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1 B205mini

1.1

The USRP Bus Series provides a fully integrated, single board, Universal Software Radio Peripheral platform with continuous frequency coverage from 70 MHz ? 6 GHz. Designed for low-cost experimentation, it combines a fully integrated direct conversion transceiver providing up to 56MHz of real-time bandwidth, an open and reprogrammable Spartan6 FPGA, and fast and convenient bus-powered SuperSpeed USB 3.0 connectivity.

1.2

1.2.1

- Xilinx Spartan 6 XC6SLX75 FPGA
- Analog Devices AD9364 RFIC direct-conversion transceiver
- Frequency range: 70 MHz - 6 GHz
- Up to 56 MHz of instantaneous bandwidth
- Full duplex, SISO (1 Tx & 1 Rx)
- Fast and convenient bus-powered USB 3.0 connectivity
- Optional Board Mounted GPSDO

1.2.2

- Xilinx Spartan 6 XC6SLX150 FPGA
- Analog Devices AD9361 RFIC direct-conversion transceiver
- Frequency range: 70 MHz - 6 GHz
- Up to 56 MHz of instantaneous bandwidth (61.44MS/s quadrature)
- Full duplex, MIMO (2 Tx & 2 Rx)
- Fast and convenient bus-powered USB 3.0 connectivity
- Optional Board Mounted GPSDO

1.2.3

- Xilinx Spartan-6 XC6SLX75 FPGA
- Analog Devices AD9364 RFIC direct-conversion transceiver
- Frequency range: 70 MHz - 6 GHz
- Up to 56 MHz of instantaneous bandwidth
- Full duplex, SISO (1 Tx & 1 Rx)
- Fast and convenient bus-powered USB 3.0 connectivity

1.2.4

- Industrial-grade Xilinx Spartan-6 XC6SLX75 FPGA
- Analog Devices AD9364 RFIC direct-conversion transceiver
- Frequency range: 70 MHz - 6 GHz
- Up to 56 MHz of instantaneous bandwidth
- Full duplex, SISO (1 Tx & 1 Rx)
- Fast and convenient bus-powered USB 3.0 connectivity

1.2.5

- Industrial-grade Xilinx Spartan-6 XC6SLX150 FPGA
- Analog Devices AD9364 RFIC direct-conversion transceiver
- Frequency range: 70 MHz - 6 GHz
- Up to 56 MHz of instantaneous bandwidth
- Full duplex, SISO (1 Tx & 1 Rx)
- Fast and convenient bus-powered USB 3.0 connectivity

1.3

1.3.1

- SSB/LO Suppression -35/50 dBc
- Phase Noise 3.5 GHz 1.0 deg RMS
- Phase Noise 6 GHz 1.5 deg RMS
- Power Output >10dBm
- IIP3 (@ typ NF) -20dBm
- Typical Noise Figure <8dB

1.4

1.4.1

- B200mini/B205mini 5.0 x 8.4 cm
- B200/B210 9.7 x 15.5 x 1.5 cm

1.5

1.5.1

- B200mini 0-40 °C
- B200mini-i 0-45 °C
- B205mini-i 0-45 °C
- B200 0-40 °C
- B210 0-40 °C

1.6

1.6.1

B200mini Schematics

1.6.2

B210 Schematics

1.7

- Transceiver - Analog Devices AD9364
- Transceiver - Analog Devices AD9361
- FPGA - Xilinx Spartan-6 Product Page
- FPGA - XC6SLX75 / XC6SLX150
- VXTCXO - B200mini VXTCXO
- GPSDO - M9107
- Frequency Synthesizer - ADF4001
- FX3: SuperSpeed USB Controller - CYUSB3014
- Antenna Switch - SKY13317
- Balun - BD3150L50100A00
- Amplifier - PGA?102+

1.8

1.8.1

- B200mini 24.0 g
- B200/B210 350 g

1.8.2

- B200mini Media:B200mini_drawing.png
- B200 [ADD]
- B210 [ADD]

1.9

- Full Steel Enclosure
- Compatible with green USRP B200 and B210 devices (revision 6 or later)
- Front and rear K-Slots for anti-theft protection

