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GETTING STARTED GUIDE

PXIe-5163

PXIe, 200 MHz, 1 GS/s, 14-bit PXI Oscilloscope

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

This document explains how to install, configure, and test the PXIe-5163. The PXIe-5163 is a 200 MHz, 1 GS/s oscilloscope.

Documentation for the PXIe-5163 is available from the **Start** menu by navigating to **NI-SCOPE Documentation** in the **National Instruments** folder.

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NATIONAL INSTRUMENTS

Verifying the System Requirements

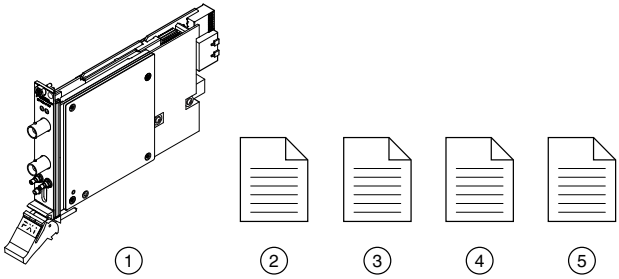
To use the NI-SCOPE instrument driver, your system must meet certain requirements.

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

Unpacking the Kit

Refer to the following figure to identify the contents of the PXIe-5163 kit.

Figure 1. PXIe-5163 Kit Contents



1. PXIe-5163
2. PXIe-5163 Safety, Environmental, and Regulatory Information
3. PXIe-5163 Getting Started Guide (this document)
4. Maintain Forced-Air Cooling Note to Users
5. Export Requirements Note to Users

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-5163. 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 Ω, 1 m (NI part number 781887-01)
- AUX 0 connectivity:
  - SCB-19 noise rejecting, shielded AUX 0 connector block (NI part number 783959-01)
  - SHH19-MH19-AUX shielded single-ended cable, 1 m (NI part number 784091-01)
  - Mini-HDMI Breakout Cable to 6 BNC, 6 in. (NI part number 786979-01)
- Oscilloscope probe compensator, SMB (NI part number 786983-01)
- Probes—refer to the following table for several options compatible with the PXIe-5163.

Table 1. Probe Options for the PXIe-5163

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
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

Table 1. Probe Options for the PXIe-5163 (Continued)

Model	NI Part Number	Description
CC5002X	786848-01	500 A RMS, 2 MHz current probe
CC15010X	786849-01	150 A RMS, 10 MHz current probe
CC3050X	785561-01	30 A RMS, 50 MHz current probe
CC30100X	785562-01	30 A RMS, 100 MHz current probe

Visit *ni.com* for more information about these additional items.

Preparing the Environment

Ensure that the environment in which you are using the PXIe-5163 meets the following specifications.

Temperature	
Operating	0 °C to 50 °C
Storage	-40 °C to 71 °C
Humidity	
Operating	10% to 90%, noncondensing
Storage	5% to 95%, noncondensing
Pollution Degree	2
Maximum altitude	4,600 m (570 mbar) (at 25 °C ambient temperature)

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* 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-5163 was first available in NI-SCOPE 18.7.
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.

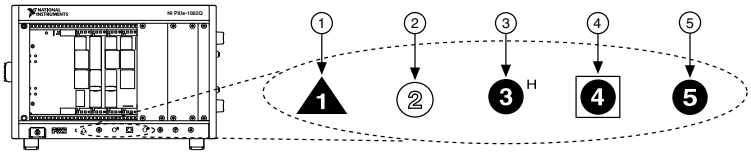
Installing the PXIe-5163

Notice To prevent damage to the PXIe-5163 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.

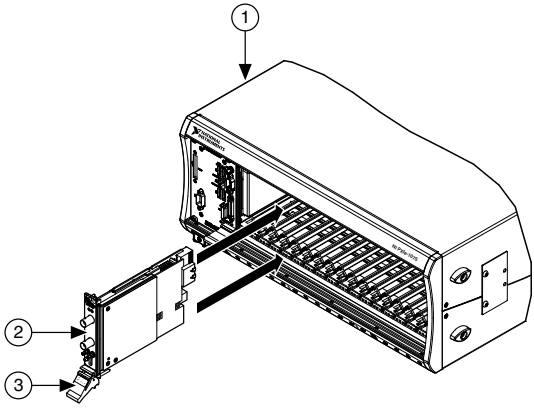
Figure 2. Chassis Compatibility Symbols



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

   PXIe-5163 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 3. 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-5163 Front Panel and Pinout

