PXIe-5672 Getting Started

Contents

NI PXIe-5672 NI RF vector signal generator

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

This document explains how to install, configure, and test the NI 5672. The NI 5672 is a 2.7 GHz RF vector signal generator (VSG) with quadrature digital upconversion. The NI 5672 ships with the NI-RFSG instrument driver, which you use to program the device.

The NI 5672 comprises the following devices:

- NI PXI-5610 (NI 5610) RF upconverter module
- NI PXIe-5442 (NI 5442) arbitrary waveform generator (AWG) module

To access NI 5672 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 5672 has been in use, it may exceed safe handling temperatures and cause burns. Allow the NI 5672 to cool before removing it from the chassis.

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 NI 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.

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

Unpacking the Kit

🛈 **Notice** To prevent electrostatic discharge (ESD) 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.

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

> ⊘ **Notice** Never touch the exposed pins of connectors.

> ✎ **Note** Do not install a device if it appears damaged in any way.

3. Unpack any other items and documentation from the kit.

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

Verifying the Kit Contents

Figure 1. NI 5672 Kit Contents
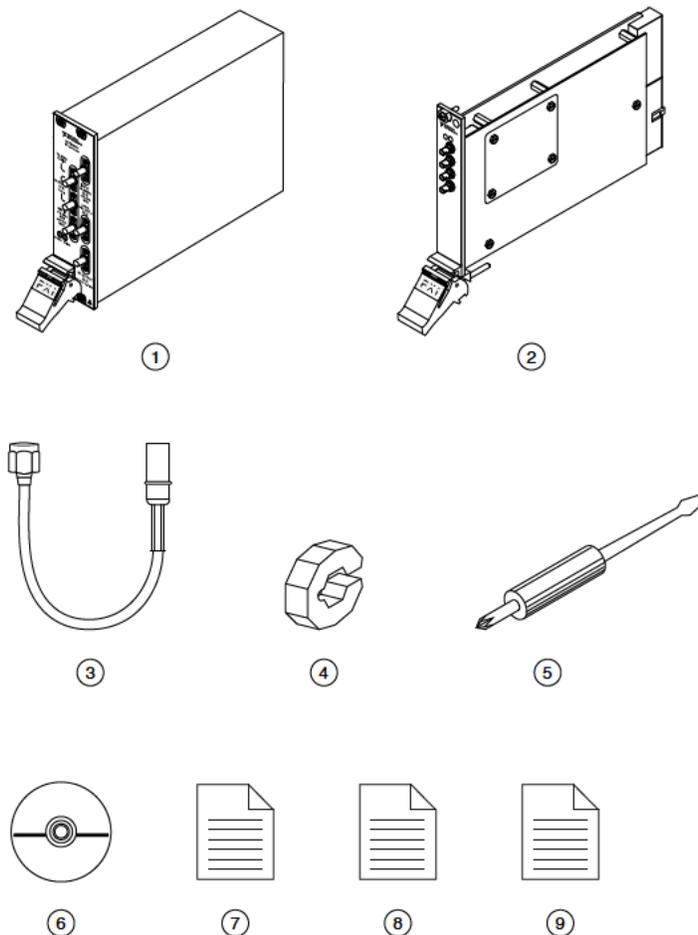
1. NI PXI-5610 RF Upconverter Module

2. NI PXIe-5442 AWG Module

3. Two Semi-Flexible SMA (m)-to-SMB Cables

4. Two Cable Wrenches, Part Number 746016-01

5. Screwdriver, Part Number 772006-01

6. Driver Software DVD

7. NI PXIe-5672 Getting Started Guide (this document)

8. Read Me First: Safety and Electromagnetic Compatibility

9. 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 5672.

Required Items

Optional Items

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

Preparing the Environment

Ensure that the environment you are using the NI 5672 in meets the following specifications.

Operating ambient temperature	
NI PXI-5610 upconverter	0 °C to 55 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL PRF-28800F Class 3 low temperature limit and MIL PRF-28800F Class 2 high temperature limit.)
NI PXIe-5442 AWG	0 °C to 55 °C operating in all NI PXI Express chassis
Operating relative humidity (IEC-60068-2-56)	10% to 90%, noncondensing
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)

Pollution Degree	2

Indoor use only.

