
Ettus USRP X420 User Manual

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Ettus USRP X420 User Manual

The Ettus USRP X420 User Manual provides detailed descriptions of the product functionality and the step by step processes for use.

Looking for Something Else?

For information not found in the User Manual for your product, such as specifications and API reference, browse *Related Information*.

Related information:

- [Software and Driver Downloads](#)
- [Release Notes](#)
- [Interactive Activation Guide](#)
- [Dimensional Drawings](#)
- [Product Certifications](#)
- [Letter of Volatility](#)
- [Discussion Forums](#)
- [NI Learning Center](#)

Ettus USRP X420 Overview

The Ettus USRP X420 is a wideband software-defined radio for advanced wireless and aerospace researchers. Use the Ettus USRP X420 to prototype and validate radar, satellite, and next-generation communication systems with dual transmit and receive channels, wide frequency coverage, and phase-coherent operation.

Ettus USRP X420 Key Features

Understand whether Ettus USRP X420 fits RF, multi-channel, and synchronization requirements for your test system. This information supports device comparison and selection during system design and procurement.

RF and Signal Capability

- 10 MHz to 20 GHz frequency coverage
- Up to 1 GHz instantaneous bandwidth
- Two transmit and two receive channels

Multi-Channel Operation

- Phase-coherent operation using per-channel local oscillator sharing
- Support for multi-radio and phased system architectures

Platform and Development

- AMD Zynq™ UltraScale+™ RFSoc architecture
- FPGA development using UHD and RFNoC frameworks

Timing and Synchronization

- GPS-disciplined 10 MHz reference clock
- PPS support for synchronized systems

Ettus USRP X420 Driver Support

Determine the earliest driver version supported for your product.



Tip To optimize product performance, update to the most recent driver version.

Table 1. Ettus USRP X420 Earliest Driver Version Support

Driver Name	Earliest Version Support
USRP Hardware Driver™	4.10.0

Related information:

- [USRP Hardware Driver and Device Manual](#)

Components of an Ettus USRP X420 System

Ettus USRP X420 is designed for use in a system that might require hardware, drivers, and software to optimize Ettus USRP X420 for your application.

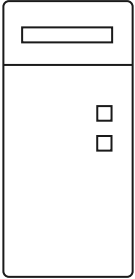
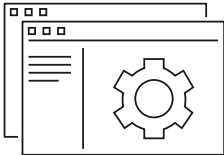


Note A system and the surrounding environment must meet any requirements defined in the relevant specifications documents.

Minimum Required System Components

Use the minimum required Ettus USRP X420 system components as a starting point for building your system.

Table 2. Ettus USRP X420 Minimum Required System Components

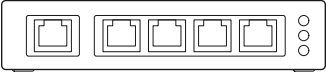
Component	Description
Ettus USRP module	Ettus USRP models provide RF signal generation and acquisition, device-level processing, timing and synchronization resources, and high-speed data interfaces for software-defined radio applications.
Host PC 	A host computer runs control software and processes streamed data. Host performance requirements depend on sample rate, bandwidth, FPGA image, and application workload.
USRP Hardware Driver™ 	Runs on the host PC and provides the APIs, tools, and drivers required to configure the Ettus USRP X420, control operation, and stream RF data.

Component	Description
Power supply 	The provided power supply delivers regulated power required to operate the Ettus USRP X420.

Additional Components for Ethernet Connectivity

The Ettus USRP X420 requires Ethernet connectivity to a host PC. The required network hardware and cables depend on the selected Ethernet configuration and FPGA image.

Table 3. Ettus USRP X420 Additional Components for Ethernet Connectivity

Component	Description
Network switch 	Used for RJ45 Ethernet configurations when a direct connection to the host PC is not available. The switch must support the required Ethernet speed.
CAT 5E Ethernet cable 	Used for RJ45 Ethernet connections between the Ettus USRP X420, host PC, and optional network switch.
100 GbE network card	Required in the host PC for configurations that use a QSFP28 100 GbE Ethernet connection.
10 GbE network card	Required in the host PC for configurations that use a QSFP28 breakout connection.
QSFP28 to QSFP28 Ethernet cable	Used for direct 100 GbE Ethernet connections between the Ettus USRP X420 and host PC.
QSFP28 to 4×SFP28 Ethernet breakout cable	Used to connect the QSFP28 port on the Ettus USRP X420 to 10 GbE network ports on the host PC.

Related tasks:

- [Unpacking the Kit](#)
- [Connecting the Ettus USRP X420](#)

- [Disconnecting the Ettus USRP X420](#)

Related reference:

- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)
- [Ettus USRP X420 Kit Contents](#)

Related information:

- [USRP Hardware Driver and USRP Manual](#)

Part Numbers for Ettus USRP X420

Recommended Cables and Accessories

Use part numbers to purchase the cables and the accessories for optimizing the performance of Ettus USRP X420.

Cables

Table 4. Ettus USRP X420 Recommended AC Cables

Region	Specification	Plug Type	Part Number
United States	Country-specific mains cable	NEMA 5-15	785023-01
United Kingdom	Country-specific mains cable	BS1363	785023-06
Europe	Country-specific mains cable	CEE 7	785023-04
China	Country-specific mains cable	GB	785023-10
Korea	Country-specific mains cable	KS	785023-09
Japan	Country-specific mains cable	JIS	785023-07
Australia	Country-specific mains cable	AS/NZS 3112	785023-03

Table 5. Ettus USRP X420 Recommended Connector Cables

Cable Type	End A	End B	Length	Part Number
HSS passive copper Ethernet cable	QSFP28	QSFP28	0.5 m	788256-0R5
HSS passive copper Ethernet breakout cable	QSFP28	4×SFP28	1 m	769979-01
CAT 5E Ethernet cable	RJ45	RJ45	3 m	763852-01
USB-A to USB-C with jack-screw cable	USB-A (male)	USB-C (male)	1 m	787057-01

Accessories

Table 6. Ettus USRP X420 Recommended Accessories

Accessory	Description	Part Number
Power supply	190 W external power supply required to operate the Ettus USRP X420.	788204-01
GPS antenna	GPS antenna that provides an external timing and positioning reference for the Ettus USRP X420.	783174-01
Single-module rack mount kit	19-inch, 1U rack mount accessory for one USRP X4x0 series device, including surrogate extension.	788149-01
Dual-module rack mount kit	19-inch, 1U rack mount accessory for two USRP X4x0 series devices mounted side by side.	788147-01
Exhaust airflow fan cartridge	Swappable fan cartridge that provides front-to-back airflow. Ships installed as the default airflow option.	788164-01
Intake airflow fan cartridge	Swappable fan cartridge that provides back-to-front airflow.	788165-01

Related concepts:

- [Ettus USRP X420 Mounting Requirements](#)

Related tasks:

- [Mounting the Ettus USRP X420 onto a Rack](#)
- [Connecting the Ettus USRP X420](#)
- [Disconnecting the Ettus USRP X420](#)

Related reference:

- [Components of an Ettus USRP X420 System](#)
- [Ettus USRP X420 RF Connectors](#)
- [Ettus USRP X420 LO Connectors](#)
- [Ettus USRP X420 GPIO Connector Pinout](#)
- [Ettus USRP X420 Timing and Reference Connectors](#)
- [Ettus USRP X420 High-Speed Data Interfaces](#)
- [Ettus USRP X420 System Interfaces](#)
- [Ettus USRP X420 Kit Contents](#)

Ettus USRP X420 Theory of Operation

Learn where to access authoritative theory of operation information for the Ettus USRP X420 through the related documentation.

