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GETTING STARTED GUIDE
NI Signal Generators

This document explains how to install, configure, and test National Instruments signal generators for generating arbitrary and standard function waveforms. This document applies to the NI 5401, NI 5402, NI 5404, NI 5406, NI 5411, NI 5412, NI 5421, NI 5422, NI 5431, NI 5441, and NI 5442 devices.

For more information about these devices, including signal generator features and programming, refer to the *NI Signal Generators Help* at **Start»All Programs»National Instruments»NI-FGEN»Documentation**. This online document contains hardware information, concepts, a detailed VI/function reference for the NI-FGEN instrument driver, and information specific to your device. For the NI signal generator specifications, refer to the specifications document included with each device.

For free downloads of the most current versions of documentation, visit `ni.com/manuals`. For the latest version of NI-FGEN, visit `ni.com/idnet`.

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Conventions

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 hot surface, which indicates that a device may be hot. Touching the device may result in bodily injury.

	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* document 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.
italic	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, functions, filenames, and extensions.
`monospace italic`	Italic text in this font denotes text that is a placeholder for a word or value that you must supply.
Platform	Text in this font denotes a specific platform and indicates that the text following it applies only to that platform.
NI-DAQ mx devices	The NI 5402/5404/5406/5412/5421/5422/5441/5442 devices.
Traditional NI-DAQ (Legacy) devices	The NI 5401/5411/5431 devices.

1. Verifying the System Requirements

To use an NI signal generator with NI-FGEN, your system must meet certain requirements. For more information on minimum system, recommended system, and supported application development environments (ADEs), refer to the *NI-FGEN Instrument Driver Readme*, which is available on the NI-FGEN CDs.



Note After you install NI-FGEN, you can access the *NI-FGEN Instrument Driver Readme* at **Start»All Programs» National Instruments»NI-FGEN»Documentation**.

2. Unpacking

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



Caution *Never* touch the exposed pins of connectors.

To avoid damage when 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

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

- ❑ NI signal generator
- ❑ SMB-BNC cable (NI 5404/5412/5421/5422/5441/5442 only)
- ❑ NI-FGEN instrument driver DVD-sized case, which contains the following items:
  - NI-FGEN CDs, which include the *NI Signal Generators Help*
  - *NI Signal Generators Getting Started Guide*
- ❑ NI Analog Waveform Editor CD. Eligible hardware kits receive an activation license. (NI 5412/5421/5422/5441/5442 only)
- ❑ Other included documents:
  - The specifications document for the NI signal generator
  - *Read Me First: Safety and Radio-Frequency Interference*
  - *Maintain Forced-Air Cooling Note to Users* (except the NI 5401/5404/5411/5431 devices)
  - *Retrofitting Your PXI Module Note to Users*
- ❑ **(NI 5431 only)** NI Composite Video Generator CD

EMI Gasket

The NI signal generator kit may also include an EMI gasket and the *Retrofitting Your PXI Module Note to Users* that describes under what conditions you should install the gasket. Refer to the *Installing PXI Modules* section for more information about when you should install the gasket.

Other Required Items

In addition to the items contained in the kit, you need the following items to install your signal generator:

- ❑ 1/8 in. flathead screwdriver
- ❑ Cables appropriate for use with your device
- ♦ For PXI devices
  - A PXI chassis, a PXI/SCXI combination chassis, or a PXI/CompactPCI chassis and chassis documentation
  - A PXI controller or MXI bridge
- ♦ For PXI Express devices
  - A PXI Express chassis and chassis documentation
  - A PXI Express controller or a MXI-Express bridge
- ♦ For PCI devices
  - A desktop computer with its documentation

Note If your application uses NI-TClk synchronization, you must use a RTSI cable to connect the devices (PCI DAQmx devices only).

4. Installing the Software

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

To install NI-FGEN, complete the following steps:

1. (Optional) If you are developing an application for the NI signal generator, install an ADE, such as LabVIEW or LabWindows™/CVI™.
2. Insert the first CD of the NI-FGEN CD set. The NI-FGEN installer should open automatically.

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

3. Follow the instructions in the installation prompts. For installation troubleshooting information contact NI technical support or visit `ni.com/support`.

   (Windows Vista) Users may see access and security messages during installation. Accept the prompts to complete the installation.
4. When the installer completes, a dialog box appears that asks if you want to restart, shut down, or restart later. Select **Restart**.
5. If you are using a system running the LabVIEW Real-Time Module, 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.

   (NI 5431 only) Insert the NI Composite Video Generator CD into the CD drive and follow the instructions in the installation window.

5. Installing the Hardware



Caution You *must* power off and unplug the computer or chassis before installing the device.

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* document for more information about handling your device.



Note You *must* install the NI-FGEN software before installing the hardware.

Cooling Considerations for PXI and PCI Devices



Caution When installing an NI-DAQmx device (except the NI 5404), follow the guidelines in the *Maintain Forced-Air Cooling Note to Users* document included in the kit to ensure that the device is cooled effectively.