Front Panel

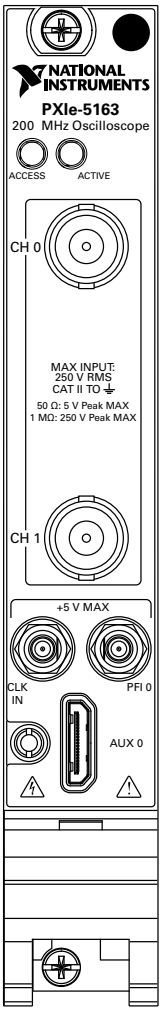


Table 2. Connectors

Signal	Connector Type	Description
CH 0 and CH 1	BNC female	Analog input connection; digitizes data and triggers acquisitions.
CLK IN	SMB	Imports an external reference clock or sample clock to the oscilloscope.
PFI 0	SMB	PFI line for digital trigger input/output, probe compensation.
AUX 0	MHDMR	Reference clock input, reference clock output, bidirectional digital PFI, and 3.3 V power output.

Table 3. Access LED

Color	Indications
Off	The module is not yet functional or the module has detected a problem with a power rail.
Amber	The module is being accessed.
Green	The module is ready to be programmed.

Table 4. Active LED

Color	Indications
Off	Module is not armed, triggered, or acquiring a waveform.
Amber	The module is armed and waiting for a Reference (Stop) Trigger.
Green	The module has received a Reference (Stop) Trigger. Also indicates that the module is acquiring a waveform.
Red	The module has detected an error. The LED remains red until the error condition is removed. The following scenarios are examples of potential errors: • Detected an unlocked condition on a previously locked PLL. A PLL that is unlocked while in reset does not show an error. • Unable to detect the external sample clock. • Detected an overheating or overpowering error. **Note** Certain driver interactions may cause the Active LED to flash red. An error condition does not exist unless the Active LED remains red.

AUX 0 Connector Pinout

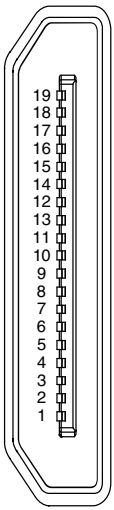


Table 5. AUX 0 Connector Pin Assignments

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	AUX 0/PFI 0	Bidirectional PFI line
9	AUX 0/PFI 1	Bidirectional PFI line
10	GND	Ground reference for signals
11	AUX 0/PFI 2	Bidirectional PFI line
12	AUX 0/PFI 3	Bidirectional PFI line
13	GND	Ground reference for signals

Table 5. AUX 0 Connector Pin Assignments (Continued)

Pin	Signal	Signal Description
14	AUX 0/PFI 4	Bidirectional PFI line
15	AUX 0/PFI 5	Bidirectional PFI line
16	AUX 0/PFI 6	Bidirectional PFI line
17	AUX 0/PFI 7	Bidirectional PFI line
18	+3.3 V	+3.3 V power (200 mA maximum)
19	GND	Ground reference for signals

PXIe-5163 SCB-19 Pinout

You can use the SCB-19 connector block to connect digital signals to the AUX 0 connector on the PXIe-5163 front panel. Refer to the following figure and table for information about the SCB-19 signals when connected to the AUX 0 front panel connector.

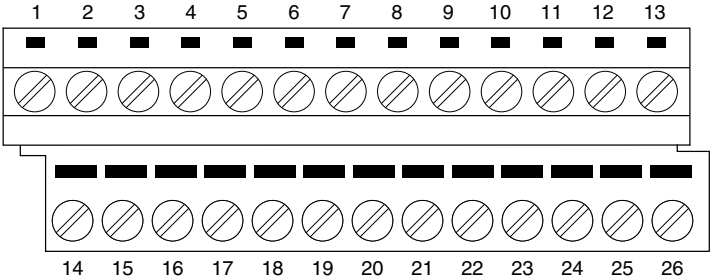


Table 6. SCB-19 Signal Descriptions

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 or sample clock

Table 6. SCB-19 Signal Descriptions (Continued)

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

PXIe-5163 Mini-HDMI Breakout Cable to 6 BNC Pinout

You can use the Mini-HDMI Breakout Cable to 6 BNC to connect digital signals to the AUX 0 connector on the PXIe-5163 front panel. Refer to the following figure and table for information about the Mini-HDMI Breakout Cable to 6 BNC signals when connected to the AUX 0 front panel connector.

