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GETTING STARTED GUIDE

NI 6.6 GHz MIMO Platform

This document describes the proper slot placement and module connections needed for a phase-coherent MIMO system with the National Instruments 6.6 GHz MIMO platform, namely the NI PXIe-5663E and NI PXIe-5673E. This document also describes how to correctly configure the devices in NI Measurement & Automation Explorer (MAX) and how to associate the modules.

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Devices Used in the NI 6.6 GHz MIMO Platform

The NI 6.6 GHz MIMO platform is made up of the NI PXIe-5663E and the NI PXIe-5673E.

The NI PXIe-5663E is composed of the following modules:

- NI PXIe-5601 RF downconverter
- NI PXIe-5652 LO source module
- NI PXIe-5622 IF digitizer

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The NI PXIe-5673E is composed of the following modules:

- NI PXIe-5611 I/Q modulator
- NI PXIe-5652 LO source module
- NI PXIe-5450 arbitrary waveform generator (AWG)

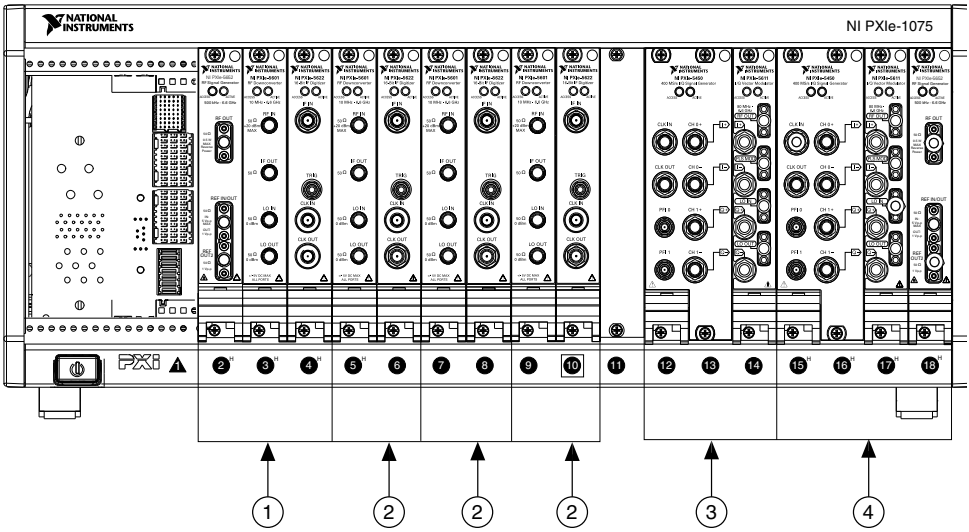
Note This MIMO system includes additional NI 5601, NI 5622, NI 5611, and NI 5450 modules. The number of additional modules depends on the number of MIMO channels.

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

Installing the Modules

The NI 6.6 GHz MIMO test system setup requires you to install a master NI 5673E, additional NI 5673E slave devices, a master NI 5663E, and additional NI 5663E slave devices in your PXI Express chassis. The following figure shows one possible setup, containing four NI 5663E devices and two NI 5673E devices.

Figure 1. NI 6.6 GHz MIMO Platform



1. Master NI 5663E
2. Slave NI 5663E
3. Slave NI 5673E
4. Master NI 5673E

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. The

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instructions in this document ensure that you install the modules in the correct locations.

Installing the NI 5673E Master

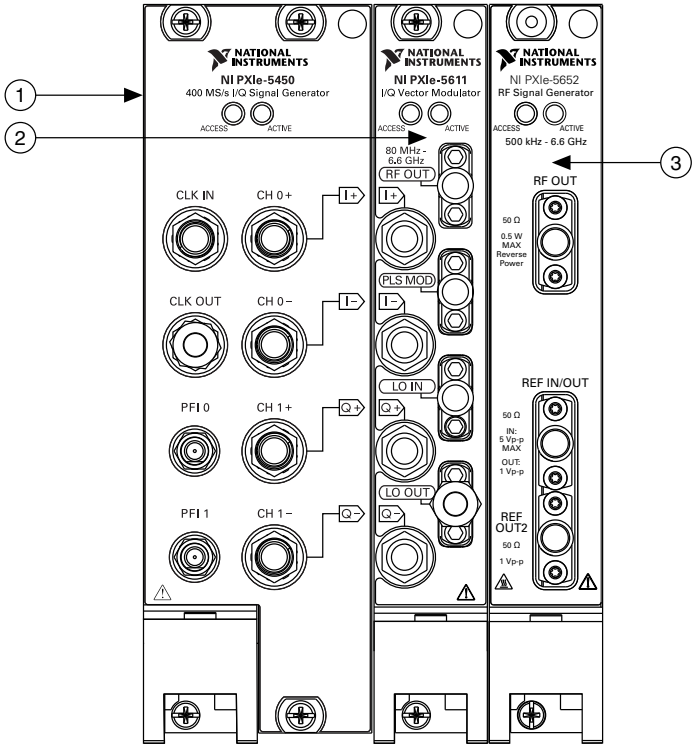
The master NI 5673E is the RF vector signal generator that receives the LO signal directly from the NI 5652 module.

