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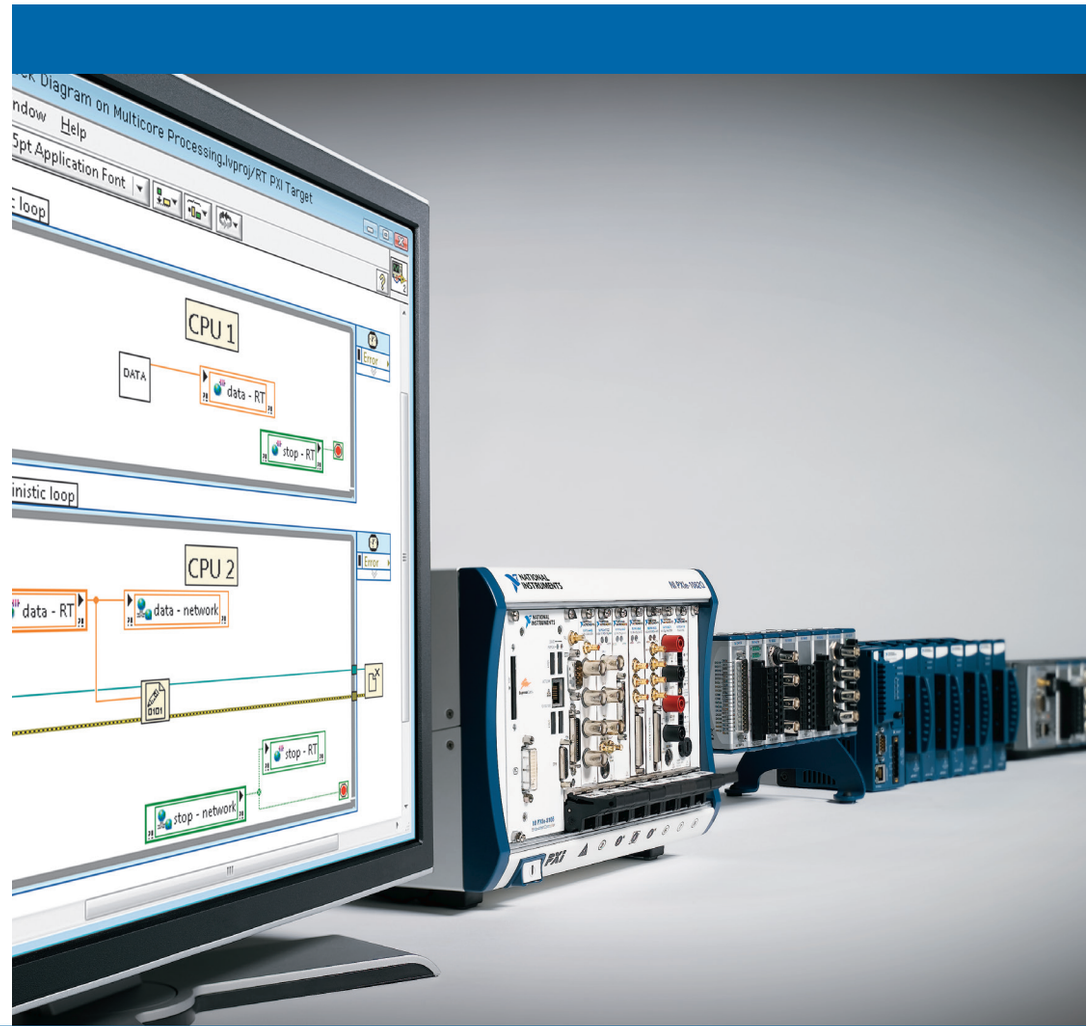
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NI PXIe-5650/5651/5652

Getting Started Guide



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NATIONAL INSTRUMENTS

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GETTING STARTED GUIDE

NI PXIe-5650/5651/5652

RF Signal Generator

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

This document explains how to install, configure, and test the NI PXIe-5650/5651/5652 (NI 5650/5651/5652) as a stand-alone device. The NI 5650/5651/5652 is a continuous-wave RF signal generator with modulation capability. The NI 5650/5651/5652 ships with the NI-RFSG instrument driver, which you use to program the device.

To access NI 5650/5651/5652 documentation, navigate to **Start»All Programs»National Instruments»NI-RFSG»Documentation**.