Thermal Shutdown—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. For information about the operating temperatures for your device, refer to the device specifications. To re-enable the device after thermal shutdown, you must perform a hard reset, using one of the following methods:

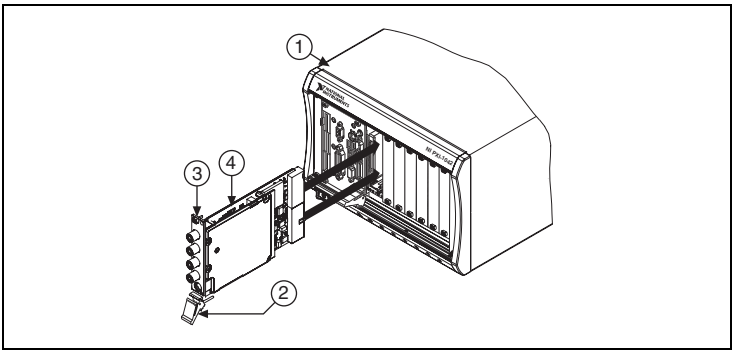
- Power off the computer or chassis that contains the device. After the device has cooled, power on the computer or chassis and reboot the controller, if necessary.
- Call the niFgen Reset Device VI or the `niFgen_ResetDevice` function.
- Perform a device reset in MAX. For more information about resetting a device in MAX, refer to *MAX Help for NI-DAQmx* by navigating to **Help»Help Topics»NI-DAQmx»MAX Help for NI-DAQmx** 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 has cooled to an acceptable operating temperature and has been reset successfully.

Installing PXI Modules

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. (Optional) If you need to use the provided EMI gasket to reduce high-frequency emissions, install it now. Refer to the *Retrofitting Your PXI Module Note to Users* for more information about installing the gasket.
3. Position the PXI chassis so that inlet and outlet vents are not obstructed. For more information, refer to the chassis documentation.
4. Make sure that the ejector handle is in the unlatched (downward) position.
5. Hold the PXI module by the ejector handle and slide it into an empty slot. Make sure that the base engages with the guides in the chassis, as shown in Figure 1.



1	PXI Chassis	3	Screws
2	Ejector Handle	4	NI PXI signal generator

Figure 1. PXI Installation

6. Slide the module completely into the chassis and latch it by pulling up on the ejector handle. Tighten the captive screws at the top and bottom of the module front panel.

Caution Performance may suffer if both screws are not tightened properly.

7. Verify that the PXI chassis fans are operable and free of dust and other contaminants restricting airflow. Refer to the *Cooling Considerations for PXI and PCI Devices* section for more information.
8. Plug in the PXI chassis.

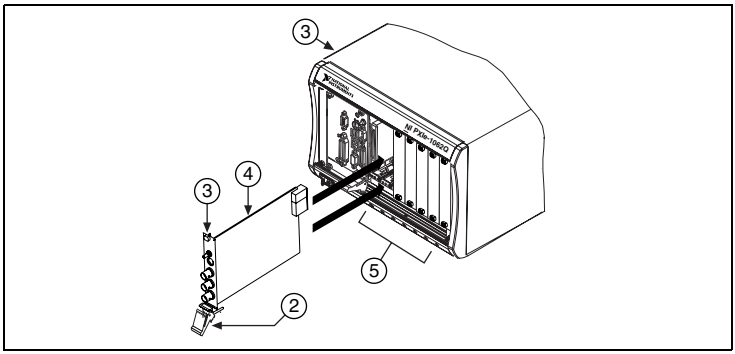
Uninstalling PXI Modules

When removing PXI modules 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.

Hot Surface 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 *only* the ejector handle and front panel.

Installing and Uninstalling PXI Express Modules

To install a PXI Express module, follow the instructions in the *Installing PXI Modules* section and install the module in a PXI Express slot of a PXI Express chassis. Refer to the chassis documentation to determine which slots are designated for PXI Express modules.



1 PXI Express Chassis	4 NI PXI Express signal generator
2 Ejector Handle	5 Chassis slot markings
3 Screws	

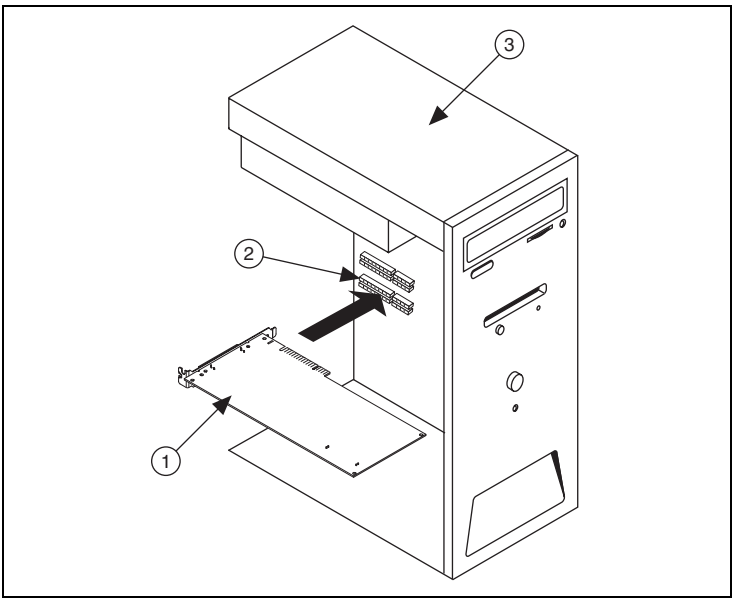
Figure 2. PXI Express Module Installation

