

## GETTING STARTED GUIDE

# PXIe-5160/5162

PXIe, 500 MHz or 1.5 GHz, 2.5 GS/s or 5 GS/s, 10-Bit PXI Oscilloscopes



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

This document explains how to install, configure, and test the PXIe-5160/5162. The PXIe-5160 is a 500 MHz, 10-bit oscilloscope with a sample rate of up to 2.5 GS/s. The PXIe-5162 is a 1.5 GHz, 10-bit oscilloscope with a sample rate of up to 5 GS/s.

Documentation for the PXIe-5160/5162 is available from the **Start** menu by navigating to **NI-SCOPE Documentation** in the **National Instruments** folder.

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# Verifying the System Requirements

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To use the NI-SCOPE instrument driver, your system must meet certain requirements.

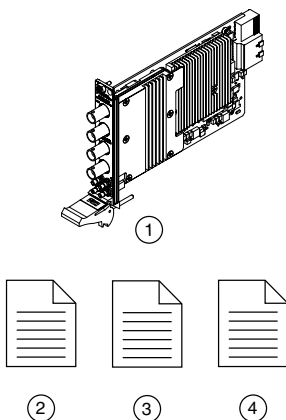
Refer to the product readme, which is available on the driver software media or online at [ni.com/manuals](http://ni.com/manuals), for more information about minimum system requirements, recommended system, and supported application development environments (ADEs).

## Unpacking the Kit

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Refer to the following figure to identify the contents of the PXIe-5160/5162 kit.

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- |   |   |
|---|---|
| 1. PXIe-5160 or PXIe-5162   | 3. PXIe-5160/5162 Getting Started Guide (this document) |
| 2. PXIe-5160 or PXIe-5162 Safety, Environmental, and Regulatory Information | 4. Maintain Forced-Air Cooling Note to Users            |
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**Notice** To prevent electrostatic discharge (ESD) from damaging the module, 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 module from the package and inspect it for loose components or other signs of damage.



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



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

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

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

# Other Equipment

There are several required items not included in your device kit that you need to operate the PXIe-5160/5162. Your application may require additional items not included in your kit to install or operate your device.

## Required Items

- A PXI Express chassis and chassis documentation
- A PXI Controller or PC with a Device for PXI Remote Control system that meets the system requirements specified in this guide and chassis documentation

## Optional Items

- PXI Slot Blocker Kit, 5 slot blockers (NI part number 199198-01)
- PXI Filler Panel Kit, 17 filler panels (NI part number 778646-01)
- BNC-to-BNC cable, 50  $\Omega$ , 1 m (NI part number 781887-01)
- Oscilloscope probe compensator, SMB (NI part number 786983-01)
- Probes—refer to the following table for several options compatible with the PXIe-5160/5162.

**Table 1.** Probe Options for the PXIe-5160/5162

Model	NI Part Number	Description
CP400X	784254-01	400 MHz, 2 m, 10X cable divider probe
CP500X	784253-01	500 MHz, 1.2 m, 10X cable divider probe
NI 5191	781785-01	800 MHz differential active probe
SA1000X	784255-01	1 GHz single-ended active probe
SA1500X	784256-01	1.5 GHz single-ended active probe
SA2500X	784257-01	2.5 GHz single-ended active probe
SP200B	780284-01	1x or 10x passive probe, 200 MHz
SP500C	783630-01	100x passive probe, 500 MHz
SP500X	783629-01	10x passive probe, 500 MHz
CC0550X	786846-01	5 A RMS, 50 MHz current probe
CC05120X	786847-01	5 A RMS, 120 MHz current probe
CC5002X	786848-01	500 A RMS, 2 MHz current probe
CC15010X	786849-01	150 A RMS, 10 MHz current probe

**Table 1.** Probe Options for the PXIe-5160/5162 (Continued)

Model	NI Part Number	Description
CC3050X	785561-01	30 A RMS, 50 MHz current probe
CC30100X	785562-01	30 A RMS, 100 MHz current probe

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

## Preparing the Environment

Ensure that the environment in which you are using the PXIe-5160/5162 meets the following specifications.