The specifications document for your device is installed with the driver software. Refer to *ni.com/manuals* for the most recent specifications for your device.

Caution The protection provided by this product may be impaired if it is used in a manner not described in this document.

Hot Surface If the NI 5650/5651/5652 has been in use, it may exceed safe handling temperatures and cause burns. Allow the NI 5650/5651/5652 to cool before removing it from the chassis.

Contents

Electromagnetic Compatibility Guidelines....2
Verifying the System Requirements....2
Unpacking the Kit....2
Preparing the Environment....3
Verifying the Kit Contents....4
    Other Equipment....4
Installing the Software....4
Installing the NI 5650/5651/5652....5
    NI 5650/5651/5652 RF Signal Generator Module....6
Installing the SMA Cables....8
Configuring the NI 5650/5651/5652 in MAX....9

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Programming the NI 5650/5651/5652.....10
NI-RFSG Examples.....11
Generating a Signal Using the NI-RFSG Soft Front Panel.....11
Building a Basic NI-RFSG Application.....12
Troubleshooting.....15
ACCESS LED is Off When Chassis is On.....15
NI 5650/5651/5652 Does Not Appear in MAX.....16
Module Fails the Self-Test.....16
Where to Go Next.....17
Worldwide Support and Services.....17

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. These requirements and limits are designed to provide reasonable protection against harmful interference when the product is operated in the intended operational electromagnetic environment.

This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

Caution To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

Caution To ensure the specified EMC performance, the length of all I/O cables must be no longer than 3 m (10 ft).

Verifying the System Requirements

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

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

Unpacking the Kit

Caution To prevent electrostatic discharge from damaging the device, 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.

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2. Remove the device from the package and inspect the device for loose components or any other sign of damage.

   Caution Never touch the exposed pins of connectors.

   Notify NI if the device appears damaged in any way. Do not install a damaged device.
3. Unpack any other items and documentation from the kit.

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

Preparing the Environment

Ensure that the environment you are using the NI 5650/5651/5652 in meets the following specifications.

Operating ambient temperature.....0 °C to 55 °C
(IEC-60068-2-1, IEC-60068-2-2)

Operating relative humidity.....10% to 90%, noncondensing
(IEC-60068-2-56)

Maximum altitude.....2,000 m (800 mbar) (at 25 °C ambient temperature)

Pollution Degree.....2

Indoor use only.

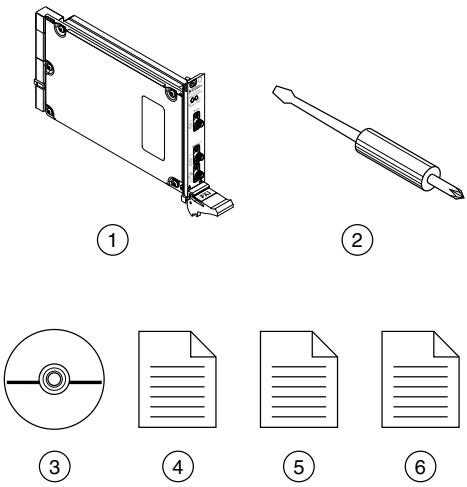
Caution Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

Note Refer to the *NI PXIe-5650/5651/5652 Specifications* at *ni.com/manuals* for complete specifications.

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Verifying the Kit Contents

Figure 1. NI 5650/5651/5652 Kit Contents



1. NI PXIe-5650/5651/5652 RF Signal Generator Module
2. Screwdriver, part number 772006-01
3. Driver Software DVD
4. NI PXIe-5650/5651/5652 Getting Started Guide (this document)
5. Read Me First: Safety and Electromagnetic Compatibility
6. Maintain Forced-Air Cooling Note to Users

Other Equipment

There are several required items not included in your device kit that you need to install or operate the NI 5650/5651/5652.

Required Items

- A PXI Express chassis and chassis documentation. The NI PXIe-1075 chassis is one available option for your device. For more information about compatible chassis options, refer to *ni.com*.
- A PXI Express embedded controller or MXI controller system that meets the system requirements specified in this guide and chassis documentation.

Optional Items

- A 1 N · m standard SMA torque wrench (NI part number 780487-01).

Installing the Software

You must be an Administrator to install NI software on your computer.

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1. Install an ADE, such as LabVIEW or LabWindows™/CVI™.
2. Insert the driver software DVD into your computer. The installer should open automatically.