To uninstall a PXI Express module, follow the instructions in the *Uninstalling PXI Modules* section.

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 3.



1	NI PCI Device	2	PCI Slot	3	Computer Chassis

Figure 3. 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 for a solid ground connection, which reduces electrical noise. Improperly secured devices may affect the accuracy of device specifications.

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 secure the device. Otherwise, you must use a different computer chassis.

5. Verify that the computer exhaust fans are operable and free of dust and other contaminants restricting airflow to prevent your device from overheating. Refer to the *Cooling Considerations for PXI and PCI Devices* section for more information.
6. Replace the PC cover.
7. Plug in the PC.

6. Power On Your Computer or PXI Chassis

Windows recognizes any newly installed device the first time you restart the computer after hardware is installed. On some Windows systems, the Found New Hardware wizard opens with a dialog box for every NI device installed. **Install the software automatically (Recommended)** is selected by default. Click **Next** or **Yes** to install the software for each device.

- **PXI or PXI Express devices controlled using MXI**—Power the PXI chassis before you power on the PC.
- **NI-DAQmx PCI devices**—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 if it is available.

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 signal generator specifications.

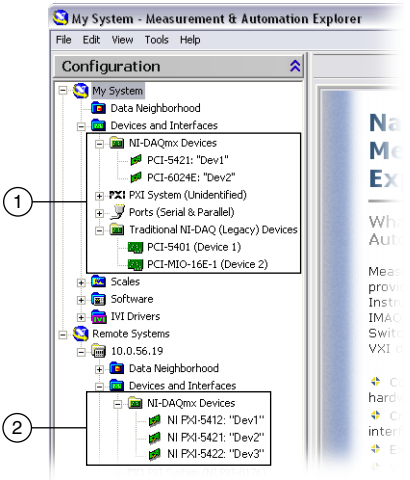
7. Configuring and Testing in MAX

Complete the following steps to configure and test your device:

1. Launch MAX.
2. In the configuration pane, double click **Devices and Interfaces** and expand the **NI-DAQmx Devices** folder.

Note If you are using a remote RT target, expand **Remote Systems**, find and expand your target, and then expand **Devices and Interfaces**.

- **NI 5401/5411/5431**—Expand **Traditional NI-DAQ (Legacy) Devices**.



1 All signal generators except the NI 5401/5411/5431 are listed under **NI-DAQmx Devices**. The NI 5401/5411/5431 are listed under **Traditional NI-DAQ (Legacy) Devices**.

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

3. Check that your device appears under **Devices and Interfaces**. If your device does not appear, press <F5> to refresh the view in MAX. If the device is still not recognized, refer to `ni.com/support`.

Note If you are using a MXI interface to control a PXI or PXI Express chassis and encounter performance or initialization issues, refer to your MXI documentation to verify the system requirements and to ensure that the MXI interface is properly configured. Software optimization might be necessary. For MXI-3 optimization, select **Start»All Programs»National Instruments MXI-3»MXI-3 Optimization**. MXI-4 and MXI-Express optimization is performed automatically by the hardware.

4. Perform a device self-test to verify installation.
   - **NI-DAQmx Devices**—Right-click the device and select **Self-Test**.
   - **Traditional NI-DAQ (Legacy) Devices**—Right-click the device, select **Properties**, and click **Test Resources**.

   A dialog box appears and indicates whether the device passed the test.

   When the self-test finishes, a message indicates either successful verification or that an error occurred.

Note If the device does not pass the self-test, reboot your system and repeat steps 1 through 4 in section *7. Configuring and Testing in MAX*. If the device still does not pass the self-test, visit NI Technical Support at `ni.com/support`.

5. Configure the device settings.
   a. Record the device number or device name assigned to the device. You need this number when programming the device.
      - **NI-DAQmx**—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. You can rename NI-DAQmx devices by right-clicking the device and selecting **Rename**.
      - **Traditional NI-DAQ (Legacy) Devices (NI 5401/5411/5431)**—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.

