GETTING STARTED GUIDE

NI USRP-2920/2921/2922

Universal Software Radio Peripheral

This document explains how to install, configure, and test the National Instruments universal software radio peripheral (USRP) 2920, 2921, or 2922 (NI 292x) device. The NI 292x 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 292x 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 those connected to the Ethernet antenna ports 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.

Verifying the System Requirements

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

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

Unpacking the Kit

⚠ **Caution**   To prevent electrostatic discharge (ESD) from damaging the device, ground yourself using a grounding strap or by holding a grounded object, such as your computer chassis.

1. Touch the antistatic package to a metal part of the computer chassis.
2. Remove the device from the package and inspect the device for loose components or any other sign of damage.

> **Caution** Never touch the exposed pins of connectors.

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

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

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

Verifying the Kit Contents
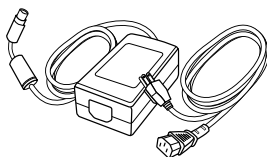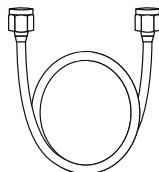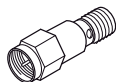
1. NI 29xx Device	4. SMA (m)-to-SMA (m) Cable
2. AC/DC Power Supply and Power Cable	5. 30 dB SMA Attenuator
3. Shielded Ethernet Cable	6. Getting Started Guide (This Document)

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

Other Required Items

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

• Computer with available gigabit Ethernet interface.

> **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
- USRP MIMO sync and data cable, available at ni.com, to synchronize clock sources
- Additional SMA (m)-to-SMA (m) cables to connect both channels with external devices or to use the REF IN and PPS IN signals
- GPS antenna for devices with GPS disciplined oscillator (GPSDO) support

Preparing the Environment

Ensure that the environment you are using the USRP device in meets the following specifications.

Operating temperature	23 ±5 °C
Operating humidity	10% to 90% relative humidity, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m

Indoor use only.

📝 **Note** Refer to the USRP device specifications at *ni.com/manuals* for complete specifications.

⚠ **Caution** Do not operate the NI 292x 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 NI for repair.

Installing the Software

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

1. Install an ADE, such as LabVIEW.
2. Visit *ni.com/info* and enter the Info Code usrpdriver to access the driver download page for the latest NI-USRP software.
3. Download the NI-USRP driver software.

4. 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.

5. When the installer completes, select **Restart** in the dialog box that prompts you to restart, shut down, or restart later.

Installing NI 292x Devices

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

> **Note** The NI 292x device connects to a host computer using a standard gigabit Ethernet interface. Refer to the documentation for your gigabit Ethernet interface for installation and configuration instructions.

1. Power on the computer.

2. Attach the antenna or cable to the front panel terminals of the NI 292x device as desired.

3. Use the Ethernet cable to connect the NI 292x device to the computer. For maximum throughput over Ethernet, NI recommends that you connect each NI 292x device to its own dedicated gigabit Ethernet interface on the host computer.

4. Connect the AC/DC power supply to the NI 292x device.

5. Plug the power supply into a wall outlet. Windows automatically recognizes the NI 292x device.

Synchronizing NI 292x Devices (Optional)

You can connect two USRP devices so that they share clocks and the Ethernet connection to the host.

1. Connect the MIMO cable included with the kit to the MIMO EXPANSION port of each device.
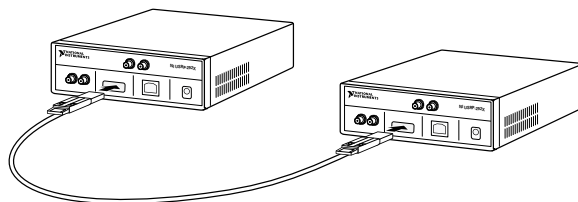
2. If you have not already done so, attach antennas to the USRP devices.

   If you want to use one USRP device as a receiver and the other as a transmitter, attach one antenna to the RX 1 TX 1 port of the transmitter, and attach another antenna to the RX 2 port of the receiver.

The NI-USRP driver ships with some examples that you can use to explore the MIMO connection, including USRP EX Rx Multiple Synchronized Inputs (MIMO Expansion).vi and USRP EX Tx Multiple Synchronized Outputs (MIMO Expansion).vi.

Configuring NI 292x 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 USRP device must be unique.

Configuring the Host Ethernet Interface with a Static IP Address

The default IP address for the NI 292x is `192.168.10.2`.

1. Ensure 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).

2. 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 1. 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 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.

Changing the IP Address

To change the USRP 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 **Devices** 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 to 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.

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 **Refresh Devices List** 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 **Devices** tab of the utility.

   Your device should appear in the list on the left side of the tab.

   Note If your device is not listed, verify that your device is powered on and correctly connected, then click the **Refresh Devices List** button to scan for USRP devices.

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 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 2. Multiple Host Ethernet Interface Configuration

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

Single Ethernet Interface—One Device

You can configure multiple devices using a single host Ethernet interface when the devices are connected to each other using a MIMO cable.

1. Assign each device a separate IP address in the subnet of the host Ethernet interface, as shown in the following table.

