

# GETTING STARTED GUIDE

# NI Signal Generators

This document explains how to install, configure, and test National Instruments signal generators to generate various waveforms. This document applies to the NI 5401, NI 5404, NI 5411, NI 5421, NI 5422, NI 5431, and NI 5441.

For more information about the device, such as features and programming, refer to the *NI Signal Generators Help* at **Start»Programs»National Instruments»NI-FGEN»Documentation»NI Signal Generators Help**. For the NI signal generator specifications, refer to the specifications document included with the device.

For free downloads of the most current versions of documentation, visit [ni.com/manuals](http://ni.com/manuals). For the most current example programs, visit [ni.com/modularinstruments](http://ni.com/modularinstruments). For the latest version of NI-FGEN, visit [ni.com/idnet](http://ni.com/idnet).

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## Conventions

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The following conventions are used in this manual:

- »           The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
- ◆           The ◆ symbol indicates that the following text applies only to a specific product, a specific operating system, or a specific software version.
-            This icon denotes a tip, which alerts you to advisory information.
-            This icon denotes a note, which alerts you to important information.
-            This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash. When this symbol is marked on the hardware product, refer to the *Read Me First: Safety and Radio-Frequency Interference*, included with the device, for precautions to take.
- bold**           Bold text denotes items that you must select or click in the software, such as menu items and dialog box options.

device	Refers to an NI PXI/PCI-5401, NI PXI-5404, NI PXI/PCI-5411, NI PXI/PCI-5421, NI PXI/PCI-5422, NI PXI/PCI-5431, or NI PXI-5441.
<i>italic</i>	Italic text denotes emphasis or a cross reference.
monospace	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for disk drives, paths, directories, fuctions, filenames, and extensions.
<i>monospace italic</i>	Italic text in this font denotes text that is a placeholder for a word or value that you must supply.
NI signal generator(s)	Refers to an NI PXI/PCI-5401, NI PXI-5404, NI PXI/PCI-5411, NI PXI/PCI-5421, NI PXI/PCI-5422, NI PXI/PCI-5431, or NI PXI-5441.

## 1. Verifying System Requirements

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To use your NI signal generator and NI-FGEN, your system must meet the listed *Minimum System Requirements* and must have one of the listed operating systems installed. For optimal performance, your system should meet the *Recommended System Requirements*. If you are developing applications, you need one of the listed [Application Development Environments](#) (ADEs) along with its documentation.

### Minimum System Requirements

- Processor—Pentium III 600 MHz or equivalent
- RAM—128 MB
- Microsoft Internet Explorer 5.5 or later
- A screen resolution of 800 × 600 with 256 colors
- One of the following operating systems:
  - Windows 2000
  - Windows NT
  - Windows XP

### Recommended System Requirements

- Processor—Pentium 4 or equivalent
- RAM—256 MB
- A screen resolution of 1024 × 768

# Application Development Environments

- NI LabVIEW 6.1 or later
- NI LabVIEW Real-Time Module 7.1 (NI 5404/5421/5422/5441 only)
- LabWindows™/CVI™ 5.5 or later
- Measurement Studio 6.0 or later
- Microsoft Visual C++ (MSVC) 6.0 or later
- Microsoft Visual Basic 6.0
- Borland-compliant C compilers

## 2. Unpacking

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NI signal generators ship in an antistatic envelope to prevent electrostatic damage. Electrostatic discharge (ESD) can damage several components on the device.



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

To avoid damage in handling the device, take the following precautions:

- Ground yourself using a grounding strap or by touching a grounded object.
- Touch the antistatic package to a metal part of your computer chassis *before* removing the device from the package.

Remove the device from the envelope and inspect it for loose components or any sign of damage. Notify NI if the device appears damaged in any way. Do *not* install a damaged device into your computer.

Store the device in the antistatic envelope when not in use.

### 3. Verifying the Kit Contents

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The following items are included in your NI signal generator kit:

- NI signal generator
- BNC cable (for use with PXI devices only)
- NI-FGEN instrument driver DVD case, which contains the following items:
  - NI-FGEN CDs
  - *NI Signal Generators Getting Started Guide*
  - *NI-FGEN Quick Reference Guide*
- Other included documents:
  - The specifications document for the NI signal generator
  - *Read Me First: Safety and Radio-Frequency Interference*
  - NI 5421/5422/5441—*Maintain Forced-Air Cooling Note to Users*



**Note** NI 5431 users also receive the NI Composite Video Generator CD in their kit.

### Other Required Items

In addition to the items contained in the kit, you need the following items:

- 1/8 in. flathead screwdriver
- Cables appropriate for use with your device
- One of the following items:
  - For PXI devices—A PXI chassis, a PXI/SCXI combination chassis, or a PXI/CompactPCI chassis, controller, and chassis documentation



**Note** If your application uses NI-TClk synchronization, you must use a PXI chassis. You cannot use a CompactPCI chassis that is not also a PXI chassis. Refer to **NI Signal Generators Help» Programming»NI-TClk Synchronization Help** for more information.

- For PCI devices—A desktop computer with its documentation

## 4. Installing the Software

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The NI-FGEN CD, included with your device, installs the instrument driver for all NI signal generators. Also included on the NI-FGEN CD is the FGEN Soft Front Panel (SFP), which is an easy interactive tool that helps you begin working with the NI signal generator quickly.

To install NI-FGEN, complete the following steps:

1. (Optional) Install an ADE, such as NI LabVIEW or LabWindows/CVI, if you are developing an application for the NI signal generator.
2. Insert the NI-FGEN CD into the CD drive, and follow the instructions in the installation window.



**Note** If the installation window does not appear, navigate to the CD drive, double-click the drive, and double-click `setup.exe`.