Detailed descriptions of the USRP X4x0 series hardware architecture, signal paths, timing model, and driver behavior are maintained in the USRP Hardware Driver™ documentation. For more information, see *USRP Hardware Driver and Device Manual* under Related Information.

Related information:

- [USRP Hardware Driver and Device Manual](#)

Ettus USRP X420 Operational Model and System Responsibilities

Understand the operational model of the Ettus USRP X420 to set correct expectations for configuration, control, and system integration.

Operating Modes

The Ettus USRP X420 supports two operating modes.

- **Stand-alone operation**—The device runs an embedded operating system that manages startup, configuration, and device-level services.
- **Host-controlled operation**—A host computer controls RF operation and data movement over a network connection.

System Responsibilities

Some system responsibilities are handled on the device rather than on the host. These responsibilities can include:

- Device initialization
- File system management
- Firmware updates
- Recovery operations

Correct operation depends on aligning host-side software with the software running on the device.

Management and Data Interfaces

The Ettus USRP X420 provides separate interfaces for management and for high-rate data transfer.

- Management interfaces support configuration, control, and maintenance tasks.
- High-speed interfaces support RF data streaming.

Understanding the intended role of each interface helps avoid configuration and performance issues.

Fixed Hardware Capabilities

The Ettus USRP X420 is a fully integrated device with fixed RF hardware.

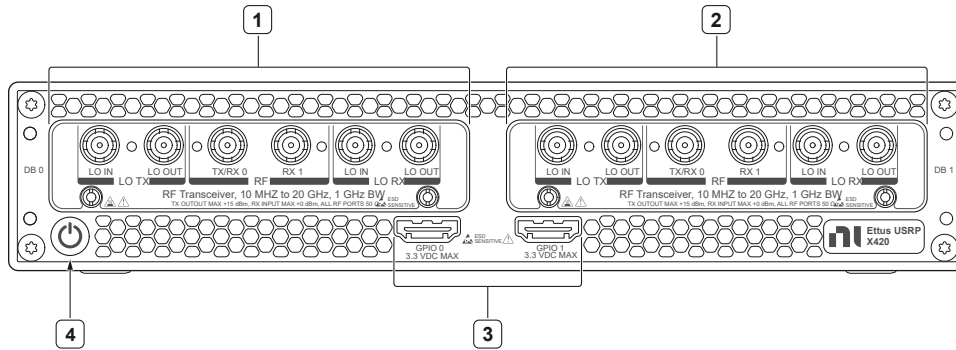
- RF front ends are not interchangeable.
- Hardware capabilities are determined by the installed variant.

Configuration affects operation, but it does not change the underlying RF hardware.

Ettus USRP X420 Front Panel

Overview of the front panel elements of the Ettus USRP X420.

Figure 1. Ettus USRP X420 Front Panel



1. RF transceiver bank DB 0
2. RF transceiver bank DB 1
3. Programmable GPIO connectors
4. Power button

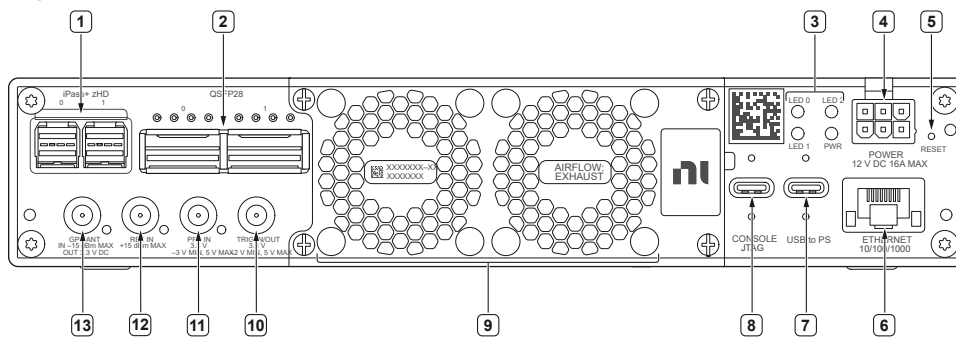
Related reference:

- [Ettus USRP X420 RF Connectors](#)
- [Ettus USRP X420 LO Connectors](#)
- [Ettus USRP X420 GPIO Connector Pinout](#)

Ettus USRP X420 Rear Panel

Learn about the connectors, indicators, and controls on the rear panel of the Ettus USRP X420.

Figure 2. Ettus USRP X420 Rear Panel



1. 2 × iPass ZHD+ connectors (unused on this model)
2. 2 × QSFP28 connectors
3. LED indicators
4. Power connector
5. Reset button
6. Ethernet management port (RJ45)
7. USB to PS connector (USB-C)
8. Console JTAG connector (USB-C)
9. Rear airflow vents
10. Trigger input/output
11. PPS input
12. Reference clock input
13. GPS antenna input

Related reference:

- [Ettus USRP X420 LED Indicators](#)
- [Ettus USRP X420 PWR LED](#)
- [Ettus USRP X420 Timing and Reference Connectors](#)
- [Ettus USRP X420 High-Speed Data Interfaces](#)
- [Ettus USRP X420 System Interfaces](#)

Related information:

- [LED 0](#)
- [LED 1](#)
- [LED 2](#)

Ettus USRP X420 Pinouts

Use the pinouts to connect to terminals on the Ettus USRP X420.



Note RF and LO connectors are repeated on the front panel and organized into two identical groups labeled DB0 and DB1. Each DB group provides equivalent radio frequency and local oscillator connectivity.

Ettus USRP X420 RF Connectors

Table 7. RF Connector Signal Descriptions

Connector	Connector Type	Description
TX/RX 0	SMA (f), 50 Ω	Bidirectional radio frequency signal connector used for transmit and receive operations.
RX 1	SMA (f), 50 Ω	Radio frequency signal connector used for receive-only operations.

Related reference:

- [Ettus USRP X420 Front Panel](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Ettus USRP X420 LO Connectors

Table 8. LO Connector Signal Descriptions

Connector	Connector Type	Description
LO IN	SMA (f), 50 Ω	Input for an external transmit and receive local oscillator signal. +10 dBm damage level. By default, the internal LO source is used.

Connector	Connector Type	Description
LO OUT	SMA (f), 50 Ω	Output of the transmit and receive local oscillator signal for sharing or external reference. +9 dBm maximum output level By default, the internal LO source is used.

Related reference:

- [Ettus USRP X420 Front Panel](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Ettus USRP X420 GPIO Connector Pinout

Table 9. GPIO Connector Signal Descriptions

Connector	Connector Type	Description
GPIO 0, GPIO 1	HDMI Type-A	General Purpose Input/Output digital terminals. Output voltage can be configured per individual connector, either 1.8 V (default), 2.5 V, or 3.3 V.

