



Product Flyer

NI Ettus USRP Software Defined Radios

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NI Ettus USRP Software Defined Radios

USRP X4xx, USRP-2974, USRP-295X, USRP-294X, USRP-293X, USRP-292X, USRP-290X



FIGURE 1
NI Ettus USRP Family

Key Features

- 1 MHz to 8.4 GHz frequency ranges
- Up to 1.6 GHz/channel of bandwidth
- Up to eight transmit and eight receive channels per radio
- Local oscillator import/export synchronization
- GPS disciplined oscillator (GPSDO)
- Development tools such as NI LabVIEW, open-source UHD, GNU Radio, MathWorks® MATLAB® software
- OS support in Windows, Linux, and Mac OS
- FPGA development using LabVIEW FPGA and RF network on chip (RFNoC) framework
- Onboard ARM and x86 processor available on some models
- Communication interfaces such as USB, gigabit Ethernet, and PCI Express

Software Defined Radios for Any Use Case

NI USRP is a suite of fully user-programmable software defined radios (SDRs) that combine general-purpose processors, field-programmable gate arrays (FPGAs), and RF front ends so that you rapidly can design, prototype, and deploy wireless systems. From low-cost to high-performance, to rugged deployable and multichannel, the NI USRP is the most popular and versatile SDR available.

Software is central to SDRs, and the NI USRP product line's roots lie in the designs of Ettus Research, acquired by NI in 2009. Whether you are a longtime LabVIEW programmer or you prefer open-source development tools, use the NI USRP product line to rapidly get up and going to build your custom wireless application. The NI USRP supports the popular GNU Radio framework with its open-source driver, USRP Hardware Driver (UHD).

Beyond software flexibility, with the NI USRP product line, you can take simulated inline digital signal processor (DSP) code and target it to the FPGA for real-time processing. You can do this with a prebuilt digital infrastructure using both LabVIEW FPGA and the powerful RFNoC framework compatible with popular open-source workflows.

NI Ettus Research SDR Hardware

From DC to 8.4 GHz, up to 1.6 GHz of real-time bandwidth, powerful DSP-focused FPGAs, and form factors ranging from handheld devices to high-channel-count systems, NI SDRs can meet your needs from design to deployment. Ettus Research provides detailed product information for B Series, N Series, E Series, and X Series devices at ettus.com.



NI Ettus USRP X440

The latest in performance in the X4 Series lineup, USRP X440 contains a Zynq UltraScale+ RFSoc, 8x8 MIMO, and up to 1.6 GHz per channel of bandwidth. It supports open-source software only.



NI Ettus USRP X410

The high-performance USRP X410 features a wide frequency range of 1 MHz to 7.2 GHz and a bandwidth of 400 MHz. Capable of 4x4 MIMO and including a powerful Zynq UltraScale+ RFSoc, the USRP X410 supports both LabVIEW and open-source software.



NI X310 Series/USRP RIO

These high-performance PCI Express, 10 gigabit Ethernet devices include a powerful Kintex-7 FPGA, a 2x2 MIMO transceiver, and up to 160 MHz of bandwidth. They support both LabVIEW and open-source software.



NI B Series/USRP 290x

Cost-effective USB SDRs with a wide frequency range, these compact-form-factor devices offer up to 56 MHz of streaming bandwidth and support both LabVIEW and open-source software.



NI E Series

Conduction-cooled, portable, and stand-alone SDRs, these contain a Zynq System-on-Chip (SoC), a 2x2 MIMO transceiver, and 56 MHz of bandwidth. Compatible with open-source software only.



NI N Series

These high-performance, stand-alone SDRs contain a Zynq SoC, 2x2 MIMO, and up to 128x128 phase synchronous systems. They offer 200 MHz of bandwidth and are compatible with open-source software only.



Stand-Alone SDR

High-performing SDRs with an onboard processor and FPGA for stand-alone applications, these offer up to 160 MHz of bandwidth and MIMO capability. They support both LabVIEW and open-source software.