3. When the installer completes, a dialog box appears that asks if you want to restart, shut down, or exit.
4. If you are using a system running the LabVIEW Real-Time Module, restart. Download NI-FGEN to the target using Measurement & Automation Explorer (MAX). Refer to the *Measurement & Automation Explorer Remote Systems Help* by selecting **Help»Help Topics»Remote Systems** in MAX.
  - If you are using an NI 5421/5422/5441, select standard NI-FGEN when downloading to the target.
  - If you are using an NI 5404, select NI-FGEN (NI 5404 version) when downloading to the target.
5. For NI 5431 devices only, complete the following steps:
  - a. Insert the NI Composite Video Generator CD into the CD drive.
  - b. Click **Install** in the installation window that appears, and follow the instructions in the dialog boxes.

## 5. Installing the Hardware

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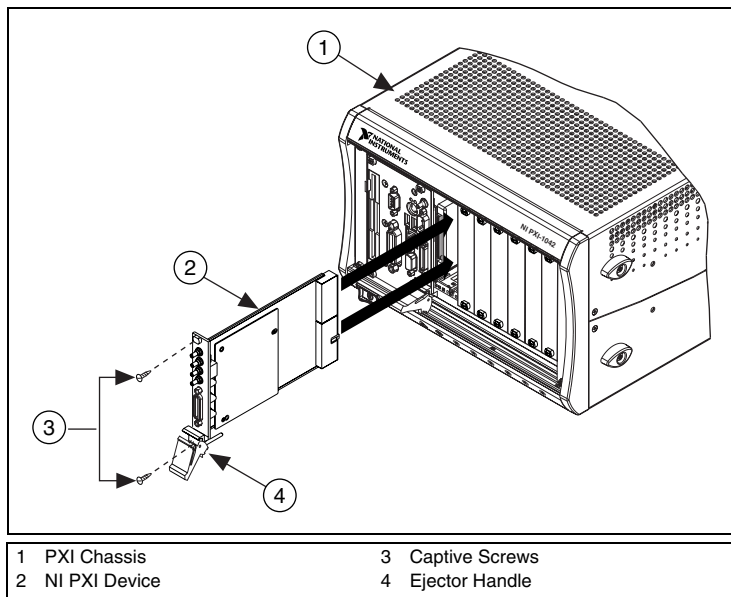
To prevent damage to the device caused by ESD or contamination, handle the device using the edges or the metal bracket. Refer to the *Read Me First: Safety and Radio-Frequency Interference* for more information.

- ◆ NI 5421/5422/5441—To ensure optimal forced-air cooling, refer to the guidelines in the *Maintain Forced-Air Cooling Note to Users* included in the NI signal generator kit.

## Installing PXI Devices

To install the device in either a PXI chassis, a PXI/SCXI combination chassis, or a PXI/CompactPCI chassis, complete the following steps:

1. Power off and unplug the PXI chassis.
2. Refer to Figure 1 to insert the device into an available PXI slot until the ejector handle locks in the up position, and tighten the captive screw(s).



**Figure 1.** PXI Installation

3. Verify that the PXI chassis fans are operable and free of dust and other contaminants restricting airflow.
4. Plug in and power on the PXI chassis.

## NI PXI-5421/5422/5441 Cooling Considerations



**Caution** When installing the NI PXI-5421/5422/5441, follow the guidelines in the *Maintain Forced-Air Cooling Note to Users* included in the NI 5421/5422/5441 kit to ensure that the device is cooled effectively.

If the device temperature rises above the maximum operating temperature, the device shuts down and MAX or NI-FGEN notifies you with an error message. To re-enable the device after thermal shutdown, perform a hard reset, using one of the following methods:

- Power off the chassis that contains the device.
- Call `niFgen_resetDevice` (niFgen Reset Device VI) or perform a device reset in MAX. For more information on resetting a device in MAX, go to **Help»Help Topics»NI-DAQmx»Measurement & Automation Explorer Help for NI-DAQmx**, which is available within MAX.

Review the guidelines in the *Maintain Forced-Air Cooling Note to Users* and make any necessary adjustments. The thermal shutdown error is reported until the device is successfully reset.

## Uninstalling PXI Devices

When removing PXI devices from the chassis, ensure that you are grounded with a grounding strap or are touching a grounded metal surface. To avoid ESD, do *not* touch the exposed connector pins or any exposed circuitry on the device. When not in use, PXI devices should be stored in the original antistatic envelope to avoid damage.



**Caution** During operation, the metal surfaces of PXI devices may become hot. Be careful when removing the device from the chassis or when moving it to a different peripheral slot. When removing the device, hold it by the ejector handle and front panel *only*.

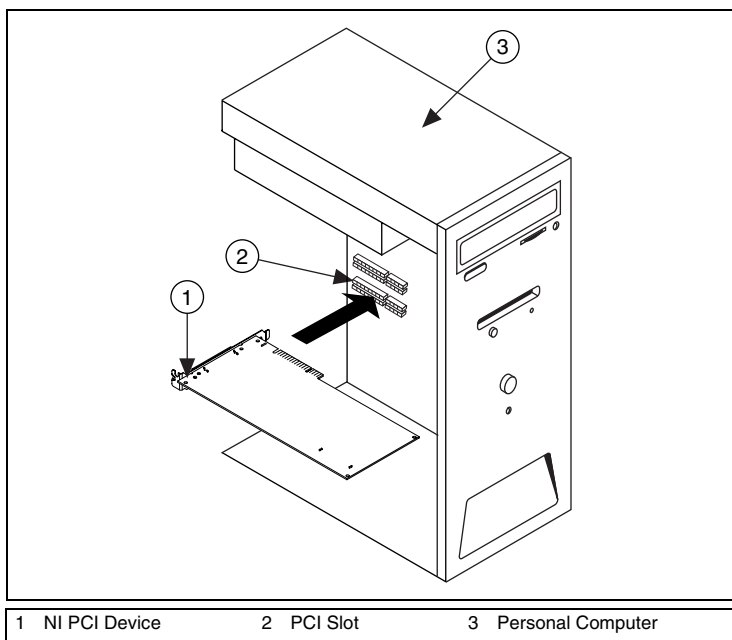
## Installing PCI Devices

To install the PCI device, complete the following steps:

1. Power off and unplug the PC.
2. Remove the PC cover.



3. Insert the device into an open PCI slot as shown in Figure 2.



**Figure 2.** PCI Installation



**Tip** To maximize airflow and extend the life of the device, leave any adjacent PCI slots empty.

4. Secure the device with a screw.



**Caution** It is important to completely screw the device into the PCI slot both for mechanical stability and to create a solid ground connection, which will reduce electrical noise. Improperly secured devices may affect the accuracy of device specifications.

