

## GETTING STARTED GUIDE

# PXIe-5170/5171

## 250 MS/s, 14-Bit Reconfigurable Oscilloscope



**Note** Before you begin, install and configure your chassis and controller.



**Caution** This icon denotes a caution, which advises you to consult documentation where this symbol is marked.



**Caution** You can impair the protection provided by the PXIe-5170/5171 if you use it in a manner not described in this document.

This document explains how to install, configure, test, and use the PXIe-5170/5171. The PXIe-5170/5171 ships with the following software options, which you can use to program the device:

- NI-SCOPE driver software
- NI LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes (instrument design libraries)

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## Electromagnetic Compatibility Guidelines

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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 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 changes or 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. The length of all I/O cables must be no longer than 3 m (10 ft).



**Caution** This product may become more sensitive to electromagnetic disturbances in the operational environment when test leads are attached or when connected to a test object.

## Verifying the System Requirements

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To use the PXIe-5170/5171, your system must meet certain requirements.

For more information about minimum system requirements, recommended system requirements, and supported ADEs, refer to the readme for your selected software support. Readmes are available on the driver software DVD and online at [ni.com/downloads](http://ni.com/downloads).

## Unpacking the Kit

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**Caution** 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.



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



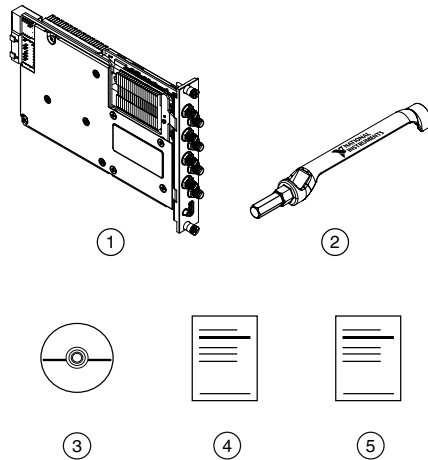
**Note** Do not install a device if it appears damaged in any way.

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

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

## Kit Contents

**Figure 1.** PXIe-5170/5171 Kit Contents



- |  |  |
|--|--|
| 1. PXIe-5170/5171 Module                 | 4. PXIe-5170/5171 Getting Started Guide      |
| 2. SMA driver bit, part number 780895-01 | 5. Maintain Forced-Air Cooling Note to Users |
| 3. Driver Software DVD                   |  |

## Other Equipment

There are several required items not included in your device kit that you need to operate the PXIe-5170/5171. Your application may require additional items not included in your kit to install or operate your PXIe-5170/5171.

### Required Items

- A PXI Express chassis and chassis documentation
- A PXI Express embedded controller or PC with MXI controller system that meets the system requirements specified in this guide and chassis documentation

## Optional Items

- PXI Slot Blocker kit (NI part number 199198-01)
- SMA (m)-to-SMA (m) coaxial cables, RG-402, 50  $\Omega$ , 1 M (NI part number 781845-01)
- SHH19-MH19-AUX shielded single-ended cable, 1 M (NI part number 784091-01)
- SCB-19 connector block (NI part number 783959-01)

Visit [ni.com](https://ni.com) for more information about these additional items.

## Preparing the Environment

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Ensure the environment in which you are using the PXIe-5170/5171 meets the following specifications.

### Operating environment

Ambient temperature range	0 °C to 45 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 4 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.)
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)
Pollution Degree	2

Indoor use only.



**Caution** You can impair the protection provided by the PXIe-5170/5171 if you use it in a manner not described in this document.



**Note** For complete specifications, refer to the specifications document for your device at [ni.com/manuals](https://ni.com/manuals).

## Choosing the Software

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### Software Options

NI provides multiple software options for interacting with the PXIe-5170/5171: NI-SCOPE soft front panel (SFP), NI-SCOPE instrument driver software, and the instrument design libraries.

**Table 1.** PXIe-5170/5171 Software Options

Use Case	Software Option
Acquire and analyze data without programming.	NI-SCOPE SFP
Create custom measurements and automation applications.	NI-SCOPE instrument driver
Customize the behavior of the device FPGA to create application-specific instrument designs.	Instrument design libraries with the LabVIEW FPGA Module



**Note** You can use a combination of these software options for your application. However, when using the NI-SCOPE driver and the instrument design libraries in a single application, only one option can access the device at a time.