USRP B Series Enclosure

1.10

1.10.1

Slice Logic Utilization

Used	Total	Percent
Number of Slice Registers	12007	93296	12%
Number of Slice LUTs	17149	46648	36%
Number used as Logic	14889	46648	31%
Number used as Memory	2260	11072	20%
Number used as RAM	336		
Number used	1924		

as SRL

Slice Logic Distribution

	Used	Total	Percent
Number with an unused Flip Flop	8325	20332	40%
Number with an unused LUT	3183	20332	15%
Number of fully used LUT-FF pairs	8824	20332	43%
Number of LUT Flip Flop pairs used	20332		
Number of unique control sets	301		

IO Utilization

	Used	Total	Percent
Number of bonded IOBs	156	280	55%
IOB Flip Flops/Latches	138		
Number of IOs	172		

Specific Feature Utilization

	Used	Total	Percent
Number of Block RAM/FIFO	144	172	83%
Number of BUFG/BUFGCTRLs	5	16	31%
Number of DSP48A1s	16	132	12%
Number using Block RAM only	144		

1.10.2

Slice Logic Utilization

	Used	Total	Percent
Number of Slice Registers	21608	184304	11%
Number of Slice LUTs	30782	92152	33%
Number used as Logic	27069	92152	29%

Number used as Memory	3713	21680	17%
Number used as RAM	480		
Number used as SRL	3233		

Slice Logic Distribution

	Used	Total	Percent
Number with an unused Flip Flop	15225	36833	41%
Number with an unused LUT	6051	36833	16%
Number of fully used LUT-FF pairs	15557	36833	42%
Number of LUT Flip Flop pairs used	36833		
Number of unique control sets	461		

IO Utilization

	Used	Total	Percent
Number of bonded IOBs	156	338	46%
IOB Flip Flops/Latches	154		
Number of IOs	172		

Specific Feature Utilization

	Used	Total	Percent
Number of Block RAM/FIFO	186	268	69%
Number of BUFG/BUFGCTRLs	5	16	31%
Number of DSP48A1s	32	180	17%
Number using Block RAM only	186		

1.11

B200/B210/B200mini - USB 3.0

1.12

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

1.13

1.14

This is a list of frequently asked questions on the USRP B200/B210/B200mini. If you have questions that are not answered in this document, please contact us - info@ettus.com.

Will the USRP B200/B210 work with USB 2.0?

Yes, both the USRP B200 and USRP B210 will fall back to the USB 2.0 standard if a USB 3.0 port is not available. There are several things to consider. First, the USB 2.0 data rates are slower. Depending on the USB controller, operating system, and other factors, you may achieve a sample rate up to 8 MS/s with USB 2.0. Also, you may not be able to bus-power the USRP B200/B210 in USB 2.0 mode.

What samples rates should I expect with USB 3.0? USB 2.0?

USB 3.0 is a new standard, and there seems to be wide variation in throughput across various USB 3.0 controllers. Ettus Research maintains a list of benchmarks for various operating systems and USB 3.0 controllers.

When can I power the USRP B200/B210/B200mini off the USB bus?

The experience may vary across various controllers. Generally speaking, bus-power is ideal for SISO operation. If you are using both channels of a USRP B210 we recommend an external power supply. We provide a power supply with the USRP B210.

MIMO operation with the USRP B210 is not recommended when using the USRP B210 on bus-power.

You should not attempt to run the device on bus-power if a GPS-disciplined oscillator is installed.

How much power does the USRP consume?

The table below shows power consumption (Watts) of a USRP B210 run with a 6V power supply. Figures on a 5V supply (USB power), or with a USRP B200 will be moderately lower. The sample rates shown are aggregate sample rates on the USB 3.0 interface.

	5 Msps	15.36 Msps	30.72 Msps	56 Msps	61.44 Msps
1 RX	1.92	2.112	2.184	2.508	
2 RX	2.148	2.436	2.508	2.64	
1 TX	2.184	2.34	2.352	2.22	
2 TX	2.76	2.88	2.904	2.64	
Full Duplex (1x1)	2.508	2.736	2.796	3.168	
2x2 MIMO	3.252	3.588	3.672	4.11	4.092

Can I build a multi-unit system with the USRP B200/B210?