| NI USRP Model | Ettus Research Model | Frequency Range | Bandwidth | Transmitter/Receiver Channels | Features |
|-----------------|-----------------------|-------------------|---------------|-------------------------------|---|
| USRP X440 | | 30 MHz to 4 GHz | Up to 1.6 GHz | 8 TX/8 RX | RFSoc-Based, Wideband, Multichannel |
| USRP X410 | | 1 MHz to 7.2 GHz | 400 MHz | 4 TX/4 RX | |
| NI USRP-2974 | — | 10 MHz to 6 GHz | 160 MHz | 2 TX/2 RX | Stand-Alone, Intel Core i7 Processor |
| NI USRP-2955 | X310 + TwinRX + GPSDO | 10 MHz to 6 GHz | 80 MHz | 0 TX/4 RX | Configurable RF Front End Programmable FPGA |
| NI USRP-2954 | X310 + UBX + GPSDO | 30 MHz to 6 GHz | 160 MHz | 2 TX/2 RX | |
| NI USRP-2945 | X310 + TwinRX | 10 MHz to 6 GHz | 80 MHz | 0 TX/4 RX | |
| NI USRP-2944 | X310 + UBX | 10 MHz to 6 GHz | 160 MHz | 2 TX/2 RX | |
| — | X310 + OBX | 10 MHz to 8.4 GHz | 160 MHz | 2 TX/2 RX | |
| — | N321 / N320 | 3 MHz to 6 GHz | 200 MHz | 2 TX/2 RX | Stand-Alone, Wide-Bandwidth, Multichannel-Sync-Ready (N32x) |
| — | N310 | 10 MHz to 6 GHz | 100 MHz | 4 TX/4 RX | |
| — | N300 | 10 MHz to 6 GHz | 100 MHz | 2 TX/2 RX | |
| NI USRP-2901 | B210 | 70 MHz to 6 GHz | 56 MHz | 2 TX/2 RX | Low SWaP-C, Highly Portable |
| NI USRP-2900 | B200 | 70 MHz to 6 GHz | 56 MHz | 1 TX/1 RX | |
| USRP B206mini-i | | 70 MHz to 6 GHz | 56 MHz | 1 TX/1 RX | Low SWaP-C, Highly Portable |
| — | E320 | 70 MHz to 6 GHz | 56 MHz | 2 TX/2 RX | Stand-Alone, Low SWaP, Embedded Deployable |

TABLE 1

The NI and Ettus Research USRP Family

| Part Description | OctoClock-G CDA-2990 | OctoClock CDA-2990 | Board Mounted GPSDO (TCXO) Recommended for USRP B200/B210 | Board Mounted GPSDO (OCXO) Recommended for USRP X300/X310 |
|------------------|----------------------|--------------------|---|---|
| Part Number | 784306-01 | 784305-01 | 783454-01 | 783173-01 |
| USRP X4xx | ✓ | ✓ | | |
| USRP X3xx | ✓ | ✓ | | ✓ |
| USRP N3xx | ✓ | ✓ | | |
| USRP 294x | ✓ | ✓ | | ✓ |
| USRP 295x | ✓ | ✓ | | Included |
| USRP B2xx | ✓ | ✓ | ✓ | |

TABLE 2

Clocking Accessories

Software Overview

Your Choice of Development Software

Regardless of your development tool preferences, NI Ettus USRPs work with the broadest range of software workflows on the market. You can choose between two drivers—NI-USRP or USRP Hardware Driver (UHD)—based on your preferred development tools. Both drivers are developed and maintained by NI’s R&D organization.

With **NI-USRP**, you can program your NI Ettus USRP with LabVIEW, NI’s flagship intuitive development environment, to rapidly develop measurement systems. You can program both the host and FPGA in a single development environment using the NI LabVIEW dataflow programming style. The abstracted design environment helps accelerate the design of wireless systems and makes FPGA programming accessible to those without HDL design expertise. If you have third-party IP that you want to incorporate, such as MathWorks® MATLAB® software or VHDL code, you can import this IP directly from LabVIEW.

UHD works with all NI Ettus USRPs, and NI publishes it under open-source licenses. It facilitates application development on USRPs in C/C++ and offers cross-platform support for several industry-standard development environments and frameworks, such as GNU Radio, Python, and MathWorks MATLAB and Simulink® software. As an active leader in open-source SDR communities such as the GNU Radio Foundation, NI consistently works to further wireless communications research through the open-source ecosystem.

| NI-USRP | | UHD |
|------------------|---------------------|---------------------------------------|
| Operating System | Windows | Windows |
| | Linux | Linux |
| Host | LabVIEW 20XX | Mac OS |
| | | GNU Radio |
| | | C/C++ |
| | | MATLAB®/Simulink®/Wireless Testbench™ |
| FPGA | LabVIEW FPGA Module | Python |
| | | RFNoC (Open-Source FPGA Framework) |
| | | VHDL |
| | | Verilog |
| | | HDL Coder |

TABLE 3
NI-USRP and UHD Drivers Overview

Programming the Host

For applications with lower data streaming rates, or when data can be processed offline instead of in real time, using a host computer for signal processing is a good fit. NI Ettus USRPs can be programmed using either the NI-USRP driver with LabVIEW or UHD with text-based and open-source programming languages like Python, C++, and GNU Radio.