Figure 3. Ettus USRP X420 GPIO Connector Pinout

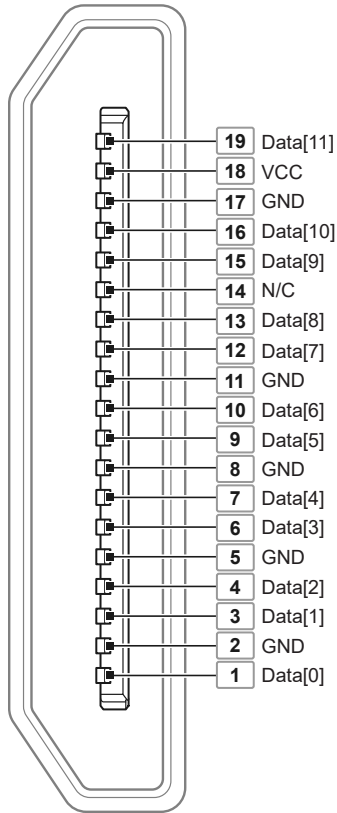


Table 10. GPIO Connector Pinout

Pin	Name	Direction	Voltage Domain	Description
1	Data[0]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
2	GND	N/A	N/A	Ground reference
3	Data[1]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
4	Data[2]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
5	GND	N/A	N/A	Ground reference
6	Data[3]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
7	Data[4]	In/Out	Configurable	General-purpose

Pin	Name	Direction	Voltage Domain	Description
			(1.8 V, 2.5 V, or 3.3 V)	digital I/O
8	GND	N/A	N/A	Ground reference
9	Data[5]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
10	Data[6]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
11	GND	N/A	N/A	Ground reference
12	Data[7]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
13	Data[8]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
14	N/C	N/A	N/A	Do not connect
15	Data[9]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
16	Data[10]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O
17	GND	N/A	N/A	Ground reference
18	VCC	Out	+3.3 V	External power for GPIO accessories (450 mA maximum)
19	Data[11]	In/Out	Configurable (1.8 V, 2.5 V, or 3.3 V)	General-purpose digital I/O



Note The GPIO connector is not intended to drive large loads.



Note Although the GPIO uses an HDMI connector, it is not an HDMI interface and must not be connected to HDMI equipment.



Note Digital I/O voltage is selectable per GPIO port and applies to all data pins.



Note The +3.3 V power pin is disabled by default and can be enabled in software.



Note The GPIO connector pins are mapped to indexed data signals in software. For details, see the *X4x0 GPIO API* documentation on uhd.readthedocs.io.

Related reference:

- [Ettus USRP X420 Front Panel](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Ettus USRP X420 Timing and Reference Connectors

Table 11. Timing and Reference Connector Signal Descriptions

Connector	Connector Type	Description
REF IN	SMA (f), 50 Ω	Input for an external 10 MHz reference clock signal used for frequency synchronization.
PPS IN	SMA (f), 50 Ω	Input for an external pulse-per-second (PPS) signal used for time synchronization.
TRIG IN/OUT	SMA (f), 50 Ω	Bidirectional trigger signal used for external event synchronization.
GPS ANT	SMA (f), 50 Ω	Input for an external GPS antenna used by the onboard GPSDO.

Related reference:

- [Ettus USRP X420 Rear Panel](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Ettus USRP X420 High-Speed Data Interfaces

Table 12. High-Speed Serial Connector Signal Descriptions

Connector	Connector Type	Description
QSFP28	zQSFP+	Supports high-speed, low-latency data streaming. Provides four lanes with data rates of up to 25 Gbps per lane and an aggregate bandwidth of up to 100 Gbps. Conforms to QSFP28 industry-standard electrical and signaling specifications.
iPass+ zHD	iPass+ zHD	The iPass+ zHD connectors are not used on this product. Do not connect peripheral devices to these connectors.

Related reference:

- [Ettus USRP X420 Rear Panel](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Ettus USRP X420 System Interfaces

Table 13. System Interface Connector Signal Descriptions

Connector	Connector Type	Description
CONSOLE JTAG	USB-C	USB Type-C connector for development and debugging. Provides access to JTAG, PS serial console, and SCU serial console. Use

Connector	Connector Type	Description
		115200 baud, 8 data bits, 1 stop bit, no parity.
USB to PS	USB-C	USB Type-C connector supporting USB 2.0 for peripheral devices connected to the processing system (PS). Supports tasks such as accessing USB mass storage devices and writing a new file system to internal storage.
ETHERNET	RJ45	1 Gb Ethernet connector that interfaces with the onboard processing system (PS). Supports SSH access and UHD management traffic in Network Mode. The interface uses a DHCP-assigned IP address by default.

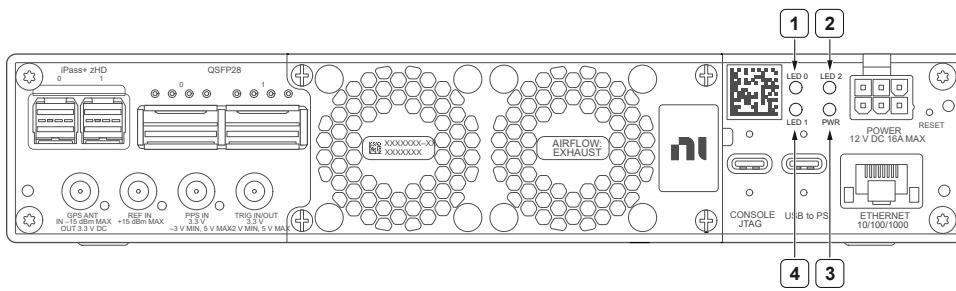
Related reference:

- [Ettus USRP X420 Rear Panel](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Ettus USRP X420 LED Indicators

Learn about the behavior of the LED indicators located on the rear panel of the Ettus USRP X420.

Figure 4. Ettus USRP X420 LED Indicators



1. LED 0
2. LED 2
3. PWR LED
4. LED 1

Related reference:

- [Ettus USRP X420 Rear Panel](#)

Ettus USRP X420 PWR LED

Understand the behavior of the PWR LED.

The PWR LED provides a visual indication of the power status of the Ettus USRP X420. The behavior of the PWR LED is fixed and cannot be reconfigured.

Figure 5. Ettus USRP X420 PWR LED



PWR

PWR LED Behavior

Table 14. Ettus USRP X420 PWR LED Behavior Descriptions

Status	Color	Device State
(Off)	N/A	No power is present at the device.
Solid	Amber	Power is present, but the device is powered off.
Solid	Green	The device is powered on with no detected power faults.
Solid	Red	A power fault condition exists.

Related reference:

- [Ettus USRP X420 Rear Panel](#)

Ettus USRP X420 User-Configurable LEDs

Understand the behavior of the user-configurable LEDs.

LED 0, LED 1, and LED 2 are user-configurable rear-panel LEDs. You can configure each LED independently to provide visual feedback for specific device conditions, system activity, or FPGA-controlled states.

By default, the LEDs are assigned predefined behaviors. You can change these behaviors temporarily or persistently through the on-board Linux system.

Supported LED Behaviors

Each user-configurable LED supports the following behaviors:

- **activity**—Flashes green to indicate CPU activity.
- **emmc**—Flashes green during read or write activity on the onboard eMMC storage.
- **heartbeat**—Flashes green with a periodic heartbeat pattern.
- **fpga**—Turns green when the FPGA is successfully loaded.
- **netdev <interface>**—Indicates network activity for a specified interface.

- Green: link is up
- Amber: activity present

`<interface>` is the network interface name, for example, `eth0`.

- **none**—Turns the LED off.
- **panic**—Turns the LED red if a kernel panic occurs.
- **user0; user1; user2**—Transfers control of the LED state to the FPGA application. The application can set the LED to off, green, red, or amber. For more information, see *Using FPGA LED Control*.

Figure 6. Ettus USRP X420 LED 0
LED 0



Figure 7. Ettus USRP X420 LED 1



LED 1

Figure 8. Ettus USRP X420 LED 2
LED 2



Default Behavior of the User-Configurable LEDs

Table 15. Ettus USRP X420 User-Configurable LEDs Behavior Descriptions

LED	Default Behavior
LED 0	heartbeat
LED 1	fpga
LED 2	emmc

Change LED Behavior Temporarily

This method applies the change immediately but does not persist across reboots.

1. Establish a serial or SSH connection to the Ettus USRP X420 Linux shell.
2. Run the following command.

```
ledctrl <led> <command>
```

The possible values for the variables are the following:

- <led>:
 - led0
 - led1
 - led2
- <command>: Any item from the list under *Supported LED Behaviors*.