Tip To avoid modifying existing applications that use a Traditional NI-DAQ (Legacy) device number, rename the assigned NI-DAQmx device name to the Traditional NI-DAQ (Legacy) device number used in your application.

b. **(PCI only)** Right-click the NI signal generator in the list, and select **Properties.**

c. **(PCI only)** Select the appropriate tab to set the configuration options. The configuration options you see depend on the device.

d. Click **OK** to close the window.

8. Setting up Synchronization for NI-DAQmx Devices in MAX

If you plan to share triggers or clocks for the purpose of synchronizing NI-DAQmx devices, you must identify or configure certain components in MAX.

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

- **PXI devices**—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 or MXI-4 controller in an external PC.
  2. Expand the PXI System tree and select the chassis name to identify the chassis you are using.
- **PXI Express devices controlled using MXI-Express**—Identify the PXI Express system controller in the MAX Configuration tree under **Devices and Interfaces** by right-clicking **PXI System»Identify As** and selecting **External PC**. Your chassis will be automatically identified.
- **PXI Express controller**—PXI Express controllers installed in a PXI Express chassis are automatically identified in MAX.

- **PCI devices**—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**.
  4. To add a device to a RTSI cable, right-click on the RTSI cable name in the Configuration tree and select **Add Device to RTSI Cable**.

9. Generating Waveforms Interactively

You can interactively generate arbitrary and standard function waveforms using the FGEN SFP. NI 5431 users can use the NI Composite Video Generator in LabVIEW to interactively generate video signals.

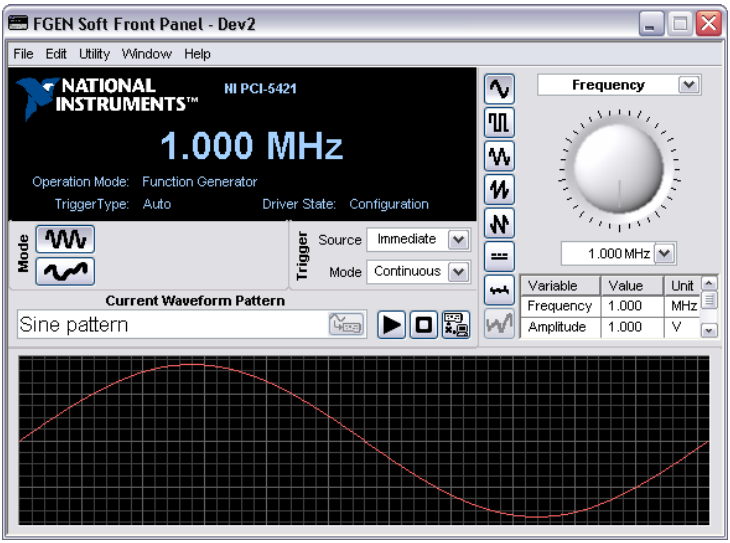


Figure 4. The FGEN Soft Front Panel

Generating a Standard Waveform

To generate a standard waveform using the FGEN SFP, complete the following steps:

1. Launch the FGEN SFP from **Start»All Programs» National Instruments»NI-FGEN»FGEN Soft Front Panel**.
2. Verify that the device you installed appears on the FGEN SFP display, shown in Figure 4, or select **Edit»Device Configuration** (Figure 5) to choose a different signal generator device from the drop-down listbox.

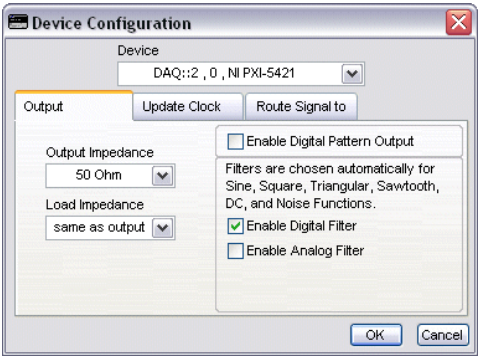


Figure 5. Device Configuration Dialog Box

3. Click the **Standard Function Mode** button show in the following figure:



4. Select the frequency, amplitude, offset, and type of waveform that you want to generate.
5. Click the **Run** button shown in the following figure 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 Ω load, and no offset. 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

To generate an arbitrary waveform using the FGEN SFP, complete the following steps:

Note **(NI 5401/5402/5404/5406 Devices)** These devices do *not* support arbitrary waveform generation.

1. Launch the FGEN SFP from **Start»All Programs» National Instruments»NI-FGEN»FGEN Soft Front Panel**.
2. Verify that the device you installed appears on the FGEN SFP display, shown in Figure 4, or select **Edit»Device Configuration** (Figure 5) to choose a different signal generator device from the drop-down listbox arrow.
3. Click the **Single Arbitrary Waveform Mode** button shown in the following figure.



4. Click the **Download Waveform** button shown in the following figure to download a waveform to the device onboard memory.



Select **Load Waveform from disk**. The Select File dialog box opens and displays waveform example files.

Note You also can download a waveform by selecting **File»Load New Waveform**. For the installation location of the example waveforms, refer to the *NI-FGEN Instrument Driver Readme*.