Tip Install the master NI 5673E modules in the chassis with enough room to install the slave NI 5673E devices to the left of the master device.

1. Install the NI 5652 LO source module in any available PXI Express (or hybrid) slot with at least three empty slots to the left.
2. Install the NI 5611 I/Q modulator module and the NI 5450 AWG module in the locations shown in the following figure.

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Figure 2. Completed NI 5673E Module Placement



1. NI 5450
2. NI 5611
3. NI 5652

Related Information

Interconnecting the NI 5673E Master on page 7

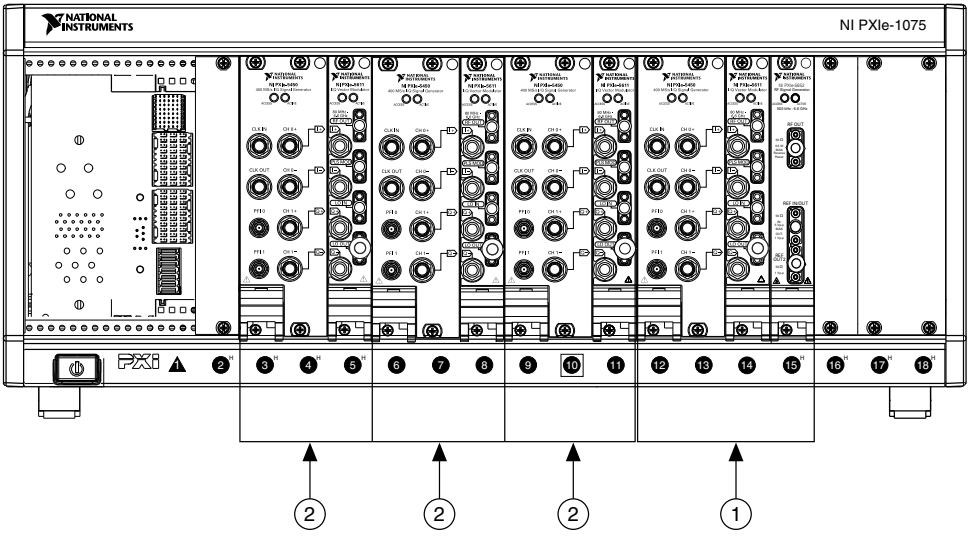
Installing the NI 5673E Slaves

Slave NI 5673E devices, which consist of NI 5450 and NI 5611 modules, are the additional generation channels that receive daisy-chained LO and digital-to-analog converter (DAC) Sample Clock signals.

1. Install the slave NI 5611 module immediately to the left of the master NI 5450 module.
2. Install the slave NI 5450 module immediately to the left of the slave NI 5611 module.
3. Install any additional slave NI 5673E devices immediately to the left of the preceding slave device, alternating NI 5611 and NI 5450 modules as shown in the following figure.

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Figure 3. NI 5673E Slave Configuration



1. Master NI 5673E
2. Slave NI 5673E

Related Information

Interconnecting the NI 5673E Slaves on page 8

Installing the NI 5663E Master

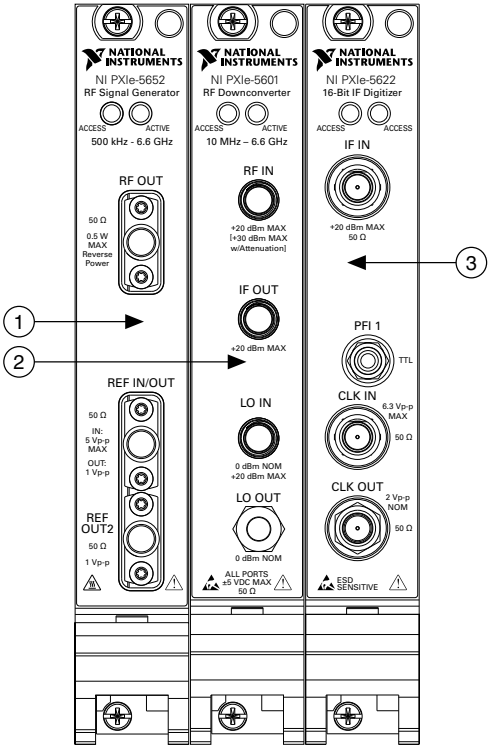
The master NI 5663E is the RF signal analyzer that receives the LO signal directly from the NI 5652 module.