Table 3. Single Host Ethernet Interface—MIMO Configuration

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

2. Connect Device 0 to the Ethernet interface and connect Device 1 to Device 0 using a MIMO cable.

Single Ethernet Interface—Multiple Devices Connected to an Unmanaged Switch

You can connect multiple 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 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 4. Single Host Ethernet Interface—Unmanaged Switch Configuration

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

Programming the NI 292x

You can use the NI-USRP instrument driver to create communications applications for the NI 292x.

NI-USRP Instrument Driver

NI-USRP features a set of VIs and properties that exercise the functionality of the NI 292x, 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 292x. 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**.
- In LabVIEW from **Functions»Instrument I/O»Instrument Drivers»NI-USRP» Examples** palette.

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.

Testing the Device (Optional)

Perform a loopback test to confirm that the device transmits and receives signals and is connected correctly to the host computer.

1. Attach the included 30 dB attenuator to one end of the SMA (m)-to-SMA (m) cable.
2. Connect the 30 dB attenuator to the RX 2 TX 2 connector on the front panel of the USRP device, and connect the other end of the SMA (m)-to-SMA (m) cable to the RX 1 TX 1 port.
3. On the host computer, open the niUSRP EX Tx Continuous Async example VI and run it.

    If the device is transmitting signals, the IQ graph displays I and Q waveforms.
4. Open the niUSRP EX Rx Continuous Async example VI and run it.

    If the device is receiving signals, the IQ graph displays I and Q waveforms.

Troubleshooting

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

Device Troubleshooting

Should I Update Device Firmware and FPGA Images?

NI 292x 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.

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

Updating NI 292x Firmware and FPGA Images (Optional)

The firmware and FPGA images for NI 292x devices are stored in the device internal memory. You can reload the FPGA image or firmware image using the NI-USRP Configuration Utility and an Ethernet connection, but you cannot create custom FPGA images using the Ethernet connection.

1. If you have not already done so, connect the host computer to the device using the Ethernet port.

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 automatically populates 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. Verify that the firmware and FPGA image paths are entered correctly.

5. Click the **Refresh Device List** 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**.

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.

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.

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

Why Doesn't the USRP Device Appear in MAX?

MAX does not support NI 292x devices. 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**.

Why Doesn't the Device Power On?

Check the power supply by substituting a different adapter.

Why Doesn't the USRP Device Appear in the NI-USRP Configuration Utility?

1. Check the connection between the USRP device and the computer.
2. Ensure that the USRP device is connected to a computer with a gigabit-compatible Ethernet adapter.
3. Ensure that a static IP address of `192.168.10.1` is assigned to the adapter in your computer.
4. Allow up to 15 seconds for the device to completely start up.

In the NI-USRP Configuration Utility, Why Does USRP2 Appear Instead of NI 292x?

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.

Why Don't NI-USRP Examples 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**.
*   In LabVIEW from **Functions**»**Instrument I/O**»**Instrument Drivers**»**NI-USRP**»**Examples** palette.

Network Troubleshooting

Why Doesn't the Device Respond to a Ping (ICMP Echo Request)?

The device should reply to an internet control message protocol (ICMP) echo request. To ping the device, open a Windows command prompt and enter `ping` *`192.168.10.2`*, where *`192.168.10.2`* is the IP address for your USRP 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

Why Doesn't the NI-USRP Configuration Utility 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 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.

Why Doesn't the Device IP Address 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 6

Why Does the Device Not Connect to the Host Interface?

The host Ethernet interface must be a gigabit Ethernet interface to connect to the 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.

Front Panels and Connectors

Direct Connections to the NI 292x

The NI 292x is a precision RF instrument that is sensitive to ESD and transients. Ensure you take the following precautions when making direct connections to the NI 292x to avoid damaging the device.
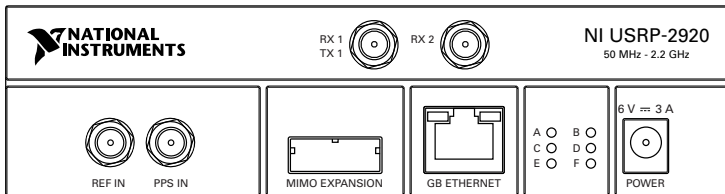
⚠️ **Caution** Apply external signals only while the NI 292x is powered on. Applying external signals while the device is powered off may cause damage.

- Ensure you are properly grounded when manipulating cables or antennas connected to the NI 292x TX 1 RX 1 or RX 2 connector.
- If you are using noninsulated devices, such as a noninsulated RF antenna, ensure the devices are maintained in a static-free environment.
- If you are using an active device, such as a preamplifier or switch routed to the NI 292x TX 1 RX 1 or RX 2 connector, ensure that there are no signal transients greater than the RF and DC specifications for the device that are being generated and sourced to the NI 292x TX 1 RX 1 or RX 2 connector.