> **⊘ Notice** Clean the hardware with a soft, nonmetallic brush or lint free cloth. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

> **✎ Note** Refer to the **NI PXIe-5672 Specifications** at ni.com/manuals for complete specifications.

Installing the Software

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

1. Install an ADE, such as LabVIEW or LabWindows™/CVI™.

2. Download the driver software installer from ni.com/downloads. NI Package Manager downloads with the driver software to handle the installation. Refer to the NI Package Manager Manual for more information about installing, removing, and upgrading NI software using NI Package Manager.

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 5672

> **⊘ Notice** To prevent damage to the NI 5672 caused by ESD or contamination, handle the module using the edges or the metal bracket.

1. Ensure the AC power source is connected to the chassis before installing the module.
   The AC power cord grounds the chassis and protects it from electrical damage while you install the module.

2. Power off the chassis.

3. Inspect the slot pins on the chassis backplane for any bends or damage prior to installation. Do not install a module if the backplane is damaged.

4. Remove the black plastic covers from all the captive screws on the module front panel.

5. Identify a supported slot in the chassis. The following figure shows the symbols that indicate the slot types.

   Figure 2. Chassis Compatibility Symbols
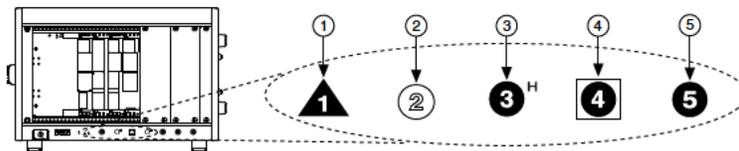
   a. PXI Express System Controller Slot

   b. PXI Peripheral Slot

   c. PXI Express Hybrid Peripheral Slot

   d. PXI Express System Timing Slot

   e. PXI Express Peripheral Slot

6. Touch any metal part of the chassis to discharge static electricity.

7. Ensure that the ejector handle is in the downward (unlatched) position.

8. Place the module edges into the module guides at the top and bottom of the chassis. Slide the module into the slot until it is fully inserted.

Figure 1. Module Installation
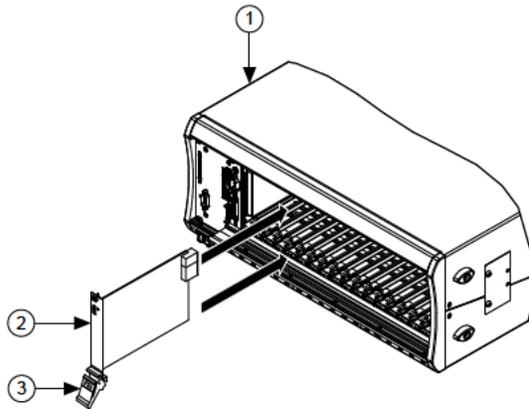
a. Chassis

b. Hardware Module

c. Ejector Handle in Downward (Unlatched) Position

9. Latch the module in place by pulling up on the ejector handle.

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

> **Note** Tightening the top and bottom mounting screws increases mechanical stability and also electrically connects the front panel to the chassis, which can improve the signal quality and electromagnetic performance.

11. Cover all empty slots using either filler panels (standard or EMC) or slot blockers with filler panels, depending on your application.

> **Note** For more information about installing slot blockers and filler panels, go to ni.com/r/pxiblocker.

12. Power on the chassis.

Related tasks:

- Installing the Software

Chassis Slot Configurations

The following figures show the two possible slot configurations for the NI 5672 module in an 8-slot NI PXIe-1062Q hybrid chassis.

