Requirements and Compatibility | Ordering Information | Detailed Specifications

For user manuals and dimensional drawings, visit the product page resources tab on ni.com.
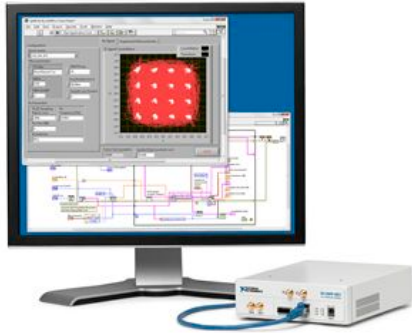
Last Revised: 2013-06-27 12:16:52.0

NI USRP-29xx Datasheet

Universal Software Radio Peripherals

- Affordable, rapid prototyping solution
- Tunable RF transceivers options covering 50MHz – 6GHz
- Stream up to 25MS/s baseband IQ for live host-based processing with LabVIEW
- Integrated GPS that improves clock precision and enables global device synchronization and position for NI USRP-293x

- Plug-and-play MIMO synchronization
- Reference design examples for record & playback, physical layer prototyping, and spectral monitoring
- NI technical support and 1-year extendable warranty

Overview

NI USRP-29xx software-programmable radio transceivers are designed for wireless communications teaching and research. Programmable with NI LabVIEW software, the USRP hardware is an affordable and easy-to-use RF platform for rapid prototyping applications such as record & playback, physical layer communication, spectrum monitoring, and more. With the ability to transmit and receive RF signals across a wide range of frequencies with up to 40 MHz of real-time bandwidth and plug-and-play MIMO support, the NI USRP enables a broad range of RF/communications applications covering common standards such as broadcast radio, digital TV, GSM Cellular, GPS, 802.11 (WiFi) and ZigBee®. LabVIEW brings increased productivity with an intuitive graphical programming approach, and m-file script compatibility enabling development of algorithms for physical layer communications. The NI USRP-293x has an integrated GPS-disciplined clock that provides improved frequency accuracy, synchronization capabilities, and GPS position information.

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Requirements and Compatibility

OS Information

Windows 7 32-bit
Windows 7 64-bit
Windows Vista
Windows XP

Driver Information

NI-USRP

Software Compatibility

LabVIEW

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Comparison Tables

Model	Frequency	GPS-Disciplined	Freq. Accuracy (No GPS Antenna)	Freq. Accuracy (With GPS Antenna)
NI USRP-2920	50 MHz to 2.2 GHz	No	± 2,500 Hz @ 1 GHz	NA
NI USRP-2921	2.4 to 2.5 GHz and 4.9 to 5.9 GHz	No	± 2,500 Hz @ 1 GHz	NA
NI USRP-2922	400 MHz – 4.4 GHz	No	± 2,500 Hz @ 1 GHz	N/A
NI USRP-2930	50 MHz – 2.2 GHz	Yes	± 2.5 Hz @ 1 GHz	± 0.01 Hz @ 1 GHz
NI USRP-2932	400 MHz – 4.4 GHz	Yes	± 2.5 Hz @ 1 GHz	± 0.01 Hz @ 1 GHz

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Application and Technology

An Affordable Lab-Ready Solution

The NI USRP platform offers new opportunities for RF and communications education, which traditionally has been focused on mathematical theory. Students can use the platform with LabVIEW to link theory and practical implementation through hands-on execution and exploration of a working communications system using live signals.

Figure 1. The NI Digital Communications Bundle

The NI Digital Communications Bundle is an affordable turnkey solution that addresses both time and budget concerns. It includes a pair of NI USRP-2920 transceivers, which enables implementation of a live communication link at frequencies between 50 MHz and 2.2 GHz with up to a 25 MHz bandwidth. The bundle also features a laboratory manual, *Digital Wireless Communication: Physical Layer Exploration Lab Using the NI USRP*, by Dr. Robert Heath, a professor at The University of Texas at Austin Department of Electrical and Computer Engineering. This material covers each element of a modern digital communications system and culminates with the design of an OFDM radio. The course material includes a printed lab manual with background content, pre-lab exercises, step-by-step lab instructions, and LabVIEW VIs associated with each exercise.