Tip Install the master NI 5663E modules in the chassis with enough room to install the slave NI 5663E devices to the right of the master device.

1. Install the NI 5652 LO source module in any available PXI Express (or hybrid) slot with at least two empty slots to the right.
2. Install the NI 5601 RF downconverter module and the NI 5622 IF digitizer module in the locations shown in the following figure.

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Figure 4. Completed NI 5663E Module Placement



1. NI 5652
2. NI 5601
3. NI 5622

Related Information

Interconnecting the NI 5663E Master on page 10

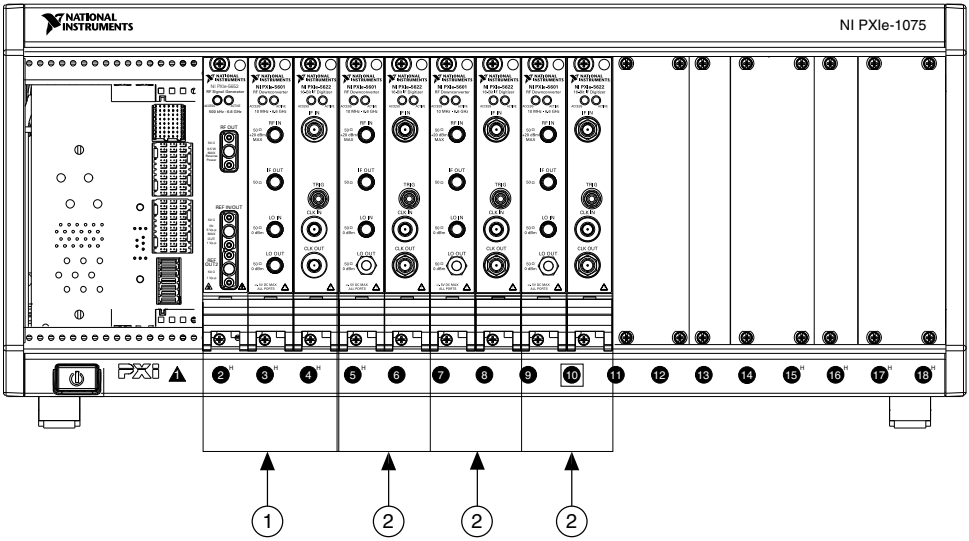
Installing the NI 5663E Slaves

Slave NI 5663E devices, which consist of NI 5601 and NI 5622 modules, are the additional analyzer channels that receive daisy-chained LO and analog-to-digital converter (ADC) Sample Clock signals.

1. Install the slave NI 5601 module immediately to the right of the master NI 5622 module.
2. Install the slave NI 5622 module immediately to the right of the slave NI 5601 module.
3. Install any additional slave NI 5663E devices immediately to the right of the preceding slave device, alternating NI 5601 and NI 5622 modules as shown in the following figure.

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Figure 5. NI 5663E Slave Configuration



1. Master NI 5663E
2. Slave NI 5663E

Related Information

Interconnecting the NI 5663E Slaves on page 11

Interconnecting the Modules

After placing the modules in the chassis, complete the following steps to connect the proper cables to the proper module terminals.