Figure 4. NI 5672 Module in Slots 2, 3, and 4 of an NI PXIe-1062Q Chassis
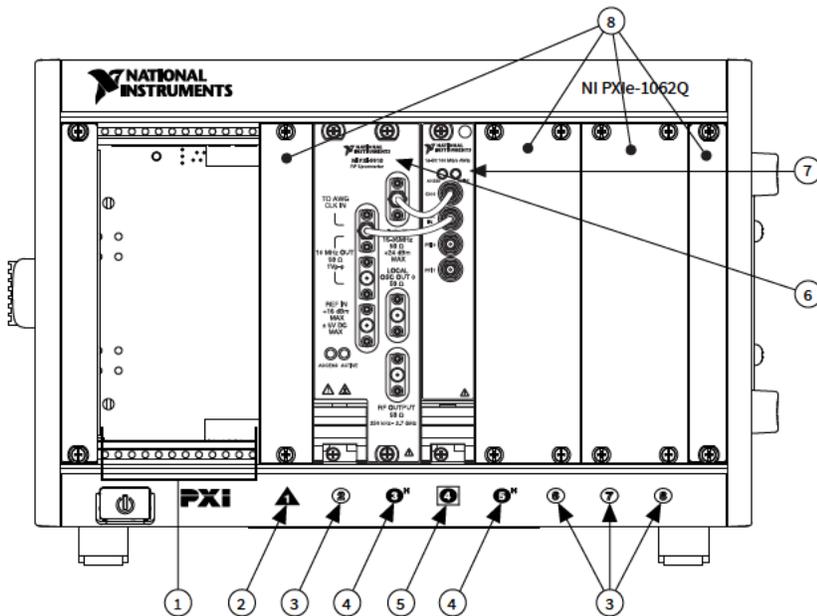
1. System Controller Expansion Slots

2. PXI Express System Controller Slot

3. PXI Peripheral Slots (PXI only)

4. PXI Express Hybrid Peripheral Slots

5. PXI Express System Timing Slot (PXI Express only)

6. NI PXI-5610 Module

7. NI PXIe-5442 Module

8. PXI/PXI Express Filler Panels

Figure 5. NI 5672 Module in Slots 3, 4, and 5 of an NI PXIe-1062Q Chassis
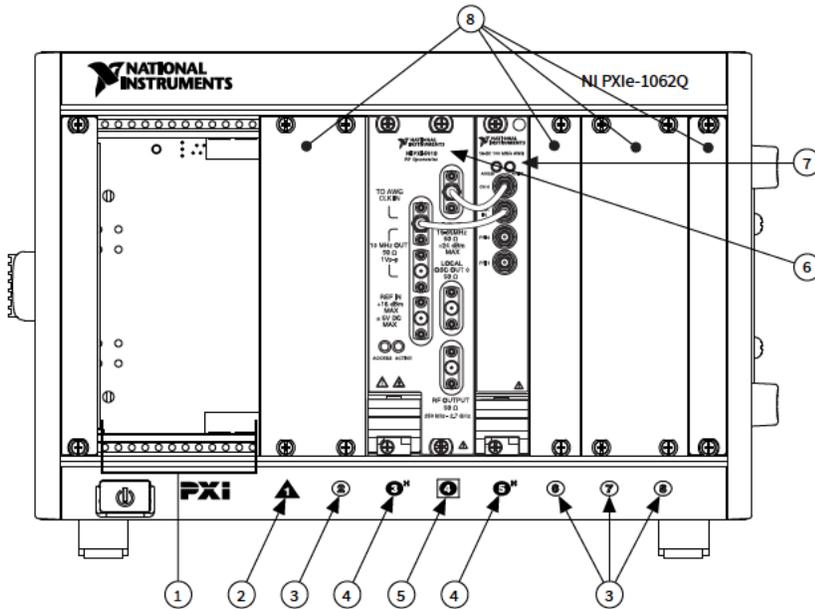
1. System Controller Expansion Slots
2. PXI Express System Controller Slot
3. PXI Peripheral Slots (PXI only)
4. PXI Express Hybrid Peripheral Slots
5. PXI Express System Timing Slot (PXI Express only)
6. NI PXI-5610 Module
7. NI PXIe-5442 Module
8. PXI/PXI Express Filler Panels

Note The NI 5610 module blocks the PXI Express System Timing slot in the configuration shown in the preceding figure.