   If the installation window does not appear, navigate to the drive, double-click it, and double-click `autorun.exe`.
3. Follow the instructions in the installation prompts to install the NI-RFSG driver software.

   Note Windows users may see access and security messages during installation. Accept the prompts to complete the installation.
4. When the installer completes, restart your system.

Installing the NI 5650/5651/5652

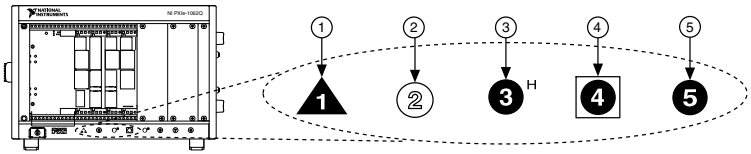
Caution To prevent damage to the device caused by ESD or contamination, handle the device using the edges or the metal bracket.

You must install NI-RFSG before installing the hardware.

Before you install the hardware, refer to the guidelines in the *Maintain Forced-Air Cooling Note to Users* included with the module to ensure that the chassis can cool the device effectively.

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

Figure 2. Chassis Compatibility Symbols



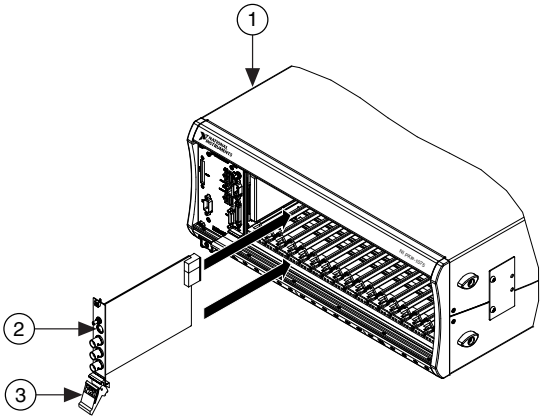
1. PXI Express System Controller Slot
2. PXI Peripheral Slot
3. PXI Express Hybrid Peripheral Slot
4. PXI Express System Timing Slot
5. PXI Express Peripheral Slot

NI 5650/5651/5652 modules can be placed in PXI Express peripheral slots or PXI Express Hybrid peripheral slots.

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6. Touch any metal part of the chassis to discharge static electricity.
7. Ensure that the ejector handle is in the unlatched (downward) position.
8. Place the module edges into the module guides at the top and bottom of the chassis. Slide the device into the slot until it is fully inserted.

Figure 3. Module Installation



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

9. Latch the module in place by pulling up on the ejector handle.
10. Secure the device front panel to the chassis using the front-panel mounting screws.
11. Cover all empty slots using filler panels or slot blockers to maximize cooling air flow.
12. Power on the chassis.

Related Information

Installing the Software on page 4

NI 5650/5651/5652 RF Signal Generator Module

The NI 5650/5651/5652 RF signal generator module contains three connectors and two multicolor LEDs.

Note The following figure depicts the NI 5652 module front panel, although each NI 5650/5651/5652 module front panel contains the same connectors and LEDs.

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Figure 4. NI 5652 RF Signal Generator Module Front Panel

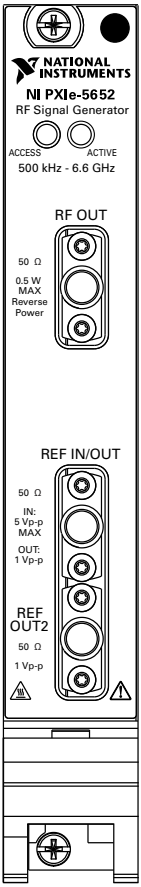


Table 1. NI 5650/5651/5652 RF Signal Generator Module Front Panel Connectors

Connector	Use
RF OUT	Output terminal for the RF signal at the requested frequency and power level.
RF IN/OUT	Routes a frequency reference signal to or from the RF signal generator. This connector can be configured as an external frequency reference input or as an output for the onboard 10 MHz Reference Clock.
REF OUT2	Routes a frequency reference signal from the RF signal generator.