It is possible to synchronize multiple USRP B200/B210 devices using the 10 MHz/1 PPS inputs and an external distribution system like to the OctoClock-G. However, USB 3.0/2.0 performance varies dramatically when multiple devices are streaming through the same controller. Generally, we recommend using the USRP N200/N210 if you need to build a high-channel count system.

Can I access the source code for the USRP B200/B210?

Yes. The USRP B200/B210 is supported by the USRP Hardware DriverTM software. You can find the driver and FPGA source code for the USRP B200/B210, and all other USRP models, in the UHD git repository:

http://files.ettus.com/manual/page_build_guide.html

What operating systems does the USRP B200/B210 work on?

The USRP B200/B210 is supported on Linux, MAC and Windows.

Does the USRP B200/B210 work with GNU Radio?

Yes. The USRP B200/B210 work with our GNU Radio plugin - gr-uhd.

Does the USRP B200/B210 work with MATLAB and Simulink?

Yes. You need to install the Communications System Toolbox Support Package for USRP Radio.

Does the USRP B200/B210 work with OpenBTS?

Yes. This is a third-party application and you can find instructions here: OpenBTS - Build, Install, Run.

For support, please sign up and contact the OpenBTS mailing list.

What tools do I need to program the FPGA?

The USRP B200 and USRP B210 include a Spartan 6 XC6SLX75 and XC6S150, respectively. The USRP B200 can be programmed with the free version of Xilinx tools, while the larger FPGA on the USRP B210 requires a licensed seat.

Can I use a GPSDO with the USRP B200/B210?

Ettus Research offers a Board-Mounted GPS-Disciplined OCXO and a Board-Mounted GPS-Disciplined TCXO, which are compatible with the USRP B200/B210. These provide a high-accuracy XO, which can be disciplined to the global GPS standard. Please note: When the GPSDO OCXO model is integrated on the USRP B200/B210, the device should be powered with an external supply instead of USB bus power. The TCXO version can be USB bus powered.

2 X310

2.1

The Ettus Research USRP X310 is a high-performance, scalable software defined radio (SDR) platform for designing and deploying next generation wireless communications systems. The hardware architecture combines two extended-bandwidth daughterboard slots covering DC ? 6 GHz with up to 120 MHz of baseband bandwidth, multiple high-speed interface options (PCIe, dual 10 GigE, dual 1 GigE), and a large user-programmable Kintex-7 FPGA in a convenient desktop or rack-mountable half-wide 1U form factor.

2.2

2.2.1

- Xilinx Kintex-7 XC7K325T FPGA
- 14 bit 200 MS/s ADC
- 16 bit 800 MS/s DAC
- Frequency range: DC - 6 GHz with suitable daughterboard
- Up 120MHz bandwidth per channel
- Two wide-bandwidth RF daughterboard slots
- Optional GPSDO
- Multiple high-speed interfaces (Dual 10G, PCIe Express, ExpressCard, Dual 1G)

2.2.2

- Xilinx Kintex-7 XC7K410T FPGA
- 14 bit 200 MS/s ADC
- 16 bit 800 MS/s DAC
- Frequency range: DC - 6 GHz with suitable daughterboard
- Up 120MHz bandwidth per channel
- Two wide-bandwidth RF daughterboard slots
- Optional GPSDO
- Multiple high-speed interfaces (Dual 10G, PCIe Express, ExpressCard, Dual 1G)

2.3

- WBX-120 / WBX-40
- SBX-120 / SBX-40
- CBX-120 / CBX-40
- UBX-160 / UBX-40
- BasicTX / BasicRX
- LFRX / LFTX

2.4

2.4.1

- SSB/LO Suppression -35/50 dBc
- Phase Noise 3.5 GHz 1.0 deg RMS
- Phase Noise 6 GHz 1.5 deg RMS
- Power Output >10dBm
- IIP3 (@ typ NF) 0dBm
- Typical Noise Figure 8dB