5. Select `arbMode-sine.lvm` and click **OK**. The File Load dialog box and Waveform Preview window launch. You can close or minimize the Waveform Preview window.
6. In the File Load dialog box, select one of the following settings from the **Waveform** drop-down listbox:
   - NI-5411/5412/5431—sine, 16 MHz at 40 MS/s
   - All other signal generators—sine, 40 MHz at 100 MS/s
7. Click **OK**.
8. 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 Ω load, and no offset. 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**.

Note You can use the NI Analog Waveform Editor to create arbitrary waveform files.

Generating a Video Signal (NI 5431 Only)

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

1. Launch the NI Video Generator Wizard by selecting **Start» All Programs»National Instruments Composite Video Generator»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`.

2. Complete the following steps to generate a video signal based on a bitmap image using the factory settings:
   a. Verify that the Device ID is set to 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.

10. Generating Waveforms Programmatically

You can control your signal generator programmatically with an ADE using the supplied NI-FGEN Interchangeable Virtual Instrument (IVI) driver. You also can run the NI-FGEN examples to demonstrate the functionality of your device.

For more information about programming with NI-FGEN, refer to the *NI Signal Generators Help*.

NI-FGEN Examples

The NI-FGEN examples demonstrate some of the functionality of the NI signal generators that you can use or integrate into your applications. These examples serve as interactive tools, programming models, and building blocks for your own applications.

To search for example programs that you can use as a basis for your first NI-FGEN program, LabVIEW and LabWindows/CVI users can use the NI Example Finder. In LabVIEW and LabWindows/CVI, select **Help» Find Examples** to launch the NI Example Finder. Examples for using NI-FGEN with LabVIEW, LabWindows/CVI, and C are located at **Start»All Programs»National Instruments»NI-FGEN»Examples**. For the installation location of the example files, refer to the *NI-FGEN Instrument Driver Readme*.

NI-FGEN Instrument Driver

The NI-FGEN API features a set of operations and attributes that exercise all the functionality of the device, including configuration, control, and other device-specific functions. Information about programming with NI-FGEN is available in the *NI Signal Generators Help.*

NI Composite Video Generator (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.

11. Creating and Editing Waveforms

The NI Analog Waveform Editor is an interactive software tool for creating and editing analog waveforms. To view or edit existing waveforms, you can open and resample data files saved in binary or ASCII file formats. Once imported, you can view and edit your waveforms. You can also create new waveforms by selecting from a library of more than 20 waveform primitives or by entering mathematical expressions.

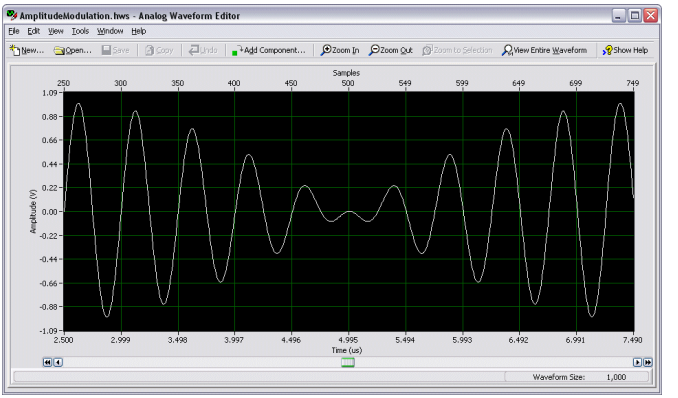


Figure 6. The NI Analog Waveform Editor

Tip The NI Analog Waveform Editor can be activated with the serial number provided in the kits with an eligible hardware purchase. You can also purchase the NI Analog Waveform Editor at `ni.com`.

Appendix A: Front Panels

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 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 7. Signal descriptions for the NI PXI-5404 are listed in Table 1. The NI PCI-5401 has four connectors—three SMB connectors and one 50-pin digital connector, as shown in Figure 7. Signal descriptions for the NI PCI-5401 are listed in Table 2.

