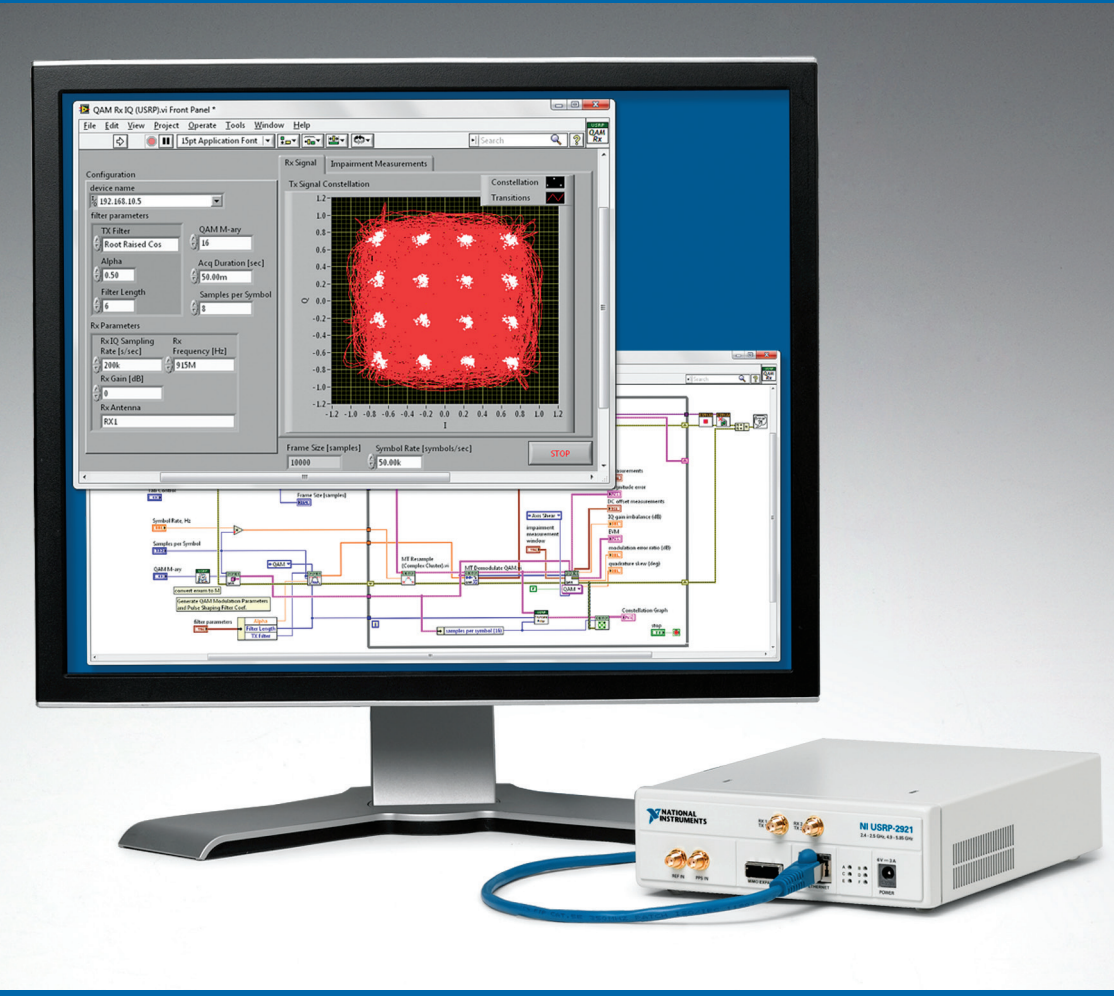
NI USRP™-29xx
Getting Started Guide



ni.com/usrp

NATIONAL INSTRUMENTS

GETTING STARTED GUIDE

NI USRP-29xx

Universal Software Radio Peripheral

This document explains how to install, configure, and test the National Instruments universal software radio peripheral (USRP) 2920, 2921, 2922, 2930, 2932, 2940R, 2942R, 2943R, 2950R, 2952R, or 2953R (NI 29xx) device. The NI USRP-29xx can send and receive signals for use in various communications applications. This device ships with the NI-USRP instrument driver, which you can use to program the device.

To access NI USRP-29xx documentation, navigate to **Start»All Programs» National Instruments»NI-USRP»Documentation**.

Contents

NATIONAL INSTRUMENTS

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 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 changes or 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 except for that connected to the GPS antenna input must be no longer than 3 m (10 ft).

Caution This product is not approved or licensed for transmission over the air using an antenna. As a result, operating this product with an antenna may violate local laws. Ensure that you are in compliance with all local laws before operating this product with an antenna.

Quick Start Steps

1. Choose whether to use the device as a PCI Express device or as an Ethernet device.

   Note NI 294x/295x devices support both PCI Express and Ethernet bus connections. All other devices support only Ethernet.

2. Install the driver software media.

3. Connect the device.
   - Ethernet connection—Keep the computer powered on. Attach the antenna or cable to the front panel terminals of the NI USRP-29xx device as desired. Connect the device directly to your computer with the included Ethernet cable and connect the power.
   - PCI Express connection—Power off the computer and the device. Connect the device to an MXI Express interface on your computer. Power on the device before powering on your computer. Attach the antenna or cable to the front panel terminals of the NI USRP-29xx device as desired.

   Note Do not connect a single device to both MXI Express and Ethernet.

4. Configure your computer.
   - Ethernet connection—Change the IP address of your standard Ethernet port to a static IP. NI recommends a static IP address of `192.168.10.1`.
   - PCI Express connection—Identify your device in Measurement & Automation Explorer (MAX) and note its RIO resource name. Optionally, create an alias for your device.
5. (Optional) Update the firmware using the NI-USRP Configuration Utility. If you are programming the device through the NI-USRP application programming interface (API) and you need to update the firmware, select **Start»All Programs»National Instruments»NI-USRP»NI-USRP Configuration Utility** to open the NI-USRP Configuration Utility. On the **N2xx/NI-29xx Image Updater** tab, click **Browse** to select a firmware image.
6. Run an example VI or sample project.

If you have trouble with any of the preceding steps, refer to the detailed sections of this guide.

Related Information

Installing the Software on page 7
Installing NI 29xx Devices on page 7
Updating Device Firmware and FPGA Images on page 14
Programming the NI 29xx on page 19

Verifying the System Requirements

To use the NI-USRP 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.
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 USRP device in meets the following specifications.

Operating temperature.....-40 °C to 70 °C

Operating humidity.....10% to 90% RH, noncondensing

Pollution Degree.....2

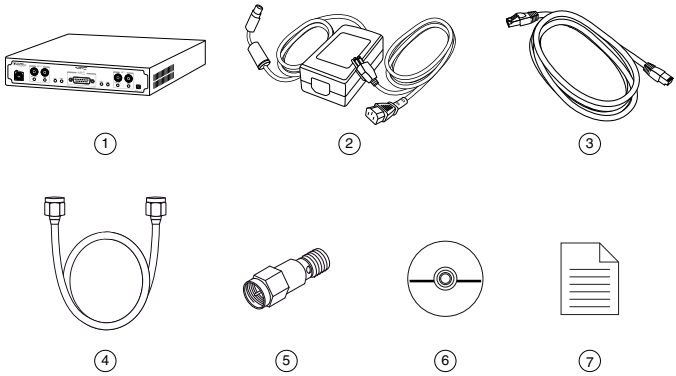
Maximum altitude.....2,000 m

Indoor use only.

Note Refer to the NI USRP device specifications on *ni.com/manuals* for complete specifications.

Caution Do not operate the device in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to National Instruments for repair.

Verifying the Kit Contents



1. NI 29xx device
2. AC/DC power supply and power cable
3. Shielded Ethernet cable (included only in NI 292x/293x kits)
4. SMA (m)-to-SMA (m) cable
5. 30 dB SMA attenuator
6. Driver software media
7. NI USRP-29xx Getting Started Guide (this document)

Caution If you directly connect or cable a signal generator to your device, or if you connect multiple NI USRP devices together, you must connect a 30 dB attenuator to the RF input (RX1 or RX2) of each receiving NI USRP device.

Note The driver software media installs the NI-USRP driver software and electronic documentation, including the *NI-USRP Help*, the *NI-USRP Readme*, and device specifications. After installation, you can find these documents at **Start»All Programs»National Instruments»NI-USRP»Documentation**.

Other Required Items

In addition to the kit contents, you must provide the following additional items:

- Computer with available gigabit Ethernet interface.
- If you plan to connect to the device using PCI Express, you need an MXI Express interface card, such as the NI PCIe-8371.
- One or more of the recommended antennas shown in the following table.

Table 1. Recommended Antennas

Device	Antenna	NI Part Number
NI USRP-2920/2922/2930/2932/2940R/2942R/2950R/2952R	VERT 400—144 MHz, 400 MHz, and 1,200 MHz tri-band vertical antenna	781915-01
NI USRP-2921/2922/2932/2942R/2943R/2952R/2953R	VERT 2450—2.4 GHz to 2.48 GHz and 4.9 GHz to 5.9 GHz to 5.9 GHz dual-band vertical antenna	781913-01

Caution This product is not approved or licensed for transmission over the air using an antenna. As a result, operating this product with an antenna may violate local laws. Ensure that you are in compliance with all local laws before operating this product with an antenna.