Interconnecting the NI 5672 Modules

Figure 6. NI 5672 Front Panel Interconnection
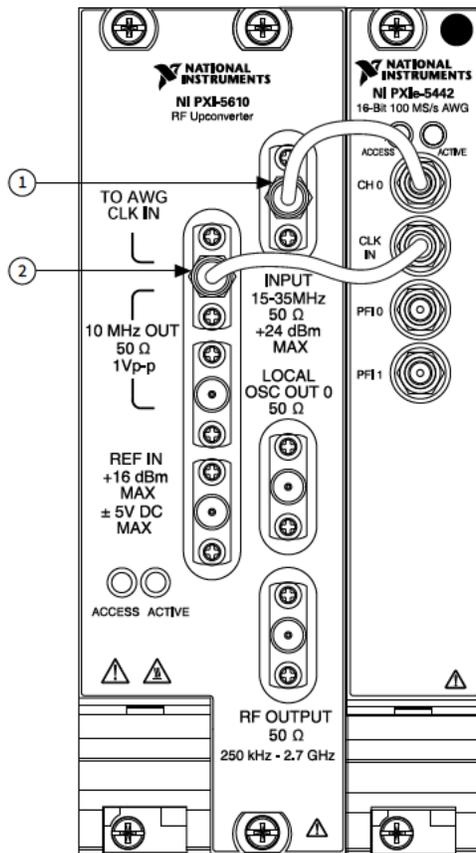
1. Flexible SMA-to-SMB Cable
2. Flexible SMA-to-SMB Cable

1. Using a flexible SMA-to-SMB cable, connect the INPUT connector on the NI 5610 front panel to the CH 0 connector on the NI 5442 front panel.

   > **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.

2. Using a flexible SMA-to-SMB cable, connect the TO AWG CLK IN connector on the NI 5610 front panel to the CLK IN connector on the NI 5442 front panel.

3. Hand-tighten all SMA cable ends on the SMA connectors. The cable connectors should tighten without much torque or effort.

4. Carefully complete tightening all SMA connectors to 1 N · m using an appropriate torque wrench or torque screwdriver and SMA driver bit (not included). Tighten only until the wrench clicks.

> ⚠️ **Caution** Incorrect torque at SMA connections can degrade signal fidelity and phase-locked loop (PLL) performance and may cause insertion loss. Use an appropriate torque wrench or torque screwdriver and SMA driver bit to ensure all SMA connections are properly torqued. SMA connectors for connections to external equipment may require torque different from 1 N · m, depending on the connector type, material, and manufacturer.

5. Power on your PXI/PXI Express chassis and controller system.
6. Verify that the ACCESS LED is illuminated on all modules. If an LED is not illuminated, refer to the **Troubleshooting** section of this document.

Related tasks:

- Configuring the NI 5672 in MAX

Direct Connections to the NI 5672

The NI 5672 is a precision RF instrument that is sensitive to ESD and transients. Ensure you take the following precautions when making direct connections to the NI 5672 to avoid damaging the device.

> 📝 **Note** Do not apply external signals to the NI 5672. Applying external signals may cause damage.

- Ensure you are properly grounded when manipulating cables or antennas connected to the NI 5672.

- If you are using nonisolated devices, such as a nonisolated RF antenna, ensure the devices are maintained in a static-free environment.

- If you are using an active device, such as a preamplifier or switch routed to the NI 5672, ensure no signal transients are sourced to the NI 5672.

NI 5610 RF Upconverter Module

The NI 5610 RF upconverter module contains six connectors and two multicolor LEDs.

Figure 7. NI 5610 RF Upconverter Module Front Panel
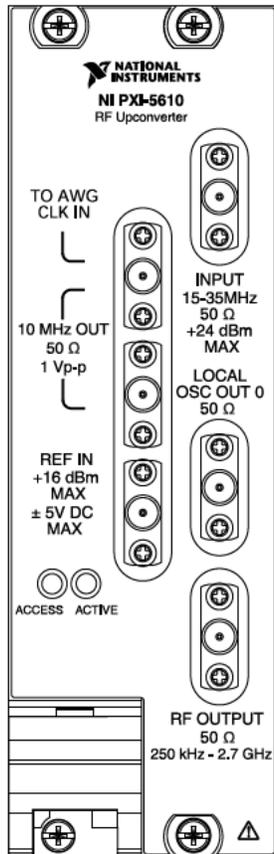
Table 1. Device Front Panel Icon Definition

⚠	Refer to the user documentation for required maintenance measures to ensure user safety and/or preserve the specified EMC performance.