2.5

2.5.1

27.7 x 21.8 x 3.9 cm

2.6

2.6.1

- X300/X310 0-40 °C

2.7

2.7.1

X300/X310 Schematics

2.8

- XC7K325T
- XC7K410T
- FPGA - XC7K410T-2FFG900
- FPGA - XC7K410T-2FFG900

- 12-Bit ADC - AD7922ARMZ

- 12-Bit DAC - AD5623RBRMZ-3

- Dual Channel, 16-Bit, 1230 MSPS DAC - AD9146
- Dual Channel, 14-Bit 210 MSPS ADC - ADS62P48

- High Speed Differential Receiver - FIN1002
- EEPROM - 24LC256T
- Jitter Cleaner With Dual Loop PLLs - LMK04816BISQ/NOPB_1/3
- MULTIPLEXER - SY89547LMGTR
- Single Schmitt-Trigger Buffer Gate - SN74AUP1T17
- SHIELD-748871-01
- NUP4302
- Synchronous Step Down SWIFT? Converter - TPS54620RGYT
- Regulator - LT1764EQ-3.3
- Voltage Regulator - TPS7A47
- Monolithic Synchronous Step-Down Regulator - LTC3603EUF_TRPBF
- LOW-DROPOUT VOLTAGE REGULATORS - TPS77625_SM
- TPS511116
- LOW-DROPOUT LINEAR REGULATORS - TPS79318_SM
- HDR2X7-761985-01
- FT223HQ

2.9

2.9.1

With 2x SBX-120: 1.7kg

2.9.2

2.10

Resource Type	X300 - XC7K325T			X310 - XC7K410T		
	Count	Total	Available	Count	Total	Available
DSP48 Blocks	753	840	90%	1453	1540	94%
Block Rams (18 kB)	5	445	1%	356	795	45%
Logic Cells	125536	203800	62%	182024	254200	72%
Slices LUTS	27413	50950	54%	38801	63550	61%

- Updated February 18, 2014 for UHD 3.8.5

2.11

Follow the links below for additional information on configuring each interface for the USRP X300 or X310 SDRs.

- Dual 10 Gigabit Ethernet - 200 MS/s Full Duplex @ 16-bit
- PCIe Express (Desktop) - 200 MS/s Full Duplex @ 16-bit
- ExpressCard (Laptop) - 50 MS/s Full Duplex @ 16-bit
- Dual 1 Gigabit Ethernet - 25 MS/s Full Duplex @ 16-bit

2.12

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

2.13

- USRP X300 and X310 Configuration Guide
- Guide for the USRP X300/X310 GPIO Expansion Kit
- Guidance on SFP+ Adapters for Fiber Connectivity on USRP X300/X310
- USRP X Series Quick Start (Daughterboard Installation)

2.14

https://www.ettus.com/kb/detail/usrp-x300x310-faq

USRP? X300 and USRP? X310 SDRs Frequently Asked Questions

- **What is the bandwidth of the USRP X300/X310**

The ADC rate on each analog RX channel is 200 MS/s quadrature, which provides a theoretical analog bandwidth of approximately 80% of the Nyquist bandwidth of +/- 100 MHz (+/- 80 MHz around the center frequency). The resulting maximum theoretical analog bandwidth is 160 MHz. The actual analog bandwidth may be reduced due the RF daughterboard selected.

RF Daughterboard Bandwidths: See the daughterboard specifications [link]

FPGA Processing Bandwidth: Up to 200 MS/s quadrature.

Host Bandwidth: Up to 200 MS/s quadrature, dependent on selected interface

For more information about achieving the maximum bandwidth with a USRP X300/X310, please see the "USRP X300/X310 Configuration Guide" or the "USRP System Bandwidth" application note.

- **How can I program the USRP X300/X310**

Like all other USRP models, the USRP X300 and X310 are compatible with the USRP Hardware Driver? (UHD) architecture. The UHD architecture is a common driver that allows users to develop and execute applications on a host-PC. UHD provides a direct C++ API to control and stream to/from the USRP X300/X310. It also provides compatibility with a variety of third-party software frameworks including GNU Radio, Labview, and Matlab. You may also customize the FPGA image provided with UHD to integrate your own signal processing. For more information about UHD, and supported software frameworks, please see:

http://files.ettus.com/manual/

- **How do I update the FPGA images and firmware with the latest from UHD**

You can find more information about updating the FPGA image through PCIe, 1/10 GigE, and JTAG here.