(NI PCI-5421/5422 only) Some computer manufacturers use a securing lever made of plastic to secure PCI devices; such a lever is unacceptable and *must* be removed. Use the screw provided in the kit to screw down the NI PCI-5421/5422. Otherwise, you must use a different computer chassis.

5. Replace the PC cover.
6. Plug in and power on the PC.
7. (NI PCI-5421/5422 only) If available, verify that spread-spectrum clocking is enabled in the PC BIOS. Refer to the PC user documentation for information about how to verify this setting.



**Caution** Spread-spectrum clocking varies the clock signal to spread the timing clock signal over a small frequency range. Disabling spread-spectrum clocking may affect the accuracy of the NI PCI-5421/5422 specifications.

## NI PCI-5421/5422 Cooling Considerations



**Caution** When installing the NI PCI-5421/5422, follow the guidelines in the *Maintain Forced-Air Cooling Note to Users* included in the NI 5421/5422 kit to ensure that the device is cooled effectively.

If the device temperature rises above the maximum operating temperature, the device shuts down and MAX or NI-FGEN notifies you with an error message. To re-enable the device after thermal shutdown, you must perform a hard reset, using one of the following methods:

- Power off the chassis that contains the device.
- Call `niFgen_resetDevice` (niFgen Reset Device VI) or perform a device reset in MAX. For more information on resetting a device in MAX, go to **Help»Help Topics»NI-DAQmx»Measurement & Automation Explorer Help for NI-DAQmx**, which is available within MAX.

Review the guidelines in the *Maintain Forced-Air Cooling Note to Users* and make any necessary adjustments. The thermal shutdown error is reported until the device is successfully reset.

## 6. Configuring and Testing in MAX

To configure and test your device, complete the following steps:

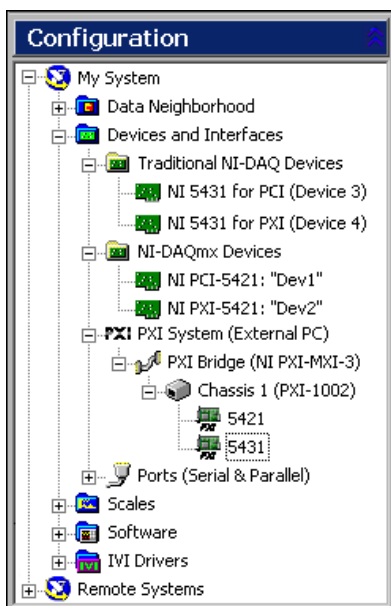
1. Launch MAX. MAX automatically detects the installed device.
2. Expand **Devices and Interfaces**.

If you are using a NI 5421/5422/5441 with the LabVIEW Real-Time Module, expand **Remote Systems**. Find your target IP address or name, expand it, and then expand **Devices and Interfaces**.



**Note** Only NI-DAQmx devices are listed under **Remote Systems» Devices and Interfaces**.

- ◆ NI 5404 in the LabVIEW Real-Time Module—In the LabVIEW Real-Time Module, an NI 5404 does not appear in the configuration tree. Instead, in MAX select **Tools»Traditional NI-DAQ Configuration»Remote DAQ Configuration**, and enter the IP address or name of the target.
3. Check that your signal generator appears under Devices and Interfaces.



**Figure 3.** MAX Configuration Tree



**Note** If you do not see the device listed, press <F5> to refresh. If the device is still not listed, repeat the steps in the [5. Installing the Hardware](#) section. For more information about using MAX, refer to the available help files within MAX.

4. Right-click your NI signal generator in the list, and select **Properties** to launch the Configuring Device window.
5. Record the device number or device name assigned to the device. You need this number when programming the device.

- ◆ **Traditional NI-DAQ (NI 5401/5404/5411/5431)**—Select the device to see its properties in the configuration view. The device number appears in the Value column. When developing your application, the resource name for your device is DAQ : : *n*, where *n* is the device number MAX assigned to your device.
- ◆ **NI-DAQmx (NI 5421/5422/5441)**—The assigned device name is appended to the device in its configuration tree label. For example, after installing the NI 5421, the device configuration tree label may appear as NI PXI-5421 : "Dev1", where *Dev1* is the device name. When developing your application, the resource name for your device is the device name MAX assigned to the device.



**Note** To avoid modifying existing applications that use a Traditional NI-DAQ device number, change the assigned NI-DAQmx device name. To change an NI-DAQmx device name, right-click the device, select **Rename**, and enter the Traditional NI-DAQ device number used in your application. For more information about device naming conventions, refer to the NI-FGEN Initiate VI at **NI Signal Generators Help»Programming»NI-FGEN Help»NI-FGEN LabVIEW VI Reference Help** or to the `niFgen_init` function at **NI Signal Generators Help»Programming»NI-FGEN Help»NI-FGEN C Function Reference Help**.

6. Perform a device self-test to verify installation.
  - ◆ **Traditional NI-DAQ**—Right-click the device, select **Properties**, and click **Test Resources**.
  - ◆ **NI-DAQmx**—Right-click the device and select **Self-Test**.  
A dialog box appears and indicates whether the device passed the test.



**Note** If the device does not pass the test, repeat the steps in the [5. Installing the Hardware](#) section. If the device still does not pass the test, visit NI Technical Support at [ni.com/support](http://ni.com/support).



**Note** If you are using the MXI-3 interface to control a PXI chassis, the MXI-3 Optimization Application must be run prior to using the NI signal generator. By default, this application runs automatically when Windows starts. If you have an initialization or performance issue with your module, or if you are not certain that the application ran, select **Start»Programs»National Instruments MXI-3»MXI-3 Optimization** to run the application. If you continue to have initialization or performance issues, refer to the MXI-3 documentation at **Start»Programs»National Instruments MXI-3**, or visit NI Technical Support at [ni.com/support](http://ni.com/support).