Interconnecting the NI 5673E Master

1. Using the four semi-rigid cables labeled A, connect the I+, I–, Q+, and Q– terminals of the NI 5450 and the NI 5611.

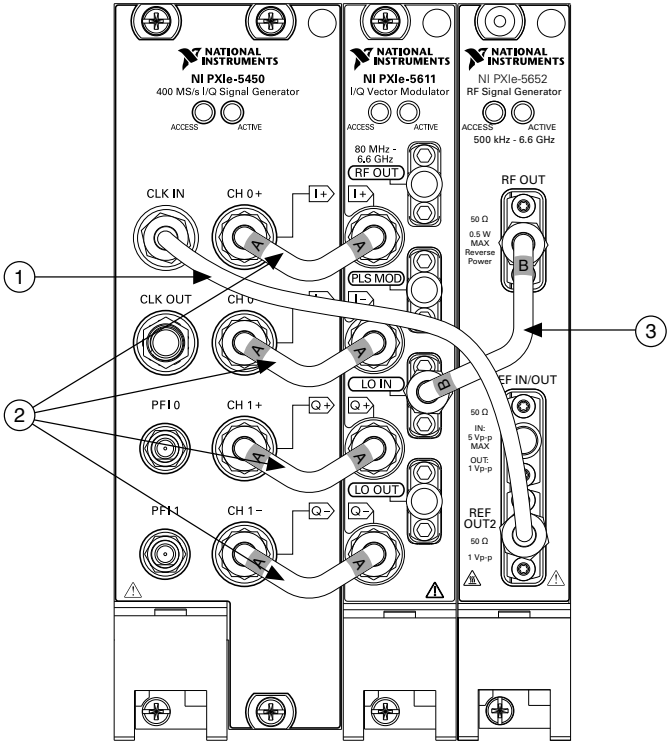
   These cables are phase-matched and connect the baseband I/Q signals from the NI 5450 to the NI 5611.
2. Using the semi-rigid cable labeled B, connect the RF OUT terminal of the NI 5652 to the LO IN terminal of the NI 5611.

   This cable connects the LO signal from the NI 5652 to the NI 5611.
3. Using the flexible SMA-to-SMA cable, connect the REF OUT2 terminal of the NI 5652 to the CLK IN terminal of the NI 5450.

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This cable passes the 10 MHz Reference Clock signal of the NI 5652 to the NI 5450 so that the NI 5450 can synthesize its DAC Sample Clock from a common timebase, such as the NI 5652.

Figure 6. Completed NI 5673E Cable Connections



1. Flexible SMA-SMA Cable
2. Semi-Rigid Cables (Labeled A)
3. Semi-Rigid Cables (Labeled B)

Related Information

Configuring the NI 5673E Master on page 13

Interconnecting the NI 5673E Slaves

1. Using the semi-rigid cables labeled A, connect the I+, I–, Q+, and Q– terminals of the slave NI 5450 and the slave NI 5611.

   These cables are phase-matched and connect the baseband I/Q signals from the NI 5450 to the NI 5611.

2. Using the flexible SMA-to-SMA cable, connect the CLK OUT terminal of the preceding NI 5450 to the CLK IN terminal of the next NI 5450.

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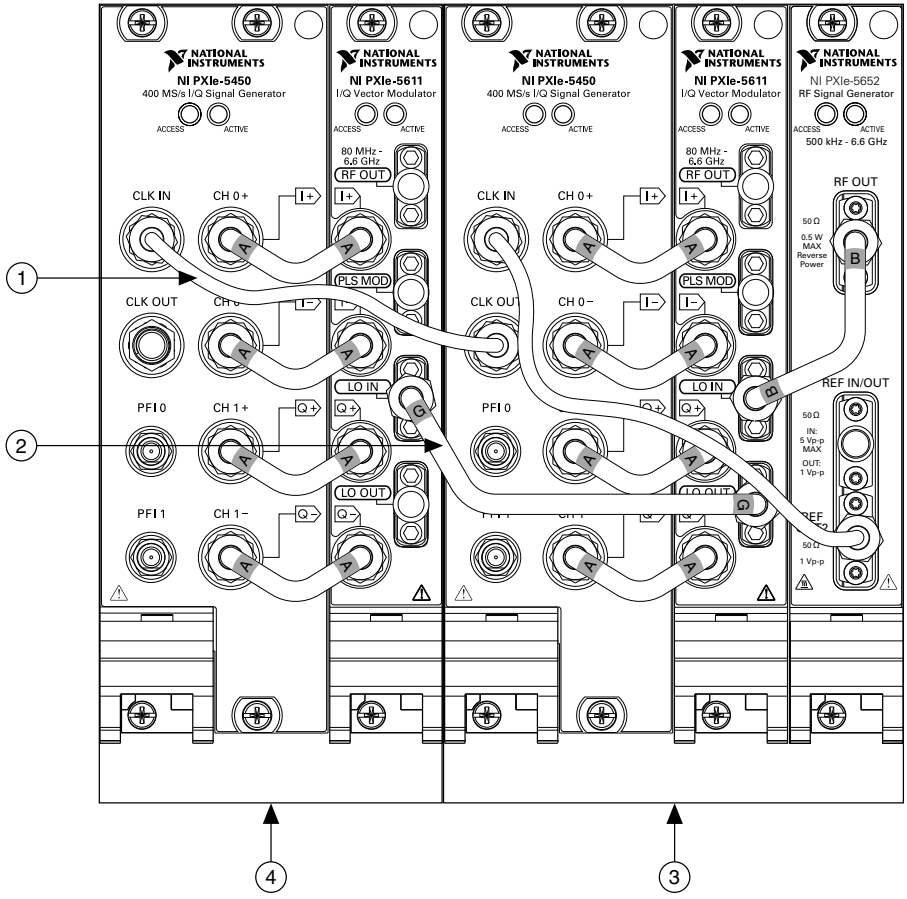
This cable passes the NI 5450 DAC Sample Clock from the master to the slave(s).