Example:

```
ledctrl led0 user0
```

This command assigns control of LED 0 to the FPGA application using User LED 0.

Change LED Behavior Persistently

Temporary changes are lost after a reboot. To make an LED configuration persistent, modify the `ledctrl systemd service` files, which run during system startup.

On the running filesystem, the service files are located at `/lib/systemd/system/ledctrl-ledX.service`, where X corresponds to the LED number (0, 1, or 2).

Using FPGA LED Control

When you select `user0`, `user1`, or `user2` as the LED behavior, the FPGA application controls the corresponding rear-panel LED.

FPGA control is implemented through a 2-bit vector that selects the LED color:

```
// Rear panel LED control
// Each LED includes a green (LSB) and red (MSB) element
localparam LED_OFF    = 2'b00;
localparam LED_GREEN  = 2'b01;
localparam LED_RED    = 2'b10;
localparam LED_AMBER  = 2'b11;

wire [1:0] user_led_ctrl [0:2];
assign user_led_ctrl[0] = LED_GREEN;
assign user_led_ctrl[1] = LED_RED;
```

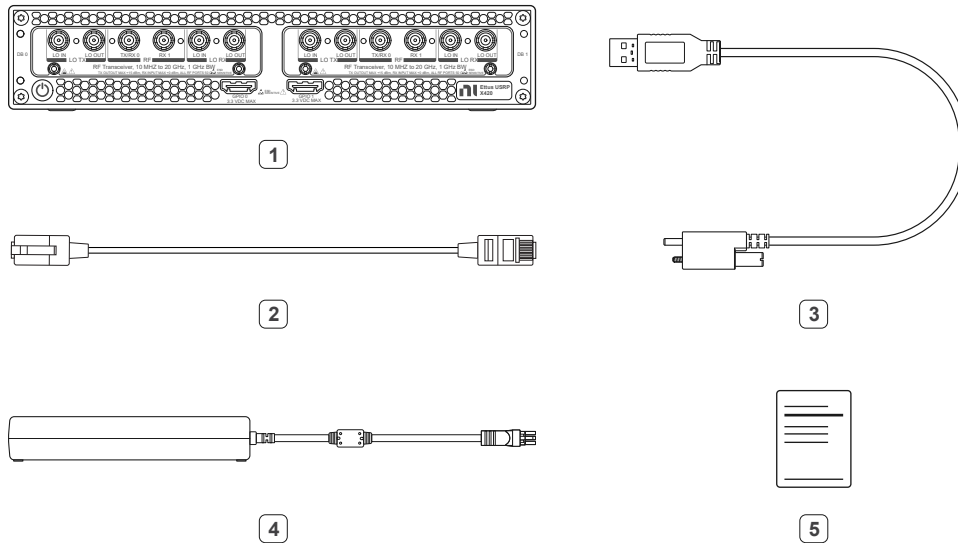
```
assign user_led_ctrl[2] = LED_AMBER;
```

Using this mechanism, the FPGA application can dynamically control each user LED to reflect application-specific states or events.

Ettus USRP X420 Kit Contents

Identify the contents of the Ettus USRP X420 kit.

Figure 9. Ettus USRP X420 Kit Contents



1. Ettus USRP X420
2. CAT 5E Ethernet cable
3. USB-A (male) to USB-C (male) with jack screw cable
4. Power supply
5. Ettus USRP X420 Safety, Environmental, and Regulatory Information

Related reference:

- [Components of an Ettus USRP X420 System](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)
- [Ettus USRP X420 Safety Guidelines](#)

Ettus USRP X420 Safety Guidelines

Follow these guidelines to use the Ettus USRP X420 safely.

Guidelines apply to all Ettus USRP X420 devices unless otherwise noted.



Notice For comprehensive safety information, refer to *Ettus USRP X420 Safety, Environmental, and Regulatory Information* that shipped with your hardware.



Caution Observe all instructions and cautions in the user documentation. Using the product in a manner not specified can damage the product and compromise the built-in safety protection.

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

Related concepts:

- [Handling the Ettus USRP X420 During Operation](#)

Related reference:

- [Ettus USRP X420 Kit Contents](#)

Related information:

- [Product Certifications](#)

Ettus USRP X420 Operating Guidelines

Follow these guidelines when operating the Ettus USRP X420.

Handling the Ettus USRP X420 During Operation

Learn how to handle the Ettus USRP X420 during operation to prevent hardware damage and ensure reliable device performance.

The Ettus USRP X420 is a precision RF device. Improper handling can damage internal components, RF ports, or connectors.

Comply with the following guidelines when handling the device while it is powered on:

- Avoid placing conductive objects near the device. Conductive materials can create unintended electrical paths or short circuits.
- Use appropriate electrostatic discharge (ESD) precautions when connecting or disconnecting cables, antennas, or peripherals.
- Ensure that RF ports are connected to an appropriate load or an antenna during operation. Operating with unterminated RF ports can degrade performance or damage the hardware.
- Avoid exposing the device to liquids, condensation, or excessive humidity while it is powered on.
- Use caution when modifying firmware, FPGA images, or software configurations. Improper changes can place the device in unsupported operating conditions.

For detailed limits and additional handling considerations, see *USRP Hardware Driver and Device Manual*.

Related concepts:

- [Ettus USRP X420 Mounting Requirements](#)

Related reference:

- [Ettus USRP X420 Safety Guidelines](#)

Related information:

- [USRP Hardware Driver and Device Manual](#)

Setting up the Ettus USRP X420

Complete the setup workflow to prepare the Ettus USRP X420 for operation.

1. [Unpacking the Kit](#)
Take precautions to prevent electrostatic discharge when unpacking and inspecting your hardware.
2. [Installing USRP Hardware Driver™ for Ettus USRP X420](#)
Access the USRP Hardware Driver™ installation guide relevant to your Ettus USRP X420 setup.
3. [Connecting the Ettus USRP X420](#)
Set up the Ettus USRP X420 for operation by connecting it to a host PC using a supported Ethernet configuration.
4. [Verifying the Installation](#)
Before using the Ettus USRP X420, verify that it is installed correctly.

Unpacking the Kit

Take precautions to prevent electrostatic discharge when unpacking and inspecting your hardware.



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

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



Notice Never touch the exposed pins of connectors.



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

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



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

Related reference:

- [Components of an Ettus USRP X420 System](#)

Installing USRP Hardware Driver™ for Ettus USRP X420

Access the USRP Hardware Driver™ installation guide relevant to your Ettus USRP X420 setup.

To program Ettus USRP X420, you must install USRP Hardware Driver™ on the host computer.

The installation guides are maintained in the USRP Hardware Driver™ documentation.

Installation steps depend on the operating system.

Select the installation guide that matches your operating system.

Operating System	Installation Guide
Linux	http://www.ni.com/r/linuxuhdinstall
Mac OS X	http://www.ni.com/r/osxuhdinstall
Windows	http://www.ni.com/r/windowsuhdinstall

Connecting the Ettus USRP X420

Set up the Ettus USRP X420 for operation by connecting it to a host PC using a supported Ethernet configuration.

Before connecting Ettus USRP X420, verify the following conditions.

- The Ettus USRP X420 device kit is complete.
- All hardware components are turned off.
- The device is properly mounted.

For details, see *Mounting the Ettus USRP X420*.

- You have components required for your planned Ethernet configuration.

For details, see *Components of an Ettus USRP X420 System*.

The Ettus USRP X420 supports multiple Ethernet connection options. Select the configuration based on the FPGA image and streaming requirements of your application.