Optional Items

- LabVIEW Modulation Toolkit (MT), included on the driver software media, which includes MT VIs and functions, examples, and documentation

  Note You must install the LabVIEW Modulation Toolkit for proper operation of the NI-USRP Modulation Toolkit example VIs.
- LabVIEW Digital Filter Design Toolkit, included on the driver software media
- LabVIEW MathScript RT Module, included on the driver software media
- NI USRP-29xx multiple-input multiple-output (MIMO) sync and data transfer cable, available at `ni.com`, to synchronize clock sources
- Additional SMA (m)-to-SMA (m) cables to connect both channels with external devices under test (DUTs) or to use the REF IN and PPS IN signals
- GPS antenna for devices with GPS disciplined oscillator (GPSDO) support
- NI PCIe - MXI Express Interface Kit for USRP RIO to connect to a desktop computer
- NI ExpressCard Slot - MXI Express Interface Kit for USRP RIO to connect to a laptop computer
- NI PXIe - MXI Express Interface Kit for USRP RIO to connect to a PXI Express chassis

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. Insert the driver software media 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.

   Note Windows users may see access and security messages during installation. Accept the prompts to complete the installation.
4. When the installer completes, select **Restart** in the dialog box that asks if you want to restart, shut down, or restart later.

Installing NI 29xx Devices

Install all the software you plan to use before you install the hardware.

Note The NI USRP device connects to a host computer using either a standard gigabit Ethernet interface or an MXI Express device. Refer to the documentation for your gigabit Ethernet interface or your MXI Express device for installation and configuration instructions.

1. Power off the computer if necessary.
   - PCI Express connection—Power off the computer and the NI USRP device. Power on the NI USRP device before powering on your computer.
   - Ethernet connection—Keep the computer powered on.
2. Attach the antenna or cable to the front panel terminals of the NI USRP device as desired.
3. Use the Ethernet cable or MXI Express interface card to connect the NI USRP device to the computer. For maximum throughput over Ethernet, NI recommends that you connect each NI USRP device to its own dedicated gigabit Ethernet interface on the host computer.

   Note Do not connect a single NI USRP device to both MXI Express and Ethernet.
4. Connect the AC/DC power supply to the NI USRP device.
5. Plug the power supply into a wall outlet. For NI 294x/295x devices, you must also press the PWR button. If your computer was powered off, you can now power on the computer. Windows automatically recognizes the NI USRP device.

Related Information

Updating USRP N2xx/NI 29xx Firmware and FPGA Images on page 14

Configuring NI 29xx Devices

Setting Up the Network (Ethernet Only)

The device communicates with a host computer over gigabit Ethernet. Set up the network to enable communication with the device.

Note The IP addresses for the host computer and each connected NI USRP device must be unique.

Related Information

Configuring Multiple Devices with Ethernet on page 11

Configure the Host Ethernet Interface with a Static IP Address

The default IP address for the NI 29xx is `192.168.10.2`. You must configure the host Ethernet interface with a static IP address on the same subnet as the connected device to enable communication, as shown in the following table.

Table 2. Static IP Addresses

Component	Address
Host Ethernet interface static IP address	`192.168.10.1`
Host Ethernet interface subnet mask	`255.255.255.0`
Default NI USRP device IP address	`192.168.10.2`

Note NI-USRP uses user datagram protocol (UDP) broadcast packets to locate the device. On some systems, the firewall blocks UDP broadcast packets. NI recommends that you change or disable the firewall settings to allow communication with the device.

Tip Make sure the host computer uses a static IP address. You may need to modify the network settings for the local area connection using the Control Panel on the host computer. Specify the static IP address in the **Properties** page for Internet Protocol Version 4 (TCP/IPv4).

Related Information

Changing the IP Address on page 8

Changing the IP Address

To change the NI 29xx device IP address, you must know the current address of the device, and you must configure the network.

1. Verify that your device is powered on and connected to your computer using the gigabit Ethernet interface.
2. Select **Start»All Programs»National Instruments»NI-USRP»NI-USRP Configuration Utility** to open the NI-USRP Configuration Utility.
3. Select the **Change IP Address** tab of the utility.

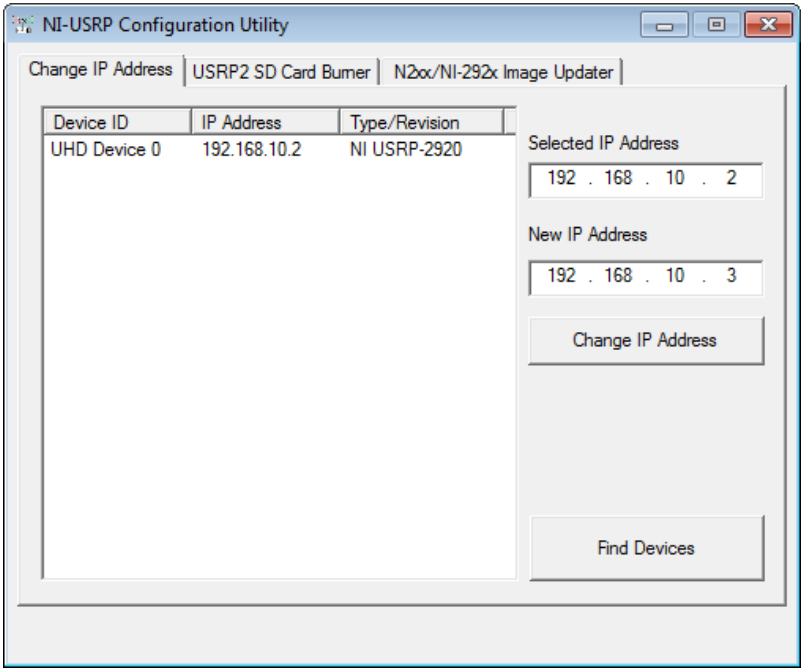
   Your device should appear in the list on the left side of the tab.
4. In the list, select the device for which you want the change the IP address.

   If you have multiple devices, verify that you selected the correct device.

   The IP address of the selected device displays in the **Selected IP Address** textbox.
5. Enter the new IP address for the device in the **New IP Address** textbox.

   The utility should appear similar to the following figure.

Figure 1. Changing the IP Address



6. Click the **Change IP Address** button or press <Enter> to change the IP address.

   The IP address of the selected device displays in the **Selected IP Address** textbox.
7. The utility prompts you to confirm your selection. Click **OK** if your selection is correct; otherwise, click **Cancel**.
8. The utility displays a confirmation to indicate the process is complete. Click **OK**.
9. Power cycle the device to apply the changes.

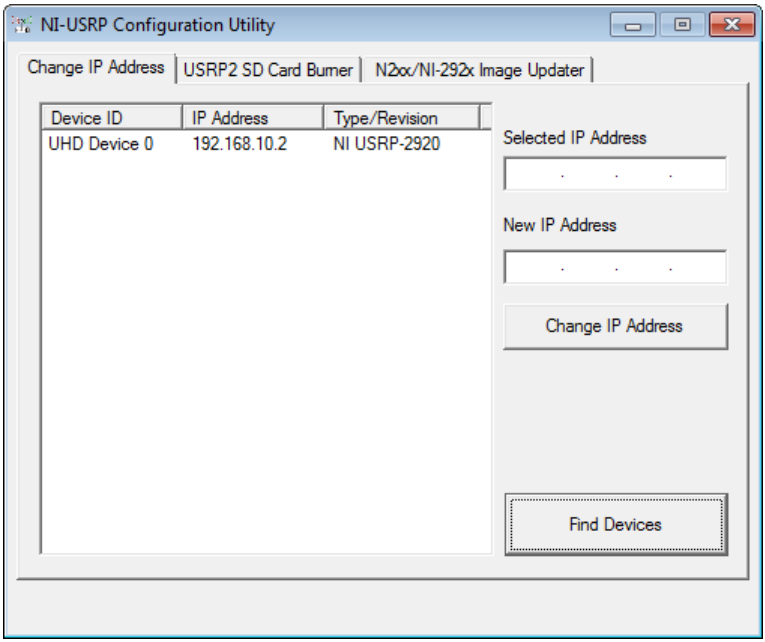
10. After you change the IP address, you must power cycle the device and click **Find Devices** in the utility to update the list of devices.

Confirming Network Connection

1. Select **Start»All Programs»National Instruments»NI-USRP»NI-USRP Configuration Utility** to open the NI-USRP Configuration Utility.
2. Select the **Change IP Address** tab of the utility.

   Your device should appear in the list on the left side of the tab, similar to the following figure.

Figure 2. Confirm Network Connection



Note If your device is not listed, verify that your device is powered on and correctly connected, then click the **Find Devices** button to scan for NI USRP devices. Your device should appear in the list on the left side of the tab.

Related Information

Changing the IP Address on page 8
The Device Does Not Connect to the Host Ethernet Interface on page 21

Configuring Multiple Devices with Ethernet

You can connect multiple devices in the following ways:

- Multiple Ethernet interfaces—One device for each interface
- Single Ethernet interface—One device connected to the interface, with additional devices connected using an optional MIMO cable
- Single Ethernet interface—Multiple devices connected to an unmanaged switch

Tip Sharing a single gigabit Ethernet interface among devices may reduce overall signal throughput. For maximum signal throughput, NI recommends that you connect no more than one device per Ethernet interface.

Multiple Host Ethernet Interfaces

To configure multiple devices connected to separate gigabit Ethernet interfaces, assign each Ethernet interface a separate subnet, and assign the corresponding device an address in that subnet, as shown in the following table.

Table 3. Multiple Host Ethernet Interface Configuration

Device	Host IP Address	Host Subnet Mask	Device IP Address
NI USRP Device 0	192.168.10.1	255.255.255.0	192.168.10.2
NI USRP Device 1	192.168.11.1	255.255.255.0	192.168.11.2

Single Host Ethernet Interface—MIMO

You can configure multiple devices using a single host Ethernet interface when the devices are connected to each other using a MIMO cable. Assign each device a separate IP address in the subnet of the host Ethernet interface, as shown in the following table. Connect Device 0 to the Ethernet interface and connect Device 1 to Device 0 using a MIMO cable.

