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Find the *National Instruments PXIe-5665* at our website: *Click HERE*

GETTING STARTED GUIDE

PXIe-5665 14 GHz Vector Signal Analyzer MIMO Platform

This document describes the proper slot placement and module connections needed for a phase-coherent multiple input, multiple output (MIMO) system with the PXIe-5665 14 GHz (PXIe-5665) vector signal analyzer (VSA).

The PXIe-5665 comprises the following modules:

- PXIe-5605 RF downconverter
- PXIe-5653 LO module
- PXIe-5622 IF digitizer

Preconfigured NI MIMO test systems that include these modules, a chassis, controller, software, and accessories are available for purchase at *ni.com/mimo*.

This document also describes how to correctly configure the devices in Measurement & Automation Explorer (MAX) and how to associate the modules. Refer to the *PXIe-5665 Getting Started Guide* and the *PXIe-5665 Specifications*, available at *ni.com/manuals*, for more information about device specifications, maintenance, and safety information.

Note The *master* PXIe-5665 is the RF signal analyzer that receives the LO signal directly from the PXIe-5653 module. *Slave* PXIe-5665 devices refer to the additional analyzer channels that receive daisy-chained LO and Reference Clock signals.

Installing the Modules

The PXIe-5665 MIMO test system equipment setup requires you to install a master PXIe-5665 and additional PXIe-5665 slave devices in your PXI Express chassis.

Note The following installation instructions use semi-rigid cables when making some module connections. The semi-rigid cables restrict slot placement because they require you to place certain modules next to each other in the chassis.

Note Multiple chassis are required for PXIe-5665 14 GHz VSA MIMO systems with four or more channels. Contact National Instruments for more information

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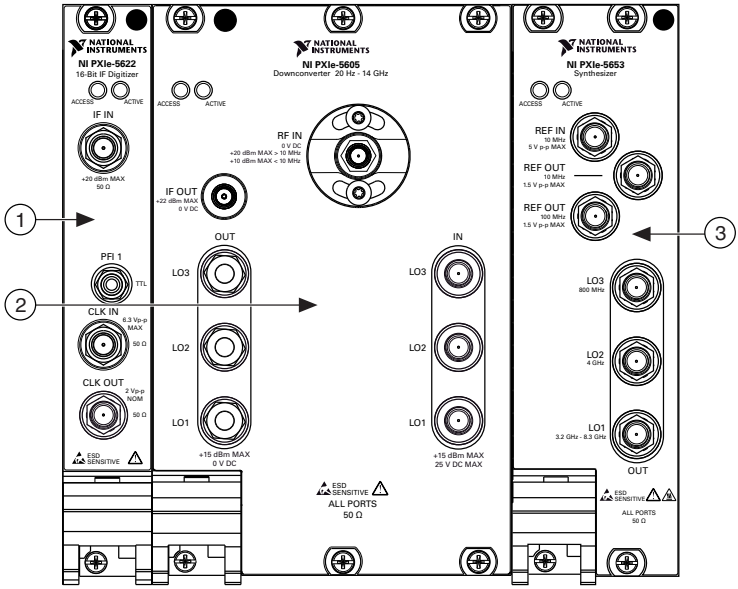
about creating PXIe-5665 14 GHz VSA MIMO test systems with four or more channels.

1. Install the PXIe-5665 master device in your chassis. To use the cables included with your module kit, install the PXIe-5622 IF digitizer module immediately to the left of the PXIe-5605 RF downconverter module, and install the PXIe-5653 LO module immediately to the right of the PXIe-5605.

   The following figure illustrates the correct placement of the three modules that comprise the PXIe-5665.

   Tip Install the master PXIe-5665 modules in the chassis with enough room to install your slave PXIe-5665 devices to the left of the master device.

Figure 1. PXIe-5665 14 GHz VSA Module Placement



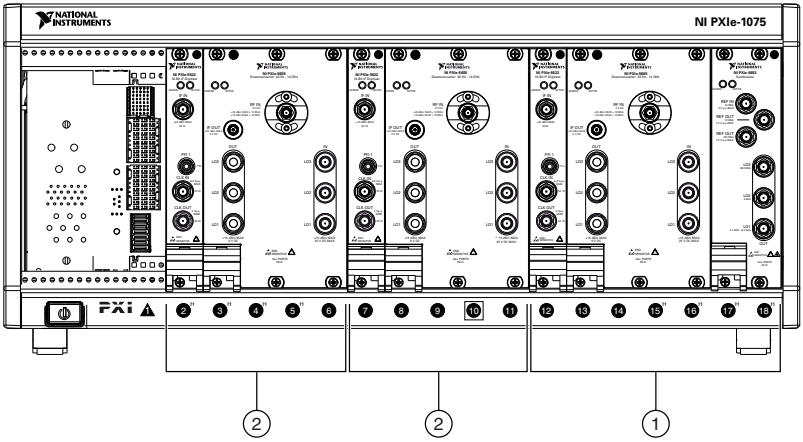
1. PXIe-5622
2. PXIe-5605
3. PXIe-5653

2. Install the slave PXIe-5665 device in your chassis to the left of the master PXIe-5665 device. You can install multiple PXIe-5665 devices to the left of the master PXIe-5665, depending on your application requirements.