### Related Information

*Installing the Software* on page 6

*Visit [ni.com/info](http://ni.com/info) and enter the Info Code IDLIntro for more information about instrument design libraries and how to use them.*

## Comparison of Software Features

NI-SCOPE instrument driver software and the instrument design libraries vary in the features they support.

**Table 2.** Comparison of Software Features

Feature	NI-SCOPE	Instrument Design Libraries
Customization of onboard FPGA	Supported using the instrument driver FPGA extensions	Supported using the LabVIEW FPGA Module
Source availability	Closed source	Open source
LabVIEW support	Yes	Yes
C/C++/C# support	Yes	Using the NI LabVIEW Application Builder, you can compile LabVIEW code into custom DLLs for use with other application development environments (ADEs).

**Table 2.** Comparison of Software Features (Continued)

Feature	NI-SCOPE	Instrument Design Libraries
NI-SCOPE SFP support	Yes	No
LabVIEW examples or sample projects	Yes	Includes LabVIEW sample projects, with additional examples available at <a href="http://ni.com/software-designed-instruments">ni.com/software-designed-instruments</a> .

### Related Information

Refer to [ni.com/labview/fpga](http://ni.com/labview/fpga) to learn more about the benefits of using LabVIEW FPGA Module to customize your device.

## Installing the Software

Close all programs before installing the software. NI recommends installing your software before installing the PXIe-5170/5171 hardware.

Install your software in the following order:

1. Install the latest service packs for your operating system.
2. Install NI LabVIEW.

Refer to the *LabVIEW Installation Guide* for installation instructions for LabVIEW and system requirements for LabVIEW software. Refer to the *LabVIEW Upgrade Notes* for additional information about upgrading to the most recent version of LabVIEW for Windows.

3. (Optional) Install NI 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.



**Note** Installation of the LabVIEW FPGA Module is required to customize the behavior of the device FPGA if you are using the instrument design libraries.

4. (Recommended) Install the latest service pack for LabVIEW and any LabVIEW modules you are using.
5. Insert the driver software DVD into the DVD drive.

The driver software installer should open automatically. If the installation window does not appear, navigate to the DVD drive, double-click the drive, and double-click `autorun.exe`.



**Note** You can also download the software from [ni.com/downloads](http://ni.com/downloads).

6. Follow the instructions in the installation prompts to install the default installation.

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



**Note** For troubleshooting information, contact NI technical support or visit [ni.com/support](https://ni.com/support).

7. When the installer completes, restart your system.

## Installing the PXIe-5170/5171

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**Caution** To prevent damage to the PXIe-5170/5171 caused by ESD or contamination, handle the module using the edges or the metal bracket.

You must install the software before installing the hardware.

Before you install the hardware, refer to the guidelines in the *Maintain Forced-Air Cooling Note to Users* included in the PXIe-5170/5171 kit to ensure that the PXIe-5170/5171 can cool itself effectively. This document is also available at [ni.com/manuals](https://ni.com/manuals).

The PXIe-5170/5171 is a single-slot module with one backplane connector. The module may be installed into any PXI Express-compatible slot.

1. Ensure the AC power source is connected to the chassis before installing the PXIe-5170/5171. The AC power cord grounds the chassis and protects it from electrical damage while you install the PXIe-5170/5171.
2. Power off the chassis.
3. Inspect the slot pins on the chassis backplane for any bends or damage prior to installation. Do not install a module if the backplane is damaged.
4. If the chassis has multiple fan speed settings, ensure the fans are set to the highest setting.



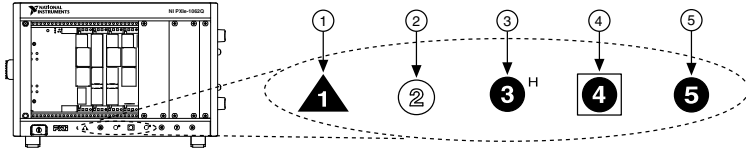
**Note** Inadequate air circulation could cause the temperature inside the chassis to rise above the optimal operating temperature for the PXIe-5170/5171, potentially causing thermal shutdown, shorter life spans, or improper performance.

5. Position the chassis so that inlet and outlet vents are not obstructed.

For more information about optimal chassis positioning, refer to the chassis documentation.

6. Remove the black plastic covers from all the captive screws on the module front panel.
7. Identify a supported slot in the chassis. The following figure shows the symbols that indicate the slot types.