Table 4. Single Host Ethernet Interface—MIMO Configuration

Device	Host IP Address	Host Subnet Mask	Device IP Address
NI USRP Device 0	192.168.10.1	255.255.255.0	192.168.10.2
NI USRP Device 1	192.168.10.1	255.255.255.0	192.168.10.3

Single Host Ethernet Interface—Unmanaged Switch

You can connect multiple NI USRP devices to a host computer through an unmanaged gigabit Ethernet switch that allows a single gigabit Ethernet adapter on the computer to interface with multiple NI USRP devices connected to the switch. Assign the host Ethernet interface a subnet, and assign each device an address in that subnet, as shown in the following table.

Table 5. Single Host Ethernet Interface—Unmanaged Switch Configuration

Device	Host IP Address	Host Subnet Mask	Device IP Address
NI USRP Device 0	192.168.10.1	255.255.255.0	192.168.10.2
NI USRP Device 1	192.168.10.1	255.255.255.0	192.168.10.3

Related Information

Setting Up the Network (Ethernet Only) on page 8

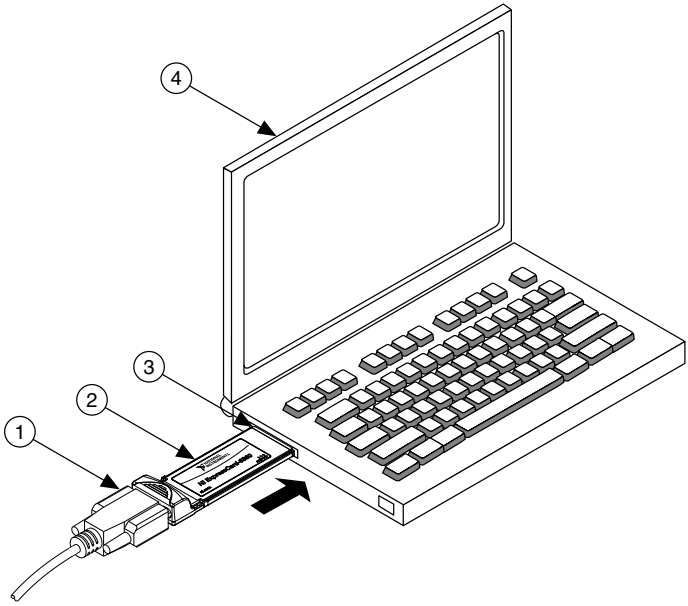
Using the Optional NI ExpressCard Slot - MXI Express Interface Kit for USRP RIO to Connect to a Laptop Computer

Laptop computers are not grounded, so you must complete the following steps to safely connect a laptop computer to your NI USRP device:

Note The ExpressCard Interface Kit can be used only with NI 294x/295x devices.

1. Ensure the NI USRP device is plugged in and powered off.
2. Touch the NI ExpressCard-8360B and outer metal case of the NI USRP device simultaneously.
3. Connect the cable to the NI ExpressCard-8360B and NI USRP device.
4. Plug the NI ExpressCard-8360B into an available ExpressCard slot. If your laptop computer is already running or hibernating when you install an NI ExpressCard-8360B, you must restart to detect the NI USRP device. Otherwise, the NI USRP device is detected when you start your computer.

Figure 3. Connecting the Express Card to a Laptop Computer



1. Cable included with ExpressCard Interface Kit
2. NI ExpressCard-8360B
3. ExpressCard Slot
4. Laptop Computer

Using the Optional NI PCIe - MXI Express Interface Kit for USRP RIO to Connect to a Desktop Computer

1. Power down your NI 294x/295x device.
2. Power down your desktop computer.
3. Follow the installation instructions in the *Hardware Installation* section of the *Set Up Your MXI™ Express ×4 System* document included in the kit to install the NI PCIe-8371.
4. Connect the NI 8371 to the to the NI 294x/295x using the included cable.
5. Power on the NI USRP device.
6. Power on the desktop computer.

Related Information

Refer to the Set Up Your MXI™ Express ×4 System printed document

Using the Optional NI PXIe - MXI Express Interface Kit for USRP RIO to Connect to a PXI Express Chassis

1. Power down your NI 294x/295x device.
2. Power down your PXI Express chassis.

3. Follow the installation instructions in the *Hardware Installation* section of the *Set Up Your MXI™ Express ×4 System* document included in the kit to install the NI PXIe-8374.
4. Connect the NI 8374 to the to the NI 294x/295x using the included cable.
5. Power on the NI 294x/295x device.
6. Power on the PXI Express chassis.

Related Information

Refer to the Set Up Your MXI™ Express ×4 System printed document

Updating Device Firmware and FPGA Images

NI 29xx devices ship with firmware and FPGA images compatible with NI-USRP driver software. You may need to update the device for compatibility with the latest version of the software.

When you use the NI-USRP API, a default FPGA loads from persistent storage on the device.

To use NI-USRP with Ettus Research USRP N2xx and USRP2 devices, you may need to update the device firmware and FPGA images. If you have used the USRP N2xx and USRP2 devices with GNU Radio, you may not have compatible images. Refer to `www.ettus.com` for more information about Ettus Research devices.

The driver software media also includes the NI-USRP Configuration Utility, which you can use to update the devices.

Note If you are using an NI 294x/295x device as a LabVIEW FPGA target, do not update firmware and FPGA images. Instead, use a sample project as a starting point to create a custom FPGA.

Related Information

Updating USRP N2xx/NI 29xx Firmware and FPGA Images on page 14
Updating USRP2 Firmware and FPGA Images on page 17
NI-USRP Sample Projects on page 19

Updating USRP N2xx/NI 29xx Firmware and FPGA Images

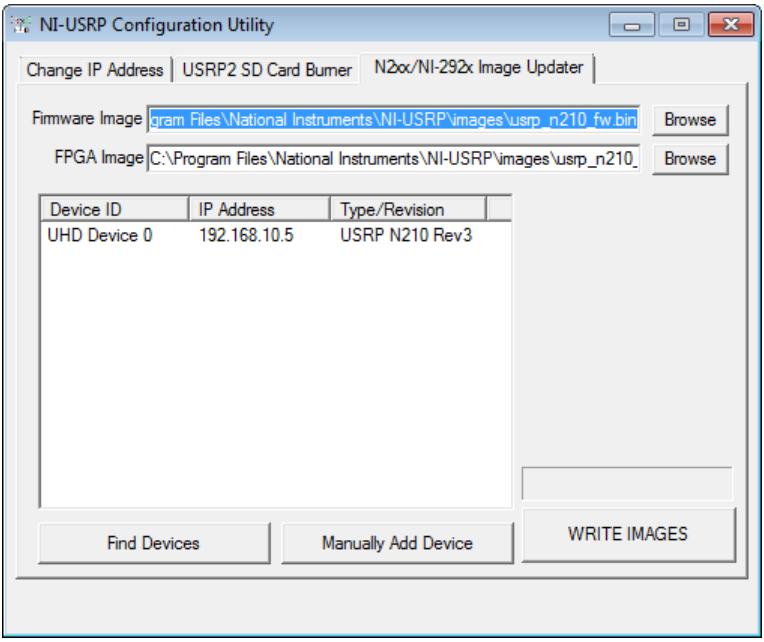
The firmware and FPGA images for the USRP N2xx and NI 29xx devices are stored in the device internal memory. You can program the device over the network to update or change the firmware and FPGA images.

1. If connected to the device using Ethernet, verify that the host Ethernet interface is configured correctly.
2. Select **Start»All Programs»National Instruments»NI-USRP»NI-USRP Configuration Utility** to open the NI-USRP Configuration Utility.
3. Select the **N2xx/NI-29xx Image Updater** tab. The utility should automatically populate the **Firmware Image** and **FPGA Image** fields with the paths to the default firmware and

FPGA image files. If you want to use different files, click the **Browse** button next to the file you want to change, and navigate to the file you want to use.

4. The utility updates the firmware and FPGA images in a single operation. Verify that the firmware and FPGA image paths are entered correctly. The utility should appear similar to the following figure.

Figure 4. N2xx/NI-29xx Image Updater

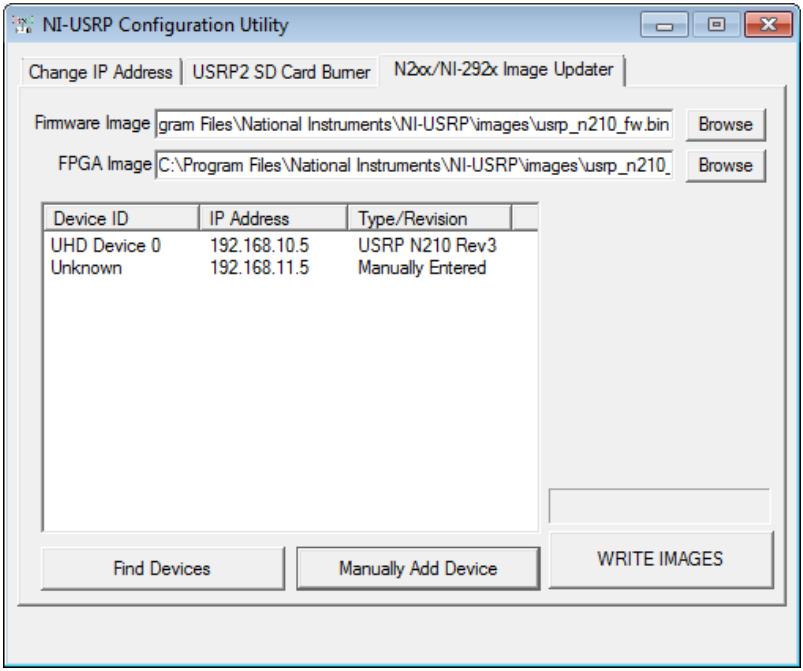


5. Click the **Find Devices** button to scan for USRP devices and update the device list.

   If your device does not appear in the list, verify that the device is on and is correctly connected to the computer.