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Table 2. NI 5650/5651/5652 RF Signal Generator Module Front Panel LEDs

LED	Indications
ACCESS	Indicates the basic hardware status of the module. OFF—The module is not yet functional or has detected a problem with a PXI Express power rail. AMBER—The module is being accessed. *Accessed* means that the device setup registers are being written to in order to control the device. GREEN—The module is ready to be programmed by NI-RFSG.
ACTIVE	Indicates the state of the module. OFF—The module is not yet generating a signal. AMBER—The module PLLs are attempting to lock. GREEN—The module is generating a signal; applicable PLLs are locked. RED—The module has detected an error state; this state may indicate a PLL lock failure or a thermal shutdown condition.

Installing the SMA Cables

To use the NI 5650/5651/5652 with other devices, you must make connections using SMA cables. For best results when connecting signals to the NI 5650/5651/5652 front panel SMA connectors, use shielded low-loss coaxial cables.

1. Connect the cable center pin on the SMA cable to the SMA connector on the appropriate device.

   Note Ensure that the SMA cable center pins properly align with the SMA connectors to avoid bending the cable pins or damaging the front panel connectors on the device. If the SMA cable does not exactly align with the SMA connector, bend the cable slightly by hand to align the cable and the connector. The amount of bending should be minimal. The cables can be damaged by excessive bending.

2. Hand-tighten the SMA cable end on the SMA connector after the cable center pins are correctly aligned and connected. The cable connectors should tighten without much torque or effort. If a cable bends due to incorrect alignment, remove the cable from the front panel connector and repeat step 1 before continuing with this step.
3. Use an appropriate torque wrench or torque screwdriver and SMA driver bit (not included) to complete the tightening of the SMA cable to 1 N · m. Rotate the torque wrench no more than one revolution to tighten the SMA cable before reaching maximum torque.

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Configuring the NI 5650/5651/5652 in MAX

Use Measurement & Automation Explorer (MAX) to configure your National Instruments hardware. MAX informs other programs about which devices reside in the system and how they are configured. MAX is automatically installed with NI-RFSG.

1. Launch Measurement & Automation Explorer (MAX).

   MAX should automatically detect the device you installed.

2. In the Configuration pane, double-click **Devices and Interfaces** to see the list of installed devices. Installed devices appear under the name of their associated chassis.

   Note If you are using the NI 5650/5651/5652 with the LabVIEW Real-Time Module, expand **Remote Systems**. Find your target IP address or name, expand it, and then expand **Devices and Interfaces**.

3. Expand your **Chassis** tree item. MAX lists all devices installed in the chassis. Your default device names may vary.

   Note If you do not see your hardware listed, press <F5> to refresh the list of installed devices. If the device is still not listed, power off the system, ensure the device is correctly installed, and restart.

4. Record the device identifier MAX assigns to the hardware. Use this identifier when programming the NI 5650/5651/5652.

5. The MAX self-test performs a basic verification of hardware resources. To self-test a module in MAX, right click the module and select **Self-Test**.

Related Information

Refer to the NI RF Signal Generators Help for information about renaming devices.

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Programming the NI 5650/5651/5652

You can generate signals interactively using the NI-RFSG Soft Front Panel (SFP) or you can use the NI-RFSG instrument driver to program your device in the supported ADE of your choice.

Table 3. NI 5650/5651/5652 Programming Options

Application Programming Interface (API)	Location	Description
NI-RFSG SFP	Available from the Start menu at **Start»All Programs»National Instruments»NI-RFSG»NI-RFSG Soft Front Panel**.	NI-RFSG SFP controls, generates, and presents data similar to stand-alone RF signal generators. The NI-RFSG SFP operates on the PC, so it provides additional processing, storage, and display capabilities.
NI-RFSG Instrument Driver	LabVIEW—Available on the LabVIEW Functions palette at **Measurement I/O»NI-RFSG**.	NI-RFSG configures and operates the device hardware, performs waveform programming and generation, and performs basic modulation tasks using LabVIEW VIs or LabWindows/CVI functions.
	C or LabWindows/CVI—Available at **Program Files»IVI Foundation»IVI»Drivers»niRFSG**.	
	Microsoft Visual C/C++—Use examples located in the `<NIDocDir>\NI-RFSG\examples` directory, where `<NIDocDir>` is one of the following directories: • Windows 8/7/Vista—`Users\Public\Documents\National Instruments` • Windows XP—`Documents and Settings\All Users\Shared Documents\National Instruments`	You can modify an NI-RFSG C example to create an application with Microsoft Visual C/C++. Copy an NI-RFSG example to copy required project settings for include paths and library files. Alternatively, refer to the *Creating an Application with Microsoft Visual C and C++* topic of the *NI RF Signal Generators Help* to manually add all required include and library files to your project.

