Affix the RTSI adapter to the top of the PCIe-6593 using the attached mounting screws.
2. Install the PCIe-6593 and up to five additional PCI Express devices in one PCI Express backplane.
3. Insert one end of the compact synchronization interface cable into the synchronization connector on the PCIe-6593. Ensure the contacts on the cable are facing the PCIe-6593.

4. Insert the other end of the compact synchronization interface cable into the closest synchronization connector on the RTSI adapter.
5. Connect one RTSI female connector on the RTSI cable to the RTSI male connector on the compact synchronization interface to RTSI adapter on the PCIe-6593. Connect the remaining RTSI female connectors on the RTSI cable to the male RTSI connectors on the other PCI Express devices.

Figure 9. Connecting FlexRIO PCI Express Devices to RTSI-Supported PCI Express Devices



-
- | | |
|--|--|
| 1. FlexRIO PCI Express device | 4. RTSI cable |
| 2. Compact synchronization cable connector | 5. Compact synchronization interface cable |
| 3. Compact synchronization interface to RTSI adapter | 6. RTSI-supported PCI Express device |
-

Troubleshooting

If an issue persists after you complete a troubleshooting procedure, search our KnowledgeBase for additional information our technical support engineers create as they answer common user questions and resolve unexpected issues.

What Should I Do if the PCIe-6593 Doesn't Appear in MAX?

1. In the MAX configuration tree, expand **Devices and Interfaces**.
2. If the module is still not listed, power off the system, ensure that all hardware is correctly installed, and restart the system.
3. Navigate to the Device Manager.

Operating System	Description
Windows 10/8.1	Right-click the Start button, and select Device Manager .
Windows 7	Select Start»Control Panel»Device Manager .

4. Verify the PCIe-6593 appears in the Device Manager.
 - a) Under an NI entry, confirm that a PCIe-6593 entry appears.
 - b) If error conditions appear, reinstall FlexRIO and the PCIe-6593.

What Should I Do if the PCIe-6593 Fails the Self-Test?

1. Restart the system.
2. Launch MAX, and perform the self-test again.
3. Power off the chassis.
4. Reinstall the failed module in a different slot.
5. Power on the chassis.
6. Perform the self-test again.

NI Services

Visit ni.com/support to find support resources including documentation, downloads, and troubleshooting and application development self-help such as tutorials and examples.

Visit ni.com/services to learn about NI service offerings such as calibration options, repair, and replacement.

Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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