   If your device still does not appear in the list, you can manually add the device to the list. Click the **Manually Add Device** button, enter the IP address of the device in the dialog box that displays, and click **OK**. The manually added device appears in the device list, similar to the following figure.

Figure 5. Manually Added Device



6. Select the device to update from the device list, and verify that you selected the correct device.
7. Verify that the version of the FPGA image file matches the board revision for the device you are updating. On Ettus devices, locate the board revision on a label on the back of the device.
8. To update the device, click the **WRITE IMAGES** button.
9. A confirmation dialog box displays. Confirm your selections and click **OK** to continue.

   A progress bar indicates the status of the update.
10. When the update completes, a dialog box prompts you to reset the device. A device reset applies the new images to the device. Click **OK** to reset the device.

    Note The utility is unresponsive while it verifies that the device reset correctly.
11. Close the utility.

12. For NI 292x/293x devices only—verify that the D LED is lit on the device front panel to confirm that the firmware and FPGA images loaded successfully.

Related Information

Refer to the Load the images onto the on-board flash (USRP-N Series only) section of the UHD - USRP2 and N Series Application Notes

Installing NI 29xx Devices on page 7

Updating USRP2 Firmware and FPGA Images

The firmware and FPGA images for the USRP2 device are stored on a secure digital (SD) card. After you power on the USRP2, the device loads firmware and FPGA images from the SD card plugged into the SD card slot.

Note NI recommends you use the SD card that shipped with the USRP2 device. Compatibility issues may result if you use a third-party SD card. However, the following SD cards are compatible:

- Patriot Signature 2 GB SD Flash Card Model PSF2G40SD
- Kingston 2 GB SD Flash Card W/E Tail Clamshell Model SD/2GBET

Note To update the USRP2 device firmware and FPGA images, you must use an SD card interface with read/write capability, such as the IOGEAR GFR281.

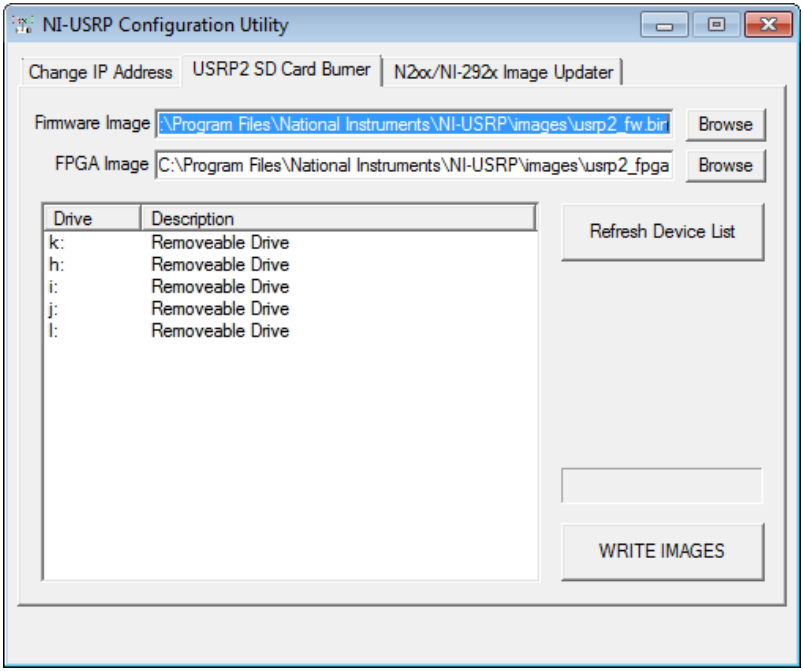
Caution If the SD card interface prompts you to format the disk, click **Cancel**. Do not format the disk.

1. Verify that the host Ethernet interface is configured correctly.
2. Insert the SD card from your device in the SD card interface connected to your system.
3. Select **Start»All Programs»National Instruments»NI-USRP»NI-USRP Configuration Utility** to open the NI-USRP Configuration Utility.
4. Select the **USRP2 SD Card Burner** tab.

   The utility should automatically populate the **Firmware Image** and **FPGA Image** fields with the paths to the default firmware and FPGA image files.
5. Optionally, if you want to use different files, click the **Browse** button next to the file you want to change, and navigate to the file you want to use.
6. Verify that the firmware and FPGA image paths are entered correctly because the utility updates both files in the same operation.

   The utility should appear similar to the following figure.

Figure 6. USRP2 SD Card Burner



7. Click the **Refresh Device List** button, and select the drive letter that corresponds to the SD card interface connected to your computer. If the drive letter for the SD card interface does not appear in the list, verify that the SD card interface appears in My Computer and the SD card is inserted in the SD card interface.

   Caution Ensure that you select the correct drive letter to update.

8. Click the **WRITE IMAGES** button or press <Enter> to write the firmware and images to your SD card.

   A progress bar indicates the status of the update.

9. Click **OK** to close the dialog box that displays to indicate the completion of the update.
10. Close the utility.
11. Return the SD card to the USRP2 device.
12. Power cycle the USRP2 device.
13. Verify that the D LED is lit on the device front panel to confirm that the firmware and FPGA images loaded successfully.

Programming the NI 29xx

You can use the NI-USRP instrument driver with all NI USRP devices. Use the NI-USRP instrument driver to create communications applications for the NI 29xx.

Some devices (NI 2940R/2942R/2943R/2950R/2952R/2953R) are LabVIEW FPGA targets, which support creating custom FPGAs and configuring the device using Instrument Design Libraries. For these devices, use a sample project as a starting point for application development.

NI-USRP Instrument Driver

NI-USRP features a set of VIs and properties that exercise the functionality of the NI 29xx, including configuration, control, and other device-specific functions. Refer to the *NI-USRP Help* for information about using the instrument driver in your applications.

NI-USRP Examples

The instrument driver examples are instructional tools that demonstrate some of the functionality of the NI 29xx. You can use these examples separately or integrate them into your systems. NI-USRP includes examples for getting started and other SDR functionality. You can access the NI-USRP examples from the following locations:

- From the Start menu at **Start»All Programs»National Instruments»NI-USRP»Examples**.
- From the LabVIEW **Functions** palette at **Instrument I/O»Instrument Drivers»NI-USRP»Examples**.

You can access additional examples from the code sharing community at `ni.com/usrp`.

Note The NI Example Finder does not include NI-USRP examples.

NI-USRP Sample Projects

The NI-USRP software contains sample projects that are a starting point for application development. You can open the projects in LabVIEW by selecting **File»Create Project»NI-USRP**.

You must install the LabVIEW FPGA Module to customize the behavior of the device FPGA.

Troubleshooting

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

Device Troubleshooting

The NI USRP Device Does Not Appear in MAX

MAX supports only NI 294x/295x devices configured with a PCI Express connection. If you are using an NI USRP 292x/293x device, or if you are using an NI 294x/295x device configured with an Ethernet connection, use the NI-USRP Configuration Utility instead. Open the NI-USRP Configuration Utility from the Start menu at **Start»All Programs»National Instruments»NI-USRP»NI-USRP Configuration Utility**.

The Device Does Not Power On

If you are using an NI 292x/293x device, check the power supply by substituting a different adapter. If you are using an NI 294x/295x device, you can also check that the power switch on the front of the device is engaged.

The Device Does Not Appear in the NI-USRP Configuration Utility

If connecting with an MXI Express cable, ensure that the NI USRP device is powered on and connected to a computer before you power on the computer.

If connecting with Ethernet, ensure the NI USRP device is connected to a computer with a gigabit-compatible Ethernet adapter. Next, ensure that a static IP address of `192.168.10.1` is assigned to the adapter in your computer. Allow up to 15 seconds for the device to completely start up.

In the NI-USRP Configuration Utility, USRP2 Appears Instead of NI-29xx

An incorrect IP address on the computer may cause this error. Check the IP address and run the NI-USRP Configuration Utility again.

An old FPGA or firmware image on the device may also cause this error. Upgrade the FPGA and firmware using the NI-USRP Configuration Utility.

The NI-USRP Palette Does Not Appear in LabVIEW (64-Bit)

NI-USRP runs only in LabVIEW (32-bit). Use LabVIEW (32-bit) instead.

NI-USRP Examples Do Not Appear in the NI Example Finder

NI-USRP does not install examples into the NI Example Finder.

You can access the NI-USRP examples from the following locations:

- From the Start menu at **Start»All Programs»National Instruments»NI-USRP»Examples**.
- From the LabVIEW **Functions** palette at **Instrument I/O»Instrument Drivers»NI-USRP»Examples**.

Network Troubleshooting

The Device Does Not Connect to the Host Ethernet Interface

The host Ethernet interface must be a gigabit Ethernet interface to connect to the NI USRP device. Ensure the connection between the host network interface card and the device cable connection is valid and both the device and computer are powered on. A lit green LED in the upper left corner of the gigabit Ethernet connection port on the device front panel indicates a gigabit Ethernet connection.

The Device Does Not Respond to a Ping (ICMP Echo Request)

The device should reply to an internet control message protocol (ICMP) echo request. Open a Windows command prompt and enter `ping 192.168.10.2`, where `192.168.10.2` is the IP address for your NI USRP device, to ping the device. If you do not receive a response, verify that the host network interface card is set to a static IP address corresponding to the same subnet as the IP address of the corresponding device. Also verify that the device IP address is set properly.

Related Information

Changing the IP Address on page 8

The NI-USRP Configuration Utility Does Not Return a Listing for My Device

If the NI-USRP Configuration Utility does not return a listing for your device, search for a specific IP address.

1. Navigate to `<Program Files>\National Instruments\NI-USRP\`.
2. <Shift>-right-click the `utilities` folder, and select **Open command window here** from the shortcut menu to open a Windows command prompt.
3. Enter `uhd_find_devices --args=addr=192.168.10.2` in the command prompt, where `192.168.10.2` is the IP address for your NI USRP device.
4. Press <Enter>.