### Temperature

Operating	0 °C to 45 °C
Storage	-40 °C to 71 °C

### Humidity

Operating	10% to 90%, noncondensing
Storage	5% to 95%, noncondensing

Pollution Degree	2
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Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)
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Indoor use only.

## 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. Visit [ni.com/downloads/drivers](http://ni.com/downloads/drivers) and search for NI-SCOPE.
3. Download the latest version of NI-SCOPE, extract the downloaded files, and run the executable (.exe) file.

Driver support for the PXIe-5160/5162 was first available in NI-SCOPE 4.1.

4. 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.

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

# Installing the PXIe-5160/5162



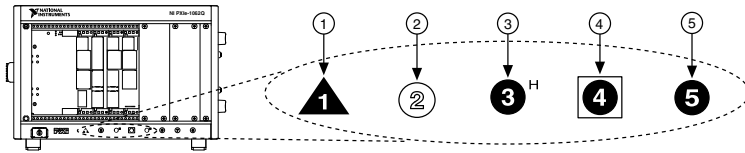
**Notice** To prevent damage to the PXIe-5160/5162 caused by ESD or contamination, handle the module using the edges or the metal bracket.

1. Ensure the AC power source is connected to the chassis before installing the module.

The AC power cord grounds the chassis and protects it from electrical damage while you install the module.

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

**Figure 1. Chassis Compatibility Symbols**

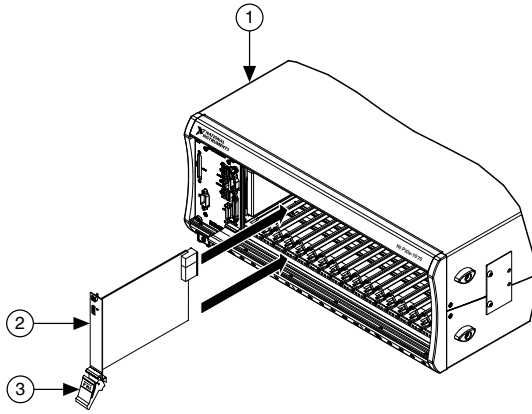


- |                                       |                                   |
|---------------------------------------|-----------------------------------|
| 1. PXI Express System Controller Slot | 4. PXI Express System Timing Slot |
| 2. PXI Peripheral Slot                | 5. PXI Express Peripheral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

PXIe-5160/5162 modules can be placed in PXI Express peripheral slots, PXI Express hybrid peripheral slots, or PXI Express system timing slots.

6. Touch any metal part of the chassis to discharge static electricity.
7. Ensure that the ejector handle is in the downward (unlatched) position.
8. 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 2. Module Installation**



1. Chassis
2. Hardware Module
3. Ejector Handle in Downward (Unlatched) Position

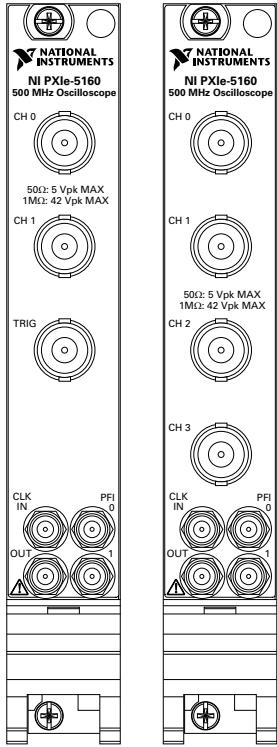
9. Latch the module in place by pulling up on the ejector handle.
10. Secure the module front panel to the chassis using the front-panel mounting screws.