Table 2. NI 5610 RF Upconverter Module Front Panel Connectors

Connector	Use
TO AWG CLK IN	Connects to the CLK IN connector on the NI 5442 AWG module front panel.
10 MHz OUT	Both connectors are output terminals for replications of the upconverter 10 MHz frequency reference signal, which is useful for

Connector	Use
	driving other devices. Each replication is 180° out of phase with the other. The output signal at these connectors is always on and cannot be disabled.
REF IN	Routes an external frequency reference signal that can be propagated to the PXI backplane. The NI 5610 can lock to this signal.
INPUT	Connects to the CH 0 output on the NI 5442 AWG module front panel. Routes the IF signal from the NI 5442 AWG module for frequency translation.
LOCAL OSC OUT 0	Routes the auxiliary local oscillator signal.
RF OUTPUT	Routes the upconverted signal at the requested RF frequency.

Table 3. NI 5610 RF Upconverter Module Front Panel LEDs

LED	Indications
ACCESS	Indicates the basic hardware status of the module. OFF—The module is not yet functional, or the module has detected a problem with a PXI 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 status of the module PLLs. OFF—The module is in an uninitialized state; there is no error. AMBER—The module PLLs are attempting to lock.

LED	Indications
	GREEN—The module is in a ready state; applicable PLLs are locked and the reverse power protection circuit is closed.
	RED—The module has detected an error state; this state may indicate an overload (reverse power protection circuit is open), a PLL lock failure, or a thermal shutdown condition.

NI 5442 AWG Module

The NI 5442 AWG module front panel contains four connectors and two multicolor LEDs.

Figure 1. NI 5442 AWG Module Front Panel

Table 6. Device Front Panel Icon Definition

⚠	Refer to the user documentation for required maintenance measures to ensure user safety

and/or preserve the specified EMC
performance.

Table 5. NI 5442 AWG Module Front Panel Connectors

Connector	Use
CH 0	Connects to the IF INPUT connector on the NI 5610 front panel. Output terminal for an IF waveform for upconversion to the desired RF frequency.
CLK IN	Connects to the REF OUT connector on the NI 5610 module front panel. Input terminal for the NI 5442 AWG module Reference Clock signal.
PFI 0 PFI 1	Both connectors accept a trigger from an external source to start or step through signal generation. Both terminals are bidirectional SMB connectors.

Table 6. NI 5442 AWG 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 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 or load waveforms. GREEN—The module is ready to be programmed by NI-RFSG.
ACTIVE	Indicates the state of the module. OFF—The module is not armed or triggered. AMBER—The module is armed and waiting for a Start Trigger.

LED	Indications
	GREEN—The module has received a Start Trigger and is generating a waveform.
	RED—The module has detected an error state; this state may indicate a PLL lock failure or a thermal shutdown condition.

Configuring the NI 5672 in MAX

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

1. Launch MAX.

2. In the configuration tree, expand **Devices and Interfaces** to see the list of installed NI hardware. If you are using the NI 5672 with the LabVIEW Real-Time Module, expand **Remote Systems**. Find your target IP address or name, expand it, and then expand **Devices and Interfaces**.
   Installed modules appear under the name of their associated chassis.

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

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

4. Record the identifier MAX assigns to the hardware. Use this identifier when programming the NI 5672.

5. Associate the hardware modules that comprise your device.

   a. Select the NI 5610 that is identified as not configured in the configuration tree.

   b. In the Associated Devices section, select the appropriate module from each system component drop-down listbox.
      For the NI 5672, you must associate the NI 5610 RF upconverter module with the NI 5442 AWG module.

c. Click **Save** in the MAX toolbar.

> ✎ **Note** Module associations may be lost when you move the modules to different chassis slots.

6. Self-test the device modules by selecting the modules in the configuration tree, and clicking **Self-Test** in the MAX toolbar. Repeat this step for all modules in your NI 5672 system.
The MAX self-test performs a basic verification of hardware resources.

Related tasks:

- Interconnecting the NI 5672 Modules

Related information:

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

Programming the NI 5672

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 7. NI 5672 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**.	The NI-RFSG SFP controls, generates, and presents data similar to stand-alone RF vector 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,

Application Programming Interface (API)	Location	Description
	LabWindows/CVI—Available at **Program Files** » **IVI Foundation** » **IVI** » **Drivers** » **niRFSG**.	and performs basic modulation tasks using LabVIEW VIs or LabWindows/CVI functions. After you associate the modules of the NI 5672 in MAX, NI-RFSG operates the modules as a single instrument.
	Microsoft Visual C/C++	Add all required include and library files to your project to create an NI-RFSG application in Microsoft Visual C/C++.

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.

- 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.