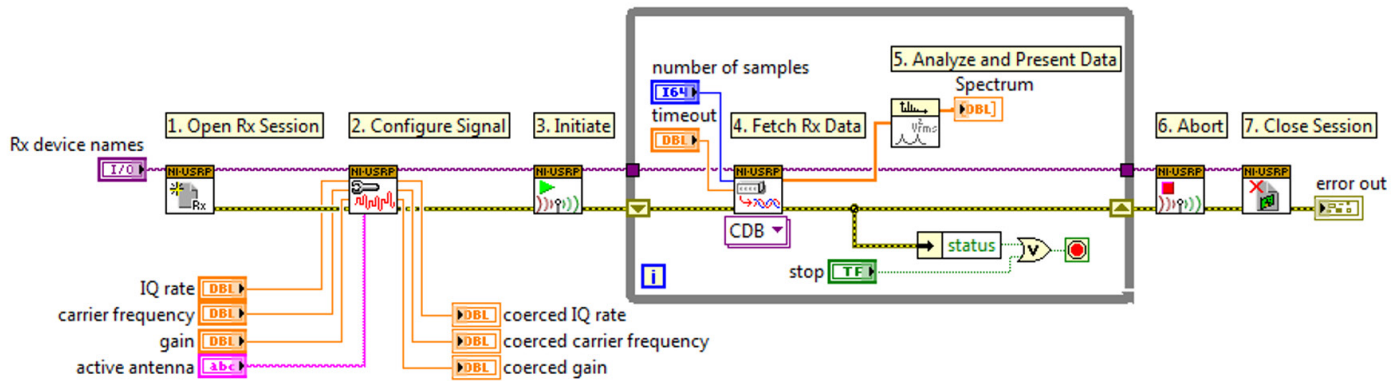


FIGURE 2
NI-USRP APIs for LabVIEW

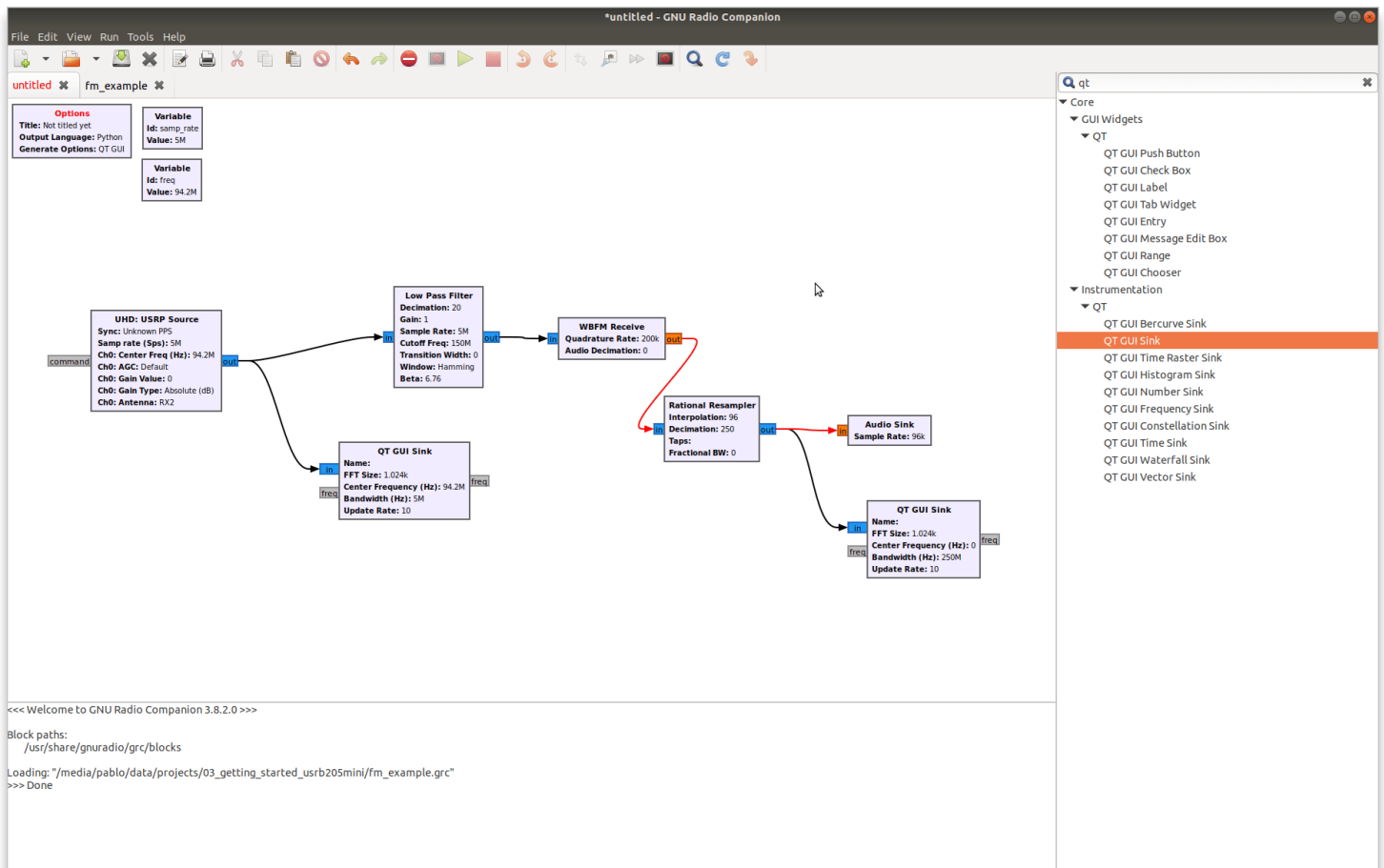


FIGURE 3
GNU Radio Companion API with UHD

Take Advantage of the Power of FPGA

As bandwidths widen and latency requirements grow more stringent, the ability to implement digital signal processing algorithms that run in real time is essential. Many NI Ettus USRP models feature a user-programmable FPGA to enable real-time signal processing.

The FPGA on an NI Ettus USRP can be programmed in several different ways. LabVIEW FPGA along with the NI-USRP driver gives users access to pin level programming with a graphical user interface.