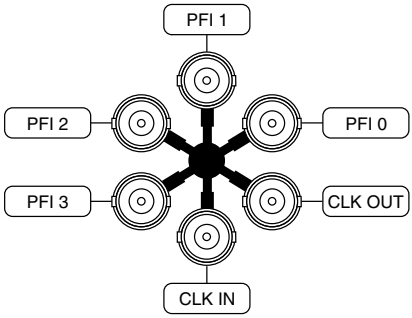


Table 7. Mini-HDMI Breakout Cable to 6 BNC Signal Descriptions

Signal	Connector Type	Description
CLK IN	BNC female	Used to import an external reference clock
CLK OUT		Used to export the reference clock
PFI 0		Bidirectional PFI line
PFI 1		Bidirectional PFI line
PFI 2		Bidirectional PFI line
PFI 3		Bidirectional PFI line

Configuring the PXIe-5163 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-5163.
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-5163 Self-Calibration

For the PXIe-5163, self-calibration yields the following benefits:

- Characterizes onboard sample clock phase adjustment circuitry
- Characterizes onboard intermodule synchronization measurement circuitry
- Corrects for DC gain and offset errors within the oscilloscope for all ranges and both input impedance paths based on comparison to a precision, high-stability internal voltage reference

- Calibrates offset error of interleaving ADCs
- Takes approximately 1 minute to complete

Running Self-Calibration

Running self-calibration enables the PXIe-5163 to yield full performance over its operating temperature range and two-year external calibration cycle.

Before running self-calibration, warm up the PXIe-5163 for at least 15 minutes.

Note Warm-up begins after the chassis and controller or PC is powered and NI-SCOPE is loaded and recognizes the PXIe-5163.

PXIe-5163 modules are externally calibrated at the factory, but for optimal performance, use self-calibration in any of the following situations:

- After first installing the PXIe-5163 in 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 ±5 °C from the previous self-calibration
- To periodically adjust for small performance drifts that occur with product aging
- When 90 days have elapsed since the previous self-calibration

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-5163 programmatically in NI-SCOPE or on demand in MAX.

Option	Description
NI-SCOPE	Use the Self Calibrate node to self-calibrate the module.
MAX	Select the device in the **Devices and Interfaces** menu and click the **Self-Calibrate** button.

When the two-year external calibration interval expires, an external calibration is required to ensure performance that is within specification 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-5163 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*.

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-5163 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*.

The following equipment is required for this procedure:

If using the Oscilloscope Probe Compensator	• Oscilloscope Probe Compensator (NI part number 786983-01)
If connecting the probe directly to the oscilloscope PFI	• A 50 Ω SMB (f)-to-BNC (f) cable, such as the SMB-100 (NI part number 781449-01) • A probe tip–to-BNC (m) adapter

The PXIe-5163 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.

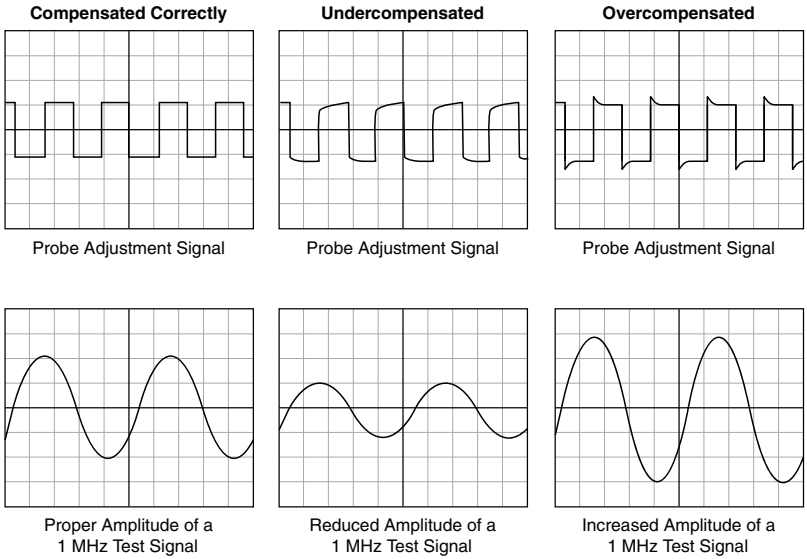
2. Depending on your connection method, connect the probe tip to the oscilloscope:
   - Oscilloscope Probe Compensator
     1. Connect the SMB end of the Oscilloscope Probe Compensator to the PFI connector of the oscilloscope that generates the probe compensation signal.
     2. Connect the ground clip 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
InstrumentStudio	In the instrument header menu () in the upper-right corner of the panel, select **Probe Compensation**»**Enabled**.
NI-SCOPE	Call Probe Compensation Signal Start.

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 MΩ**.
   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-5163

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 8. PXIe-5163 Programming Options

Application	Location	Description
InstrumentStudio	**Note** 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. InstrumentStudio is automatically installed when you install the NI-SCOPE driver. You can access InstrumentStudio in one of the following ways: • From the Windows start menu, select **National Instruments**» **[Driver] Soft Front Panel**. This launches InstrumentStudio and runs a soft front panel populated with NI-SCOPE devices. • From the Windows **Start** menu, select **National Instruments**» **InstrumentStudio [year]**. This launches InstrumentStudio and runs a soft front panel populated with devices detected on your system. • From Measurement & Automation Explorer (MAX), select a device and then click **Test Panels...**. This launches InstrumentStudio and runs a soft front panel for the device you selected.	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.