   If the `uhd_find_devices` command does not return the listing for your device, the firewall may be blocking replies to UDP broadcast packets. Windows installs and enables a firewall by default. To allow UDP communication with a device, disable any firewall software associated with the network interface for the device.

The Device IP Address Does Not Reset to the Default

If you cannot reset the default device IP address, your device may be on a different subnet than the host network adapter. You can power cycle the device in a safe (read-only) image, which sets the device to the default IP address of `192.168.10.2`.

1. Open the device enclosure, making sure to take appropriate static precautions.
2. Locate the safe-mode button, a push-button switch (S2), inside the enclosure.
3. Press and hold the safe-mode button while you power cycle the device.
4. Continue to press the safe-mode button until the front-panel LEDs blink and remain solid.
5. While in safe-mode, run the NI-USRP Configuration Utility to change the IP address from the default, `192.168.10.2`, to a new value.
6. Power cycle the device without holding the safe-mode button to return the normal mode.

Note NI recommends that you use a dedicated network with no other USRP devices connected to the host computer to avoid the possibility of an IP address conflict. Also, verify that the static IP address of the host network adapter on the computer that runs the NI-USRP Configuration Utility is different from the device default IP address of `192.168.10.2` and different from the new IP address to which you want to set the device.

Note If the device IP address is on a different subnet from the host network adapter, the host system and configuration utility cannot communicate with and configure the device. For example, the utility recognizes, but cannot configure a device with an IP address of `192.168.11.2` connected to a host network adapter with a static IP address of `192.168.10.1` and a subnet mask of `255.255.255.0`. To communicate with and configure the device, change the host network adapter to a static IP address on the same subnet as the device, such as `192.168.11.1`, or change the subnet mask of the host network adapter to recognize a wider range of IP addresses, such as `255.255.0.0`.

Related Information

Changing the IP Address on page 8

Front Panels, Back Panels, and Connectors

NI USRP-2920

Figure 7. NI USRP-2920 Front Panel

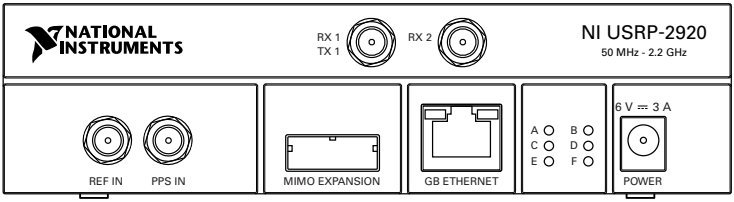


Table 6. NI USRP-2920 Module Front Panel Connectors

Connector	Use
RX1 TX1	Input and output terminal for the RF signal. RX1 TX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
REF IN	Input terminal for an external reference signal for the local oscillator (LO) on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.
PPS IN	Input terminal for the pulse per second (PPS) timing reference. PPS IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals.
MIMO EXPANSION	The MIMO EXPANSION interface port connects two NI USRP devices using a compatible MIMO cable.
GB ETHERNET	The gigabit Ethernet port accepts an RJ-45 connector and gigabit Ethernet compatible cable (Category 5, Category 5e, or Category 6).
POWER	The power input accepts a 6 V, 3 A external DC power connector.

Table 7. NI USRP-2920 Module LEDs

LED	Indication
A	Indicates the transmit status of the module: OFF—The module is not transmitting data. GREEN—The module is transmitting data.
B	Indicates the status of the physical MIMO cable link: OFF—The modules are not connected using the MIMO cable. GREEN—The modules are connected using the MIMO cable.

Table 7. NI USRP-2920 Module LEDs (Continued)

LED	Indication
C	Indicates the receive status of the module: OFF—The module is not receiving data. GREEN—The module is receiving data.
D	Indicates the firmware status of the module: OFF—The firmware is not loaded. GREEN—The firmware is loaded.
E	Indicates the reference lock status of the LO on the module: OFF—There is no reference signal, or the LO is not locked to a reference signal. BLINKING—The LO is not locked to a reference signal. GREEN—The LO is locked to a reference signal.
F	Indicates the power status of the module: OFF—The module is powered off. GREEN—The module is powered on.

NI USRP-2921

Figure 8. NI USRP-2921 Front Panel

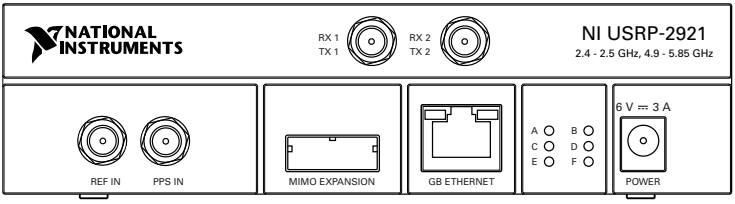


Table 8. NI USRP-2921 Module Front Panel Connectors

Connector	Use
RX1 TX1	Input and output terminal for the RF signal. RX1 TX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Table 8. NI USRP-2921 Module Front Panel Connectors (Continued)

Connector	Use
REF IN	Input terminal for an external reference signal for the local oscillator (LO) on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.
PPS IN	Input terminal for the pulse per second (PPS) timing reference. PPS IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals.
MIMO EXPANSION	The MIMO EXPANSION interface port connects two NI USRP devices using a compatible MIMO cable.
GB ETHERNET	The gigabit Ethernet port accepts an RJ-45 connector and gigabit Ethernet compatible cable (Category 5, Category 5e, or Category 6).
POWER	The power input accepts a 6 V, 3 A external DC power connector.

Table 9. NI USRP-2921 Module LEDs

LED	Indication
A	Indicates the transmit status of the module: OFF—The module is not transmitting data. GREEN—The module is transmitting data.
B	Indicates the status of the physical MIMO cable link: OFF—The modules are not connected using the MIMO cable. GREEN—The modules are connected using the MIMO cable.
C	Indicates the receive status of the module: OFF—The module is not receiving data. GREEN—The module is receiving data.
D	Indicates the firmware status of the module: OFF—The firmware is not loaded. GREEN—The firmware is loaded.

Table 9. NI USRP-2921 Module LEDs (Continued)

LED	Indication
E	Indicates the reference lock status of the LO on the module: OFF—There is no reference signal, or the LO is not locked to a reference signal. BLINKING—The LO is not locked to a reference signal. GREEN—The LO is locked to a reference signal.
F	Indicates the power status of the module: OFF—The module is powered off. GREEN—The module is powered on.

NI USRP-2922

Figure 9. NI USRP-2922 Front Panel

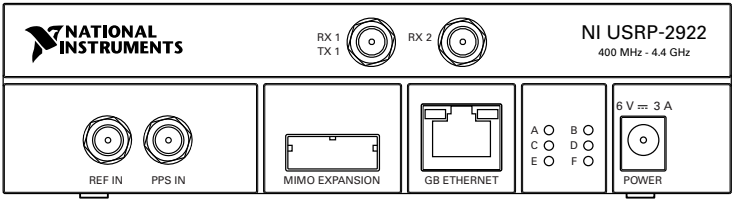


Table 10. NI USRP-2922 Module Front Panel Connectors

Connector	Use
RX1 TX1	Input and output terminal for the RF signal. RX1 TX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
REF IN	Input terminal for an external reference signal for the local oscillator (LO) on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.

Table 10. NI USRP-2922 Module Front Panel Connectors (Continued)

Connector	Use
PPS IN	Input terminal for the pulse per second (PPS) timing reference. PPS IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals.
MIMO EXPANSION	The MIMO EXPANSION interface port connects two NI USRP devices using a compatible MIMO cable.
GB ETHERNET	The gigabit Ethernet port accepts an RJ-45 connector and gigabit Ethernet compatible cable (Category 5, Category 5e, or Category 6).
POWER	The power input accepts a 6 V, 3 A external DC power connector.

Table 11. NI USRP-2922 Module LEDs

LED	Indication
A	Indicates the transmit status of the module: OFF—The module is not transmitting data. GREEN—The module is transmitting data.
B	Indicates the status of the physical MIMO cable link: OFF—The modules are not connected using the MIMO cable. GREEN—The modules are connected using the MIMO cable.
C	Indicates the receive status of the module: OFF—The module is not receiving data. GREEN—The module is receiving data.
D	Indicates the firmware status of the module: OFF—The firmware is not loaded. GREEN—The firmware is loaded.

Table 11. NI USRP-2922 Module LEDs (Continued)

LED	Indication
E	Indicates the reference lock status of the LO on the module: OFF—There is no reference signal, or the LO is not locked to a reference signal. BLINKING—The LO is not locked to a reference signal. GREEN—The LO is locked to a reference signal.
F	Indicates the power status of the module: OFF—The module is powered off. GREEN—The module is powered on.

NI USRP-2930

Figure 10. NI USRP-2930 Front Panel

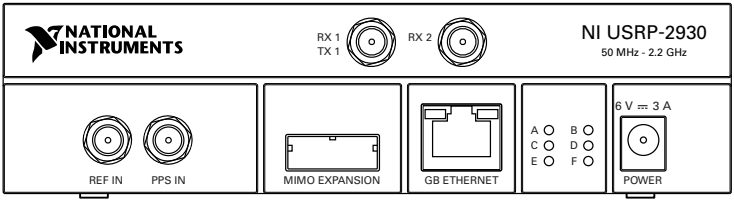


Table 12. NI USRP-2930 Module Front Panel Connectors

Connector	Use
RX1 TX1	Input and output terminal for the RF signal. RX1 TX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
REF IN	This terminal is not used for this device.
PPS IN	Input terminal for the PPS timing reference. PPS IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel. PPS IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals.
MIMO EXPANSION	The MIMO EXPANSION interface port connects two USRP devices using a compatible MIMO cable.

