



National Instruments PXIe-5111 Manual  
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## GETTING STARTED GUIDE

# PXIe-5110/5111/5113

PXIe; 100 MHz, 350 MHz, or 500 MHz; 1 GS/s or 3 GS/s; 8-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-5110/5111/5113. The PXIe-5110, PXIe-5111, and PXIe-5113 are 8-bit oscilloscopes with respective bandwidth and maximum sample rates of 100 MHz, 1 GS/s; 350 MHz, 3 GS/s; and 500 MHz, 3 GS/s.

Documentation for the PXIe-5110/5111/5113 is available from the **Start** menu by navigating to **NI-SCOPE Documentation** in the **National Instruments** folder.



**Caution** You can impair the protection provided by the PXIe-5110/5111/5113 if you use it in a manner not described in this document.

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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).

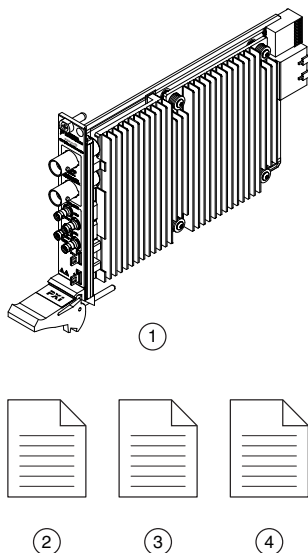
## Unpacking the Kit

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Refer to the following figure to identify the contents of the PXIe-5110/5111/5113 kit.

**Figure 1.** PXIe-5110/5111/5113 Kit Contents

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- 
- |   |  |
|---|--|
| 1. PXIe-5110, PXIe-5111, or PXIe-5113   | 3. PXIe-5110/5111/5113 Getting Started Guide (this document) |
| 2. PXIe-5110, PXIe-5111, or PXIe-5113 Safety, Environmental, and Regulatory Information | 4. Maintain Forced-Air Cooling 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

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There are several required items not included in your PXIe-5110/5111/5113 kit that you need to operate the PXIe-5110/5111/5113. Your application may require additional items not included in your kit to install or operate your PXIe-5110/5111/5113.

### 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)
- HD-BNC (m)-to-BNC (m) cable, 1 m, 50  $\Omega$  impedance (NI part number 784996-01)
- Probes: refer to the following table for single-ended passive probes recommended for the PXIe-5110/5111/5113.

**Table 1.** Probe Options for the PXIe-5110/5111/5113

Module	Recommended Probe <sup>1</sup>	NI Part Number	Description
PXIe-5110	SP200B	780284-01	200 MHz, $\pm 60$ V, 1x or 10x attenuation
PXIe-5111 PXIe-5113	SP500X	783629-01	500 MHz, $\pm 300$ V, 10x attenuation

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

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<sup>1</sup> The recommended probe is based on module bandwidth. You can use either probe with any PXIe-5110/5111/5113 module.

# Preparing the Environment

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Ensure that the environment in which you are using the PXIe-5110/5111/5113 meets the following specifications.

## Temperature

Operating	0 °C to 55 °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 (at 25 °C ambient temperature)

Indoor use only.

# Installing the Software

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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 by clicking **Download** and then running the executable (.exe) file.

Driver support for the PXIe-5110/5111/5113 was first available in NI-SCOPE 18.6.

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-5110/5111/5113

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**Notice** To prevent damage to the PXIe-5110/5111/5113 caused by ESD or contamination, handle the module using the edges or the metal bracket.

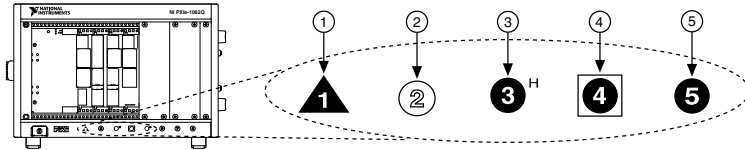
1. Ensure the AC power source is connected to the chassis before installing the module.

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**

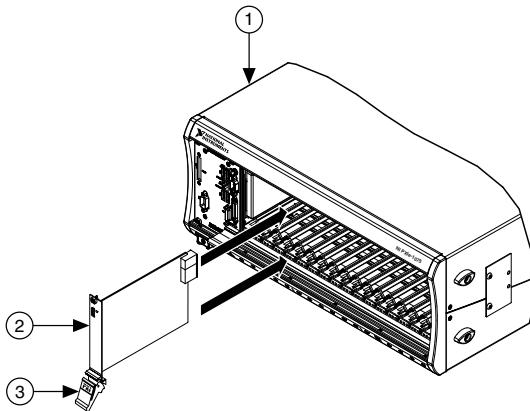


- |                                       |                                   |
|---------------------------------------|-----------------------------------|
| 1. PXI Express System Controller Slot | 4. PXI Express System Timing Slot |
| 2. PXI Peripheral Slot                | 5. PXI Express Peripheral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

PXIe-5110/5111/5113 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.