3. Using the semi-rigid cable labeled G, connect the LO OUT terminal of the preceding NI 5611 to the LO IN terminal of the next NI 5611.

   This cable is used to daisy chain the LO signal.

4. Place SMA terminators on the LO OUT terminal (NI 5611) and CLK OUT terminal (NI 5450) of the final slave device.

Figure 7. Completed NI 5673E Slave Cabling



1. Flexible SMA-SMA Cable
2. Semi-Rigid MIMO LO Cable (Labeled G)
3. Master NI 5673E
4. Slave NI 5673E

Related Information

Configuring the NI 5673E Slaves on page 15

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Interconnecting the NI 5663E Master

1. Using the semi-rigid cable labeled C, connect the RF OUT terminal of the NI 5652 to the LO IN terminal of the NI 5601.

   This cable connects the LO signal from the NI 5652 to the NI 5601.

2. Using the semi-rigid cable labeled D, connect the IF OUT terminal of the NI 5601 to the IF IN terminal of the NI 5622.

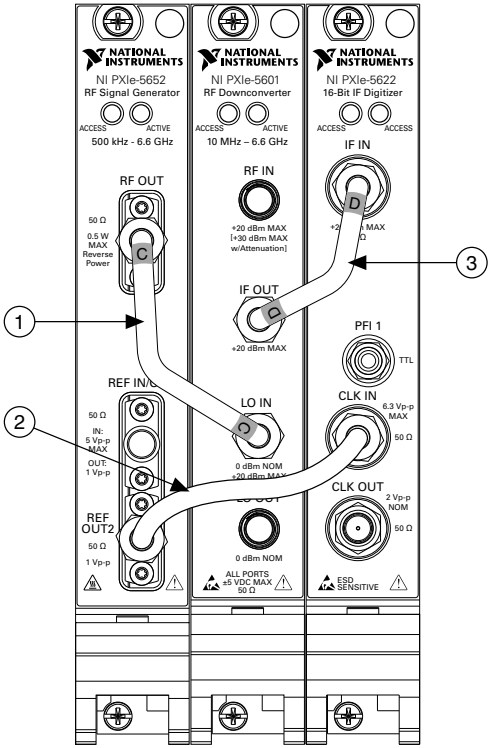
   This cable connects the downconverted IF signal from the NI 5601 to the NI 5622.

3. Using the flexible SMA-SMA cable, connect the REF OUT2 terminal of the NI 5652 to the CLK IN terminal of the NI 5622.

   This cable passes the 10 MHz Reference Clock signal of the NI 5652 to the NI 5622 so that the NI 5622 can synthesize its ADC Sample Clock from a common timebase, such as the NI 5652.

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Figure 8. Completed NI 5663E Cable Connections



1. Semi-Rigid Cable (Labeled C)
2. Flexible SMA-SMA Cable
3. Semi-Rigid Cable (Labeled D)

Related Information

Configuring the NI 5663E Master on page 16

Interconnecting the NI 5663E Slaves

1. Using the semi-rigid cable labeled D, connect the IF OUT terminal on the slave NI 5601 to the IF IN terminal on the slave NI 5622.

   This cable connects the downconverted IF signal from the NI 5601 to the NI 5622.
2. Using the flexible SMA-SMA cable, connect the CLK OUT terminal of the preceding NI 5622 to the CLK IN terminal of the next NI 5622.