Table 16. Ettus USRP X420 Connection Options

Configuration	Description	Required Additional Components
RJ45 Ethernet connection through network switch	Standard Ethernet connection for device discovery, control, and lower-bandwidth data streaming.	Network switch; two CAT 5E Ethernet cables
RJ45 Ethernet direct connection	Standard Ethernet connection for device discovery, control, and lower-bandwidth data streaming.	CAT 5E Ethernet cable
100 GbE direct connection	High-throughput point-to-point Ethernet connection for wideband data streaming.	100 GbE network card; QSFP28 to QSFP28 Ethernet cable
10 GbE direct connection	Multi-lane Ethernet connection using a QSFP28 breakout for lower-bandwidth streaming.	10 GbE network card; QSFP28 to 4×SFP28 Ethernet breakout cable

To connect the Ettus USRP X420, complete the following steps.

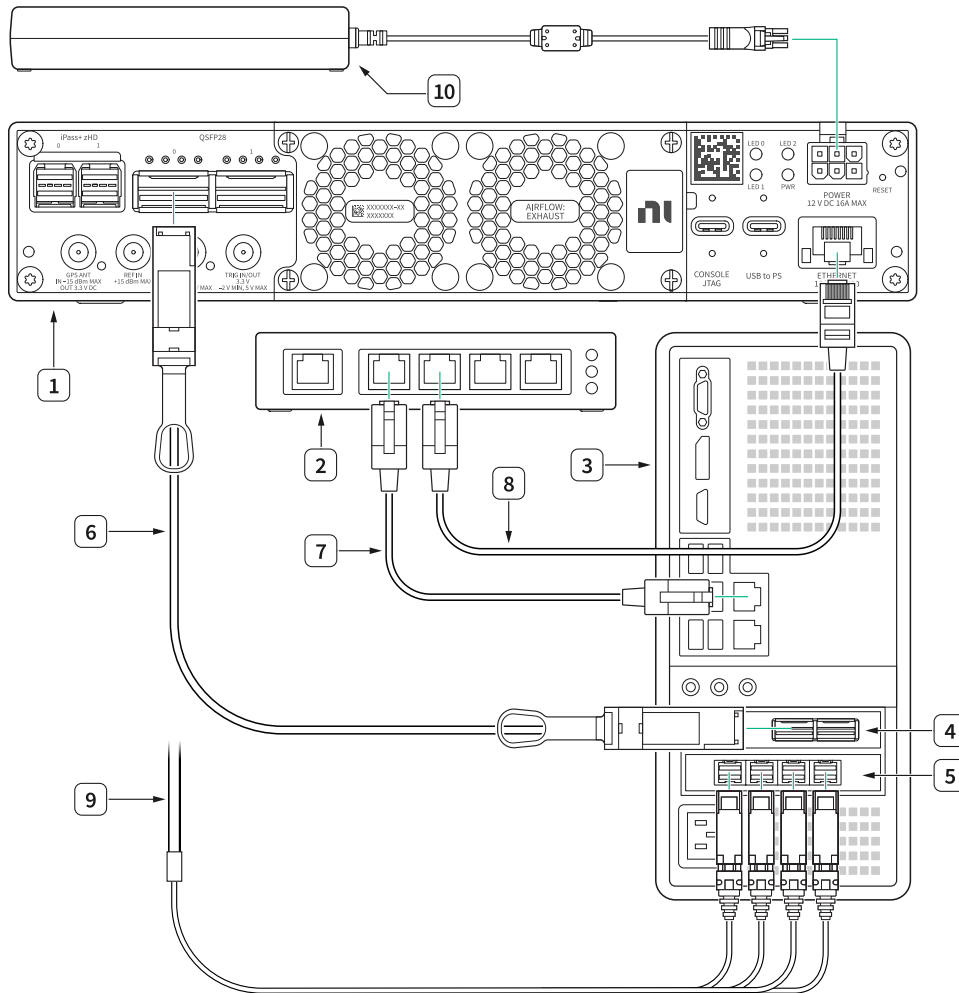
1. Place all hardware components on a flat surface near power outlets.
2. Connect the host PC to power and complete the initial computer setup. Follow the instructions provided with the host PC.
3. Connect any additional project-specific equipment to the front panel terminals of the Ettus USRP X420.
4. Connect the Ettus USRP X420 to the host PC using the method that matches your chosen configuration.

Configuration	Method
RJ45 Ethernet connection through network switch	- Connect the network switch to power. - Connect one CAT 5E Ethernet cable from the Ettus USRP X420 to the network switch. - Connect a second CAT 5E Ethernet cable from the host PC to the network switch.
RJ45 Ethernet direct connection	Connect one CAT 5E Ethernet cable directly between the Ettus USRP X420 and the host pc.
100 GbE direct connection	- Install the 100 GbE network card in the host PC. - Connect the QSFP28 port on the Ettus USRP X420 to the 100 GbE network card using a QSFP28 to QSFP28 Ethernet cable.
10 GbE breakout connection	- Install the 10 GbE network card in the host PC. - Connect the QSFP28 port on the Ettus USRP X420 to the 10 GbE network card using a QSFP28 to 4×SFP28 Ethernet cable.

5. Connect the Ettus USRP X420 power supply to the device.

The Ettus USRP X420 is now fully connected.

Figure 10. Ettus USRP X420 Connection Diagram



1. Ettus USRP X420
2. Network switch (optional)
3. Host PC
4. 100 G Ethernet network card (optional)
5. 10 G Ethernet network card (optional)
6. QSF28 to QSF28 Ethernet cable (optional)
7. CAT 5E Ethernet cable (optional)
8. CAT 5E Ethernet cable (optional)
9. QSF28 to 4×SFP28 Ethernet breakout cable (optional)
10. Ettus USRP X420 power supply

Figure 10. Ettus USRP X420 Connection Diagram illustrates multiple hardware connection options. Some callouts indicate alternative cables or ports, where only one option is used.

The hardware setup requires additional software configuration. Configure a DHCP server on the host PC or assign a static IP address to the Ettus USRP X420.

Related reference:

- [Components of an Ettus USRP X420 System](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)
- [Verifying the Installation](#)

Verifying the Installation

Before using the Ettus USRP X420, verify that it is installed correctly.

The installation verification guide is maintained in the USRP Hardware Driver™ documentation. For more information, see *USRP Hardware Driver and Device Manual* under Related Information.



Note

The verification procedure requires the Ettus USRP X420 to be powered on and connected to a host PC using a supported Ethernet configuration. Before performing verification, complete the preceding setup tasks in *Setting up the Ettus USRP X420*, and then complete the procedure described in *Powering On the Ettus USRP X420*.

Related tasks:

- [Connecting the Ettus USRP X420](#)
- [Powering On the Ettus USRP X420](#)

Related information:

- [USRP Hardware Driver and Device Manual](#)