- **How can I modify the FPGA of the USRP X300/X310**

The source code (Verilog) for the USRP X300/X310 is available in the UHD repository. The USRP X300/X310 requires ISE 14.4 or newer. The build process leverages the existing CMAKE build system used to compile the host-side driver. A Linux-based setup will provide the best results.

- **How much free space is available in the USRP X300/X310 FPGA**

Please see the USRP X300/X310 FPGA resources page for more information.

- **What type of PC setup is recommended for use with the USRP X300/X310**

The type of PC required depends heavily on the complexity and bandwidth of the application. To demonstrate the USRP X300/X310, we typically use a desktop computer with a quadcore i7, 8+ GB of DDR3, and install the PCIe interface card that is also provide with the 10 GigE, PCIe, and ExpressCard interface kits.

- **What frequency range does the USRP X300/X310 cover**

The frequency range depends on the daughterboard select by the users. For more information, please see the USRP X300/X310 Configuration Guide.

- **What components do I need to purchase for a complete USRP X300/X310 system**

For a more comprehensive guide, please see the USRP X300/X310 Configuration Guide.

- **What is the difference between the USRP X300/X310**

The USRP X310 includes a larger Kintex-7 series FPGA (XC7K410T) with additional development resources for more complex designs. The USRP X300 includes the smaller XC7K325T FPGA.

3 N210

3.1

The USRP Network Series offers high-bandwidth, high-dynamic range processing capability. The Gigabit Ethernet interface of the USRP Network Series allows high-speed streaming capability up to 50 MS/s in both directions (8-bit samples). These features, combined with plug-and-play MIMO capability make the USRP Network an ideal candidate for software defined radio systems with demanding performance requirements.

3.2

3.2.1

- Xilinx® Spartan® 3A-DSP 1800 FPGA
- 14 bit 100 MS/s dual ADC
- 16 bit 400 MS/s dual DAC
- Frequency range: DC - 6 GHz with suitable daughterboard
- Up to 50 MS/s in both directions
- Full duplex, SISO (1 Tx & 1 Rx)
- Fully-Coherent MIMO Capability
- Optional GPSDO
- Gigabit Ethernet connectivity

3.2.2

- Xilinx® Spartan® 3A-DSP 3400 FPGA
- 14 bit 100 MS/s dual ADC
- 16 bit 400 MS/s dual DAC
- Frequency range: DC - 6 GHz with suitable daughterboard
- Up to 50 MS/s in both directions
- Full duplex, SISO (1 Tx & 1 Rx)
- Fully-Coherent MIMO Capability
- Optional GPSDO
- Gigabit Ethernet connectivity

3.3

- SBX-40
- UBX-40
- WBX-40
- CBX-40
- LFRX / LFTX
- BasicRX / BasicTX
- TVRX2
- DBSRX2

3.4

3.4.1

- SSB/LO Suppression -35/50 dBc
- Phase Noise 1.8 GHz 10kHz -80 dBc/Hz
- Phase Noise 1.8 GHz 100kHz -100 dBc/Hz
- Phase Noise 1.8 GHz 1MHz -137 dBc/Hz
- Power Output 15 dBm
- IIP3 (@ typ NF) 0 dBm
- Typical Noise Figure 5 dB

3.5

3.5.1

22 x 16 x 5 cm

3.6

3.6.1

- N200/N210 0-40 °C

3.7

3.7.1

N200/N210 Schematics

3.8

- Dual Channel, 16-Bit DAC - AD9777
- Dual Channel, 14-Bit ADC - ADS62P4X
- FPGA - XC3SD3400AFG676 - Double check
- AD56x3

- Clock Distribution IC - AD9510
- Gigabit Ethernet Transceiver - ET1011C2
- Pipelined SRAM - CY7C1354C
- Drivers/Receiver MAX232

3.9

3.9.1

1.2 kg

3.9.2

3.10

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3.11

3.11.1

- Gigabit Ethernet

3.12

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

3.13

3.14

4 E312

4.1

The USRP E310 offers a portable stand-alone SDR platform designed for field deployment. The flexible 2x2 MIMO AD9361 transceiver from Analog Devices provides up to 56 MHz of instantaneous bandwidth and spans frequencies from 70 MHz ? 6 GHz to cover multiple bands of interest.