Related Information

For detailed instructions about how to generate signals in a specific ADE, refer to the Getting Started section of the NI RF Signal Generators Help.

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NI-RFSG Examples

Examples demonstrate the functionality of the device and serve as programming models and building blocks for your own applications. The NI Example Finder is a utility available for some ADEs that organizes examples into categories and allows you to easily browse and search installed examples. You can see descriptions and compatible hardware models for each example or see all the examples compatible with one particular hardware model.

Table 4. Locating NI-RFSG Examples

ADE	How to Locate Examples
LabVIEW or LabWindows/CVI	Locate examples with the NI Example Finder. Within LabVIEW or LabWindows/CVI, select **Help»Find Examples** and navigate to **Hardware Input and Output»Modular Instruments**.
ANSI C or Microsoft Visual C/C++	Locate examples in the `<NIDocDir>\NI-RFSG\examples` directory, where `<NIDocDir>` is one of the following directories: • Windows 8/7/Vista—`Users\Public\Documents\National Instruments` • Windows XP—`Documents and Settings\All Users\Documents\National Instruments`

Generating a Signal Using the NI-RFSG Soft Front Panel

To verify your device configuration, use the NI-RFSG Soft Front Panel (SFP) in MAX to generate a simple signal.

1. Within MAX, right-click the NI PXIe-5650/5651/5652 RF signal generator module and select **Test Panels**.

   The NI-RFSG SFP launches.

2. Within the NI-RFSG SFP, specify a frequency and a power level for signal generation.

   Caution Clicking **RF On/Off** generates a signal from the RF OUT connector of the NI 5650/5651/5652 front panel. Disconnect any equipment that can be damaged by the test signal prior to clicking the **RF On/Off** button on the NI-RFSG SFP.

3. Click **RF On/Off** to begin signal generation.

   Note Refer to the *Troubleshooting* section of this document if an ACTIVE LED does not turn on or if the NI-RFSG SFP generates an error.

   During signal generation, the ACTIVE LED on the NI 5650/5651/5652 hardware module illuminates.

4. Click **RF On/Off** to stop signal generation.

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Building a Basic NI-RFSG Application

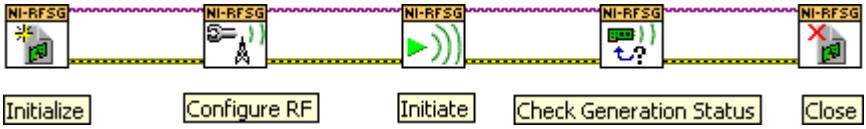
This section describes how to build a basic NI-RFSG application in LabVIEW for generating continuous sine wave signals.

Adding the Core NI-RFSG VIs to a Blank VI

The following steps create a new application that includes the core NI-RFSG VIs.

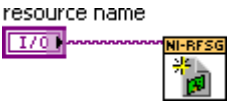
1. Launch LabVIEW.
2. To create a blank VI, select **File»New VI**.
3. Display the block diagram by selecting **Window»Show Block Diagram**.
4. Activate the LabVIEW context help by selecting **Help»Show Context Help**.
5. Right-click the VI block diagram to launch the Functions palette.
6. Navigate to the NI-RFSG VIs on the **Functions»Measurement I/O»NI-RFSG** palette.
7. Add the core NI-RFSG VIs from the NI-RFSG palette to the block diagram, and wire the VIs together as shown in the following figure.

Figure 5. Basic NI-RFSG Block Diagram



8. Right-click the resource name input on the niRFSG Initialize VI, and select **Create» Control** to create a front panel control where you specify the NI RF signal generator device name.

Figure 6. Resource Name Input on the niRFSG Initialize VI



9. Right-click the frequency (Hz) input on the niRFSG Configure RF VI, and select **Create» Control** .
10. Right-click the power level (dBm) input on the niRFSG Configure RF VI, and select **Create»Control** .
11. Display the VI front panel by clicking it or by selecting **Window»Show Front Panel**.
12. In the VI front panel **power level (dBm)** control, enter `0`. In the **frequency (Hz)** control, enter `100M` (100 MHz).
13. In the VI front panel **resource name** control, enter the NI 5650/5651/5652 device name that you specified in MAX.