Mounting the Ettus USRP X420

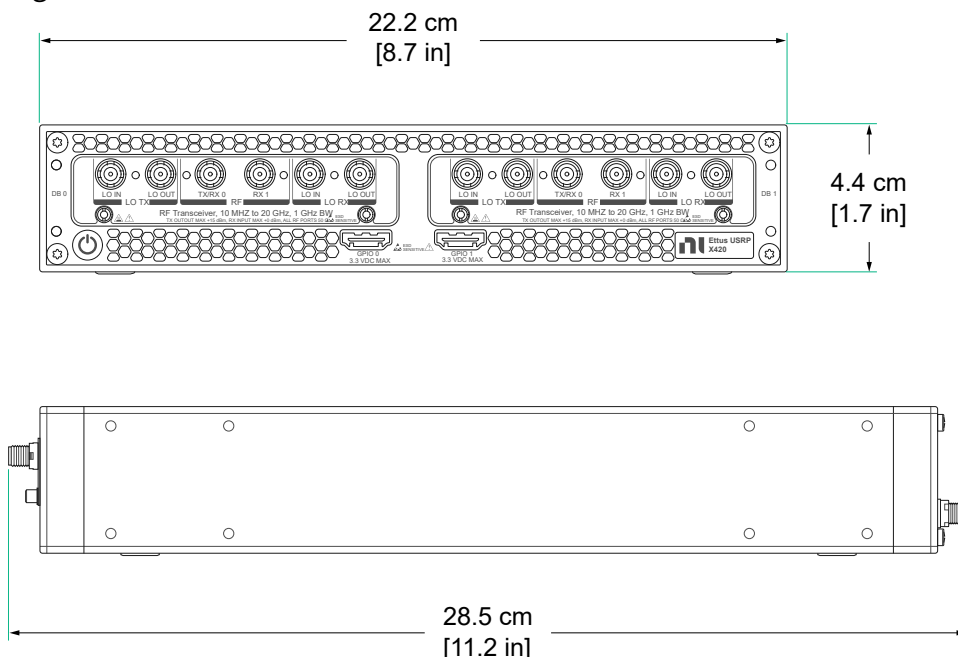
Learn how to mount the Ettus USRP X420 for safe operation and reliable thermal performance. Follow airflow, clearance, and grounding guidelines for benchtop or rack-mounted installation.

To ensure proper functionality across the supported operating temperature range, you must mount the Ettus USRP X420 in a configuration that supports adequate airflow and ventilation. Installing the device according to the referenced requirements helps ensure reliable operation and protects internal components from thermal and environmental stress.

Table 17. Ettus USRP X420 Physical Characteristics

Dimensions, enclosure	26.7 cm × 22.2 cm × 4.4 cm (10.5 in. × 8.7 in. × 1.7 in.)
Dimensions, enclosure with connectors	28.5 cm × 22.2 cm × 4.4 cm (11.2 in. × 8.7 in. × 1.7 in.)
Weight	2.8 kg (6.2 lb)
Form factor	1U half-wide 19" rack

Figure 11. Ettus USRP X420 Dimensions



For more information on mounting options for the Ettus USRP X420, see to the following sections.

Ettus USRP X420 Mounting Requirements

Adhere to these requirements to maintain proper cooling and ensure safe operation of the Ettus USRP X420.

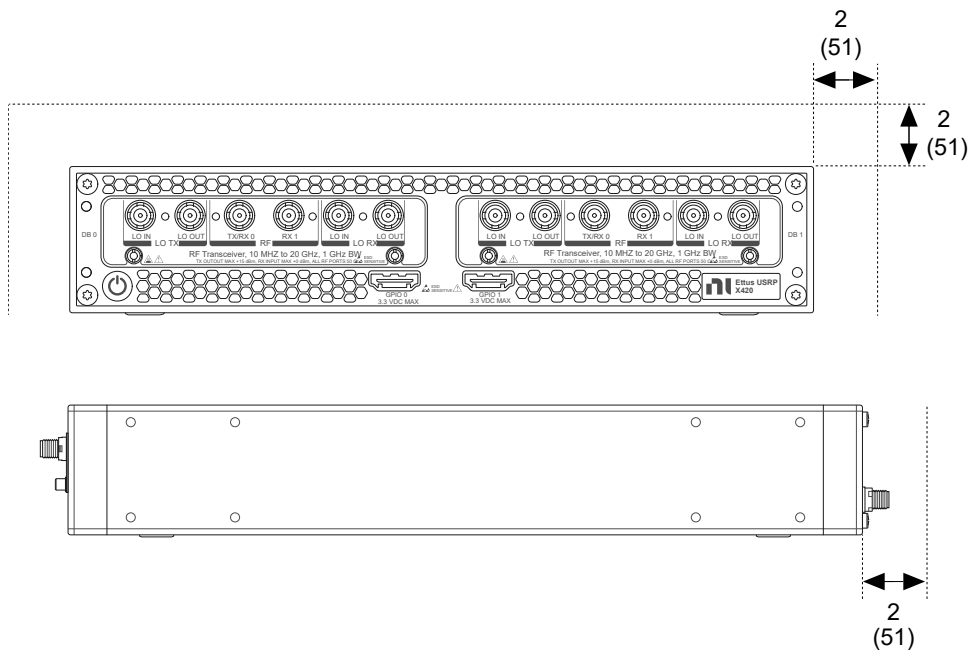
Cooling Clearances

Maintain the minimum required ventilation clearance at the front and rear of the enclosure.

Table 18. Minimum Cooling Clearances

Front clearance	51 mm (2 in.)
Rear clearance	51 mm (2 in.)

Figure 12. Ettus USRP X420 Cooling Clearances



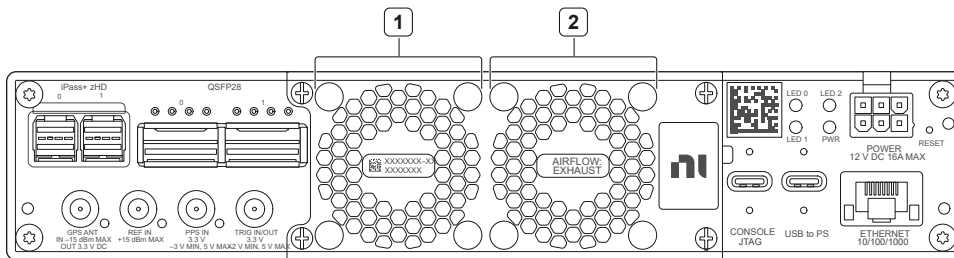
Note Some benchtop and rack-mounted installations require additional clearance to maintain airflow and prevent hot air recirculation.

Ventilation

The Ettus USRP X420 supports operation with either an intake-fan (back-to-front airflow) configuration or an exhaust-fan (front-to-back airflow) configuration.

The product uses the exhaust-fan configuration by default. You can switch to an intake fan configuration with back-to-front airflow by using a fan cartridge accessory.

Figure 13. Ettus USRP X420 Vents



1. Exhaust fan (left)
2. Exhaust fan (right)

Provide adequate clearance at the front and rear of the product to ensure proper cooling. Keep airflow paths unobstructed and locate heat-generating equipment away from the air inlets and outlets.

Environmental Conditions

Install the Ettus USRP X420 only in environments that meet the specified operating temperature, humidity, and altitude limits.

Related concepts:

- [Handling the Ettus USRP X420 During Operation](#)

Related tasks:

- [Mounting the Ettus USRP X420 onto a Flat Surface](#)
- [Mounting the Ettus USRP X420 onto a Rack](#)

Related reference:

- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Mounting the Ettus USRP X420 onto a Flat Surface

Place the Ettus USRP X420 onto a flat surface to support stable operation and proper airflow.

Before you start the procedure, verify the following:

- The mounting area meets the criteria described in *Ettus USRP X420 Mounting Requirements*.

To mount the Ettus USRP X420 onto a flat surface, complete the following steps.

1. Complete one of the following actions based on the current state of the device.

Device State	Action
Device is not connected and not powered on	Proceed to the next step.
Device is connected but powered off	Complete the procedure in <i>Disconnecting the Ettus USRP X420</i> .
Device is connected and powered on	Complete the procedure in <i>Powering Off the Ettus USRP X420</i> , and then complete the procedure in <i>Disconnecting the Ettus USRP X420</i> .

2. Select a flat surface near power outlets and required network connections.
3. Place the Ettus USRP X420 on the flat surface in a stable orientation.
4. Ensure that the surface is level and that the device does not rock or tilt.
5. Maintain clearance at the front and rear of the chassis for airflow.
6. Route the power cable, Ethernet cables, and QSFP28 cables to avoid strain on rear-panel connectors.