Table 8. PXIe-5163 Programming Options (Continued)

Application	Location	Description
NI-SCOPE Instrument Driver	LabVIEW—Available on the LabVIEW Functions palette at **Measurement I/O»NI-SCOPE**.	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 **Program Files»IVI Foundation»IVI»Drivers»niScope**.	
	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 *Creating an Application* section of the *NI High-Speed Digitizers Help* 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 **Help»Find Examples**, and navigate to **Hardware Input and Output» Modular Instruments**.
Visual C/C++ or Visual Basic	Locate examples in the file directory `Users\Public\Public Documents\National Instruments\NI-SCOPE\examples`.
Visual C# or Visual Basic .NET	

Troubleshooting

If an issue persists after you complete a troubleshooting procedure, contact NI technical support or visit *ni.com/support*.

Why Is the ACCESS LED Off When the Chassis Is On?

The LEDs may not light until the module has been configured in MAX. Before proceeding, verify that the PXIe-5163 appears in MAX.

If the ACCESS LED fails to light after you power on the chassis, a problem may exist with the chassis power rails, a hardware module, or the LED.

Notice Apply external signals only while the PXIe-5163 is powered on. Applying external signals while the module is powered off may cause damage.

1. Disconnect any signals from the module front panels.
2. Power off the chassis.
3. Remove the module from the chassis and inspect it for damage. Do not reinstall a damaged module.
4. Install the module in a different chassis slot from which you removed it.
5. Power on the chassis.

Note If you are using a PC with a device for PXI remote control system, power on the chassis before powering on the computer.

6. Verify that the module appears in MAX.
7. Reset the module in MAX and perform a self-test.

What Should I Do if the PXIe-5163 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
Windows 10/8.1	Right-click the Start button, and select **Device Manager**.
Windows 7	Select **Start»Control Panel»Device Manager**.

5. Verify the PXIe-5163 appears in the Device Manager.
   a) Under an NI entry, confirm that a PXIe-5163 entry appears.

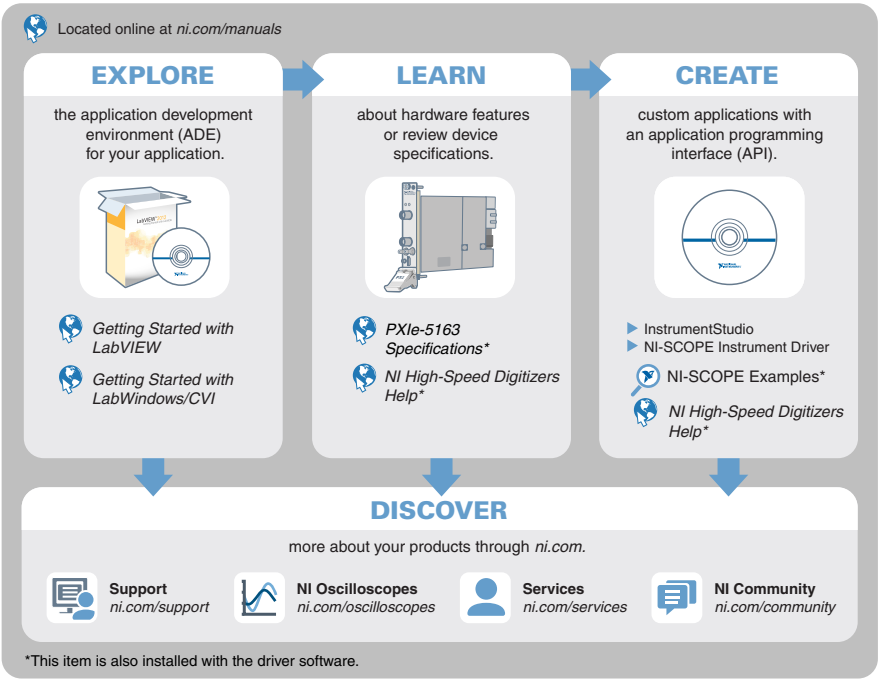
   Note If you are using a PC with a device for PXI remote control system, under **System Devices**, also confirm that no error conditions appear for the **PCI-to-PCI Bridge**.

   b) If error conditions appear, reinstall NI-SCOPE and the PXIe-5163.

What Should I Do if the PXIe-5163 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.

Where To Go Next



Worldwide Support and Services

The NI website is your complete resource for technical support. At *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* for information about the services NI offers.

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