4.2

- Xilinx Zynq 7020 SoC: 7 Series FPGA with ARM Cortex A9 667 MHz dual-core processor
- Analog Devices AD9361 RFIC direct-conversion transceiver
- Frequency range: 70 MHz - 6 GHz
- Up to 56 MHz of instantaneous bandwidth
- 2x2 MIMO transceiver
- Up to 10 MS/s sample data transfer rate to ARM processor
- RX, TX filter banks
- Integrated GPS receiver
- 9-axis inertial measurement unit

4.3

4.3.1

- SSB/LO Suppression -35/50 dBc
- Phase Noise 3.5 GHz 1.0 deg RMS
- Phase Noise 6 GHz 1.5 deg RMS
- Power Output >10dBm
- IIP3 (@ typ NF) -20dBm
- Typical Noise Figure <8dB

4.4

4.4.1

- 133 x 68 x 26.4 mm

4.5

4.5.1

- E310 0-40 °C

4.6

4.6.1

E310 Schematics

E310 DB

4.7

TXS02612RTWR

XC7Z020-1CLG484CES9919

USB3340-EZK-TR

AK4571VQP

FT230XQ-R

88E1512

24LC024/SN

DS1339,SM

ADT7408

MPU-9150

BMP180

BQ24192

TPS54478

MAX6510HAUT-T

ATTINY88-MU

TPS61253YFF

AD9361 Product Page

Xilinx Zynq Product Page

InvenSense MPU-9150 Product Page

Request a detailed whitepaper covering features and components from info@ettus.com

4.8

4.8.1

- Partial Enclosure 225 g
- Full Enclosure 375 g

4.8.2

- E310 Drawings - File:E310 Dimensional Sketches.pdf

4.9

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4.10

- 10/100/1000 BASE-T Ethernet
- Stereo audio out, mono mic in
- Integrated GPS receiver
- Host USB support
- 9-axis IMU

4.11

[ADD E310 FPGA IMAGES]

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

4.12

- USRP E310 Architecture

4.13

5 OctoClock

5.1

The OctoClock is an affordable solution for high-accuracy time and frequency reference distribution. The OctoClock accepts 10 MHz and PPS signals from an external source, and distributed each signal 8 ways. This is a useful accessory for users that would like to build multi-channel systems that are synchronized to a common timing source.

5.2

- 8-Way Time and Frequency Distribution (1 PPS and 10 MHz)
- Convenient Solution for Multi-Channel Synchronization
- Use with MIMO Capable N-Series Devices for Coherent System
- External 10 MHz/1 PPS Source Required
- 19" Rackmount ? 1U

5.3

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5.5

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5.6

5.6.1

- 0-40 °C

5.7

5.7.1

OctoClock Schematics

5.8

- Ethernet Controller - ENC28J60?DIG
- Microcontroller - ATmega128
- SMT OCXO-Based GPSDO - M9107
- VOLTAGE-LEVEL TRANSLATOR - SN74AUP1T57
- Output Clock Programmable Buffer - CDCE18005?PWR
- Binary Ripple Counter -74HC4020
- Power Module - LMZ12001

5.9

5.9.1

4 x 17.187x 1.75 inches

5.9.2

2.6 lbs

5.10

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5.11

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5.12

Octoclock Spec Sheet

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

5.13

5.14

- **What is the OctoClock**

The OctoClock is a USRP-compatible accessory that allows you to easily synchronize up to 8 USRP radios. Multiple OctoClock devices can be combined for synchronization of larger numbers of USRP radios.