7. Click **Close** when you have finished testing the device.
8. Click **OK** in the Configuring Device window.
9. Exit MAX.

## Synchronizing NI-DAQmx Devices in MAX



**Note** The following step is required for any type of synchronization involving an NI-DAQmx device, including NI-TClk synchronization. For information about NI-TClk synchronization, refer to **NI Signal Generators Help»Programming»NI-TClk Synchronization Help**.

If you plan to share triggers or clocks for the purpose of synchronizing NI-DAQmx devices (for example, the NI 5421/5422/5441), you must identify or configure certain components in MAX.

- ◆ For PXI devices, you must identify the PXI system controller by completing the following steps:
  1. In the MAX configuration tree under Devices and Interfaces, right-click **PXI System»Identify As** and select your controller from the list. For example, select **External PC** if you are using a MXI-3 controller in an external PC.
  2. Expand the PXI System tree and select the name of the chassis to identify the chassis you are using.
- ◆ For PCI devices, you must configure the RTSI cable by completing the following steps:
  1. Connect a RTSI cable between the PCI devices to physically share triggers or clocks.
  2. In the MAX configuration tree under Devices and Interfaces, right-click **NI-DAQmx Devices**.
  3. Select **Create New NI-DAQmx Device»RTSI Cable**.

# 7. Generating Waveforms

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You can control your signal generator programmatically with an ADE using the supplied NI-FGEN Interchangeable Virtual Instrument (IVI) driver. You can control your signal generator interactively using the FGEN SFP. NI 5431 users can use the NI Composite Video Generator in LabVIEW.

## Generating Waveforms Programmatically

You can use NI-FGEN to program the signal generators in your ADE. Programming examples for using NI-FGEN with LabVIEW, CVI, and C are located at **Start»Programs»National Instruments»NI-FGEN»Examples**.

For more information about programming with NI-FGEN, refer to the *NI Signal Generators Help* at **Start»Programs»National Instruments»NI-FGEN»Documentation**.

## Generating Waveforms Interactively with the FGEN Soft Front Panel

To interactively generate waveforms, use the FGEN Soft Front Panel (SFP).

- ◆ NI 5431—In addition to generating waveforms with the NI 5431, you can also generate video signals using the NI Video Generator Wizard. To generate a video signal with the NI 5431, complete the steps in the [Generating a Video Signal \(NI 5431 only\)](#) section of this document.

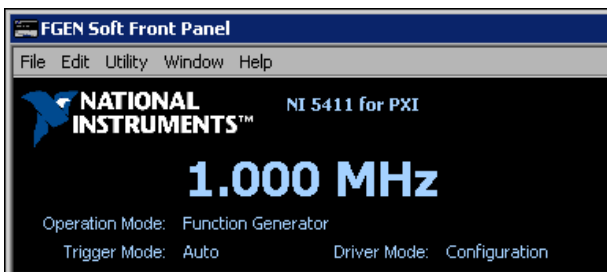
## Generating a Standard Waveform

- ◆ To generate a standard waveform, complete the following steps:
  1. Launch MAX.
  2. Verify that the device you want to test appears under Devices and Interfaces.



**Note** If the device is not in the Devices and Interfaces list, press <F5> to refresh. If the device is still not in the list, repeat the steps in the [6. Configuring and Testing in MAX](#) section.

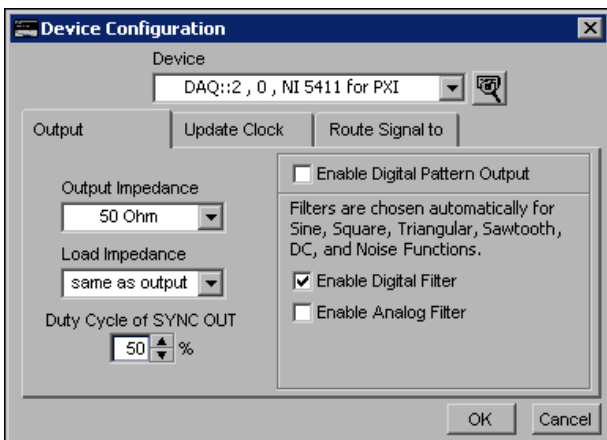
3. Launch the FGEN SFP by one of the following methods:
  - Select **Start»Programs»National Instruments»NI-FGEN»FGEN Soft Front Panel**.
  - Select **Tools»Soft Front Panels»NI-FGEN Soft Front Panel** from the menu bar in MAX.
4. Verify that the device appears on the FGEN SFP display, as shown in Figure 4.





**Figure 4.** FGEN SFP Display with the NI PXI-5411 Selected



**Note** If the device is not listed, or if you have more than one type of NI signal generator installed, select **Edit»Device Configuration**. In the Device Configuration dialog box, shown in Figure 5, click the Device drop-down listbox arrow, and select the device from the list. Click **OK** to close the Device Configuration dialog box.



**Figure 5.** Device Configuration Dialog Box

5. Verify that the Standard Function mode button  is selected.
6. Select the frequency, amplitude, offset, and type of waveform that you want to generate.
7. Click the run button  to initiate waveform generation.

The FGEN SFP default settings instruct the signal generator to generate a continuous sine wave at a frequency of 1 MHz, with a peak-to-peak amplitude of 1 V into a 50  $\Omega$  load, and no offset. Adjust the sine waveform settings in the FGEN SFP to match your needs. For more information about the FGEN SFP, select **Help»FGEN SFP Help** or **Help»Show Context Help**. For device-specific help, select **Help»Hardware-Specific Help**.