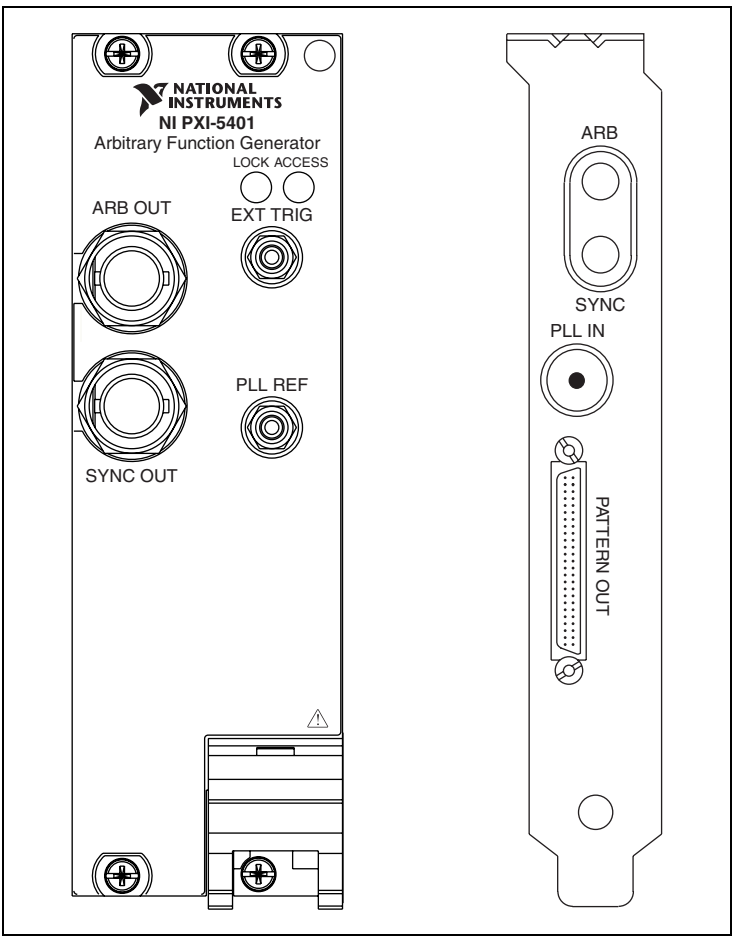


Figure 7. NI PXI/PCI-5401 Front Panel

Table 1. NI PXI-5401 Front Panel Connectors

Connector	Access	Function
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 Sample clock timebase to the external Reference clock.

Table 2. NI PCI-5401 Front Panel Connectors

Connector	Access	Function
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 Sample clock timebase to the external Reference clock.
PATTERN OUT	Input	Supplies the external trigger input to the device. Refer to the *NI Signal Generators Help* for connector pin assignments and signal descriptions.

NI PXI/PCI-5402/5406

The NI 5402 is a 20 MHz bandwidth,14-bit arbitrary function generator. The NI 5406 is a 40 MHz bandwidth, 16-bit arbitrary function generator. These devices have four BNC connectors, as shown in Figure 8. Signal descriptions are listed in Table 3.

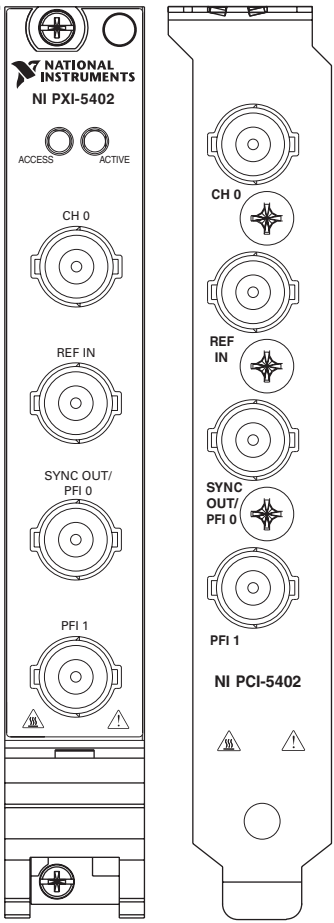


Figure 8. NI PXI/PCI-5402 Front Panel (NI PXI/PCI-5406 devices are similar)

Table 3. NI PXI/PCI-5402/5406 Front Panel Connectors

Connector	Access	Function
CH 0	Output	Provides the waveform output.
REF IN	Input	Accepts a PLL Reference clock from an external source and can frequency lock the Sample clock timebase to the external Reference clock.
SYNC OUT/ PFI 0	Input/Output	Provides a TTL-level output of the waveform being generated on CH 0. It can also be configured to accept 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 *NI Signal Generators Help* 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 *NI Signal Generators Help* for signal descriptions and routing information.

NI PXI-5404

The NI PXI-5404 is a 100 MHz frequency generator. The NI PXI-5404 has five SMB connectors, as shown in Figure 9. Signal descriptions are listed in Table 4.

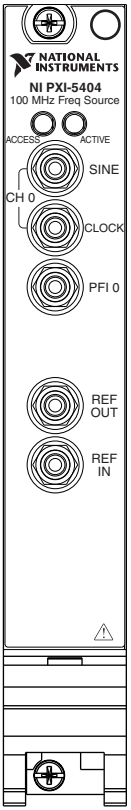


Figure 9. NI PXI-5404 Front Panel

Table 4. NI PXI-5404 Front Panel Connectors

Connector	Access	Function
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 Sample clock timebase 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 5.