- **When would I used the OctoClock**

The OctoClock is useful for synchronizing multiple USRP devices for high channel count systems.

The following applications can benefit from OctoClock clock distribution:

- Direction Finding
- Beamforming
- Adaptive Beamforming
- Multiple-In-Multiple-Out (MIMO) Prototyping
- Geolocation Systems that Use Time-Difference-of-Arrival (TDOA)
- Multi-Channel, Multi-Static, and Passive RADAR
- Multi-Band GPS Record and Playback
- Multi-Band Cellular Monitoring

Essentially, anything that requires from synchronization or the distribution of timing information would benefit from the use of the OctoClock.

- **Are there example applications that could benefit from the OctoClock**

32-Channel Phased-Array Receiver Built with QR210 - OctoClock a Component in the System

Afford 8x8 MIMO Testbed

Share your applications with us and we will add them to the list.

- **How does the OctoClock work**

The OctoClock accepts 10 MHz and PPS signals from an external source. Active circuits are used to amplify and split the signals 8-ways. Matched-length traces minimize phase differences between all 10 MHz and 1 PPS outputs

The OctoClock-G includes an internal GPSDO (GPS Disciplined Oscillator) which provides an internal source for 10 MHz and PPS from an OCXO high precision oscillator. Add a GPS antenna (optional) with a clear view of the sky for GPS Disciplining of the OCXO that futher enhances frequency accuracy of the OCXO and global time synchronization.

- **Where can I find user manuals for the OctoClock and USRP**

Here is helpful document. Sync. and MIMO w/ the USRP

Also, here is some documentation on how to use UHD? to interact with multi-USRP systems.

- **What USRP model do you recommend for MIMO systems**

The USRP N200 or N210 and USRP X300 or X310 are recommended for building high channel count and MIMO systems. These models provide external PPS and 10 MHz reference inputs. The USRP N200 and N210 support the USRP MIMO cable.

The USRP B100, B200, B210, E100, E110, and E310 can be synchronized with 10 MHz/PPS but are not phase coherent MIMO capable devices. The USRP1 cannot be synchronized with 10 MHz/PPS.

- **How does the automatic switchover functionality work**

When using the OctoClock-G, the Internal/External switch on the front panel allows the user to choose between the internal GPSDO and external source 10 MHz/PPS source. If the selected sournce is not availble, the device will automatically switch over to the backup frequency source. When switchover is active the corresponding LED indicator will illuminate.

If neither source is present, the internal, external and status LEDs will not be illuminated and the user will not received valid 10 MHz/PPS outputs.

- **What do the LED indications mean**

The following list describes the behavior when each of the 6 LED status indicators is illuminated:

- Internal - internal GPSDO is selected and present.

- External - external source is selected and present
- Status - Either the internal GPSDO or external source is selected. If neither source is present this LED will turn off (no signals are output).
- PPS - selected PPS pulse high.
- GPS Locked - GPS is receiving signals and has valid time/position lock.
- Power - Power is applied - smoke is still inside.

- **What are the input and output specifications**

- 10 MHz Input ? 0-10 dBm
- 10 MHz Outputs - ~1.4 Vpp Square Wave, Impedance 50 ohm nominal
- 1 PPS Input - Logic-level pulse, 2.5V - 5V
- 1 PPS Outputs - Logic-level pulse, 2.5V - 5V

- **What is the function of the Ethernet port**

Currently, the Ethernet port is non-functional. In the future the Ethernet port may be used to provide a method for reading GPS time and NMEA sentences.

- **What is the input voltage rating**

The OctoClock can be powered at any voltage between 6 and 15Vdc.

- **Are the design files open source**

As with all of our products, the driver code is free & open source, and can be found in our UHD repository. The schematics are also available.

6 WBX

6.1

The WBX is a wide bandwidth transceiver that provides up to 100 mW of output power and a noise figure of 5 dB. The LO's for the receive and transmit chains operate independently, but can be synchronized for MIMO operation.