**Figure 2. Chassis Compatibility Symbols**

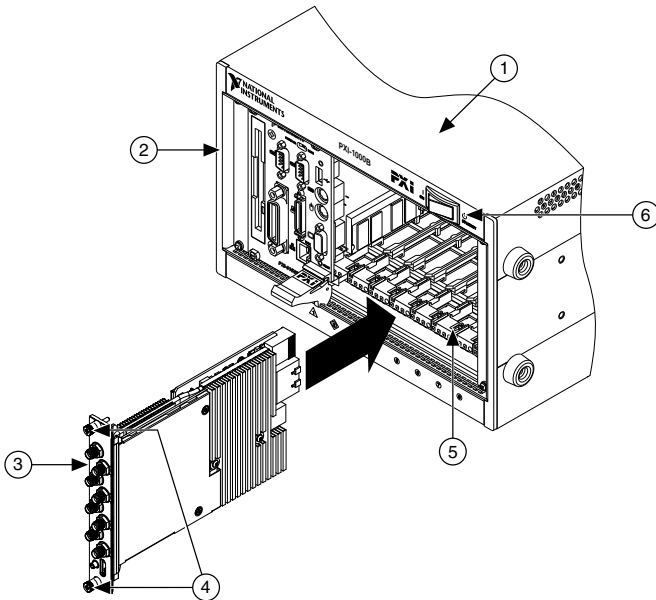


- 
- |                                       |                                   |
|---------------------------------------|-----------------------------------|
| 1. PXI Express System Controller Slot | 4. PXI Express System Timing Slot |
| 2. PXI Peripheral Slot                | 5. PXI Express Peripheral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

The PXIe-5170/5171 can be placed in PXI Express Hybrid peripheral slots, PXI Express system timing slots, or PXI Express peripheral slots.

8. Touch any metal part of the chassis to discharge static electricity.
9. Place the module edges into the module guides at the top and bottom of the chassis. Slide the module into the slot until it is fully inserted.

**Figure 3. PXIe-5170/5171 Module Installation**



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- |                      |                                |
|----------------------|--------------------------------|
| 1. Chassis           | 4. Front-Panel Mounting Screws |
| 2. System Controller | 5. Module Guides               |
| 3. Hardware Module   | 6. Power Switch                |
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- Secure the module front panel to the chassis using the front-panel mounting screws.

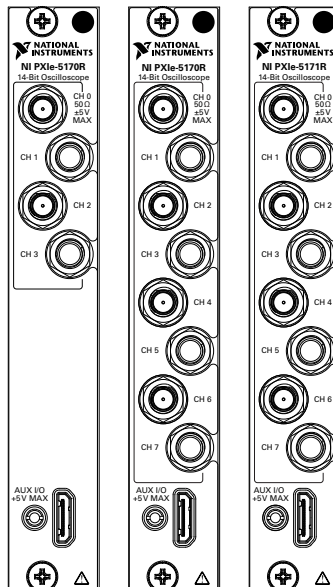


**Note** Tightening the top and bottom mounting screws increases mechanical stability and also electrically connects the front panel to the chassis, which can improve the signal quality and electromagnetic performance.

- Cover all empty slots using EMC filler panels or fill using slot blockers to maximize cooling air flow, depending on your application.
- Power on the chassis.

## Front Panel Connectors

**Figure 4.** PXIe-5170/5171 Front Panels



**Table 3. PXIe-5170/5171 Front Panel Connectors**

Label	Connector Type	Function
CH 0 to CH 3	SMA connector	Analog input terminal
CH 4 to CH 7	SMA connector	Additional analog input terminals on the PXIe-5170 (8 CH) and PXIe-5171
AUX I/O	MHDMMR connector	Sample Clock or Reference Clock input, Reference Clock output, bidirectional digital PFI, and 3.3 V power output



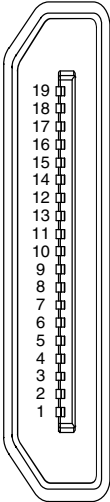
**Note** The AUX I/O connector accepts a standard, third-party HDMI™ type C cable, but the AUX I/O port is not an HDMI interface and the specified performance of the AUX I/O connector is not guaranteed if a third-party HDMI cable is used. Use NI cable type SHH19-MH19-AUX for all AUX I/O connections. Do not connect the AUX I/O port on the PXIe-5170/5171 to the HDMI port of another device. NI is not liable for any damage resulting from such signal connections.