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.

You can locate LabVIEW or LabWindows/CVI examples with the NI Example Finder.

Within LabVIEW or LabWindows/CVI, select **Help** » **Find Examples** and navigate to **Hardware Input and Output** » **Modular 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, select the NI 5610 module in the configuration tree.

2. Select **Soft Front Panel** from the MAX toolbar.

The NI-RFSG SFP launches.

3. 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 OUTPUT connector of the NI 5610 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.

4. 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 each of the NI 5672 hardware modules illuminates.

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

Building a Basic NI-RFSG Application

You can build a basic NI-RFSG application in LabVIEW for generating continuous sine wave signals.

Adding the Core NI-RFSG VIs to a Blank VI

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**.

> 💡 **Tip** Activate the LabVIEW context help by selecting **Help » Show Context Help**.

4. Right-click the VI block diagram to launch the Functions palette.

5. Navigate to the NI-RFSG VIs on the **NI-RFSG** palette.

> **Tip** You can use the **Search** button on the **Functions** palette to find the **NI-RFSG** palette.

6. 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 9. Basic NI-RFSG Block Diagram

Initialize   Configure RF   Initiate   Check Generation Status   Close
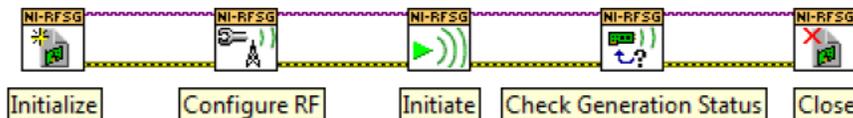
7. Right-click the resource name input on the niRFSG Initialize VI, and select **Create » Control** to create a front panel control where you specify the NI RF vector signal generator device name.

Figure 10. Resource Name Input on the niRFSG Initialize VI
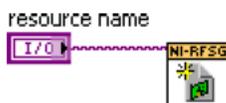
8. Right-click the frequency (Hz) input on the niRFSG Configure RF VI, and select **Create » Control**.

9. Right-click the power level (dBm) input on the niRFSG Configure RF VI, and select **Create » Control**.

10. Display the VI front panel by clicking it or by selecting **Window » Show Front Panel**.

11. In the VI front panel **power level (dBm)** control, enter 0. In the **frequency (Hz)** control, enter 100M (100 MHz).

12. In the VI front panel **resource name** control, enter the NI 5610 upconverter device name that you specified in MAX.

Adding a While Loop

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 Structures palette.

> **Tip** You can use the **Search** button on the Functions palette to find the Structures palette.

2. Enclose the niRFSG Check Generation Status VI in the While Loop, as shown in the following figure.

Figure 11. The niRFSG Check Generation Status VI Enclosed in the While Loop
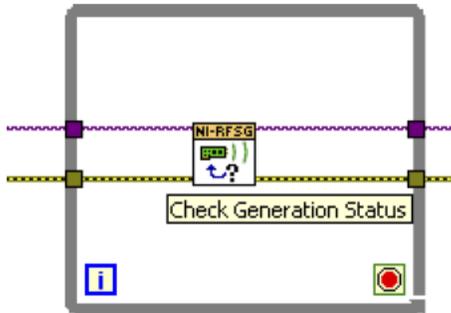
3. Right-click the While Loop tunnels, and select **Replace with Shift Register**.

4. Select the Or function on the Boolean palette. Place the function inside the While Loop.

5. Wire the output of the Or function to the conditional terminal of the While Loop.

6. Select the Unbundle by Name function on the 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 12. While Loop with Stop Button
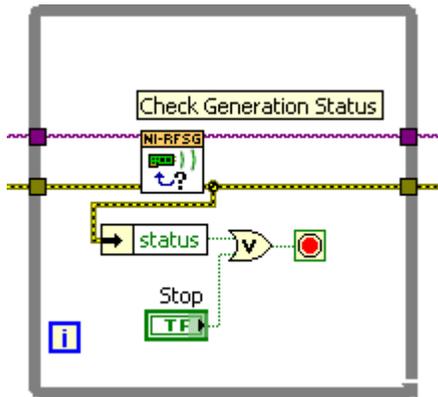
Adding an Error Indicator