   The following figure illustrates the correct placement of the slave devices in a chassis.

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Figure 2. PXIe-5665 14 GHz VSA Slave Module Placement



1. Master PXIe-5665 14 GHz VSA
2. Slave PXIe-5665 14 GHz VSA

Interconnecting the Modules

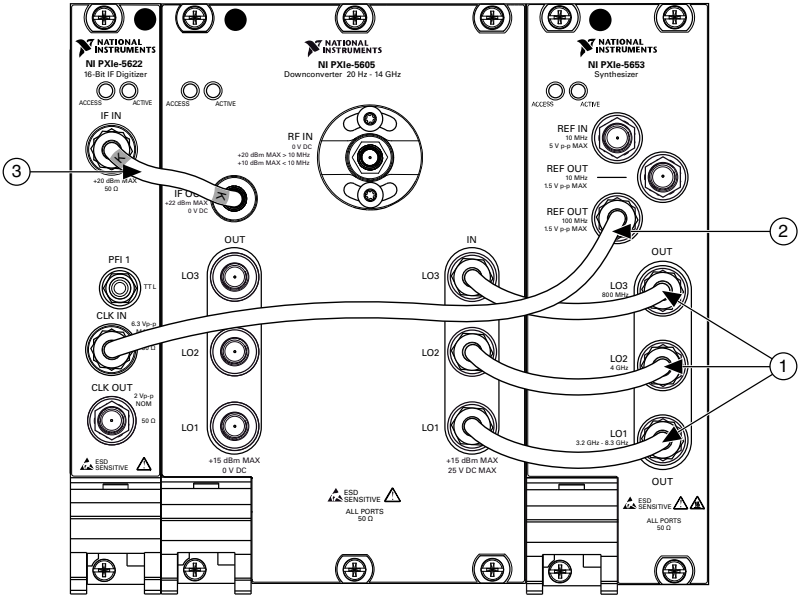
This section describes how to interconnect the master PXIe-5665 modules and how to connect the slave PXIe-5665 modules to the master PXIe-5665 modules.

Note This module configuration frequency-locks to the PXIe-5653 100 MHz onboard Reference Clock by daisy chaining the 100 MHz Reference Clock to slave digitizer modules. To frequency-lock to the PXI backplane, the PXIe-5653 requires an OCXO-quality timebase source present on the PXI backplane.
For the best long-term phase stability over temperature, use the PXI backplane as the Reference Clock source, but override the native PXI chassis backplane clock with an OCXO-quality timebase that meets the requirements listed in the *PXIe-5665 Specifications*. The PXIe-5665 cannot lock to the native PXI chassis backplane clock, and attempting to do so without overriding it with an OCXO timebase results in phase-locked loop (PLL) lock errors. The PXIe-6674T Timing and Multichassis Synchronization module is an option for synchronizing multiple digitizer clocks. The PXIe-6674T 10 MHz clock can be driven onto the PXI backplane when placed in the chassis System Timing Slot, also known as the Star Trigger Controller Slot. You can also connect the output of the PXIe-6674T 10 MHz clock to the 10 MHz BNC IN terminal on the back of the PXI chassis from any PXI chassis slot using an SMA-to-BNC cable.

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Interconnecting the Master PXIe-5665 Modules

Figure 3. PXIe-5665 14 GHz Master VSA Cable Configuration



1. Short, Silver Flexible RF SMA-to-SMA Cables
2. Flexible SMA-to-SMA Cable
3. Short, Semi-Rigid SMA-to-SMA Cable, Labeled K

1. Using the three short, silver flexible RF SMA-to-SMA cables, connect the LO1, LO2, and LO3 connectors on the PXIe-5653 front panel to the associated LO1 IN, LO2 IN, and LO3 IN connectors on the PXIe-5605 front panel.
2. Using the flexible SMA-to-SMA cable, connect the REF OUT 100 MHz connector on the PXIe-5653 front panel to the CLK IN connector on the PXIe-5622 front panel.
3. Using the short semi-rigid SMA-to-SMA cable (labeled K), connect the IF OUT connector on the PXIe-5605 front panel to the IF IN connector on the PXIe-5622 front panel.
4. Hand-tighten all SMA cable ends on the SMA connectors 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 reconnect the cable center pin on the SMA cable to the SMA connector.
5. Carefully complete tightening all SMA connectors to 1 N · m using an appropriate torque wrench (not included) or torque screwdriver and SMA driver bit. Tighten only until the wrench clicks.