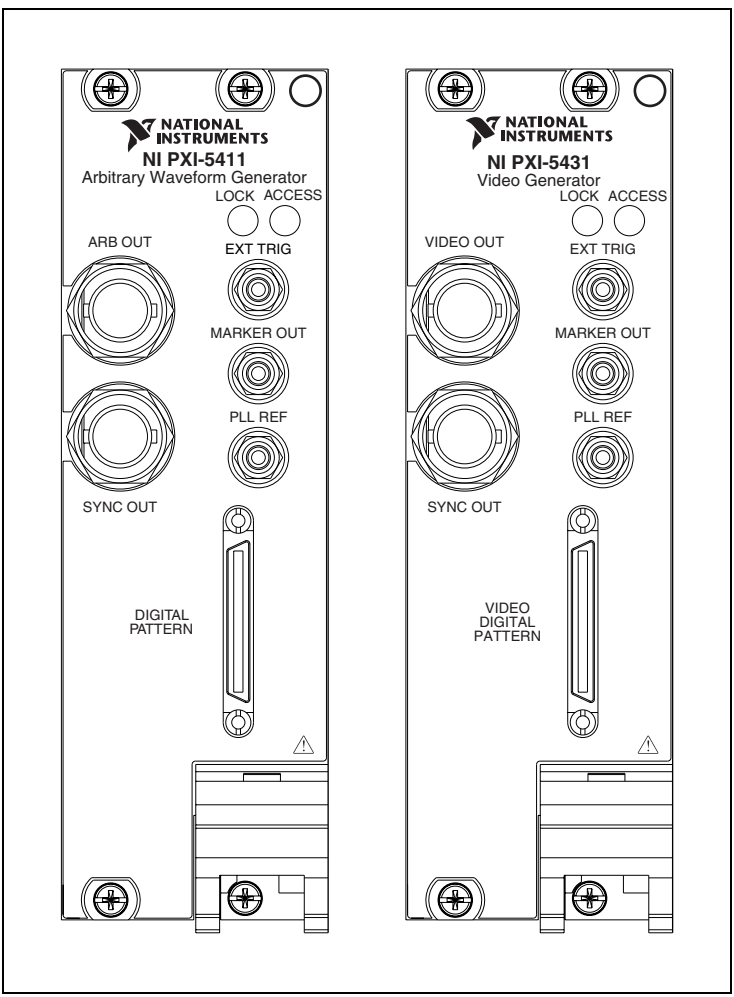


Figure 10. NI PXI-5411/5431 Front Panel

Table 5. NI PXI-5411/5431 Front Panel Connectors

Connector	Access	Function
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 Sample clock timebase 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 *NI Signal Generators Help* for connector pin assignments and signal descriptions.

NI PCI-5411/5431

The NI PCI-5411 is a 40 MS/s arbitrary waveform generator. 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 6.

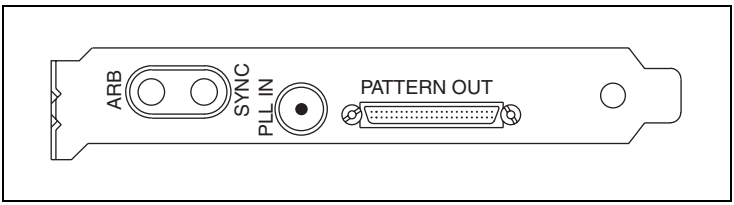


Figure 11. NI PCI-5411/5431 Front Panel

Table 6. NI PCI-5411/5431 Front Panel Connectors

Connector	Access	Function
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 Sample clock timebase 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 *NI Signal Generators Help* for connector pin assignments and signal descriptions.

NI PXI/PCI-5412/5421/5422/5441

The NI 5412 is a 100 MS/s, 20 MHz, 14-bit arbitrary waveform generator. The NI 5421 is a 100 MS/s, 43 MHz, 16-bit arbitrary waveform generator. The NI 5422 is a 200 MS/s, 80 MHz, 16-bit arbitrary waveform generator. The NI 5441 is a 100 MS/s, 43 MHz, 16-bit arbitrary waveform generator with Onboard Signal Processing (OSP). These devices have up to five connectors—four SMB connectors and one 68-pin male VHDCI connector, as shown in Figure 12. Signal descriptions are listed in Table 7.