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 13. Basic Sine Wave Generation VI Block Diagram
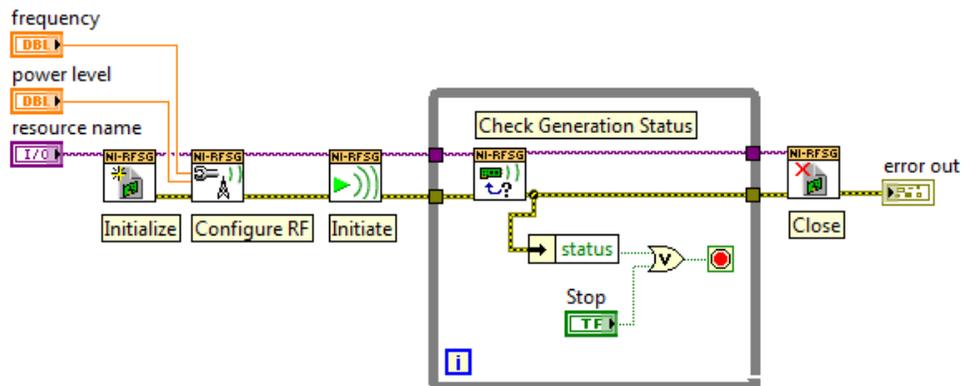
Figure 14. Basic Sine Wave Generation VI Front Panel
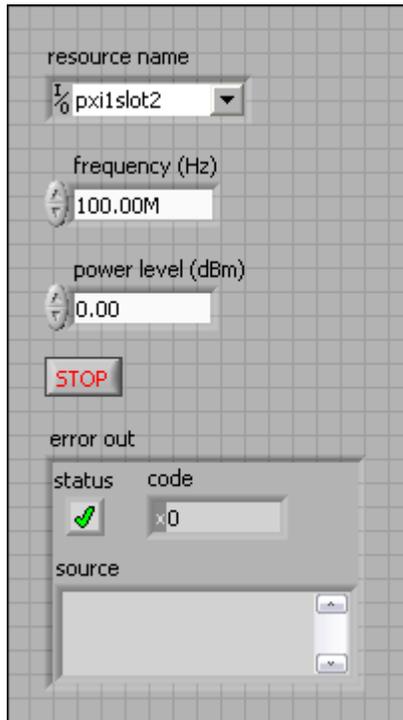
3. Open the VI front panel, and select the NI 5610 upconverter module name specified in MAX in the **resource name** control.

4. Click the **Run** button on the toolbar 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 5672.

Troubleshooting

If an issue persists after you complete a troubleshooting procedure, search our KnowledgeBase for additional information our technical support engineers create as they answer common user questions and resolve unexpected issues.

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

The LEDs may not light until the device has been configured in MAX. Before proceeding, verify that the NI 5672 appears in MAX.

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

> (!) **Notice** Apply external signals only while the NI 5672 is powered on. Applying external signals while the device is powered off may cause damage.

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

What Should I Do if the NI 5672 Does Not Appear in MAX?

1. In the MAX configuration tree, expand **Devices and Interfaces**.
2. Expand the **Chassis** tree to see the list of installed hardware, and press <F5> to refresh the list.
3. If the module is still not listed, power off the system, ensure that all hardware is correctly installed, and restart the system.
4. Navigate to the Device Manager by right-clicking the Start button, and selecting **Device Manager**.
5. Verify the NI 5672 appears in the Device Manager.

    a. Under an NI entry, confirm that a NI 5672 entry appears.

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

    b. If error conditions appear, reinstall the NI-RFSG driver.

What Should I Do if the NI 5672 Fails the Self-Test?

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

What Should I Do if the Thermal Shutdown Error Appears?

The thermal shutdown error appears when device temperatures exceed safe limits. The NI 5672 shuts down until temperatures fall to acceptable levels and you reset the device in MAX.

1. Power off the chassis that contains the device.
2. Review the **Maintain Forced-Air Cooling Note to Users** included in the NI 5672 kit and make any necessary adjustments to ensure that the device is effectively cooled.
3. Reset the device in MAX.
   The thermal shutdown error continues to be reported until you successfully reset the device.

NI Services

Visit ni.com/support to find support resources including documentation, downloads, and troubleshooting and application development self-help such as tutorials and examples.

Visit ni.com/services to learn about NI service offerings such as calibration options, repair, and replacement.

Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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