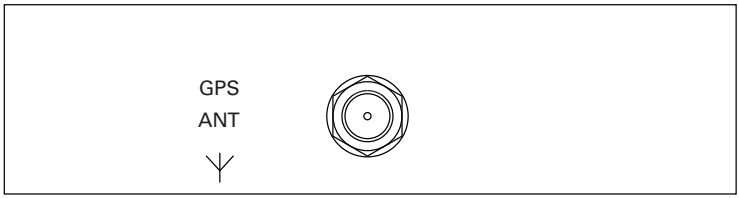
Table 12. NI USRP-2930 Module Front Panel Connectors (Continued)

Connector	Use
GB ETHERNET	The gigabit Ethernet port accepts an RJ-45 connector and gigabit Ethernet compatible cable (Category 5, Category 5e, or Category 6).
POWER	The power input accepts a 6 V, 3 A external DC power connector.

Table 13. NI USRP-2930 Module LEDs

LED	Indication
A	Indicates the transmit status of the module: OFF—The module is not transmitting data. GREEN—The module is transmitting data.
B	Indicates the status of the physical MIMO cable link: OFF—The modules are not connected using the MIMO cable. GREEN—The modules are connected using the MIMO cable.
C	Indicates the receive status of the module: OFF—The module is not receiving data. GREEN—The module is receiving data.
D	Indicates the firmware status of the module: OFF—The firmware is not loaded. GREEN—The firmware is loaded.
E	Indicates the reference lock status of the LO on the module: OFF—There is no reference signal, or the LO is not locked to a reference signal. BLINKING—The LO is not locked to a reference signal. GREEN—The LO is locked to a reference signal.
F	Indicates the power status of the module: OFF—The module is powered off. GREEN—The module is powered on.

Figure 11. NI USRP-2930 Back Panel



GPS ANT is the input terminal for the GPS antenna signal. GPS ANT is an SMA (f) connector with an impedance of 50 Ω.

NI USRP-2932

Figure 12. NI USRP-2932 Front Panel

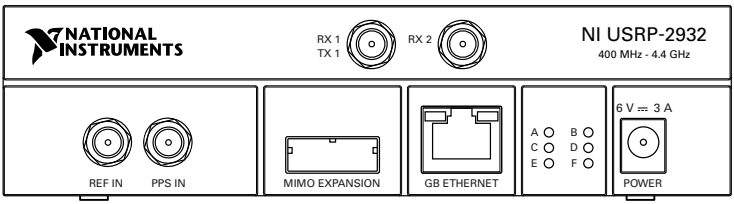


Table 14. NI USRP-2932 Module Front Panel Connectors

Connector	Use
RX1 TX1	Input and output terminal for the RF signal. RX1 TX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
REF IN	This terminal is not used for this device.
PPS IN	Input terminal for the PPS timing reference. PPS IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel. PPS IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals.
MIMO EXPANSION	The MIMO EXPANSION interface port connects two USRP devices using a compatible MIMO cable.

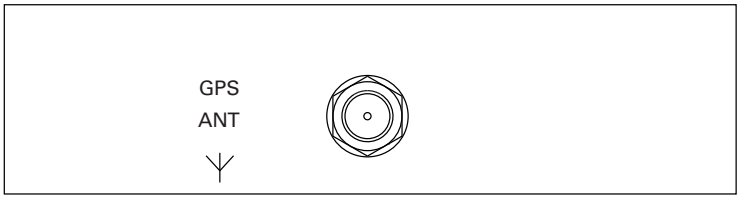
Table 14. NI USRP-2932 Module Front Panel Connectors (Continued)

Connector	Use
GB ETHERNET	The gigabit Ethernet port accepts an RJ-45 connector and gigabit Ethernet compatible cable (Category 5, Category 5e, or Category 6).
POWER	The power input accepts a 6 V, 3 A external DC power connector.

Table 15. NI USRP-2932 Module LEDs

LED	Indication
A	Indicates the transmit status of the module: OFF—The module is not transmitting data. GREEN—The module is transmitting data.
B	Indicates the status of the physical MIMO cable link: OFF—The modules are not connected using the MIMO cable. GREEN—The modules are connected using the MIMO cable.
C	Indicates the receive status of the module: OFF—The module is not receiving data. GREEN—The module is receiving data.
D	Indicates the firmware status of the module: OFF—The firmware is not loaded. GREEN—The firmware is loaded.
E	Indicates the reference lock status of the LO on the module: OFF—There is no reference signal, or the LO is not locked to a reference signal. BLINKING—The LO is not locked to a reference signal. GREEN—The LO is locked to a reference signal.
F	Indicates the power status of the module: OFF—The module is powered off. GREEN—The module is powered on.

Figure 13. NI USRP-2932 Back Panel



GPS ANT is the input terminal for the GPS antenna signal. GPS ANT is an SMA (f) connector with an impedance of 50 Ω.

NI USRP-2940R

Figure 14. NI USRP-2940R Front Panel

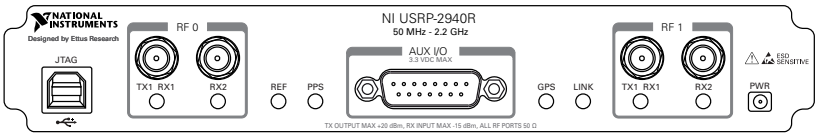


Table 16. NI USRP-2940R Module Front Panel Connectors

Connector		Use
JTAG		A USB port that connects the host computer to the device FPGA for development and debugging. LabVIEW FPGA does not currently support configuring or programming the device FPGA using the JTAG connector.
RF 0	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
AUX I/O		General-purpose I/O (GPIO) port. AUX I/O is controlled by the FPGA.

Table 16. NI USRP-2940R Module Front Panel Connectors (Continued)

Connector		Use
RF 1	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Note The LED indications described in the following table occur only when you use the NI-USRP API with the default FPGA image. When you use LabVIEW FPGA, you customize the LED indications.

Table 17. NI USRP-2940R Module LEDs

LED		Indication
RF 0	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.
REF		Indicates the status of the reference signal: OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference signal.
PPS		Indicates the pulse per second (PPS): OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference time signal.
GPS		Indicates whether the GPSDO is locked: OFF—There is no GPSDO or the GPSDO is not locked. GREEN—The GPSDO is locked.

Table 17. NI USRP-2940R Module LEDs (Continued)

LED		Indication
LINK		Indicates the status of the link to a host computer: OFF—There is no link to a host computer. GREEN/YELLOW/RED—The host is actively communicating with the device.
RF 1	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.

Figure 15. NI USRP-2940R Module Back Panel

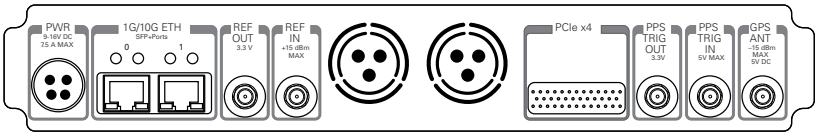


Table 18. NI USRP-2940R Module Back Panel Connectors

Connector	Use
PWR	The power input accepts a 9 V to 16 V, 6 A external DC power connector.
1G/10G ETH	The Ethernet ports accept 1G SFP modules and 10G SFP+ modules. With a 1G ETH module inserted, the ports accept gigabit Ethernet-compatible cables (Category 5, Category 5e, or Category 6).
REF OUT	Output terminal for an external reference signal for the LO on the device. REF OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference output. REF OUT outputs a 10 MHz signal at 3.3 V.

Table 18. NI USRP-2940R Module Back Panel Connectors (Continued)

Connector	Use
REF IN	Input terminal for an external reference signal for the LO on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.
PCIe x4	This port accepts a PCI Express Generation 1, x4 bus connection through an MXI Express four-lane cable.
PPS TRIG OUT	Output terminal for PPS timing reference. PPS TRIG OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS TRIG OUT outputs 0 V to 3.3 V TTL. You can also use this port as a triggered output (TRIG OUT) that you control using NI-USRP software.
PPS TRIG IN	Input terminal for PPS timing reference. PPS TRIG IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel. PPS TRIG IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals. You can also use this port as a triggered input (TRIG IN) that you control using NI-USRP software.
GPS ANT	Input terminal for the GPS antenna signal. GPS ANT is an SMA (f) connector with a maximum input power of -15 dBm and an output of DC 5 V to power an active antenna. **Caution** Do not terminate the GPS ANT port if you do not use it.

NI USRP-2942R

Figure 16. NI USRP-2942R Front Panel

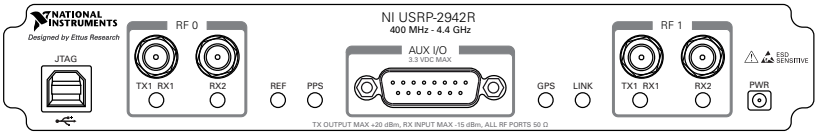


Table 19. NI USRP-2942R Module Front Panel Connectors

Connector		Use
JTAG		A USB port that connects the host computer to the device FPGA for development and debugging. LabVIEW FPGA does not currently support configuring or programming the device FPGA using the JTAG connector.
RF 0	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
AUX I/O		General-purpose I/O (GPIO) port. AUX I/O is controlled by the FPGA.
RF 1	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Note The LED indications described in the following table occur only when you use the NI-USRP API with the default FPGA image. When you use LabVIEW FPGA, you customize the LED indications.

Table 20. NI USRP-2942R Module LEDs

LED		Indication
RF 0	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.

Table 20. NI USRP-2942R Module LEDs (Continued)

LED		Indication
REF		Indicates the status of the reference signal: OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference signal.
PPS		Indicates the pulse per second (PPS): OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference time signal.
GPS		Indicates whether the GPSDO is locked: OFF—There is no GPSDO or the GPSDO is not locked. GREEN—The GPSDO is locked.
LINK		Indicates the status of the link to a host computer: OFF—There is no link to a host computer. GREEN/YELLOW/RED—The host is actively communicating with the device.
RF 1	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.