# Connecting Digital Signals

You can use the AUX I/O front panel connector to import and export digital signals to the device.

## AUX I/O Connector Pinout

**Table 4.** AUX I/O Connector Pin Assignments

AUX I/O Connector	Pin	Signal	Signal Description
	1	GND	Ground reference for signals.
	2	CLK IN	Used to import an external Reference Clock.
	3	GND	Ground reference for signals.
	4	GND	Ground reference for signals.
	5	CLK OUT	Used to export the Reference Clock.
	6	GND	Ground reference for signals.
	7	GND	Ground reference for signals.
	8	PFI 0	Bidirectional PFI line.
	9	PFI 1	Bidirectional PFI line.
	10	GND	Ground reference for signals.
	11	PFI 2	Bidirectional PFI line.
	12	PFI 3	Bidirectional PFI line.
	13	GND	Ground reference for signals.
	14	PFI 4	Bidirectional PFI line.
	15	PFI 5	Bidirectional PFI line.
	16	PFI 6	Bidirectional PFI line.
	17	PFI 7	Bidirectional PFI line.
	18	+3.3 V	+3.3 V power (200 mA maximum)
	19	GND	Ground reference for signals.



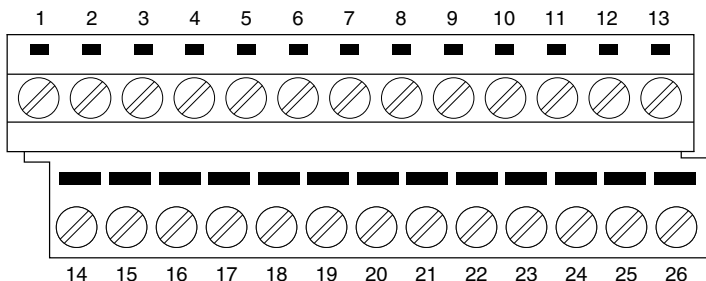
**Note** The AUX I/O connector accepts a standard, third-party HDMI™ type C cable, but the AUX I/O port is not an HDMI interface and the specified performance of the AUX I/O connector is not guaranteed if a third-party HDMI cable is used. Use

NI cable type SHH19-MH19-AUX for all AUX I/O connections. Do not connect the AUX I/O port on the PXIe-5170/5171 to the HDMI port of another device. NI is not liable for any damage resulting from such signal connections.

## PXIe-5170/5171 SCB-19 Pinout

NI recommends using the SCB-19 accessory to connect digital signals to the AUX I/O front panel connector.

**Figure 5. SCB-19 Pins**



**Table 5. SBC-19 Pin Assignments**

Pin	Signal	Signal Description
1	PFI 0	Bidirectional PFI line.
2	PFI 1	Bidirectional PFI line.
3	PFI 2	Bidirectional PFI line.
4	PFI 3	Bidirectional PFI line.
5	NC	No connection.
6	CLK IN	Used to import an external Reference Clock.
7	NC	No connection.
8	CLK OUT	Used to export the Reference Clock.
9	PFI 4	Bidirectional PFI line.
10	PFI 5	Bidirectional PFI line.
11	PFI 6	Bidirectional PFI line.
12	PFI 7	Bidirectional PFI line.

**Table 5. SBC-19 Pin Assignments (Continued)**

Pin	Signal	Signal Description
13	+3.3 V	+3.3 V power (200 mA maximum)
14 to 26	GND	Ground reference for signals.

## Configuring the Hardware in MAX

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 the instrument design libraries and NI-SCOPE.

1. Launch MAX by navigating to **Start»All Programs»National Instruments»NI MAX**.
2. In the Configuration pane, expand **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. PXIe-5170/5171 devices appear as NI-RIO devices in the list. Your default device names may vary.



**Note** If you do not see your hardware listed, refer to the *Troubleshooting* section of this document.

4. Record the device identifier MAX assigns to the hardware. Use this identifier when programming the PXIe-5170/5171.



**Caution** When you install, uninstall, or move an NI-RIO device in your system, resource identification of your NI-RIO devices may change. Whenever any of these changes occur, verify resource identification of all your NI-RIO devices in MAX, and, if necessary, make changes to your software and documentation.