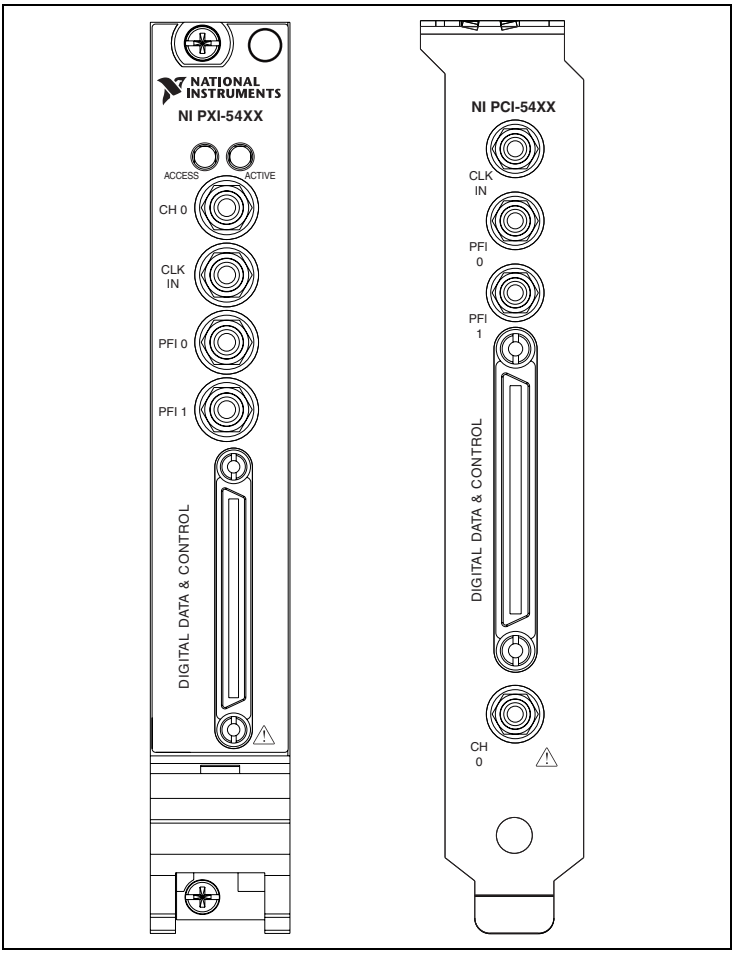


Figure 12. NI PXI/PCI-5421 Front Panel (NI PXI/PCI-5412/5422/5441 devices are similar)

Note The Digital Data & Control connector is not available on the NI 5412 or the NI 5421/5422 with the 8 MB memory option.

Table 7. NI PXI/PCI-5412/5421/5422/5441 Front Panel 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 Sample clock timebase to the external Reference clock. The signal input onto this connector can also be used as a Sample clock source.
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 *NI Signal Generators Help* 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 *NI Signal Generators Help* 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 *NI Signal Generators Help* for connector pin assignments and signal descriptions.

NI PXIe-5442

The NI 5442 is a PXI Express, 100 MS/s, 43 MHz, 16-bit arbitrary waveform generator with Onboard Signal Processing (OSP). The NI 5442 has four SMB connectors, as shown in Figure 13. Signal descriptions are listed in Table 8.

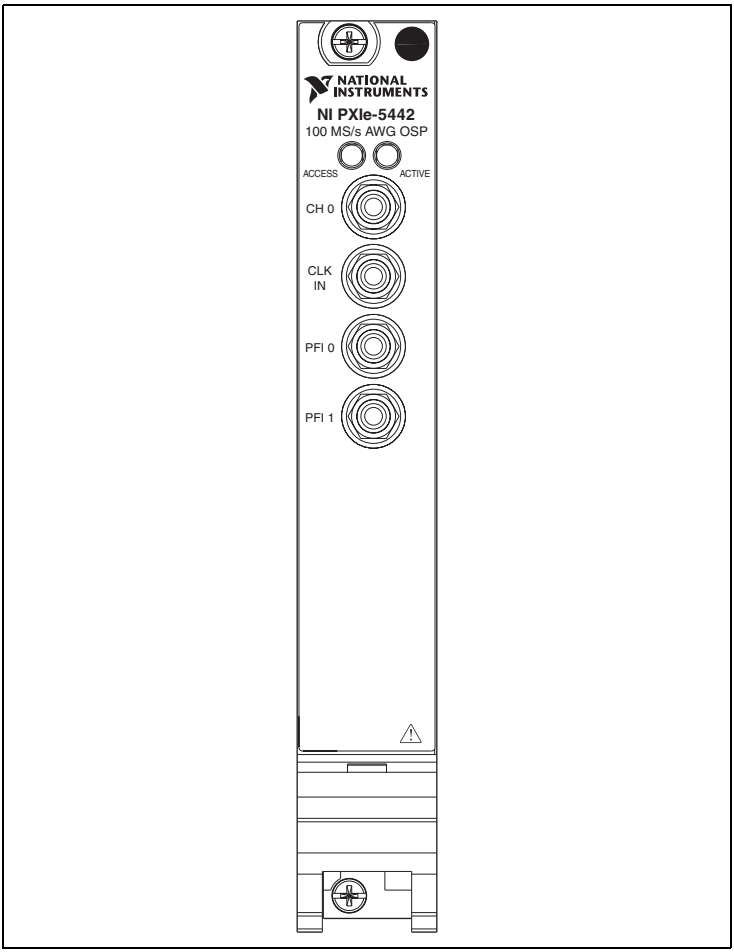


Figure 13. NI PXIe-5442 Front Panel

Table 8. NI PXIe-5442 Front Panel 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 Sample clock timebase to the external Reference clock. The signal input onto this connector can also be used as a Sample clock source.
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 *NI Signal Generators Help* 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 *NI Signal Generators Help* for signal descriptions and routing information.

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