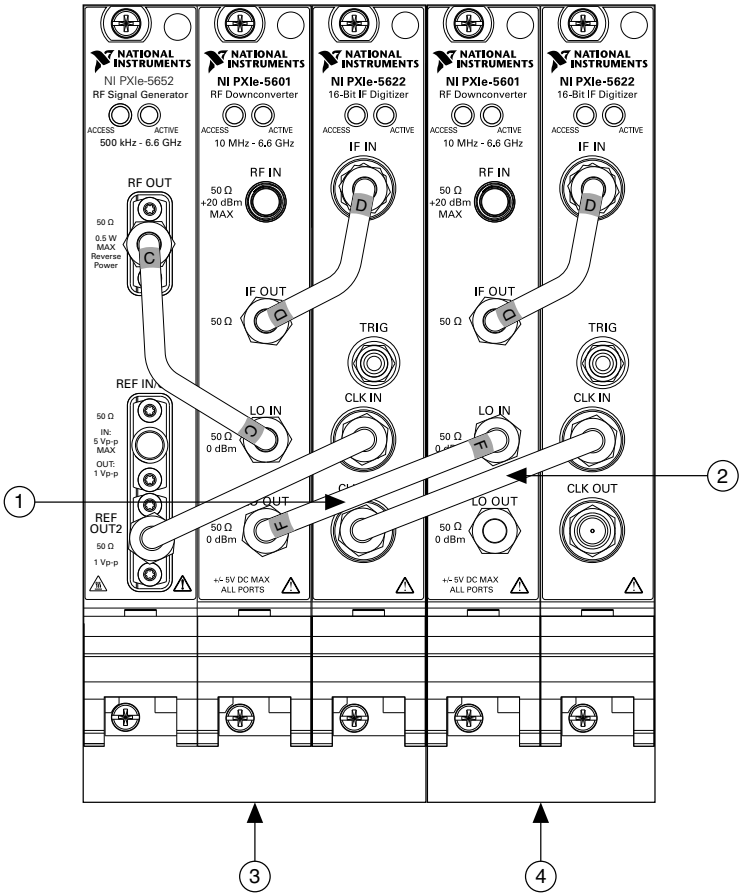
   This cable passes the digitizer ADC Sample Clock from the master to the slave(s).
3. Using the semi-rigid cable labeled F, connect the LO OUT terminal of the preceding NI 5601 to the LO IN terminal of the next NI 5601.

   This cable is used to daisy chain the LO signal.

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4. Place 50 Ω terminators on the LO OUT terminal (NI 5601) and CLK OUT terminal (NI 5622) of the final slave device.

Figure 9. Completed NI 5663E Slave Cabling



1. Semi-Rigid MIMO LO Cable (Labeled F)
2. Flexible SMA-SMA Cable
3. Master NI 5663E
4. Slave NI 5663E

Related Information

Configuring the NI 5663E Slaves on page 18

Completing the Setup

To tighten the SMA connectors and verify that you installed all modules successfully, complete the following steps:

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1. Using an appropriate torque wrench (not included) or torque screwdriver and SMA driver bit, tighten all SMA connectors. NI recommends use of 1 N·m (9 in·lbs).

   Caution Incorrect torque at SMA connections can degrade signal fidelity and PLL performance and may increase 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 connector type, material, and manufacturer.

2. Power on the chassis and controller system.
3. Verify that the ACCESS LEDs on all modules are illuminated. If the LEDs are not illuminated, refer to the *Troubleshooting* section of either the *NI PXIe-5663E Getting Started Guide* or the *NI PXIe-5673E Getting Started Guide*.

Configuring the Devices in MAX

The NI-RFSA and NI-RFSG instrument drivers for the NI 5663E and NI 5673E use a single resource name to reference the devices in software. However, each device is composed of three modules, so you must configure the hardware in MAX so that the driver software knows which modules are associated with each device.

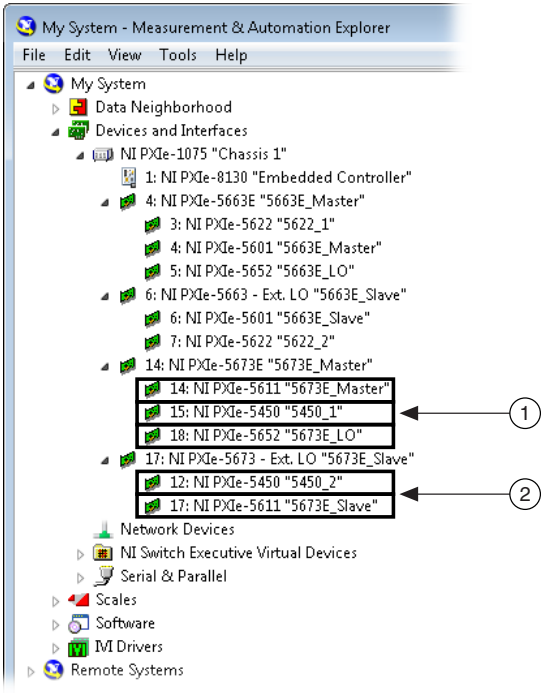
The following sections explain how to associate the modules in MAX.