## Self-Calibration

Self-calibration adjusts the PXIe-5170/5171 for variations in the module environment. Perform a complete self-calibration after first installing your module and letting it warm up for 15 minutes.



**Note** Warm-up begins after the chassis is powered, the device is recognized by the host, and the device is configured using the instrument design libraries or NI-SCOPE. Running an included sample project or running self-calibration using NI MAX will configure the device and start warm-up.

The PXIe-5170/5171 modules are externally calibrated at the factory; however, you should perform a self-calibration in any of the following situations:

- After first installing the PXIe-5170/5171 into your chassis
- After any module in the chassis is installed, uninstalled, or moved
- When the system is in an environment where the ambient temperature varies or the module temperature has drifted more than  $\pm 5$  °C from the temperature at the last self-calibration
- To periodically adjust for small performance drifts that occur with product aging

To programmatically self-calibrate the PXIe-5170/5171 when using instrument design libraries, use the Self Calibrate VI located on the **Functions»FPGA Interface»Software-Designed Instruments» Oscilloscopes»NI PXIe-5170R/5171R»Calibration** palette.

To programmatically self-calibrate the PXIe-5170/5171 when using NI-SCOPE, use the Self Calibrate function located on the **Functions»Measurement I/O»NI-SCOPE»Calibration** palette.

You can also self-calibrate the PXIe-5170/5171 by pressing the **Self Calibrate** button for the device in MAX.

## First Measurements

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### Making a Measurement with Instrument Design Libraries

You can verify proper installation and configuration of your device by making a measurement using a LabVIEW sample project.

This measurement requires installation of the instrument design libraries.

1. Launch LabVIEW.
2. Select **File»Create Project**.
3. On the left side of the **Create Project** window, select **Oscilloscopes**.
4. On the right side of the **Create Project** window, select the **Multirecord Acquisition** sample project and click **Next**.
5. Specify a name, location, and device target for the project in the **Create Project** window and click **Finish**.
6. In the project tree, navigate to **My Computer»Project Documentation**, open the `.html` file, and navigate to the *Running this Sample Project* section of the documentation.
7. Follow the instructions in the project documentation for making the measurement.

### Making a Measurement with NI-SCOPE

#### Making a Measurement with NI-SCOPE SFP

1. Connect CH 0 to an input signal.
2. Launch the NI-SCOPE SFP from the **Start** menu.
3. In the **Select Device** dialog box, select the device name assigned to the device in MAX.

4. Click **Auto** to adjust the acquisition display.
5. If the SFP is not already running, click **Run**.

## Making a Measurement with LabVIEW

1. Launch LabVIEW.
2. Select **Help»Find Examples**.
3. Open the example VI that you want to use by selecting **Hardware Input and Output»Modular Instruments»NI-SCOPE (High-Speed Digitizers)**.



**Tip** If you are not sure which example to run, use the Quick Start VI, which is found under **Hardware Input and Output»Modular Instruments»NI-SCOPE (High-Speed Digitizers)»Demos»niScope EX Quick Start.vi**.

4. Follow any setup instructions in the VI and specify any desired settings.
5. Click **Run** to run the example program.

## Troubleshooting

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If an issue persists after you complete a troubleshooting procedure, contact NI technical support or visit [ni.com/support](http://ni.com/support).

### What Should I Do if the PXIe-5170/5171 Doesn't Appear in MAX?

1. In the MAX configuration tree, expand **Devices and Interfaces**.
2. Expand the **Chassis** tree to see the list of installed hardware, and press <F5> to refresh the list.
3. If the module is still not listed, power off the system, ensure that all hardware is correctly installed, and restart the system.
4. Navigate to the Device Manager.

Option	Description
<b>Windows 8</b>	Right-click the Start screen, and select <b>All apps»Control Panel»Hardware and Sound»Device Manager</b> .
<b>Windows 7</b>	Select <b>Start»Control Panel»Device Manager</b> .
<b>Windows Vista</b>	Select <b>Start»Control Panel»System and Maintenance»Device Manager</b> .

5. Verify the PXIe-5170/5171 appears in the Device Manager.
  - a) Under an NI entry, confirm that a PXIe-5170/5171 entry appears.



**Note** If you are using a PC with a device for PXI remote control system, under **System Devices**, also confirm that no error conditions appear for the **PCI-to-PCI Bridge**.