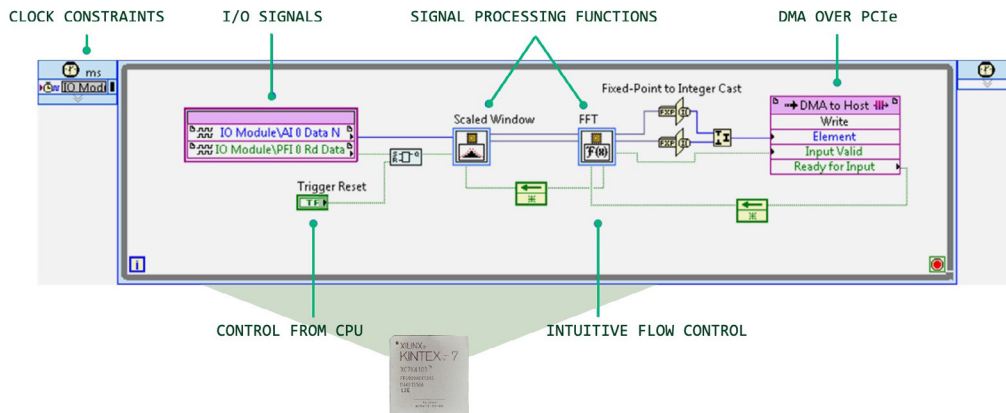


FIGURE 4
LabVIEW FPGA Graphical Abstraction of FPGA IP Integration

NI Ettus USRPs are also all supported with the RF Network on Chip (RFNoC) framework. RFNoC is a prebuilt framework that gives you the infrastructure you need to build an SDR application with the FPGA—without having to develop the digital infrastructure—programmed with VHSIC Hardware Description Language and Verilog Hardware Description Languages with plug-ins for GNU Radio.