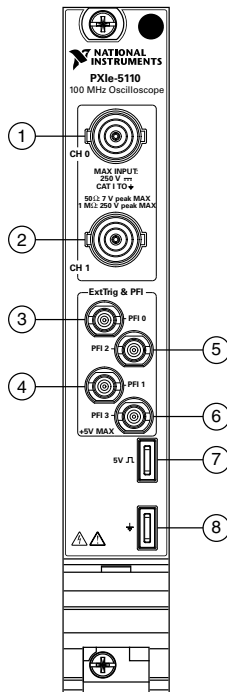
- Secure the module front panel to the chassis using the front-panel mounting screws.



**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.

## PXIe-5110/5111/5113 Front Panel



**Table 2.** Signal Descriptions

	Signal	Connector Type	Description
1	CH 0	BNC female	Analog input connection; digitizes data and triggers acquisitions.
2	CH 1		

**Table 2.** Signal Descriptions (Continued)

	Signal	Connector Type	Description
3	PFI 0	HD-BNC female	PFI line for digital trigger input/output.
4	PFI 1		
5	PFI 2		
6	PFI 3		
7	5 V square wave	Probe compensation terminal	Generates a 5 V square wave for passive probe compensation.
8	Ground	Probe compensation terminal	Ground reference for passive probe compensation.

## Configuring the PXIe-5110/5111/5113 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-5110/5111/5113.
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-5110/5111/5113 Self-Calibration

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You can self-calibrate the PXIe-5110/5111/5113 to mitigate measurement error.

Self-calibrating the PXIe-5110/5111/5113 corrects for the following:

- Gain errors
- Offset errors
- Interleaving spurs
- Intermodule synchronization errors

## Self-Calibrating the PXIe-5110/5111/5113

Running self-calibration enables the PXIe-5110/5111/5113 to yield full performance over its operating temperature range and two-year external calibration cycle.

Before running self-calibration, warm up the PXIe-5110/5111/5113 for 15 minutes.



**Note** Warm-up begins after the chassis and controller or PC is powered.

PXIe-5110/5111/5113 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 any module in the chassis is installed, uninstalled, or moved
- When the controller or PC wakes from sleep or hibernate, is reset, or is power cycled
- To periodically adjust for small performance drifts that occur with product aging
- When the system temperature changes more than  $\pm 5$  °C from the temperature of the previous self-calibration
- Once 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-5110/5111/5113 programmatically in NI-SCOPE or on demand in MAX.


Option	Description
<b>NI-SCOPE</b>	Use the Self Calibrate node to self-calibrate the module.
<b>MAX</b>	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

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## 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-5110/5111/5113 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.

## 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.



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

The PXIe-5110/5111/5113 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. Connect the ground clip of the probe to the ground terminal on the front of the oscilloscope.

3. Contact the tip of the probe to the 5 V square wave terminal on the front of the oscilloscope.



**Note** The probe compensation signal at this terminal is activated by default on the PXIe-5110/5111/5113. You can disable and re-enable the signal in InstrumentStudio with the **Probe Compensation** options in the instrument

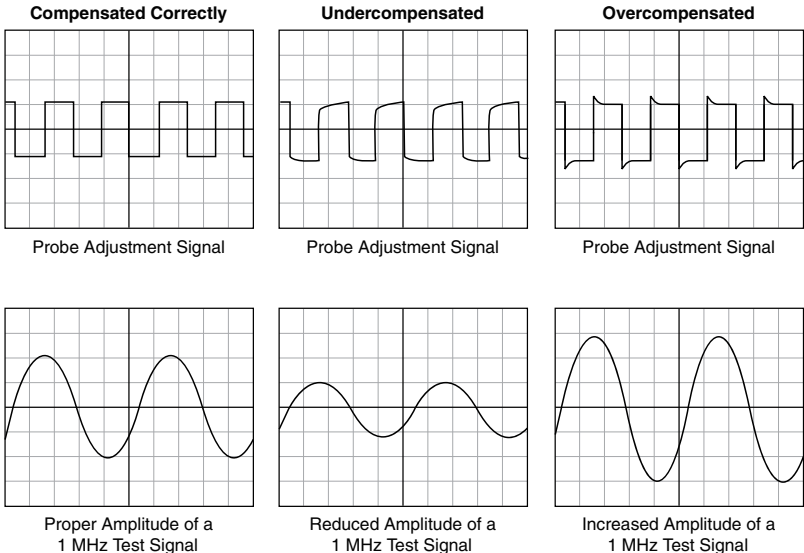
header menu () in the upper-right corner of the panel or programmatically in NI-SCOPE with Probe Compensation Signal Stop and Probe Compensation Signal Start.