## Generating an Arbitrary Waveform

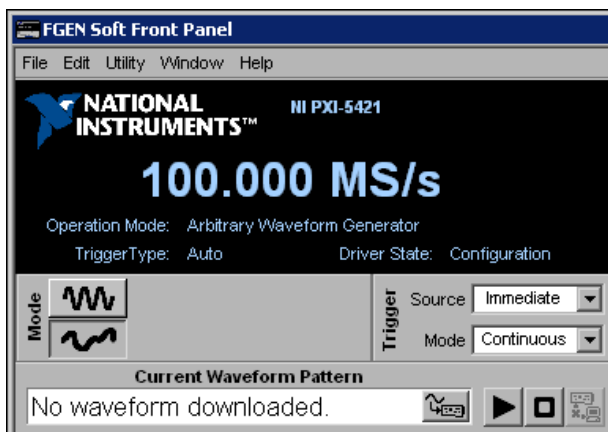
◆ NI 5411/5421/5422/5431/5441—To generate an arbitrary waveform with your device, complete the following steps:

1. Launch MAX.
2. Verify that the device you want to test appears under Devices and Interfaces.



**Note** If the device is not listed under Devices and Interfaces, press <F5> to refresh. If the device is still not listed, repeat the steps in the [6. Configuring and Testing in MAX](#) section.

3. Select **Start»Programs»National Instruments»NI-FGEN»FGEN Soft Front Panel**.
4. Verify that the device you installed appears on the FGEN SFP display. Select the single arbitrary waveform output button, as shown in Figure 6.



**Figure 6.** FGEN SFP Display with NI PXI-5421 Selected



**Note** If the device is not listed, or if you have more than one type of NI signal generator installed, select **Edit»Device Configuration**. In the Device Configuration dialog box, shown in Figure 5, click




the Device drop-down listbox arrow, and select the device from the list. Click **OK** to close the Device Configuration dialog box.

- To download a waveform to the device onboard memory, click the Current Waveform Pattern button, select **New Waveform**, and click **Next**. The File Load dialog box and Select File window both open. The Select File window displays waveform example files.



**Note** You also can download a waveform by selecting **File»Load New Waveform** and clicking **Next**. The default location for example waveforms is `\ProgramFiles\IVI\Drivers\niFgen\Examples\Waveforms`.

- Select **File** and click **Next**.
- Select `arbMode-sine.lvm` and click **OK**. A preview of the waveform launches. You can close or minimize the Waveform Preview window.
- In the File Load dialog box, select one of the following settings from the **Waveform** drop-down listbox:
  - ◆ NI PXI-5411/5431—sine, 16 MHz @ 40 MS/s
  - ◆ NI PXI-5421/5422/5441—sine, 40 MHz @ 100 MS/s
- Click **OK**.
- Click the run button  to initiate waveform generation. To optimize the sine wave shape, select **Edit»Device Configuration**, and change the filter settings.

The FGEN SFP default settings instruct the arbitrary waveform generator to generate a continuous sine wave, with a peak-to-peak amplitude of 1 V into a 50  $\Omega$  load, and no offset. Adjust the sine waveform settings in the FGEN SFP to match your needs. For more information about the FGEN SFP, select **Help»FGEN SFP** or **Help»Show Context Help**.

## Generating a Video Signal (NI 5431 only)

To programmatically generate video signals, use the NI Composite Video Generator in LabVIEW. For information about programmatically generating video signals, refer to the *NI 5431 Composite Video Generator Help*. Access this help file by selecting **Help»NI 5431** from the LabVIEW VI menu bar.

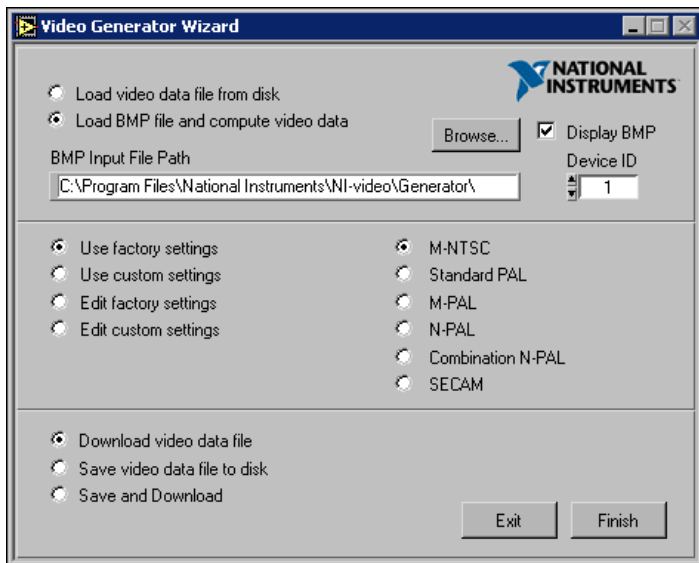
To interactively generate a video signal using the NI Video Generator Wizard, complete the following steps:

- Launch MAX.
- Verify that the device you want to test appears under Devices and Interfaces.



**Note** If the device is not listed under Devices and Interfaces, press <F5> to refresh. If the device is still not listed, repeat the steps in the *6. Configuring and Testing in MAX* section.

3. Launch the NI Video Generator Wizard, shown in Figure 7, by selecting **Start>Programs>National Instruments Composite Video Generator>Video Generator Wizard**.



**Figure 7.** NI Video Generator Wizard



**Note** To use the NI Video Generator Wizard, the LabVIEW Run-Time Engine version 5.1.1 must be installed. You can download this software at [ni.com/softlib.nsf](http://ni.com/softlib.nsf).

4. Generate a video signal based on a bitmap image using the factory settings. Refer to Figure 7 to complete the following steps:
  - a. Verify that the Device ID is set to the correct value—the device number previously configured in MAX.
  - b. Select **Load BMP file and compute video data**.
  - c. Click **Browse**.

- d. Double-click the appropriate directory from the following choices:
  - For NTSC users, double-click the 640x480 or the 1044x480 directory.
  - For PAL and SECAM users, double-click the 768x576 or the 1040x576 directory.



**Note** For information about video data file formats, refer to the *NI Signal Generators Help*.

- e. Double-click any of the example .bmp files. The bitmap image file path appears in the BMP Input File Path control box.
- f. Select **Use factory settings**. This option applies the default video parameters to the video signal you want to generate.
- g. Select **M-NTSC**, **Standard-PAL**, or **SECAM**, depending on the video format you want to generate.
- h. Select **Download video data file**. This option downloads the binary video data from your computer to the NI 5431 device.