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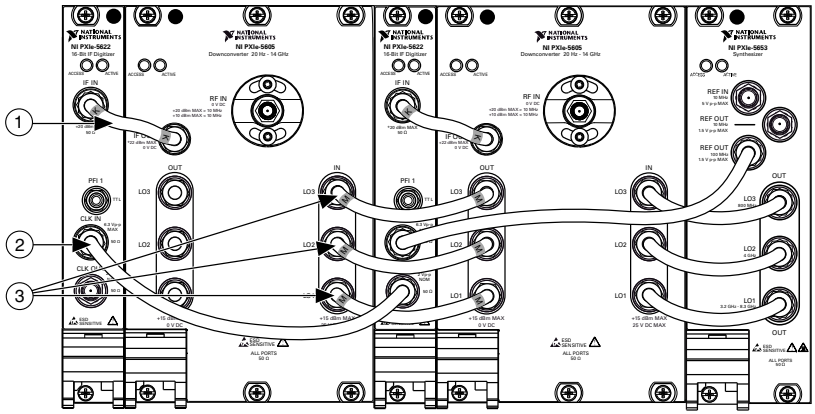
Caution Incorrect torque at SMA connections can degrade signal fidelity and phase-locked loop (PLL) performance and may cause insertion loss. Use an appropriate torque wrench or torque screwdriver and SMA driver bit to ensure all SMA connections are properly torqued. SMA connectors for connections to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

Interconnecting the Slave PXIe-5665 Modules

The PXIe-5665 MIMO test system includes the following cables to interconnect additional modules:

- Semi-rigid SMA-to-SMA cable (labeled M), (x3)
- Short, semi-rigid SMA-to-SMA cable (labeled K)
- Flexible SMA-to-SMA cable

Figure 4. PXIe-5665 14 GHz VSA Slave Module Cable Configuration



1. Short, Semi-Rigid SMA-to-SMA Cable, Labeled K
2. Flexible SMA-to-SMA Cable
3. Medium, Semi-Rigid SMA-to-SMA Cables, Labeled M

1. Using the short, semi-rigid SMA-to-SMA cable (labeled K), connect the IF OUT connector on the slave PXIe-5605 front panel to the IF IN connector on the slave PXIe-5622 front panel.
2. Using the flexible SMA-to-SMA cable, connect the CLK OUT connector from the preceding PXIe-5622 front panel to the CLK IN connector on the next PXIe-5622 front panel. This cable passes the 100 MHz Reference Clock from the preceding PXIe-5622 to the CLK IN connector of the next PXIe-5622.
3. Using the three medium, semi-rigid SMA-to-SMA cables (labeled M), connect the LO1 OUT, LO2 OUT, and LO3 OUT connectors on the preceding PXIe-5605 front panel to the associated LO1 IN, LO2 IN, and LO3 IN connectors on the next PXIe-5605 front panel.
4. Hand-tighten all SMA cable ends on the SMA connectors after the cable center pins are correctly aligned and connected. The cable connectors should tighten without much

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torque or effort. If a cable bends due to incorrect alignment, remove the cable from the front panel connector and reconnect the cable center pin on the SMA cable to the SMA connector.

5. Carefully complete tightening all SMA connectors to 1 N · m using an appropriate torque wrench (not included) or torque screwdriver and SMA driver bit. 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.

Configuring the PXIe-5665 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-RFSA.

1. Launch MAX.
2. In the configuration tree, expand **Devices and Interfaces** to see the list of installed NI hardware.

Note If you are using the PXIe-5665 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 PXIe-5665.
5. Associate the hardware modules that comprise the master and slave PXIe-5665.
   a) Select the master PXIe-5605 module 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 master PXIe-5665, you must associate the PXIe-5622 IF digitizer module and the PXIe-5653 LO source module.
   c) Select the slave PXIe-5605 module that is identified as not configured in the configuration tree.

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d) In the Associated Devices section, select the appropriate module from each system component drop-down listbox.

For the slave PXIe-5665, you must associated the PXIe-5622 IF digitizer module and you must select **External** as the LO source for each slave device because the LO signals are shared by all PXIe-5665 devices.

e) 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 PXIe-5665 system.

   The MAX self-test performs a basic verification of hardware resources.

Where Do I Go from Here?

Now that you have installed your hardware, interconnected the modules, and configured the modules in MAX, you can begin programming your hardware using the NI-RFSA instrument driver.

Visit *ni.com/mimo* for more information about how to start creating your MIMO application. This web site provides many useful MIMO articles, videos, and example programs.

The following documents provide more information that you may need as you create your MIMO application:

- *RF Multichannel Community*—Visit *ni.com/info* and enter the Info Code `exvi3p` to access the latest RF multi-channel reference software in LabVIEW for phase-coherent and non-phase-coherent hardware configurations.
- *NI RF Vector Signal Analyzers Help*—Use this help file, located at **Start»All Programs»National Instruments»NI-RFSA»Documentation**, to learn how to operate the PXIe-5665. This help file also includes hardware information and detailed programming references.
- *PXIe-5665 Specifications*—This document, located at **Start»All Programs»National Instruments»NI-RFSA»Documentation**, provides additional hardware information.
- *PXIe-5665 Getting Started Guide*—This printed document is included in your hardware kit and provides additional hardware configuration information.

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