Figure 17. NI USRP-2942R Module Back Panel

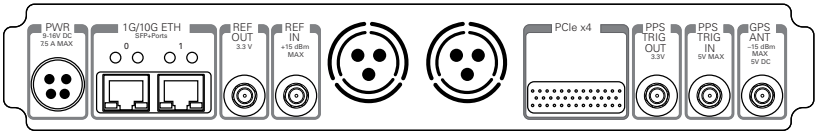


Table 21. NI USRP-2942R Module Back Panel Connectors

Connector	Use
PWR	The power input accepts a 9 V to 16 V, 6 A external DC power connector.
1G/10G ETH	The Ethernet ports accept 1G SFP modules and 10G SFP+ modules. With a 1G ETH module inserted, the ports accept gigabit Ethernet-compatible cables (Category 5, Category 5e, or Category 6).
REF OUT	Output terminal for an external reference signal for the LO on the device. REF OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference output. REF OUT outputs a 10 MHz signal at 3.3 V.
REF IN	Input terminal for an external reference signal for the LO on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.
PCIe x4	This port accepts a PCI Express Generation 1, x4 bus connection through an MXI Express four-lane cable.
PPS TRIG OUT	Output terminal for PPS timing reference. PPS TRIG OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS TRIG OUT outputs 0 V to 3.3 V TTL. You can also use this port as a triggered output (TRIG OUT) that you control using NI-USRP software.
PPS TRIG IN	Input terminal for PPS timing reference. PPS TRIG IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel. PPS TRIG IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals. You can also use this port as a triggered input (TRIG IN) that you control using NI-USRP software.
GPS ANT	Input terminal for the GPS antenna signal. GPS ANT is an SMA (f) connector with a maximum input power of -15 dBm and an output of DC 5 V to power an active antenna. **Caution** Do not terminate the GPS ANT port if you do not use it.

NI USRP-2943R

Figure 18. NI USRP-2943R Front Panel

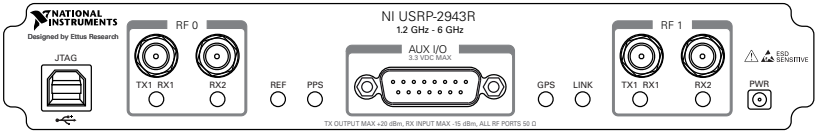


Table 22. NI USRP-2943R Module Front Panel Connectors

Connector		Use
JTAG		A USB port that connects the host computer to the device FPGA for development and debugging. LabVIEW FPGA does not currently support configuring or programming the device FPGA using the JTAG connector.
RF 0	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
AUX I/O		General-purpose I/O (GPIO) port. AUX I/O is controlled by the FPGA.
RF 1	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Note The LED indications described in the following table occur only when you use the NI-USRP API with the default FPGA image. When you use LabVIEW FPGA, you customize the LED indications.

Table 23. NI USRP-2943R Module LEDs

LED		Indication
RF 0	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.
REF		Indicates the status of the reference signal: OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference signal.
PPS		Indicates the pulse per second (PPS): OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference time signal.
GPS		Indicates whether the GPSDO is locked: OFF—There is no GPSDO or the GPSDO is not locked. GREEN—The GPSDO is locked.
LINK		Indicates the status of the link to a host computer: OFF—There is no link to a host computer. GREEN/YELLOW/RED—The host is actively communicating with the device.

Table 23. NI USRP-2943R Module LEDs (Continued)

LED		Indication
RF 1	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.

Figure 19. NI USRP-2943R Module Back Panel

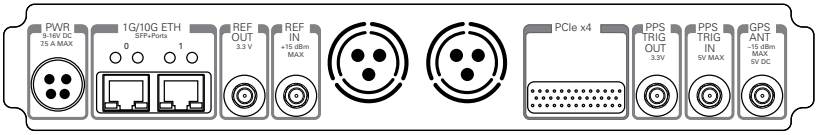


Table 24. NI USRP-2943R Module Back Panel Connectors

Connector	Use
PWR	The power input accepts a 9 V to 16 V, 6 A external DC power connector.
1G/10G ETH	The Ethernet ports accept 1G SFP modules and 10G SFP+ modules. With a 1G ETH module inserted, the ports accept gigabit Ethernet-compatible cables (Category 5, Category 5e, or Category 6).
REF OUT	Output terminal for an external reference signal for the LO on the device. REF OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference output. REF OUT outputs a 10 MHz signal at 3.3 V.
REF IN	Input terminal for an external reference signal for the LO on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.
PCIe x4	This port accepts a PCI Express Generation 1, x4 bus connection through an MXI Express four-lane cable.

Table 24. NI USRP-2943R Module Back Panel Connectors (Continued)

Connector	Use
PPS TRIG OUT	Output terminal for PPS timing reference. PPS TRIG OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS TRIG OUT outputs 0 V to 3.3 V TTL. You can also use this port as a triggered output (TRIG OUT) that you control using NI-USRP software.
PPS TRIG IN	Input terminal for PPS timing reference. PPS TRIG IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel. PPS TRIG IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals. You can also use this port as a triggered input (TRIG IN) that you control using NI-USRP software.
GPS ANT	Input terminal for the GPS antenna signal. GPS ANT is an SMA (f) connector with a maximum input power of -15 dBm and an output of DC 5 V to power an active antenna. **Caution** Do not terminate the GPS ANT port if you do not use it.

NI USRP-2950R

Figure 20. NI USRP-2950R Front Panel

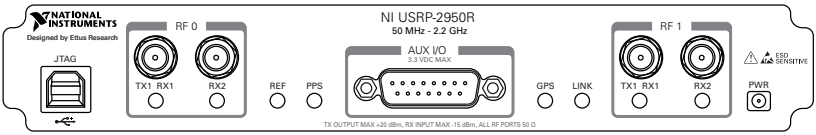


Table 25. NI USRP-2950R Module Front Panel Connectors

Connector		Use
JTAG		A USB port that connects the host computer to the device FPGA for development and debugging. LabVIEW FPGA does not currently support configuring or programming the device FPGA using the JTAG connector.
RF 0	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Table 25. NI USRP-2950R Module Front Panel Connectors (Continued)

Connector		Use
AUX I/O		General-purpose I/O (GPIO) port. AUX I/O is controlled by the FPGA.
RF 1	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Note The LED indications described in the following table occur only when you use the NI-USRP API with the default FPGA image. When you use LabVIEW FPGA, you customize the LED indications.

Table 26. NI USRP-2950R Module LEDs

LED		Indication
RF 0	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.
REF		Indicates the status of the reference signal: OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference signal.
PPS		Indicates the pulse per second (PPS): OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference time signal.

Table 26. NI USRP-2950R Module LEDs (Continued)

LED		Indication
GPS		Indicates whether the GPSDO is locked: OFF—There is no GPSDO or the GPSDO is not locked. GREEN—The GPSDO is locked.
LINK		Indicates the status of the link to a host computer: OFF—There is no link to a host computer. GREEN/YELLOW/RED—The host is actively communicating with the device.
RF 1	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.

Figure 21. NI USRP-2950R Module Back Panel

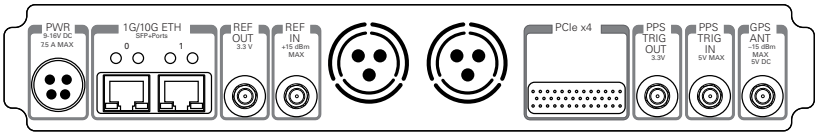


Table 27. NI USRP-2950R Module Back Panel Connectors

Connector	Use
PWR	The power input accepts a 9 V to 16 V, 6 A external DC power connector.
1G/10G ETH	The Ethernet ports accept 1G SFP modules and 10G SFP+ modules. With a 1G ETH module inserted, the ports accept gigabit Ethernet-compatible cables (Category 5, Category 5e, or Category 6).
REF OUT	Output terminal for an external reference signal for the LO on the device. REF OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference output. REF OUT outputs a 10 MHz signal at 3.3 V.

Table 27. NI USRP-2950R Module Back Panel Connectors (Continued)

Connector	Use
REF IN	Input terminal for an external reference signal for the LO on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.
PCIe x4	This port accepts a PCI Express Generation 1, x4 bus connection through an MXI Express four-lane cable.
PPS TRIG OUT	Output terminal for PPS timing reference. PPS TRIG OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS TRIG OUT outputs 0 V to 3.3 V TTL. You can also use this port as a triggered output (TRIG OUT) that you control using NI-USRP software.
PPS TRIG IN	Input terminal for PPS timing reference. PPS TRIG IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel. PPS TRIG IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals. You can also use this port as a triggered input (TRIG IN) that you control using NI-USRP software.
GPS ANT	Input terminal for the GPS antenna signal. GPS ANT is an SMA (f) connector with a maximum input power of -15 dBm and an output of DC 5 V to power an active antenna. **Caution** Do not terminate the GPS ANT port if you do not use it.

NI USRP-2952R

Figure 22. NI USRP-2952R Front Panel

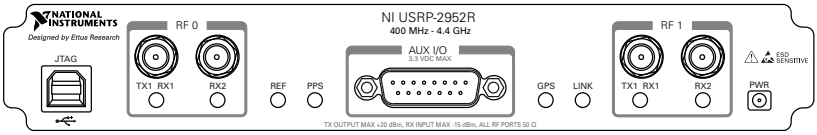


Table 28. NI USRP-2952R Module Front Panel Connectors

Connector		Use
JTAG		A USB port that connects the host computer to the device FPGA for development and debugging. LabVIEW FPGA does not currently support configuring or programming the device FPGA using the JTAG connector.
RF 0	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
AUX I/O		General-purpose I/O (GPIO) port. AUX I/O is controlled by the FPGA.
RF 1	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Note The LED indications described in the following table occur only when you use the NI-USRP API with the default FPGA image. When you use LabVIEW FPGA, you customize the LED indications.