**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.

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

# PXIe-5160/5162 Front Panels



**Note** PXIe-5160 shown.

**Table 2.** PXIe-5160/5162 Signal Descriptions

Signal	Connector Type	Description
CH 0, CH 1	BNC	Analog input connection; digitizes data and triggers acquisitions
CH 2, CH 3		Additional analog input connections on the PXIe-5160/5162 (4 CH)
TRIG		External analog trigger connection; signals on the TRIG connector cannot be digitized; PXIe-5160/5162 (2 CH) only

**Table 2.** PXIe-5160/5162 Signal Descriptions (Continued)

Signal	Connector Type	Description
CLK IN	SMB	Imports an external Reference Clock or Sample Clock to the device
CLK OUT		Exports the Reference Clock from the device
PFI 0		PFI line for digital trigger input/output
PFI 1		PFI line for digital trigger input/output and probe compensation; no subsample trigger accuracy

## Configuring the PXIe-5160/5162 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 NI-SCOPE.

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

Installed modules appear under the name of their associated chassis.

3. Expand your **Chassis** tree item.

MAX lists all modules installed in the chassis. Your default names may vary.



**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.

4. Record the identifier MAX assigns to the hardware. Use this identifier when programming the PXIe-5160/5162.
5. 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.



# PXIe-5160/5162 Self-Calibration

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To eliminate errors caused by changing temperatures, NI-SCOPE provides a highly repeatable self-calibration function.

For the PXIe-5160/5162, self-calibration yields the following benefits:

- Corrects for DC gain and offset errors within the digitizer by comparison to a precision, high-stability internal voltage reference for all ranges, input impedance paths (50  $\Omega$  and 1 M $\Omega$ ), and filter paths.
- Calibrates trigger level offset and gain.
- Calibrates trigger timing, as well as the time-to-digital conversion circuitry to ensure accurate trigger timing and time-stamping.
- Calibrates gain, offset, and phase for interleaved ADC modes, reducing ADC interleaving errors in time-interleaved sampling modes.
- Calibrates the phase DAC used to adjust the phase of the sample clock.

Self-calibration takes approximately two minutes to complete.

## Running Self-Calibration

Running self-calibration enables the PXIe-5160/5162 to yield full performance over its operating temperature range and two-year external calibration cycle.

Before running self-calibration:

- Warm up the PXIe-5160/5162 for at least 15 minutes
- When possible, disconnect the inputs<sup>1</sup>

PXIe-5160/5162 modules are externally calibrated at the factory, but for optimal performance, use self-calibration in any of the following situations:

- When the module is placed in a new system
- When the temperature changes more than  $\pm 3$  °C from the previous self-calibration
- Once 90 days have elapsed since the previous self-calibration



**Note** Unless temperature variations are a serious problem in your application, self-calibration is not recommended more than once per day.



**Tip** You can use the nodes on the NI-SCOPE External Calibration palette to programmatically return the date and module temperature of the previous self-calibration. You can also view this information by selecting the device in MAX.

Self-calibrate the PXIe-5160/5162 programmatically in NI-SCOPE or on demand in MAX.

Option	Description
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<b>NI-SCOPE</b>	Use the Self Calibrate node to self-calibrate the module.
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<sup>1</sup> If high-voltage, high-frequency signals are present during self-calibration, the calibration results may be adversely affected or the calibration may fail with an error.

Option	Description
MAX	Select the device in the <b>Devices and Interfaces</b> menu and click the <b>Self-Calibrate</b> button.

When the two-year external calibration interval expires, an external calibration is required to ensure performance within specifications over the subsequent two years.

## First Measurements

### Making a Measurement with InstrumentStudio

1. Connect CH 0 to an input signal.
2. Launch InstrumentStudio at **Start»National Instruments**.
3. In the instrument header menu in the upper-right corner of the panel () add the PXIe-5160/5162 to the large panel with **Add/Remove Devices**.
4. Click **Auto** to automatically configure device settings for the detected signal.
5. If the soft front panel is not already running, click **Run/Stop**.
6. Add oscilloscope measurements to the channel by selecting **Add/Remove** in the measurement table of the oscilloscope.