Configuring the NI 5673E Master

The following figure shows the MAX configuration tree for all the modules present in a 2 × 2 MIMO setup, which can consist of two NI 5673E devices and two NI 5663E devices in a phase-coherent configuration. The two NI 5673E devices are highlighted in the figure.

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Figure 10. MAX Configuration Tree



1. Master NI 5673E
2. Slave NI 5673E

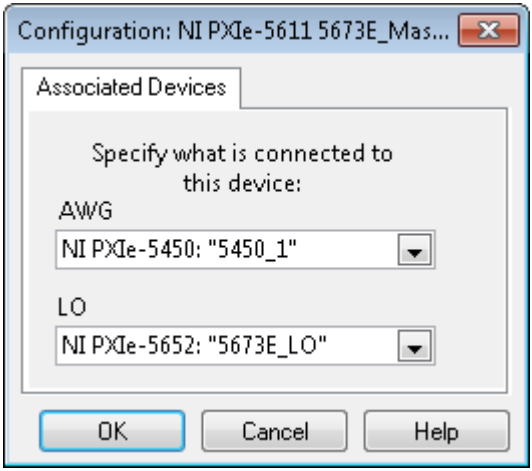
Tip Instead of using the naming convention shown in these figures, you may find it convenient to name your devices in MAX to correspond to the slot number. This approach allows you to easily locate each module.

When using the NI 5673E, each NI 5611 must have an LO source and an AWG module associated with it. To configure the module association, complete the following steps:

1. Right-click the master NI 5611 module and choose **Configure**. The following figure shows an example of the dialog box that appears.

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Figure 11. MAX Configuration Dialog Box for Master NI 5611



2. Select the module name for the AWG you need to associate with the master NI 5673E.
3. Select the module name for the LO you need to associate with the master NI 5673E.

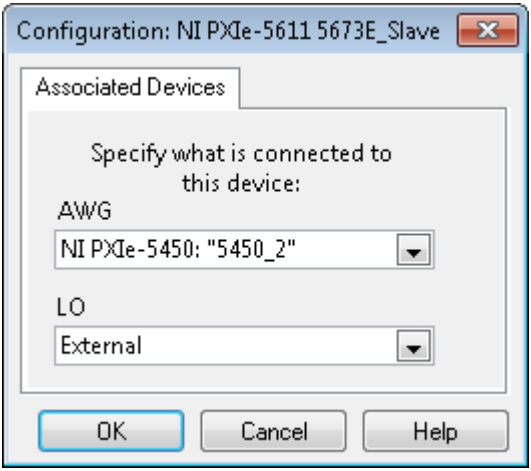
Configuring the NI 5673E Slaves

The configuration of the slave NI 5673E devices is the same as the master, with one key difference. You must select **External** as the LO source for each slave NI 5611 module because the LO signal is shared by all NI 5673E devices. To configure the module association, complete the following steps:

1. Right-click the slave NI 5611 module and choose **Configure**. The following figure shows an example of the dialog box that appears.

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Figure 12. MAX Configuration Dialog Box for Slave NI 5611



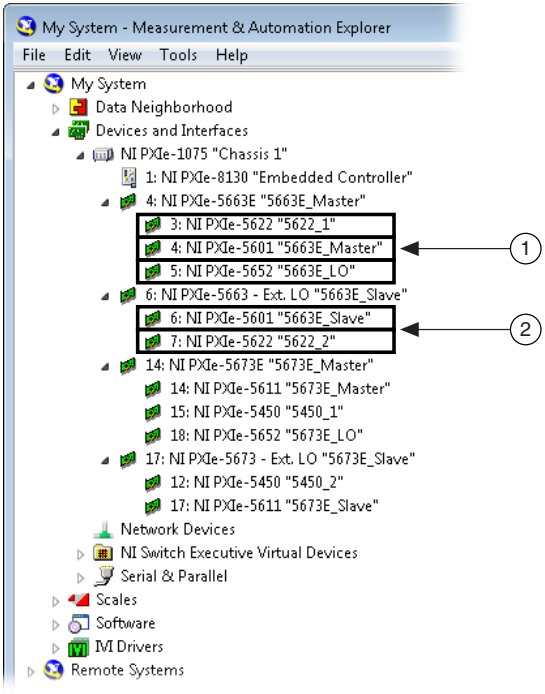
2. Select the module name for the AWG you need to associate with the slave NI 5673E.
3. Select **External** as the LO.