**Note** To display the .bmp file on your computer monitor, enable **Display BMP**.

- i. Click **Finish**. The Processing dialog box appears displaying the processing status.

Based on the .bmp file you selected, the NI Video Generator Wizard calculates either NTSC, PAL, or SECAM video data, downloads the calculated data to the NI 5431 device, and automatically starts generating the video signal on the VIDEO OUT connector.

## Appendix A: Front Panels

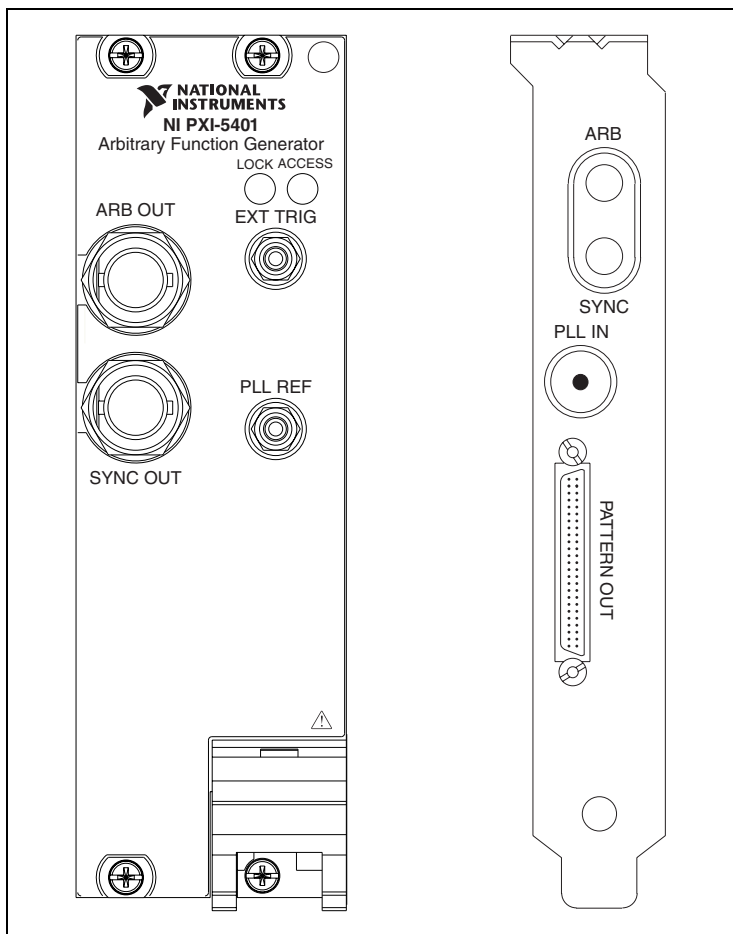
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This section contains front panel connector figures and connector description tables that describe the signal connection options for NI signal generators.

### NI PXI/PCI-5401

The NI PXI-5401 is a 16 MHz function generator for the PXI platform. The NI PXI-5401 has four connectors—two BNC connectors and two SMB connectors, as shown in Figure 8. Signal descriptions are listed in Table 1.

The NI PCI-5401 is a 16 MHz function generator for the PCI bus. The NI PCI-5401 has four connectors—three SMB connectors and one 50-pin digital connector, as shown in Figure 8. Signal descriptions are listed in Table 2.



**Figure 8.** NI PXI/PCI-5401 Front Panel Connectors

**Table 1.** NI PXI-5401 Connectors

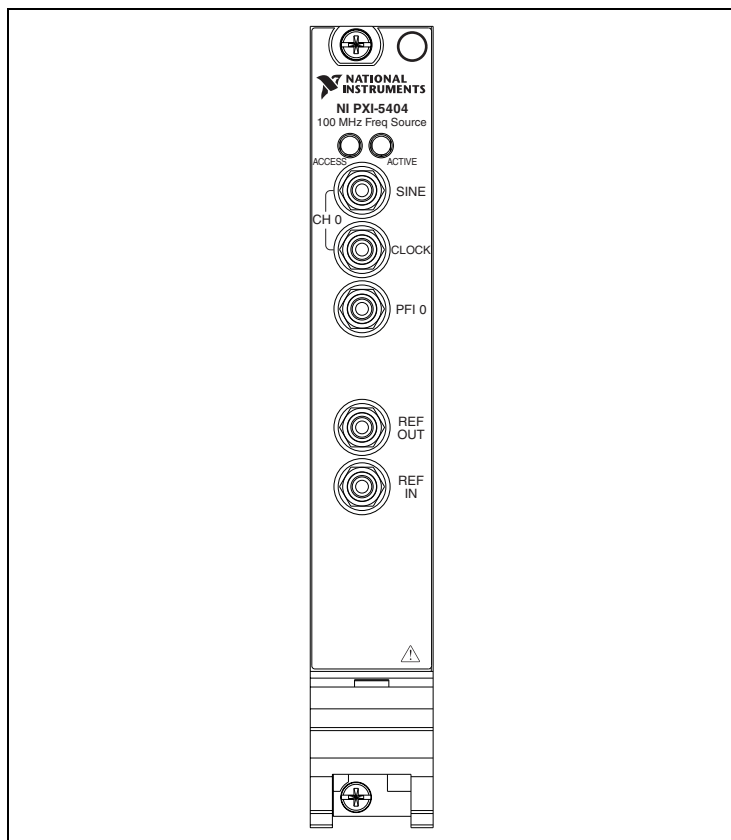
<b>Connector</b>	<b>Access</b>	<b>Function</b>
ARB OUT	Output	Provides the waveform output.
SYNC OUT	Output	Provides a TTL-level output of the waveform being generated at the ARB OUT connector.
EXT TRIG	Input	Accepts a TTL-level signal that you can use to start or step through a waveform generation.
PLL REF	Input	Accepts a PLL reference clock from an external source and can frequency lock the NI PXI-5401 internal clock to the external reference clock.