Lab 1.1	AWGN Simulator
Lab 2.1	Modulation/Demodulation
Lab 2.2	Pulse Shaping
Lab 3	Energy Detection
Lab 4	Equalization
Lab 5	Frame Detection
Lab 6	Intro to OFDM
Lab 7	Frequency Correction and Synchronization
Lab 8	OFDM Channel Coding

Table 1. Topics Covered by Digital Wireless Communication: Physical Layer Exploration Lab Using the NI USRP

Communications Research

LabVIEW provides a scalable platform for communications research bridging design and test, allowing a designer to share code between USRP prototyping and PXI RF test hardware. Get started quickly by leveraging proven reference designs provided by NI for applications such as physical layer prototyping, record and playback, and GPS simulation or integrate your own written in LabVIEW, m-file script or C.

Hardware

The USRP software-defined radios are RF software-programmable radio transceivers designed for wireless communications research. When the USRP is connected to a host PC, it acts as a software-defined radio with host-based digital signal processing capabilities. Each USRP device provides an independent transmit and receive channel capable of full duplex operation in some hardware configurations.

The NI USRP-2930 and NI USRP-2932 include an integrated GPS-disciplined 10MHz reference clock. The reference clock provides improved frequency accuracy, synchronization capabilities, and GPS position information. Figure 1 shows the USRP system block diagram. There are two separate transmit and receive signal chains which are common among all USRP models. The highlighted section represents the GPS disciplined clock, which is common to NI USRP-293x models. The reference clock is shared among both the transmit and receive paths, and from which the local oscillator (LO) is derived.
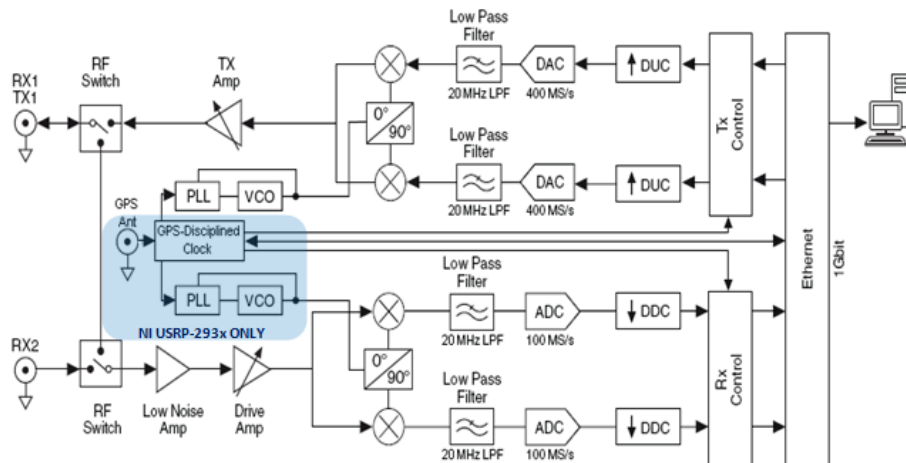

Figure 2. NI USRP-2920 System Block Diagram

LabVIEW Software and the NI-USRP Driver

The LabVIEW development system provides an ideal way to interface with NI USRP hardware for the development and exploration of communications algorithms that process received signals and synthesize signals for transmission. The NI-USRP software driver provides functions (LabVIEW VIs) for the hardware / software configuration with tools for opening / closing sessions and performing read/ write operations.
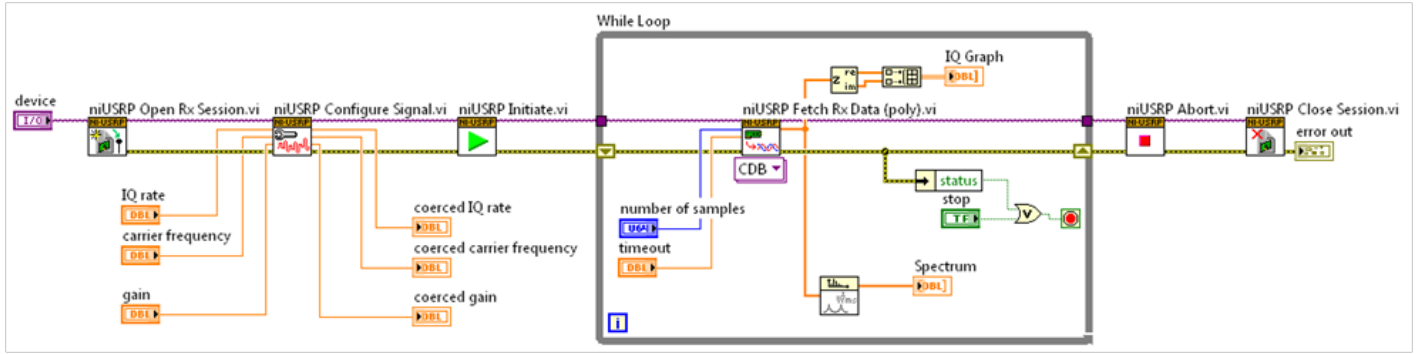