If you encounter issues during the flat surface mount procedure, check the following items.

Symptom	Possible Cause	Action
Device overheats during operation	Airflow is obstructed	Increase clearance around the device.
Device is unstable on surface	Surface is uneven	Move the device to a level surface.
Cable damage	Excessive cable strain	Reroute cables and provide strain relief.
Fan noise increases	Restricted airflow	Inspect front and rear airflow paths.

Related concepts:

- [Ettus USRP X420 Mounting Requirements](#)

Related tasks:

- [Powering Off the Ettus USRP X420](#)
- [Disconnecting the Ettus USRP X420](#)

Mounting the Ettus USRP X420 onto a Rack

Mount the Ettus USRP X420 onto a rack to support stable operation and proper airflow.

Before you start the procedure, verify the following:

- The approved rack-mount kit is available.
- The rack meets the criteria described in *Ettus USRP X420 Mounting Requirements*.

The Ettus USRP X420 is designed to be rack-mounted using an optional rack-mount kit. For the relevant part numbers, see [Table 6. Ettus USRP X420 Recommended Accessories](#).

Proper mounting supports cooling requirements and prevents mechanical stress on the chassis.

To mount the Ettus USRP X420 onto a rack, complete the following steps.

1. Complete one of the following actions based on the current state of the device.

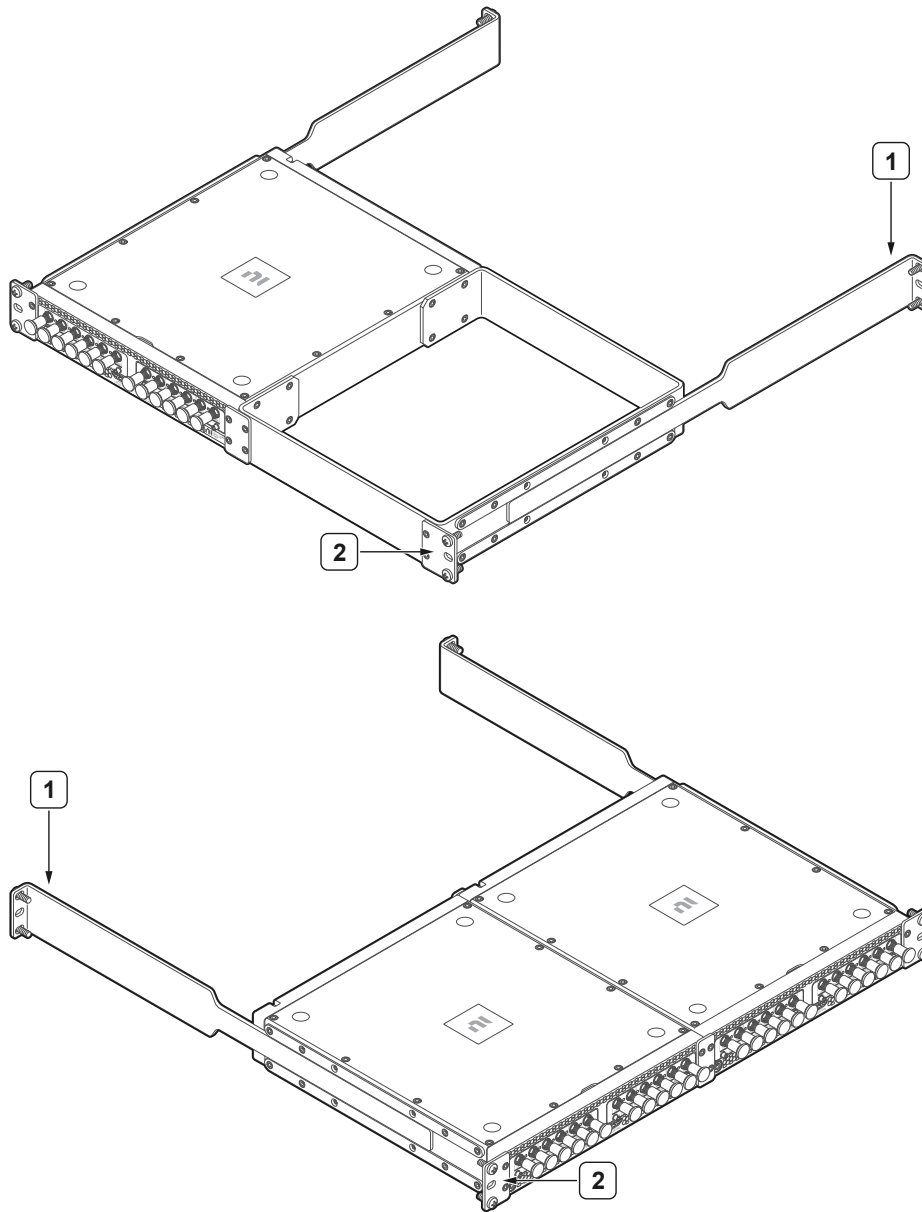
Device State	Action
Device is not connected and not powered on	Proceed to the next step.
Device is connected but powered off	Complete the procedure in <i>Disconnecting the Ettus USRP X420</i> .
Device is connected and powered on	Complete the procedure in <i>Powering Off the Ettus USRP X420</i> , and then complete the procedure in <i>Disconnecting the Ettus USRP X420</i> .

2. Identify the intended rack position based on required rack units and airflow direction.
3. Confirm whether the fan assembly provides front-to-back or back-to-front airflow.
4. Ensure that rack rails or mounting surfaces can support the device.
5. Secure the Ettus USRP X420 into the rack using the rack-mount kit hardware.
6. Verify that the device is level and securely fastened.
7. Maintain clearance at the front and rear of the chassis for airflow.
8. Route the power cable, Ethernet cables, and QSFP28 cables to avoid strain on rear-panel connectors.

If you encounter issues during the rack mount procedure, check the following items.

Symptom	Possible Cause	Action
Device overheats in rack	Insufficient airflow clearance	Increase spacing or adjust rack layout.
Chassis flex or instability	Improper mounting	Verify rack-mount hardware installation.
Cable damage	Excessive cable strain	Reroute cables and add strain relief.
Fan noise increases	Restricted airflow	Inspect front and rear airflow paths.

Figure 14. Ettus USRP X420 Rack Mount



1. Front rack mount
2. Rear rack mount

The Ettus USRP X420 in single module (top) and dual module (bottom) rack mount installations.

Related concepts:

- [Ettus USRP X420 Mounting Requirements](#)

Related tasks:

- [Powering Off the Ettus USRP X420](#)
- [Disconnecting the Ettus USRP X420](#)

Related reference:

- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Powering On the Ettus USRP X420

Use the following method to safely power on the Ettus USRP X420.

Before you power on the device, complete steps 1 through 3 of the setup workflow described in *Setting up the Ettus USRP X420*.

To power on the device, complete the following steps.

1. Plug the power supply of the Ettus USRP X420 into a wall outlet.
2. Press the power button on the front of the Ettus USRP X420.
3. Power on the host PC.



Note If present, power on any supporting network hardware.

If you encounter issues during the power-on procedure, check the following items.