For more information on the measurements available for oscilloscopes in InstrumentStudio, refer to the *InstrumentStudio Manual* at [ni.com/manuals](http://ni.com/manuals).

### 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.

# PXIe-5160/5162 Compensating Passive Probes

Compensating passive probes increases the accuracy of your measurements by matching the capacitance of your probe to the capacitance of a particular oscilloscope input channel.

Before beginning this procedure, complete the following:

- Set up your oscilloscope in a compatible chassis;
- Install a version of NI-SCOPE compatible with your oscilloscope on your system; and
- Configure a panel and layout in InstrumentStudio to include your oscilloscope.



**Note** For more information on using InstrumentStudio, refer to the *InstrumentStudio Manual* at [ni.com/manuals](http://ni.com/manuals).

The following equipment is required for this procedure:

If using the Oscilloscope Probe Compensator	<ul style="list-style-type: none"><li>• Oscilloscope Probe Compensator (NI part number 786983-01)</li></ul>
If connecting the probe directly to the oscilloscope PFI	<ul style="list-style-type: none"><li>• A 50 <math>\Omega</math> SMB (f)-to-BNC (f) cable, such as the SMB-100 (NI part number 781449-01)</li><li>• A probe tip-to-BNC (m) adapter</li></ul>

The PXIe-5160/5162 can output a 1 kHz square wave that you can use to compensate passive probes.

To compensate a passive probe, complete the following steps:

1. Connect the BNC end of the probe to an input channel of your oscilloscope.
2. Depending on your connection method, connect the probe tip to the oscilloscope:
  - Oscilloscope Probe Compensator
    1. Connect the SMB end of the Oscilloscope Probe Compensator to the PFI connector of the oscilloscope that generates the probe compensation signal.
    2. Connect the ground clip of the probe to the ground terminal.
    3. Contact the tip of the probe to the square wave terminal.
  - Direct connection to PFI
    1. Connect the SMB end of the SMB (f)-to-BNC (f) cable to the PFI connector of the oscilloscope that generates the probe compensation signal.
    2. Attach the BNC adapter to the tip of the probe.
    3. Connect the probe tip via the BNC adapter to the BNC end of the cable.
3. Enable the probe compensation signal:

Option	Description
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<b>InstrumentStudio</b>	
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	In the instrument header menu (  ) in the upper-right corner of the panel, select <b>Probe Compensation»Enabled</b> .
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Option	Description
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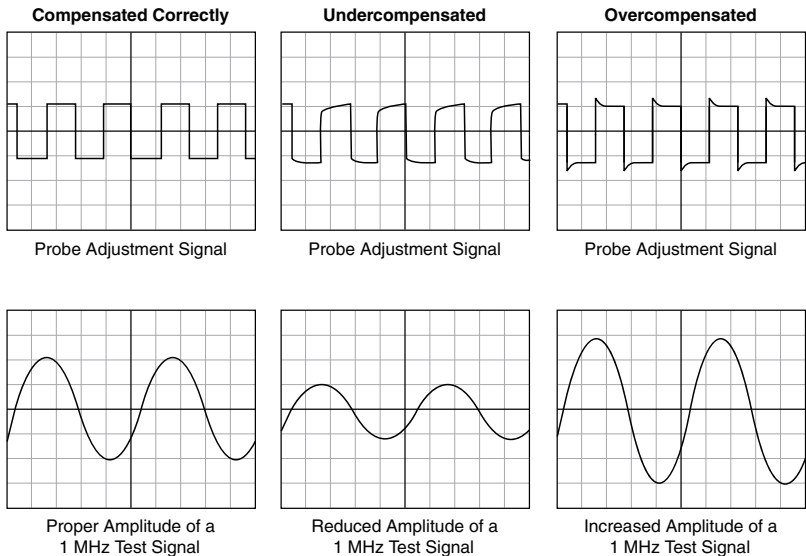
<b>NI-SCOPE</b>	Call Probe Compensation Signal Start.
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4. In InstrumentStudio, configure the settings of the input channel to which you connected the probe.
  - a) Set the channel to **On** to display the signal.
  - b) Set the **Input impedance** of the channel to **1 M $\Omega$** .
  - c) Match the **Probe attenuation** setting to the setting on your probe.
5. Adjust the vertical range on the input channel until the signal starts to clip and then increase the vertical range by one step so that it no longer clips.