**Table 2.** NI PCI-5401 Connectors

<b>Connector</b>	<b>Access</b>	<b>Function</b>
ARB	Output	Provides the waveform output.
SYNC	Output	Provides a TTL-level output of the waveform being generated at the ARB OUT connector.
PLL IN	Input	Accepts a PLL reference clock from an external source and can frequency lock the NI PCI-5401 internal clock to the external reference clock.
PATTERN OUT	Input	Supplies the external trigger input to the device. Refer to the <i>NI Signal Generators Help</i> for connector pin assignments and signal descriptions.

## NI PXI-5404

The NI PXI-5404 is a 100 MHz frequency generator for the PXI platform. The NI PXI-5404 has five SMB connectors, as shown in Figure 9. Signal descriptions are listed in Table 3.



**Figure 9.** NI PXI-5404 Front Panel Connectors

**Table 3.** NI PXI-5404 Connectors

<b>Connector</b>	<b>Access</b>	<b>Function</b>
SINE	Output	Provides a sine waveform of the desired frequency output.
CLOCK	Output	Provides a TTL version of the sine waveform being generated at the SINE connector.
PFI 0	Input/ Output	Accepts either a TTL signal to start waveform generation, or provides an output to synchronize—or trigger—other devices at a certain time within waveform generation.
REF OUT	Output	Routes signals from the PXI backplane clock, PXI trigger lines, or a divided-down version of the internal NI 5404 clock.
REF IN	Input	Accepts a PLL reference clock from an external source and can frequency lock the NI PXI-5404 internal clock to the external reference clock.

# NI PXI-5411/5431

The NI PXI-5411 is a 40 MS/s arbitrary waveform generator for the PXI platform. The NI PXI-5431 is a video signal generator for the PXI platform. The NI PXI-5411/5431 has six connectors—two BNC connectors, three SMB connectors, and one 50-pin digital connector, as shown in Figure 10. Signal descriptions are listed in Table 4.