Table 19. Ettus USRP X420 Power-On Troubleshooting

Symptom	Possible Cause	Action
Device does not power on	Power supply is not connected	Verify that the power supply is connected securely to the device and to a wall outlet.
Device does not power on	Wall outlet does not provide power	Test the wall outlet with a known-working device.
Device does not power on	Incorrect or unsupported power supply	Ensure that you are using the power supply shipped with the device or an approved equivalent.
Device does not power on	Power button was not pressed correctly	Press the power button according to the device power-on requirements.
Device does not power on	Loose or damaged power cables	Inspect all power cables and reseat or replace cables as needed.
Device does not power on	Device is in a fault state	Power cycle the device by disconnecting the power

Symptom	Possible Cause	Action
		supply, waiting at least 10 seconds, and reconnecting the power supply.
Device powers on but is not detected by the host PC	Ethernet cable is connected incorrectly	Verify that the Ethernet cable is connected to the correct port on the device and host PC.
Device powers on but is not detected by the host PC	Network interface is disabled	Verify that the host PC network interface is enabled.
Device powers on but does not communicate	IP configuration is incorrect	Verify that the device and host PC IP configurations are compatible.
Device shuts down unexpectedly	Environmental conditions are outside specifications	Ensure that temperature and airflow meet the operating requirements of the device.

Related reference:

- [Verifying the Installation](#)

Powering Off the Ettus USRP X420

Use the following procedure to safely power off the Ettus USRP X420.

Before you power off the device, complete the following:

- Stop all running applications or measurements that use the Ettus USRP X420.
- Verify that no data transfers or configuration changes are in progress.

To power off the Ettus USRP X420, complete the following steps.

1. Stop communication between the host PC and Ettus USRP X420, as required by the application.



Note Some hardware products require a specific shutdown sequence or a software-initiated power-off procedure. Confirm whether additional steps or restrictions apply.

2. Press the power button on the front panel of the Ettus USRP X420 to initiate shutdown.



Note If you are shutting down the entire system, power off any supporting network equipment as required by your environment.

3. Wait until the Ettus USRP X420 powers off completely.
4. Complete one of the following actions based on your planned next activity.

Planned Activity	Action
Continuing use in the same physical location	Leave the power supply connected.
Moving the Ettus USRP X420	Disconnect the power supply from the device.
Servicing the Ettus USRP X420	Disconnect the power supply from the device.

If you encounter issues during the power-off procedure, check the following items.

Table 20. Ettus USRP X420 Power-Off Troubleshooting

Symptom	Possible Cause	Action
Device does not power off	Active software communication	Stop all applications or services that communicate with Ettus USRP X420.
Device does not power off	Shutdown sequence not initiated	Press the power button again according to the device shutdown requirements.
Device does not power off	Device is busy processing data	Wait until all data transfers or operations complete.
Device does not power off	Device is unresponsive	Power cycle the device by disconnecting the power supply, waiting at least 10 seconds, and reconnecting the power supply.
Device powers off unexpectedly	Host PC initiated shutdown	Verify host PC power and shutdown settings.
Device powers off unexpectedly	Network instability during shutdown	Verify stable network connections during device operation and shutdown.
Device shuts down but does not restart	Incomplete shutdown	Wait until the device powers off completely before powering on again.
Device shuts down and reports a fault on restart	Improper shutdown sequence	Follow the documented power-off procedure before restarting the device.

Related tasks:

- [Mounting the Ettus USRP X420 onto a Flat Surface](#)
- [Mounting the Ettus USRP X420 onto a Rack](#)
- [Cleaning and Maintaining the Ettus USRP X420](#)

Disconnecting the Ettus USRP X420

Disconnect the Ettus USRP X420 from supporting hardware to prepare the device for relocation, cleaning and maintenance, or reconfiguration.

Before disconnecting the Ettus USRP X420, complete the following steps:

- Stop all running applications or measurements that use the device.
- Complete the power-off procedure described in *Powering Off the Ettus USRP X420*.
- Stop all data transfers and network activity.

Disconnecting hardware in the correct order helps prevent cable damage, connector wear, and unintended electrical or network issues.

To disconnect the Ettus USRP X420, complete the following steps.

1. Power off the host PC.



Note If present, power off any supporting network hardware.

2. Complete one of the following actions based on the Ethernet configuration in use.

Configuration	Action
RJ45 Ethernet connection through network switch	a. Disconnect the CAT 5E Ethernet cable from the host PC and the Ettus USRP X420. b. Disconnect Ethernet cables from the network switch, as required.
RJ45 Ethernet direct connection	Disconnect the CAT 5E Ethernet cable from the host PC and the Ettus USRP X420.
100 GbE direct connection	Disconnect the QSFP28 to QSFP28 Ethernet cable from the host PC network card and from the QSFP28 port on the Ettus USRP X420.
10 GbE breakout connection	Disconnect the QSFP28 to 4×SFP28 Ethernet breakout cable

Configuration	Action
	from the host PC network card and from the QSFP28 port on the Ettus USRP X420.

3. Disconnect any additional project-specific cables from the front panel terminals of the Ettus USRP X420.
4. Disconnect the power supply from the Ettus USRP X420.
5. Disconnect the power supply from the wall outlet.

The Ettus USRP X420 is now fully disconnected.

If you encounter issues during the disconnection procedure, check the following items.

Symptom	Possible Cause	Action
Cable is difficult to remove	Connector latch engaged	Release the connector latch before removing the cable.
Network switch reports link errors	Device disconnected before shutdown	Verify that the device was powered off before disconnection.
Connector appears damaged	Excessive cable strain	Reroute cables and apply strain relief during reconnection.
Device does not reconnect later	Incomplete teardown	Verify that all required cables and the power supply are available before reconnection.

Related tasks:

- [Mounting the Ettus USRP X420 onto a Flat Surface](#)
- [Mounting the Ettus USRP X420 onto a Rack](#)
- [Cleaning and Maintaining the Ettus USRP X420](#)

Related reference:

- [Components of an Ettus USRP X420 System](#)
- [Part Numbers for Ettus USRP X420 Recommended Cables and Accessories](#)

Cleaning and Maintaining the Ettus USRP X420

Clean and maintain the Ettus USRP X420 to preserve airflow, prevent damage, and maintain reliable operation.

Before you clean and maintain the device, ensure that electrostatic discharge (ESD) precautions are in place.

Dust accumulation and improper handling can obstruct airflow, increase operating temperatures, and degrade RF performance. Regular cleaning and basic maintenance help maintain cooling effectiveness and reduce the risk of avoidable hardware faults during operation.



Note This procedure does not include internal disassembly, fan replacement, or use of cleaning liquids.



Note Use only dry, non-abrasive cleaning methods.

To clean and maintain the Ettus USRP X420, complete the following steps.

1. Complete one of the following actions based on the current state of the device.

Device State	Action
Device is not connected and not powered on	Proceed to the next step.
Device is connected but powered off	Complete the procedure in <i>Disconnecting the Ettus USRP X420</i> .
Device is connected and powered on	Complete the procedure in <i>Powering Off the Ettus USRP X420</i> , and then complete the procedure in <i>Disconnecting the Ettus USRP X420</i> .

2. Inspect the exterior of the chassis for visible dust, debris, or damage.

3. Wipe the exterior surfaces of the chassis using a dry, lint-free cloth.
4. Remove dust from vents and openings using a soft, dry brush.
5. Verify that the front and rear airflow paths are unobstructed.
6. Inspect RF connectors and ensure that no foreign material is present.
7. Confirm that all RF transmit ports are terminated with an antenna or a 50 Ω load before the next operation.

If you encounter issues during cleaning and maintenance, check the following items.

Symptom	Possible Cause	Action
Device overheats during operation	Airflow is obstructed	Ensure that the front and rear airflow paths are unobstructed.
Hardware damage observed	Improper handling	Review handling and ESD precautions before further use.
RF performance degraded	RF port not terminated	Attach an antenna or 50 Ω load before operation.
Device becomes non-functional	Exposure to moisture or voltage spikes	Remove the device from service and contact support.

Related tasks:

- [Powering Off the Ettus USRP X420](#)
- [Disconnecting the Ettus USRP X420](#)