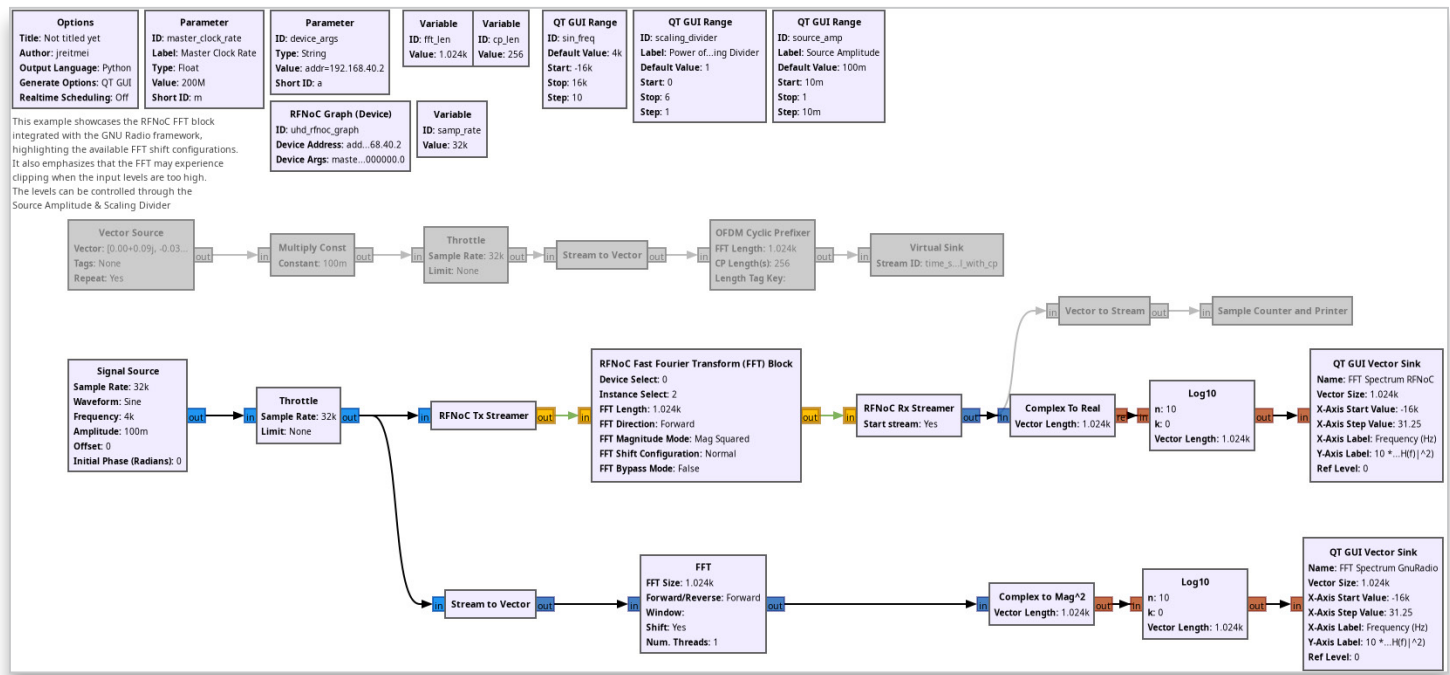


FIGURE 5
GNU Radio Companion API Example with RFNoC FPGA IP Blocks

NI Hardware Services

All NI hardware includes a one-year warranty for basic repair coverage and calibration in adherence to NI specifications prior to shipment. PXI systems also include basic assembly and a functional test. NI offers additional entitlements to improve uptime and lower maintenance costs with service programs for hardware. Learn more at ni.com/services/hardware.

| | Hardware | Standard | Premium | Description |
|---|---------------------------------|-------------------|------------------------|---|
| Duration at Point of Sale | 1 year; included | 3 years; optional | 3 years; optional | NI enhances warranty coverage with additional service benefits provided with a hardware service program. |
| Maximum Duration with Renewal | <3 years with a service program | <3 years | <3 years | NI maintains the high performance and availability of your hardware for up to three years with a hardware service program. |
| Extended Repair Coverage | • | • | • | NI restores your device's functionality and includes firmware updates and factory calibration within <10 working days ⁴ plus standard shipping time. |
| System Configuration, Assembly, and Test ¹ | | • | • | NI technicians assemble, install software in, and test your system per your custom configuration prior to shipment. |
| Advanced Replacement ² | | | • | NI stocks replacement hardware that can be shipped immediately if a repair is needed. |
| System Return Material Authorization (RMA) ¹ | | | • | NI accepts the delivery of fully assembled systems when performing repair services. |
| Technical Support | • | • | • | NI provides access to support resources for your hardware. |
| Calibration Plan (Optional) | | Standard | Expedited ³ | NI performs the requested level of calibration at the specified calibration interval for the duration of the service program. |

¹ This option is only available for PXI, CompactRIO, and CompactDAQ systems.

² This option is not available for all products in all countries. Contact your local NI sales engineer to confirm availability.

³ Expedited calibration is only available for the traceable calibration level.

⁴ This applies to non-RF products only. Standard extended repair coverage for RF products is <15 working days plus standard shipping time.

PremiumPlus Service Program

NI can customize the previously listed offerings or offer additional entitlements such as on-site calibration, custom sparring, and lifecycle services through a [PremiumPlus Service Program](#). Contact your NI sales representative to learn more.

Technical Support

NI hardware service programs and warranty include access to technical support provided by NI Support Agents during local business hours. Service requests can be managed online. Additionally, take advantage of NI's award winning [online resources](#) and [communities](#).

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