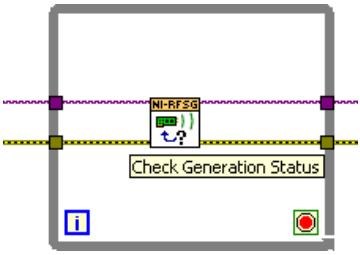
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Adding a While Loop

The following steps add a While Loop to continuously generate the signal and check the generation status until you click the Stop button.

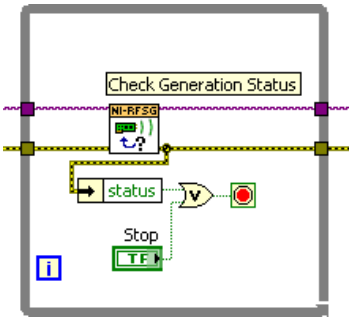
1. Display the VI block diagram, and select the While Loop on the **Functions**»**Programming**»**Structures** palette.
2. Enclose the niRFSG Check Generation Status VI in the While Loop, as shown in the following figure.

Figure 7. The niRFSG Check Generation Status VI Enclosed in the While Loop



3. Right-click the While Loop tunnels, and select **Replace with Shift Register**.
4. Select the Or function on the **Functions**»**Programming**»**Boolean** palette. Place the function inside the While Loop.
5. Wire the output of the Or function to the Loop Condition terminal of the While Loop.
6. Select the Unbundle by Name function on the **Functions**»**Programming**»**Cluster, Class, & Variant** palette. Place the function inside the While Loop.
7. Wire the error out output of the niRFSG Check Generation Status VI to the Unbundle by Name function.
8. Wire the output of the status element to an input of the Or function.
9. Right-click the unused input of the Or function, and select **Create**»**Control** to create a Boolean control.
10. In the VI front panel, right-click the Boolean control created in step 9, and select **Replace**»**Modern**»**Boolean**»**Stop Button** to create a stop button.

Figure 8. While Loop with Stop Button



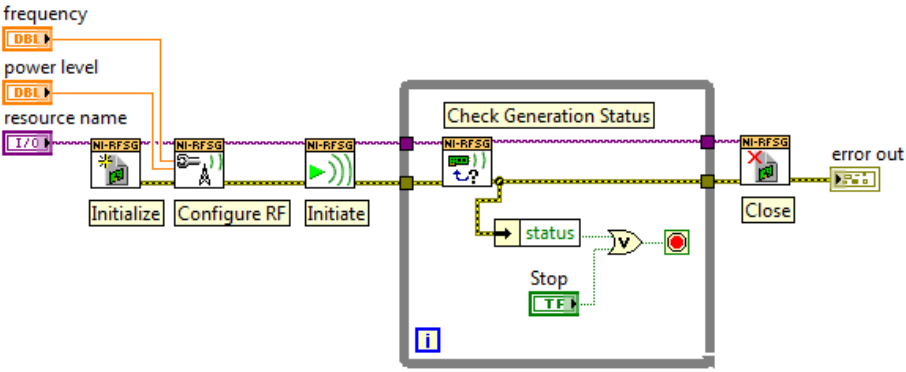
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Adding an Error Indicator

The following steps add an error indicator to the VI front panel.

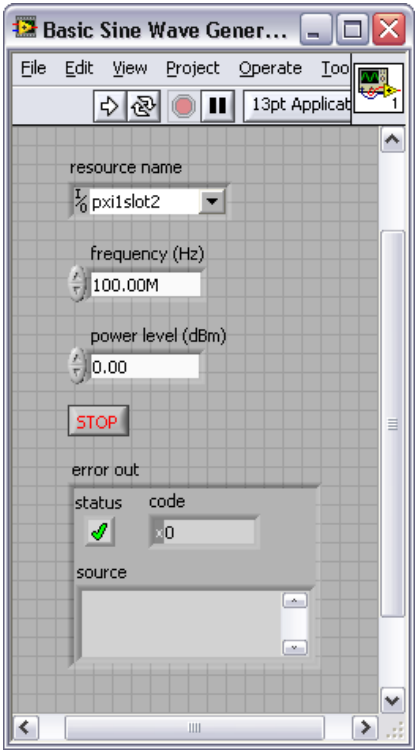
1. Create an error indicator by right-clicking the error out output of the niRFSG Close VI and selecting **Create»Indicator**.
2. Verify that the VI block diagram and VI front panel now look similar to the following figures.