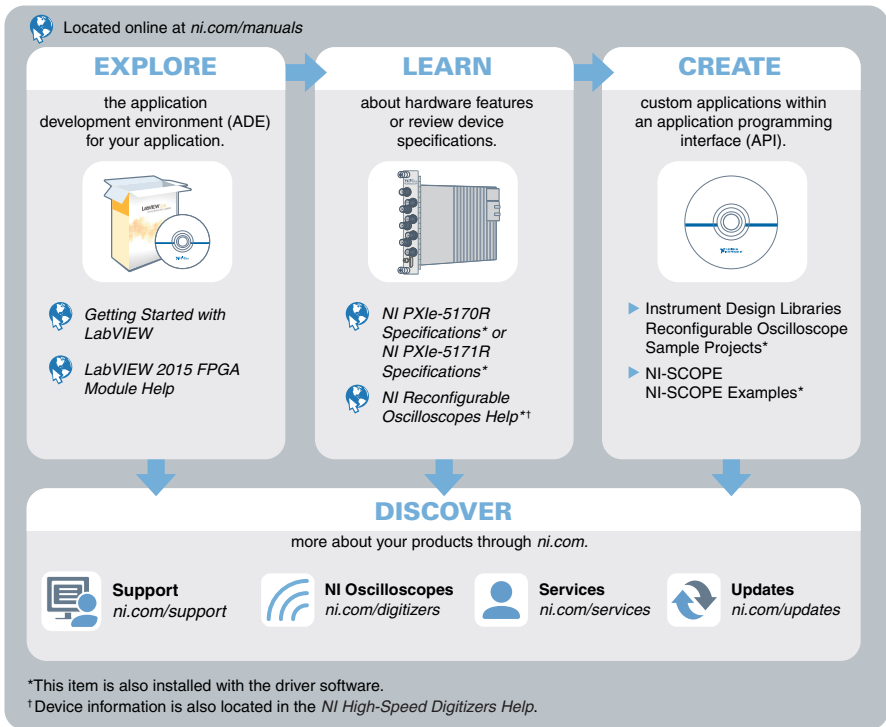
- b) If error conditions appear, reinstall NI LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes and the PXIe-5170/5171.

# What Should I Do if the PXIe-5170/5171 Fails the Self-Test or Self-Calibration?

1. Restart the system.
2. Launch MAX, and perform the self-test or self-calibration 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 or self-calibration again.

## Where To Go Next

After you have installed your hardware, configured the module in MAX, and taken a basic measurement, you can begin programming your hardware using the instrument design libraries, NI-SCOPE, or custom logic. Refer to the following list for resources and information that you may need as you create your application.





[ni.com/labview/fpga](http://ni.com/labview/fpga)

Visit this web page for information about LabVIEW FPGA Module.

*The Benefits of Templates and Sample Projects*

Visit [ni.com/info](http://ni.com/info) and enter the Info Code `exqazs` for resources on LabVIEW sample projects.

[ni.com/software-designed-instruments](http://ni.com/software-designed-instruments)

Visit this web page for resources on designing application-specific instrumentation for the PXIe-5170/5171, including programming and FPGA customization information, examples, and IP.

**Sample Projects**

Use as a starting point for application development using instrument design libraries. Available in LabVIEW under **Create Project»Sample Projects»Oscilloscopes**.

*NI Reconfigurable Oscilloscopes Help*

Use this help file, located at **Start»All Programs»National Instruments»Reconfigurable Oscilloscopes**, to learn how to operate the PXIe-5170/5171 using instrument design libraries. This help file also includes device information and programming information.

*NI High-Speed Digitizers Help*

Use this help file, located at **Start»All Programs»National Instruments»NI-SCOPE**, to learn how to operate the PXIe-5170/5171 using the NI-SCOPE device driver. This help file also includes device information and programming information.



**Note** Help documentation installs with both software options or can be downloaded from [ni.com/manuals](http://ni.com/manuals).

The most recent versions of product documentation are available at [ni.com/manuals](http://ni.com/manuals).

## Worldwide Support and Services

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The NI website 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.

Visit [ni.com/services](http://ni.com/services) for NI Factory Installation Services, repairs, extended warranty, and other services.

Visit [ni.com/register](http://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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can obtain the DoC for your product by visiting [ni.com/certification](https://ni.com/certification). If your product supports calibration, you can obtain the calibration certificate for your product at [ni.com/calibration](https://ni.com/calibration).

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