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) Set the **Vertical offset** to 2.5 V.
  - d) 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-5110/5111/5113

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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-5110/5111/5113 Programming Options**

Application	Location	Description
InstrumentStudio	<p>Available on 64-bit systems at any of the following locations:</p> <ul style="list-style-type: none"> <li>• From the Windows start menu at <b>Start»All Programs»National Instruments»NI-SCOPE»NI-SCOPE Soft Front Panel</b>.</li> <li>• From the Windows start menu at <b>Start»All Programs»National Instruments»InstrumentStudio [year]</b>.</li> <li>• From Measurement &amp; Automation Explorer (MAX) by selecting a device and clicking <b>Test Panels....</b></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.</p> <p>InstrumentStudio is a software-based front panel application that allows you to perform interactive measurements on several different device types, including oscilloscopes, in a single program.</p>
NI-SCOPE Instrument Driver	<p>LabVIEW—Available on the LabVIEW Functions palette at <b>Measurement I/O»NI-SCOPE</b>.</p>	<p>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.</p>
	<p>C or LabWindows/CVI—Available at <b>Program Files»IVI Foundation»IVI»Drivers»niScope</b>.</p>	
	<p>Microsoft Visual C/C++—Use examples located in the file directory <code>Users\Public\Documents\National Instruments\NI-SCOPE\examples</code>.</p>	

# 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-5110/5111/5113 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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Windows 10/8.1	Right-click the Start button, and select <b>Device Manager</b> .
----------------	--

Windows 7	Select <b>Start»Control Panel»Device Manager</b> .
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5. Verify the PXIe-5110/5111/5113 appears in the Device Manager.
  - a) Under an NI entry, confirm that a PXIe-5110/5111/5113 entry appears.



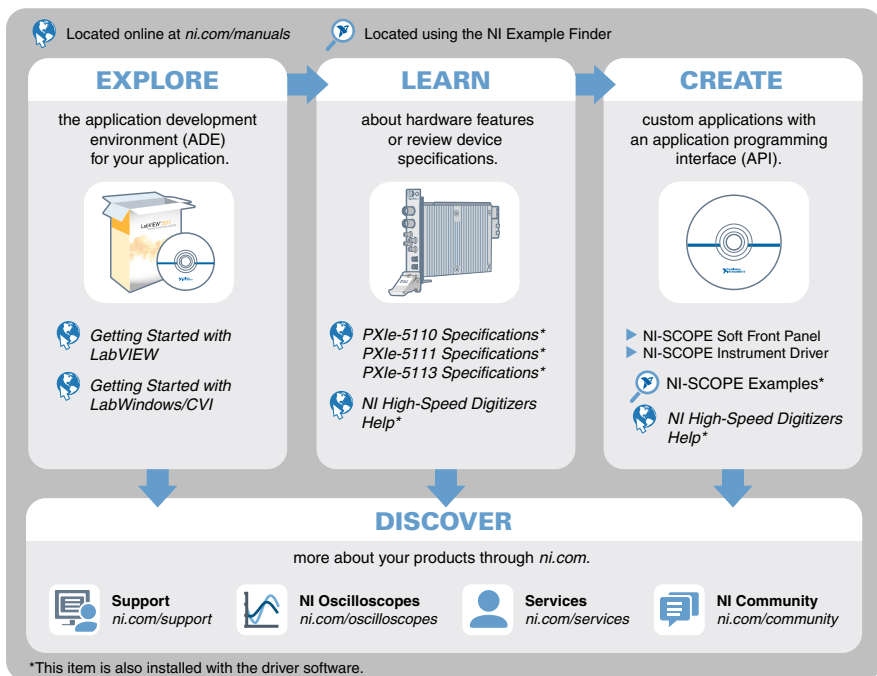
**Note** If you are using a PC with a device for PXI remote control system, under **System Devices**, also confirm that no error conditions appear for the **PCI-to-PCI Bridge**.

- b) If error conditions appear, reinstall NI-SCOPE and the PXIe-5110/5111/5113.

## What Should I Do if the PXIe-5110/5111/5113 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](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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