NI USRP-2920

Figure 1. NI USRP-2920 Front Panel

Table 5. NI USRP-2920 Module Front Panel Connectors

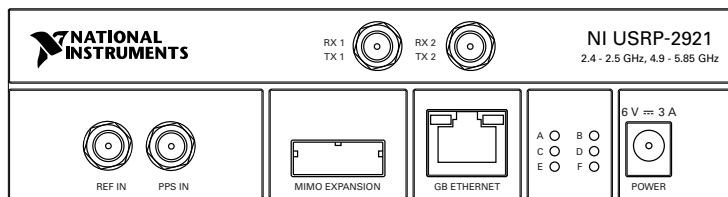| Connector	Use
RX 1 TX 1	Input and output terminal for the RF signal. RX 1 TX 1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
RX 2	Input terminal for the RF signal. RX 2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.
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 Vpk-pk) and a maximum input power of 15 dBm (3.56 Vpk-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 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 6. 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 6. 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 2. NI USRP-2921 Front Panel

Table 7. NI USRP-2921 Module Front Panel Connectors

Connector	Use
RX 1 TX 1	Input and output terminal for the RF signal. RX 1 TX 1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
RX 2	Input terminal for the RF signal. RX 2 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input channel.

Table 7. NI USRP-2921 Module Front Panel Connectors (Continued)

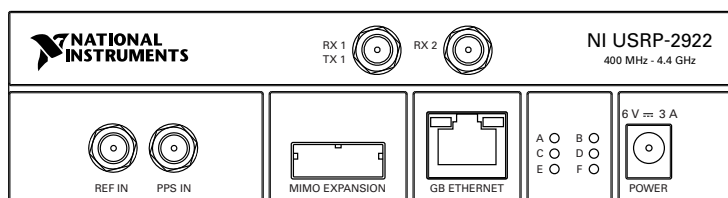| Connector	Use
REF IN	Input terminal for an external reference signal for the local oscillator (LO) on the device. REF IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended reference input. REF IN accepts a 10 MHz signal with a minimum input power of 0 dBm (.632 Vpk-pk) and a maximum input power of 15 dBm (3.56 Vpk-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 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 8. 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 8. 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 3. NI USRP-2922 Front Panel

Table 9. NI USRP-2922 Module Front Panel Connectors

Connector	Use
RX 1 TX 1	Input and output terminal for the RF signal. RX 1 TX 1 is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input or output channel.
RX 2	Input terminal for the RF signal. RX 2 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 Vpk-pk) and a maximum input power of 15 dBm (3.56 Vpk-pk) for a square wave or sine wave.

Table 9. NI USRP-2922 Module Front Panel Connectors (Continued)

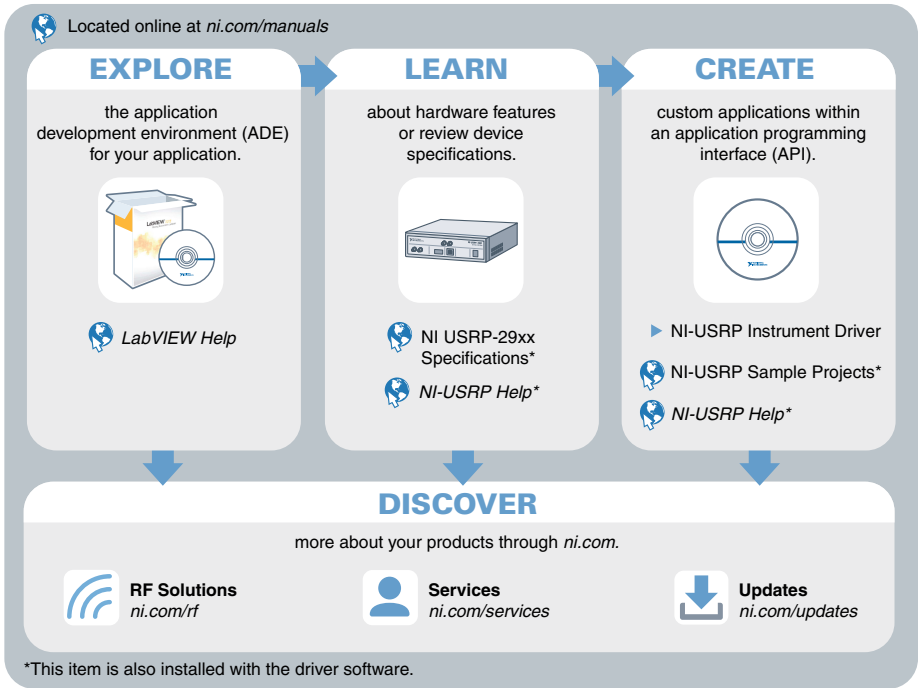| Connector	Use
PPS IN	Input terminal for the pulse per second (PPS) timing reference. PPS IN is an SMA (f) connector with an impedance of 50 Ω and is a single-ended input. PPS IN accepts 0 V to 3.3 V TTL and 0 V to 5 V TTL signals.
MIMO EXPANSION	The MIMO EXPANSION interface port connects two USRP devices 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 10. 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 10. 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.

Where to Go Next

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

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*This item is also installed with the driver software.

> 💡 **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.

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