Figure 9. Basic Sine Wave Generation VI Block Diagram



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Figure 10. Basic Sine Wave Generation VI Front Panel



3. Open the VI front panel, and select the NI 5650/5651/5652 module name specified in MAX in the **resource name** control.
4. Click the **Run** icon on the VI taskbar to initiate sine wave generation.
5. Click the VI front panel **STOP** button to stop sine wave generation.

You have successfully generated a continuous sine wave signal using the NI-RFSG instrument driver and the NI 5650/5651/5652.

Troubleshooting

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

ACCESS LED is Off When Chassis is On

The LEDs may not illuminate until the device has been configured in MAX. Before proceeding, verify that the NI 5650/5651/5652 appears in MAX.

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

Caution Apply external signals only while the NI 5650/5651/5652 is powered on. Applying external signals while the device is powered off may cause damage.

1. Disconnect any signals from the PXI Express module front panels.
2. Power off the PXI Express chassis.
3. Remove the module from the PXI Express chassis and inspect it for damage. Do not reinstall a damaged device.
4. Install the module in a different PXI Express chassis slot from which you removed it.
5. Power on the PXI Express chassis.
6. Verify that the device appears in MAX.
7. Reset the device in MAX and perform a self-test.

NI 5650/5651/5652 Does Not Appear in MAX

1. In the MAX Configuration pane, click **Devices and Interfaces**.
2. Expand the **Chassis** tree to see the list of installed devices, 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.

Option	Description
Windows 8	Right-click the Start screen, and select **All apps»Control Panel» Hardware and Sound»Device Manager**.
Windows 7	Select **Start»Control Panel»Device Manager**.
Windows Vista	Select **Start»Control Panel»System and Maintenance»Device Manager**.
Windows XP	Select **Start»Control Panel»System»Hardware»Device Manager**.

5. If you are using a PXI controller, verify that a **National Instruments** entry appears in the system device list. Reinstall NI-RFSG and the device if error conditions appear in the list. If you are using a MXI controller, right-click **PCI-to-PCI Bridge**, and select **Properties** from the shortcut menu to verify that the bridge is enabled.

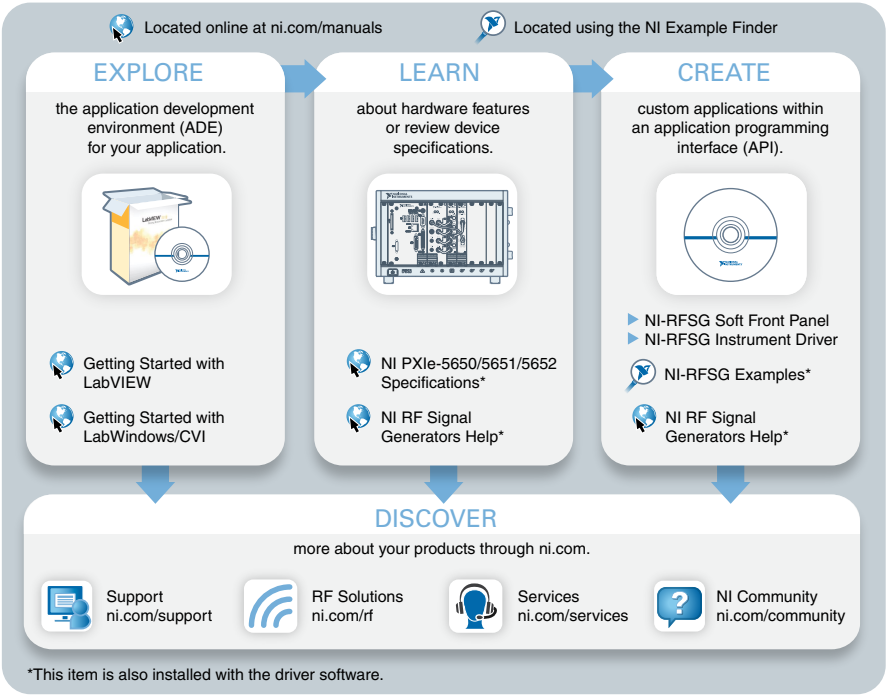
Module Fails the Self-Test

1. Restart the system.
2. Launch MAX, and perform the self-test again.
3. Power off the PXI Express chassis.
4. Reinstall the failed module in a different PXI Express slot.
5. Power on the PXI Express chassis.
6. Perform the self-test again.