Figure 3. Continuous Receive Using NI-USRP Driver in LabVIEW Software

LabVIEW Modulation Toolkit

The LabVIEW Modulation Toolkit extends LabVIEW with VIs for rapid development of communications systems for simulation or to operate on live signals associated with NI-USRP hardware. On the transmit side, included VIs provide functionality for PN-sequence generation, channel coding, and baseband modulation. Receiver-side functionality includes demodulation, equalization, channel decoding and more. Included utilities enable the addition of baseband impairments, BER measurement, modulation domain measurements, and communications-oriented visualization. An entire communication system can be simulated and analyzed with channel impairments and then updated to transmit / receive live signals.
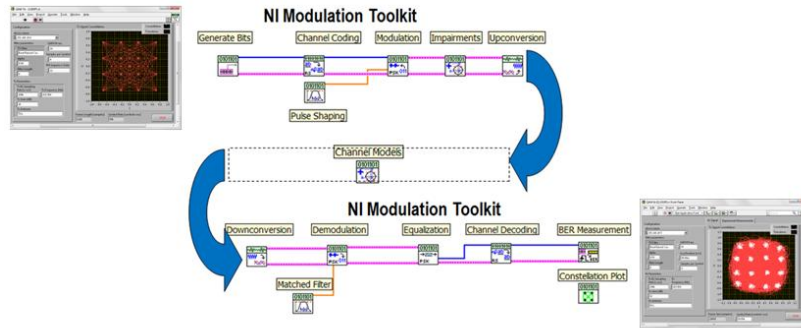

Figure 4. LabVIEW Modulation Toolkit

LabVIEW MathScript RT Module

With the LabVIEW MathScript RT Module, you can efficiently execute .m file syntax in a LabVIEW diagram to combine both graphical and textual models of computation. In addition, you can design and implement communications algorithms using the popular .m file script syntax.
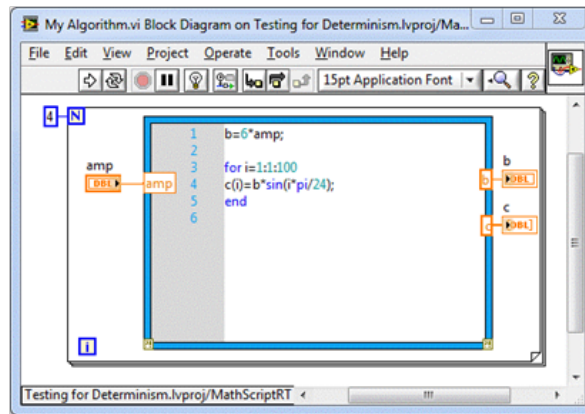

Figure 5. A LabVIEW MathScript RT Node Inside a LabVIEW For Loop

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Ordering Information

For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number

| Optional Accessories		
VERT400: Tri-Band Vertical Antenna (144 MHz, 400 MHz, 1200 MHz)	781915-01	No accessories required.
MIMO Sync and Data Transfer Cable for NI USRP-292x, 0.5M	781916-01	No accessories required.
VERT2450: Dual-Band Vertical Antenna (2.4 GHz, 5 GHz)	781913-01	No accessories required.
Digital Communication Bundle		
NI Digital Communications Bundle: 2 NI USRP-2920 Kits With LabVIEW Add-Ons, MIMO Cable, and Ready-to-Use Courseware	781908-01	No accessories required.
NI USRP-29xx Hardware Kits		
NI USRP-2920, 50 MHz to 2.2 GHz Software Radio Kit: LabVIEW Driver, Modulation Toolkit, MathScript RT, Digital Filter Design Toolkit	781906-01	No accessories required.
NI USRP-2921, 2.4 AND 5 GHz Software Radio Kit: LabVIEW Driver, Modulation Toolkit, MathScript RT, Digital Filter Design Toolkit	781907-01	No accessories required.
NI USRP-2932, 400MHz to 4.4 GHz + GPS Clock Software Radio Kit: LabVIEW Driver, Modulation Toolkit, MathScript RT, Digital Filter Design Toolkit	781911-01	No accessories required.
NI USRP-2922, 400MHz to 4.4 GHz Software Radio Kit: LabVIEW Driver, Modulation Toolkit, MathScript RT, Digital Filter Design Toolkit	781909-01	No accessories required.
NI USRP-2930, 50MHz to 2.2 + GPS Clock GHz Software Radio Kit: LabVIEW Driver, Modulation Toolkit, MathScript RT, Digital Filter Design Toolkit	781910-01	No accessories required.