This process ensures you are using the maximum dynamic range of the ADC.

6. Examine the digitized signal and adjust the tunable capacitor on the probe.

The probe is correctly compensated when the waveform appears as square as possible:



Once compensated, the probe conveys signals to the input channel accurately, without artificially attenuating or amplifying frequency components of the signal.



**Tip** For the most accurate measurements:


- Compensate probes for each channel of the oscilloscope;
- Use a compensated probe only with the channel you used to compensate it; and
- Compensate your probes frequently.

# Programming the PXIe-5160/5162

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You can acquire data interactively using InstrumentStudio, or you can use the NI-SCOPE instrument driver to program your device in the supported ADE of your choice.

**Table 3. PXIe-5160/5162 Programming Options**

Application	Location	Description
InstrumentStudio	 <p><b>Note</b> InstrumentStudio is supported only on 64-bit systems. If you are using a 32-bit system, use your driver's specific soft front panel instead of InstrumentStudio.</p> <p>InstrumentStudio is automatically installed when you install the NI-SCOPE driver. You can access InstrumentStudio in one of the following ways:</p> <ul style="list-style-type: none"> <li>• From the Windows start menu, select <b>National Instruments» [Driver] Soft Front Panel</b>. This launches InstrumentStudio and runs a soft front panel populated with NI-SCOPE devices.</li> <li>• From the Windows <b>Start</b> menu, select <b>National Instruments» InstrumentStudio [year]</b>. This launches InstrumentStudio and runs a soft front panel populated with devices detected on your system.</li> <li>• From Measurement &amp; Automation Explorer (MAX), select a device and then click <b>Test Panels...</b> This launches InstrumentStudio and runs a soft front panel for the device you selected.</li> </ul>	<p>When you install NI-SCOPE on a 64-bit system, you can monitor, control, and record measurements from supported devices using InstrumentStudio. InstrumentStudio is a software-based front panel application that allows you to perform interactive measurements on several different device types in a single program.</p>

**Table 3. PXIe-5160/5162 Programming Options (Continued)**

Application	Location	Description
NI-SCOPE Instrument Driver	LabVIEW—Available on the LabVIEW Functions palette at <b>Measurement I/O»NI-SCOPE</b> .	The NI-SCOPE API configures and operates the device hardware and provides customizable acquisition, control, analysis, and measurement options using LabVIEW VIs or LabWindows/CVI functions.
	C or LabWindows/CVI—Available at <b>Program Files»IVI Foundation»IVI»Drivers»niScope</b> .	
	Microsoft Visual C/C++, .NET—Use examples located in the file directory Users\Public\Public Documents\National Instruments\NI-SCOPE\examples.	You can modify an NI-SCOPE C example to create an application with Microsoft Visual C/C++, or modify a .NET example to create an application with Visual Basic .NET or Visual C#. Copy an NI-SCOPE example to copy required project settings for include paths and library files. Alternatively, refer to the <i>Creating an Application</i> section of the <i>NI High-Speed Digitizers Help</i> to manually add all required include and library files to your project.

## NI-SCOPE Examples

Examples demonstrate the functionality of the device and serve as programming models and building blocks for your own applications.