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Where to Go Next

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



Tip The *NI RF Signal Generators Help* is an HTML version of a traditional user manual that includes detailed information about RF fundamentals, device features, and programming with NI-RFSG.

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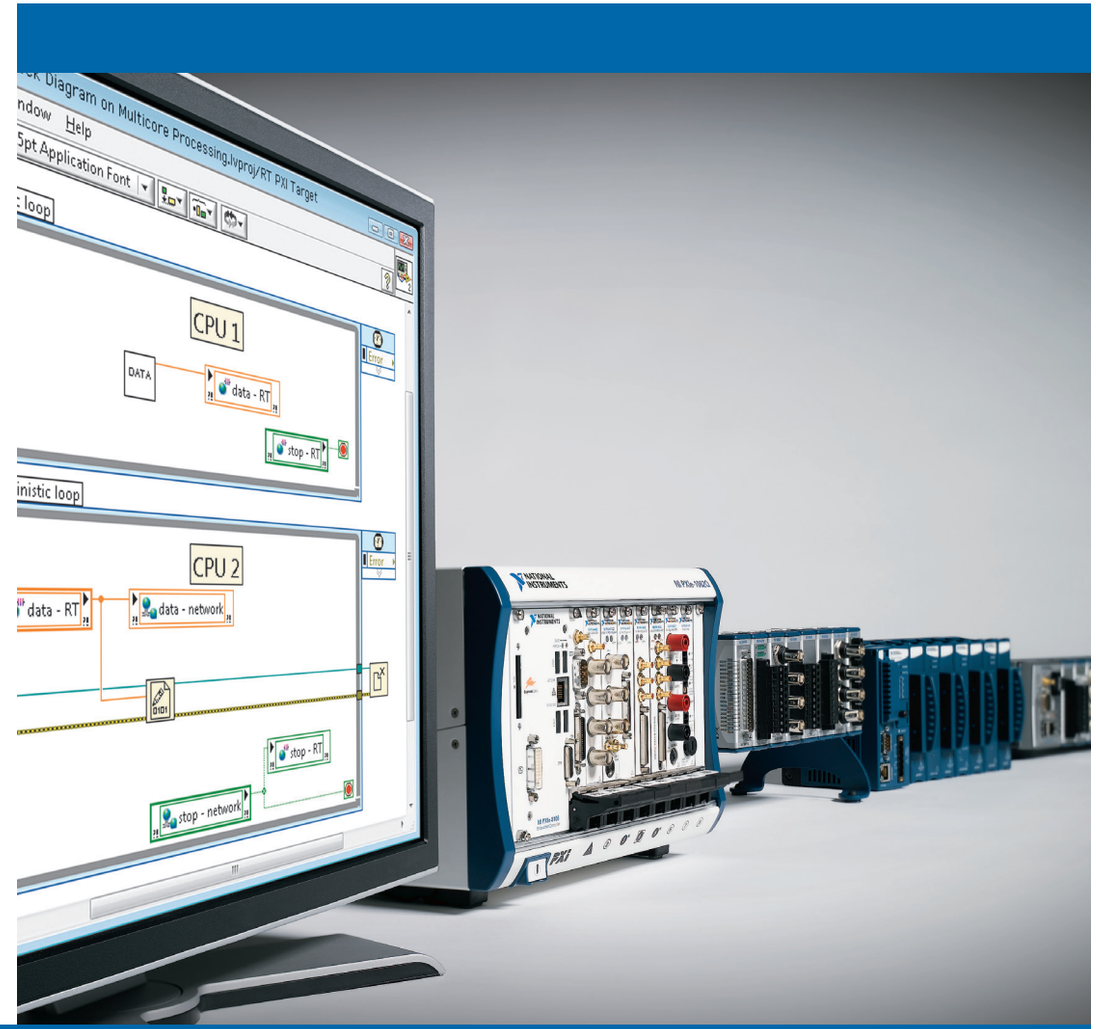
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