Table 29. NI USRP-2952R Module LEDs

LED		Indication
RF 0	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.

Table 29. NI USRP-2952R Module LEDs (Continued)

LED		Indication
REF		Indicates the status of the reference signal: OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference signal.
PPS		Indicates the pulse per second (PPS): OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference time signal.
GPS		Indicates whether the GPSDO is locked: OFF—There is no GPSDO or the GPSDO is not locked. GREEN—The GPSDO is locked.
LINK		Indicates the status of the link to a host computer: OFF—There is no link to a host computer. GREEN/YELLOW/RED—The host is actively communicating with the device.
RF 1	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.

Figure 23. NI USRP-2952R Module Back Panel

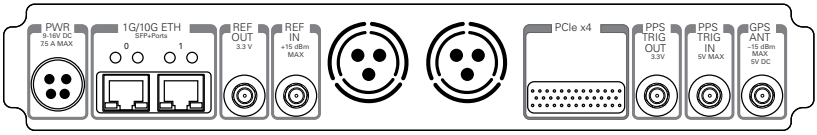


Table 30. NI USRP-2952R Module Back Panel Connectors

Connector	Use
PWR	The power input accepts a 9 V to 16 V, 6 A external DC power connector.
1G/10G ETH	The Ethernet ports accept 1G SFP modules and 10G SFP+ modules. With a 1G ETH module inserted, the ports accept gigabit Ethernet-compatible cables (Category 5, Category 5e, or Category 6).
REF OUT	Output terminal for an external reference signal for the LO on the device. REF OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference output. REF OUT outputs a 10 MHz signal at 3.3 V.
REF IN	Input terminal for an external reference signal for the LO on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.
PCIe x4	This port accepts a PCI Express Generation 1, x4 bus connection through an MXI Express four-lane cable.
PPS TRIG OUT	Output terminal for PPS timing reference. PPS TRIG OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS TRIG OUT outputs 0 V to 3.3 V TTL. You can also use this port as a triggered output (TRIG OUT) that you control using NI-USRP software.
PPS TRIG IN	Input terminal for PPS timing reference. PPS TRIG IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel. PPS TRIG IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals. You can also use this port as a triggered input (TRIG IN) that you control using NI-USRP software.
GPS ANT	Input terminal for the GPS antenna signal. GPS ANT is an SMA (f) connector with a maximum input power of -15 dBm and an output of DC 5 V to power an active antenna. **Caution** Do not terminate the GPS ANT port if you do not use it.

NI USRP-2953R

Figure 24. NI USRP-2953R Front Panel

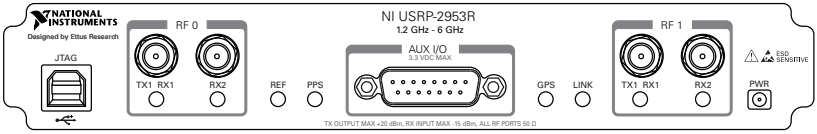


Table 31. NI USRP-2953R Module Front Panel Connectors

Connector		Use
JTAG		A USB port that connects the host computer to the device FPGA for development and debugging. LabVIEW FPGA does not currently support configuring or programming the device FPGA using the JTAG connector.
RF 0	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
AUX I/O		General-purpose I/O (GPIO) port. AUX I/O is controlled by the FPGA.
RF 1	TX1 RX1	Input and output terminal for the RF signal. TX1 RX1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
	RX2	Input terminal for the RF signal. RX2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Note The LED indications described in the following table occur only when you use the NI-USRP API with the default FPGA image. When you use LabVIEW FPGA, you customize the LED indications.

Table 32. NI USRP-2953R Module LEDs

LED		Indication
RF 0	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.
REF		Indicates the status of the reference signal: OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference signal.
PPS		Indicates the pulse per second (PPS): OFF—There is no reference signal or the device is not locked to the reference signal. BLINKING—The device is not locked to the reference signal. GREEN—The device is locked to the reference time signal.
GPS		Indicates whether the GPSDO is locked: OFF—There is no GPSDO or the GPSDO is not locked. GREEN—The GPSDO is locked.
LINK		Indicates the status of the link to a host computer: OFF—There is no link to a host computer. GREEN/YELLOW/RED—The host is actively communicating with the device.

Table 32. NI USRP-2953R Module LEDs (Continued)

LED		Indication
RF 1	TX1/ RX1	Indicates the transmit status of the module: OFF—The module is not active. RED—The module is receiving data. GREEN—The module is transmitting data.
	RX2	Indicates the receive status of the module: OFF—The module is not receiving. GREEN—The modules is receiving.

Figure 25. NI USRP-2953R Module Back Panel

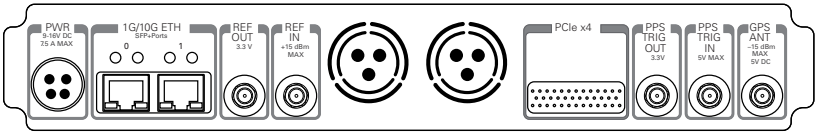


Table 33. NI USRP-2953R Module Back Panel Connectors

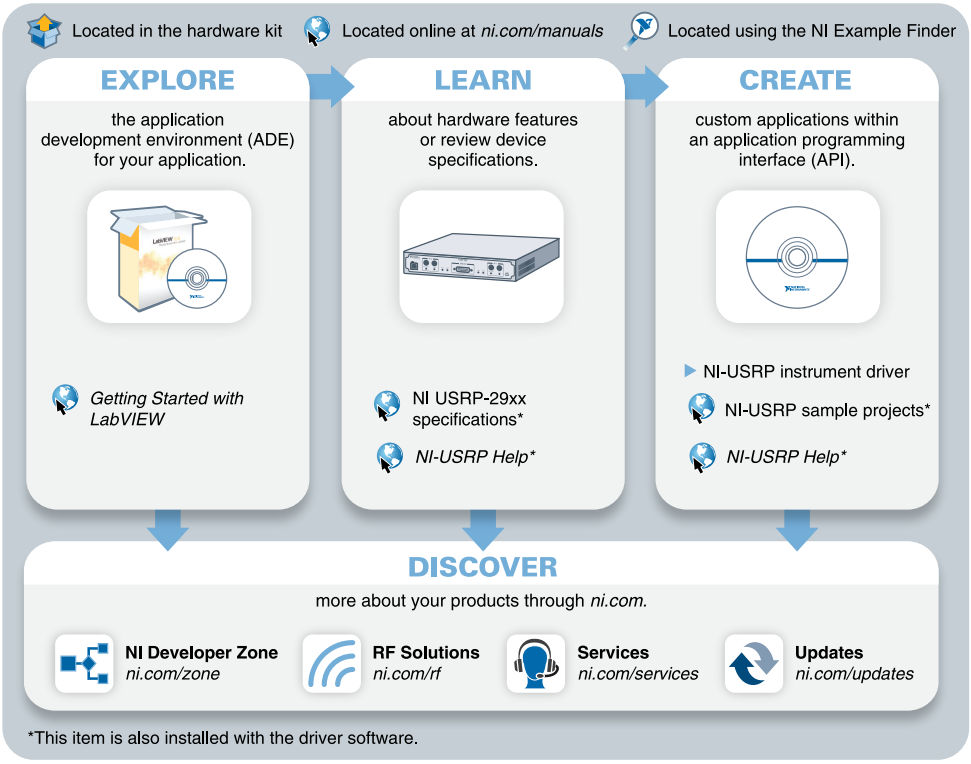
Connector	Use
PWR	The power input accepts a 9 V to 16 V, 6 A external DC power connector.
1G/10G ETH	The Ethernet ports accept 1G SFP modules and 10G SFP+ modules. With a 1G ETH module inserted, the ports accept gigabit Ethernet-compatible cables (Category 5, Category 5e, or Category 6).
REF OUT	Output terminal for an external reference signal for the LO on the device. REF OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference output. REF OUT outputs a 10 MHz signal at 3.3 V.
REF IN	Input terminal for an external reference signal for the LO on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 V_{pk-pk}) and a maximum input power of 15 dBm (3.56 V_{pk-pk}) for a square wave or sine wave.
PCIe x4	This port accepts a PCI Express Generation 1, x4 bus connection through an MXI Express four-lane cable.

Table 33. NI USRP-2953R Module Back Panel Connectors (Continued)

Connector	Use
PPS TRIG OUT	Output terminal for PPS timing reference. PPS TRIG OUT is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS TRIG OUT outputs 0 V to 3.3 V TTL. You can also use this port as a triggered output (TRIG OUT) that you control using NI-USRP software.
PPS TRIG IN	Input terminal for PPS timing reference. PPS TRIG IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel. PPS TRIG IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals. You can also use this port as a triggered input (TRIG IN) that you control using NI-USRP software.
GPS ANT	Input terminal for the GPS antenna signal. GPS ANT is an SMA (f) connector with a maximum input power of -15 dBm and an output of DC 5 V to power an active antenna.  **Caution** Do not terminate the GPS ANT port if you do not use it.

Where to Go Next

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



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

Worldwide Support and Services

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.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting *ni.com/certification*. If your product supports calibration, you can obtain the calibration certificate for your product at *ni.com/calibration*.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world. For telephone support in the United States, create your service request at *ni.com/support* or dial 512 795 8248. For telephone support outside the United States, visit the *Worldwide Offices* section of *ni.com/niglobal* to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

375717E-01 Feb14

375717E-01 Feb14