Software Recommendations

NI LabVIEW Digital Filter Design Toolkit
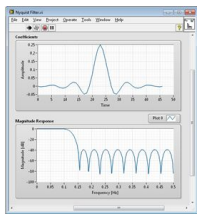
Floating- and fixed-point design with LabVIEW or ANSI C autocode generation
Digital filter design, analysis, and implementation within LabVIEW
Comprehensive tools that meet basic or advanced needs
Includes Digital Filter Design MathScript RT Module functions

NI Modulation Toolkit
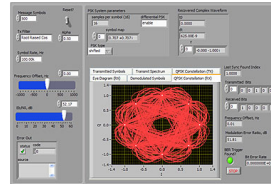
Simulate and measure impairments including DC offset, I/Q gain imbalance, and quadrature skew
Handles standard and custom modulation formats(AM, FM, PM, ASK, FSK, MSK, GMSK, PSK, QPSK, PAM, QAM)
Measurements including bit error rate (BER), phase error, burst timing, and frequency deviation
Quality measurements including EVM, modulation error ratio (MER), and ρ (rho)
Powerful 3D eye diagrams enhance the suite of traditional 2D eye, trellis, and constellation plots
More than 100 source code example programs

Support and Services

Technical Support

Get answers to your technical questions using the following National Instruments resources.

Support - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
Discussion Forums - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
Online Community - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

Classroom training in cities worldwide - the most comprehensive hands-on training taught by engineers.
On-site training at your facility - an excellent option to train multiple employees at the same time.
Online instructor-led training - lower-cost, remote training if classroom or on-site courses are not possible.
Course kits - lowest-cost, self-paced training that you can use as reference guides.
Training memberships and training credits - to buy now and schedule training later.
Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

Detailed Specifications

All characteristics described in this document are based on the manufacturing design. *This equipment information is only for product description* and is not covered by warranty. This device is not calibrated.

Characteristics	NI USRP-2920	NI USRP-2921	NI USRP-2922	NI USRP-2930	NI USRP-2932
Transmitter					
Frequency Range	50MHz-2.2GHz	2.4GHz-2.5GHz 4.9GHz-5.9GHz	400MHz-4.4GHz	50MHz- 2.2GHz	400MHz-4.4GHz
SW Adjustable TX Frequency Step	< 1KHz				
MAX Output Power	15 dBm - 20 dBm				
TX Output Power Gain Range	0 dB - 31 dB				
SW Adjustable Output Power Step Size	1dB				
Instantaneous Real-Time Bandwidth	20MHz (16bit samples)				
	40MHz (8bit-samples)				
DAC (Digital to Analog Conversion)	2 channels, 400MS/s, 16 bit				
DAC SFDR (Spurious Free Dynamic Range)	80 dB				
Receiver					
Software Adjustable RX Frequency Step	< 1KHz				
Max Input Power (Pin)	0 dBm				
Noise Figure	5 to 7 dB				

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Instantaneous Real-Time Bandwidth	20MHz (16bit samples) 40MHz (8bit-samples)				
ADC (Analog to Digital Conversion)	2 channels, 100MS/s, 14 bit				
ADC SFDR (Spurious Free Dynamic Range)	88 dB				

Reference Clock					
Clock Type	TCXO	TCXO	TCXO	OCXO	OCXO
GPS Disciplined	NO	NO	NO	YES	YES
Freq.Accuracy of 10MHz Ref (No GPS Antenna)	2.5ppm	2.5ppm	2.5ppm	2.5 ppb	2.5 ppb
Freq.Accuracy of 10MHz Ref (GPS Antenna)	NA	NA	NA	0.01 ppb	0.01 ppb

Shared Characteristics (Apply all NI-29xx devices)

Connections		Physical Specifications	
TX1 RX1, TX2 RX2, RX2 Ports	SMA	Enclosure Dimensions	6.25" Wide x 1.9" Tall x 8.35" Deep
Ethernet Connection	1 Gigabit Ethernet	Weight	2.63 lbs
Power Adapter	6VDC, 3A	Operating Temperature	23°C ±5°, Room Temperature
Ref Clock (10-Mhz external reference input)	SMA, 10 MHz		
PPS Input (Pulse Per Second reference input)	SMA, 3-5V TTL Compatible		
MIMO Expansion Port	High-Speed SerDes protocol		

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