The NI Example Finder is a utility available for some ADEs that organizes examples into categories and allows you to easily browse and search installed examples. You can see descriptions and compatible hardware models for each example, or see all the examples compatible with one particular hardware model.

To locate examples, refer to the following table:

Application Development Environment (ADE)	Locating Examples
LabVIEW or LabWindows/CVI	Locate examples with the NI Example Finder. Within LabVIEW or LabWindows/CVI, select <b>Help»Find Examples</b> , and navigate to <b>Hardware Input and Output»Modular Instruments</b> .
Visual C/C++ or Visual Basic	Locate examples in the file directory <code>Users\Public\Public Documents\National Instruments\NI-SCOPE\examples</code> .
Visual C# or Visual Basic .NET	

## Troubleshooting

### What Should I Do if the PXIe-5160/5162 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.

Operating System	Description
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<b>Windows 10/8.1</b>	Right-click the Start button, and select <b>Device Manager</b> .
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<b>Windows 7</b>	Select <b>Start»Control Panel»Device Manager</b> .
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5. Verify the PXIe-5160/5162 appears in the Device Manager.
  - a) Under an NI entry, confirm that a PXIe-5160/5162 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-SCOPE and the PXIe-5160/5162.

### What Should I Do if the PXIe-5160/5162 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.

## Thermal Shutdown Error

If you receive an over-temperature or thermal shutdown error and your device shuts down, complete the following steps to re-enable your device:

1. Power off the computer or chassis that contains the device.
2. Reinstall the device and make any necessary adjustments to make sure that the device is effectively cooled.
3. Power on the computer or chassis.

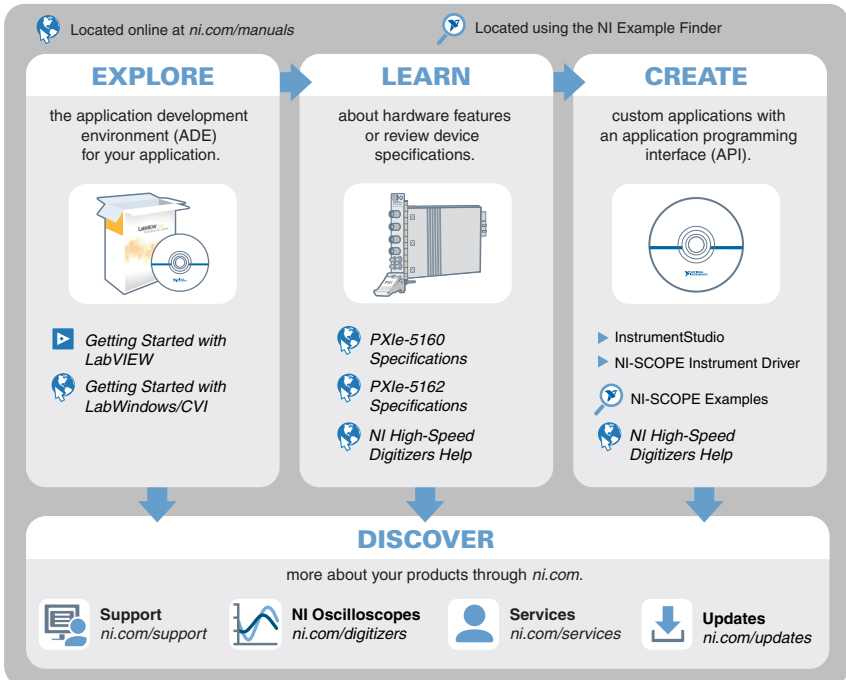


**Note** The thermal shutdown error is reported until the device has cooled to an acceptable operating temperature and has been successfully reset.

For more information about cooling the device, refer to the *Maintain Forced-Air Cooling Note to Users* included in your kit.

## Where To Go Next

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



# Worldwide Support and Services

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The NI website is your complete resource for technical support. At [ni.com/support](https://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](https://ni.com/services) for information about the services NI offers.

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