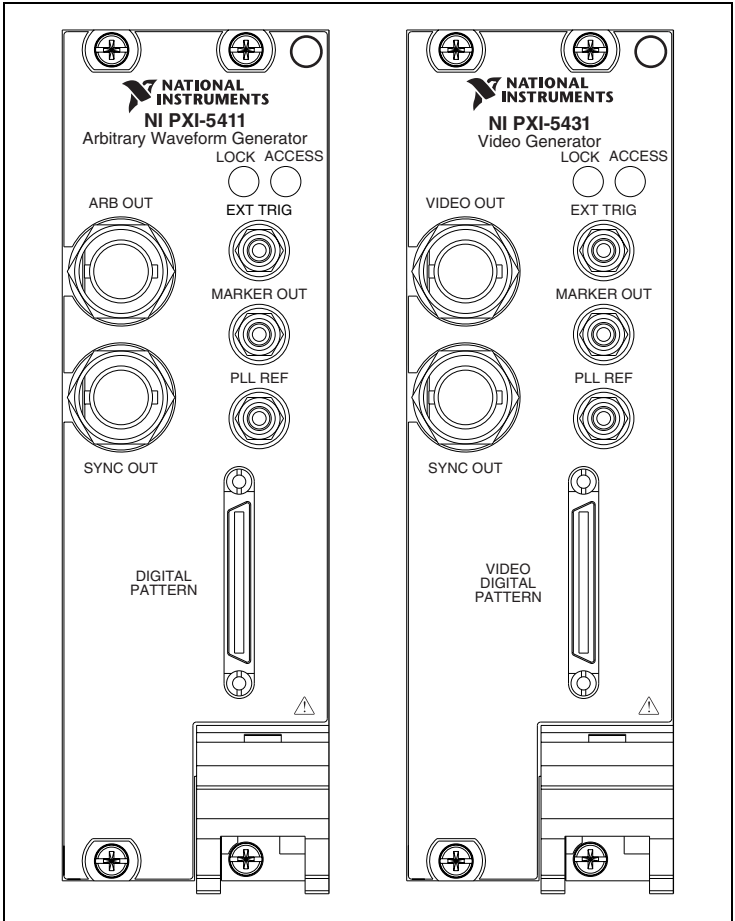


Figure 10. NI PXI-5411/5431 Front Panel Connectors

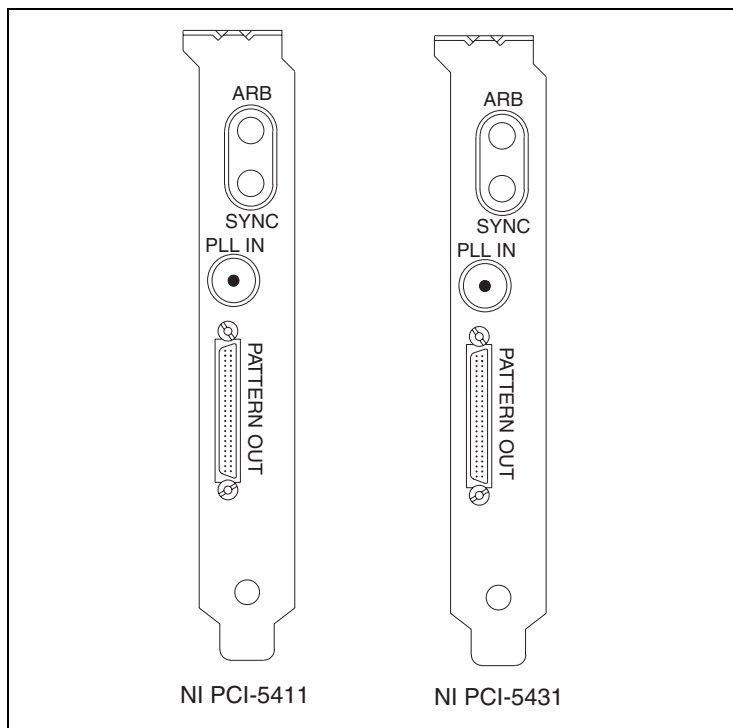


**Table 4.** NI PXI-5411/5431 Connectors

<b>Connector</b>	<b>Access</b>	<b>Function</b>
ARB OUT/ VIDEO OUT	Output	Provides the waveform output.
SYNC OUT	Output	Provides a TTL-level output of the waveform being generated at the ARB OUT connector.
EXT TRIG	Input	Accepts a TTL-level signal that you can use to start or step through a waveform generation.
MARKER OUT	Output	Sends a TTL-level signal that you can set at any point in the waveform being generated. You can use this signal to synchronize or trigger other devices at a certain time within waveform generation.
PLL REF	Input	Accepts a PLL reference clock from an external source and can frequency lock the NI PXI-5411/5431 internal clock to the external reference clock. You also can use this connector as a source of the device sample clock from an external device.
DIGITAL PATTERN/ VIDEO DIGITAL PATTERN	Input/ Output	Routes 16-bit digital pattern outputs, digital pattern clock output, marker output, external trigger input, and +5 V power output. Refer to the <i>NI Signal Generators Help</i> for connector pin assignments and signal descriptions.

## NI PCI-5411/5431

The NI PCI-5411 is a 40 MS/s arbitrary waveform generator for the PCI platform. The NI PCI-5431 is a video signal generator for the PCI platform. The NI PCI-5411/5431 has four connectors—three SMB connectors and one 50-pin digital connector, as shown in Figure 11. Signal descriptions are listed in Table 5.



**Figure 11.** NI PCI-5411/5431 Front Panel Connectors

**Table 5.** NI PCI-5411/5431 Connectors

<b>Connector</b>	<b>Access</b>	<b>Function</b>
ARB	Output	Provides the waveform output.
SYNC	Output	Provides a TTL-level output of the waveform being generated at the ARB OUT connector.
PLL IN	Input	Accepts a PLL reference clock from an external source and can frequency lock the NI PCI-5411/5431 internal clock to the external reference clock.
PATTERN OUT	Input/Output	Routes the 16-bit digital pattern outputs, digital pattern clock output, marker output, external trigger input, and +5 V power output. Refer to the <i>NI Signal Generators Help</i> for connector pin assignments and signal descriptions.

## NI PXI/PCI-5421/5422/5441

The NI 5421 is a 100 MS/s, 16-bit arbitrary waveform generator. The NI 5422 is a 200 MS/s, 16-bit arbitrary waveform generator. The NI 5441 is a 100 MS/s, 16-bit arbitrary waveform generator with onboard signal processing (OSP). These devices have five connectors—four SMB connectors and one 68-pin male VHDCI connector, as shown in Figure 12. Signal descriptions are listed in Table 6.

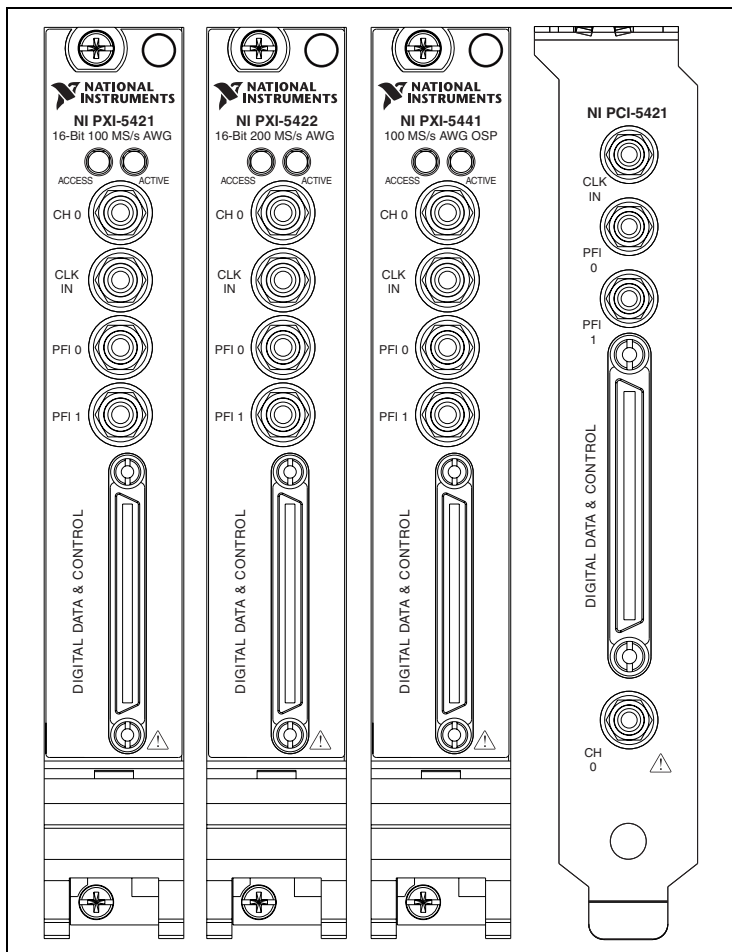


Figure 12. NI PXI/PCI-5421/5422/5441 Front Panel Connectors

**Table 6.** NI PXI/PCI-5421/5422/5441 Connectors

Connector	Access	Function
CH 0	Output	Provides the waveform output.
CLK IN	Input	Accepts a PLL reference clock from an external source and can frequency lock the NI 5421/5422/5441 internal clock to the external reference clock. The signal input onto this connector can also be used as a sample clock source for the NI 5421/5422/5441.
PFI 0	Input/Output	Accepts a trigger from an external source that can start or step through waveform generation, or can route signals out from several clock, event, and trigger sources. Refer to the <i>NI Signal Generators Help</i> for signal descriptions and routing information.
PFI 1	Input/Output	Accepts a trigger from an external source that can start or step through waveform generation, or can route signals out from several clock, event, and trigger sources. Refer to the <i>NI Signal Generators Help</i> for signal descriptions and routing information.
Digital Data & Control (DDC)	Input/Output	Routes the 16-bit digital pattern outputs, digital pattern clock output, trigger outputs, trigger inputs, and a clock input. Refer to the <i>NI Signal Generators Help</i> for connector pin assignments and signal descriptions.

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