Configuring the NI 5663E Master

The following figure shows the MAX configuration tree for all the modules present in a 2 × 2 MIMO setup, which can consist of two NI 5673E devices and two NI 5663E devices in a phase-coherent configuration. The two NI 5663E devices are highlighted in the figure.

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Figure 13. MAX Configuration Tree for a 2 × 2 MIMO Configuration



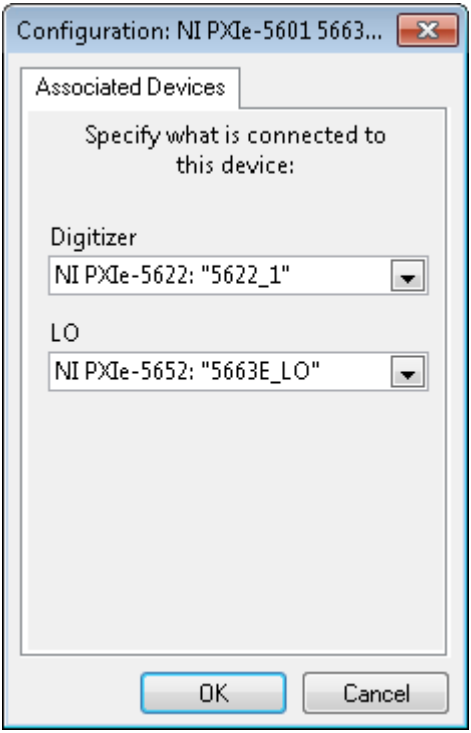
1. Master NI 5663E
2. Slave NI 5663E

When using the NI 5663E, each NI 5601 must have an LO and a baseband digitizer module associated with it. To configure the module association, complete the following steps:

1. Right-click the master NI 5601 module and choose **Configure**. The following figure shows an example of the dialog box that appears.

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Figure 14. MAX Configuration Dialog Box for Master NI 5601



2. Select the module name for the digitizer you need to associate with the master NI 5663E.
3. Select the module name for the LO you need to associate with the master NI 5663E.

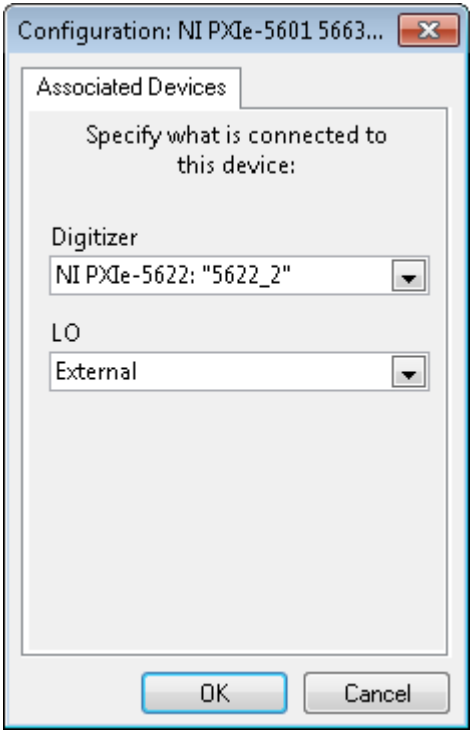
Configuring the NI 5663E Slaves

The configuration of the slave NI 5663E devices is the same as the master, with one key difference. You must select **External** as the LO source for each slave NI 5601 module because the LO signal is shared by all NI 5663E devices. To configure the module association, complete the following steps:

1. Right-click the slave NI 5601 module and choose **Configure**. The following figure shows an example of the dialog box that appears.

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Figure 15. MAX Configuration Dialog Box for Slave 5601



2. Select the module name for the digitizer you need to associate with the slave NI 5663E.
3. Select **External** as the LO.

Locating Additional Documentation

The following table shows how to locate additional documentation for the NI 5663E and NI 5673E.

Table 1. Additional Documentation for the NI 5663E and NI 5673E

Device	Documents	Location
NI 5663E	*NI PXIe-5663E Getting Started Guide*	**Start»All Programs»National Instruments»NI-RFSA»Documentation**
	NI PXIe-5663E Specifications	

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Table 1. Additional Documentation for the NI 5663E and NI 5673E (Continued)

Device	Documents	Location
NI 5673E	*NI PXIe-5673E Getting Started Guide*	**Start»All Programs»National Instruments»NI-RFSG»Documentation**
	NI PXIe-5673E Specifications	

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The National Instruments website is your complete resource for technical support. At *ni.com/support* you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

Visit *ni.com/services* for NI Factory Installation Services, repairs, extended warranty, and other services.

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

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