6.2

- Frequency Range: 50MHz - 2.2GHz
- Versions: 40MHz / 120MHz
- Power Output: 100mW
- Noise Figure: 5dB

6.3

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6.5

6.5.1

- 0-40 °C

6.6

6.6.1

WBX Schematics

WBX FE Schematics

6.7

HMC472LP4 - digikey link

MGA82563

MGA62563

ADL5387

ADL5385

ADA4937

ADF4350

ADP3336

24LC024

GVA?84+

6.8

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6.10

- WBX without UHD Corrections

6.11

FPGA Resources

UHD Stable Binaries

7 SBX

7.1

The SBX is a wide bandwidth transceiver that provides up to 100 mW of output power, and a typical noise figure of 5 dB. The local oscillators for the receive and transmit chains operate independently, which allows dual-band operation. The SBX is MIMO capable, and provides 40 MHz or 120 MHz of bandwidth. The SBX is ideal for applications requiring access to a variety of bands in the 400 MHz-4400 MHz range. Example application areas include WiFi, WiMax, S-band transceivers and 2.4 GHz ISM band transceivers.

7.2

- Frequency Range: 400MHz - 4.4GHz
- Versions: 40MHz / 120MHz
- Power Output: 100mW

7.3

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7.5

7.5.1

- 0-40 °C

7.6

7.6.1

SBX Schematics

7.7

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7.8

MGA82563

AS225-313LF

HMC624LP4E

LFCN-5850+

PHA-1+

GVA-84+

ADL5380ACPZ

ADA4927-2YCPZ

AD8591ARTZ-REEL

NC7WZ04P6X

ADF4350BCPZ

SKY13267-321

LFCN-1200+

TC1-1-43A+

LP3878MR-ADJ

NC7WZ04P6X

24LC024

ADL5375

SKY13267

7.9

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7.11

- SBX without UHD Corrections

7.12

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

8 CBX

8.1

The CBX is a full-duplex, wideband transceiver that covers a frequency band from 1.2 GHz to 6 GHz with a instantaneous bandwidth of 40 MHz or 120 MHz. The CBX can serve a wide variety of application areas, including WiFi research, cellular base stations, cognitive radio research, and RADAR.

8.2

- Frequency Range: 1.2GHz - 6GHz
- Versions: 40MHz / 120MHz

8.3

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8.5

8.5.1

- 0-40 °C

8.6

8.6.1

CBX Schematics

8.7

VMMK-3603

AS225-313LF

HMC624LP4E

MGA82563

GVA-84+

PHA-1+

ADL5380ACPZ

ADA4927-2YCPZ

AD8591ARTZ-REEL

NC7WZ04P6X

MAX2870ETJ+

SKY13267-321

LFCN-2000+

LP3878MR-ADJ

24LC024

ADL5375-05

8.8

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8.10

- CBX without UHD Corrections

8.11

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

9 UBX

9.1

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9.5

9.5.1

- 0-40 °C

9.6

9.6.1

UBX Schematics

9.7

MAX2871

ADL5375-05

LFCN-2250+

LTC5510

LFCN-490+

HMC624LP4E

NBB-400

PHA-1+

ADA4927-2

ADL5380

MGA-62563

LFCN-1700+

VMMK-3603

LFCN-2600+

855916

LTC5510

LFCN-2600+

TCM1-63AX+

ADA4927-2

AD8591

ADL5380

ZXTC2062E6

NFA21SL

HMC624ALP4E

LFCN-800+

ADP7104-3.3

ADL5375-05

LTC5510

24LC024

ADP7104-5.0

ZXTC2062E6

9.8

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9.10

- UBX without UHD Corrections

9.11

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

10 BasicRX

10.1

The BasicRx/BasicTx daughterboards are low-cost daughterboards that provides direct access to the ADC inputs. The boards can accept real-mode signals from 1 to 250 MHz. The BasicRx/BasicTx is ideal for applications using an external front end providing relatively clean signals within operable bandwidth. Wideband transformers couple each RF input to a single channel of the USRP device's ADC. The signals sampled by the ADC are manipulated in the FPGA, and can be processed as two real-mode signals, or a single I-Q pair.

10.2

- 1-250 MHz coverage
- Real or Complex sampling

10.3

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10.6

10.6.1

Basic RX Schematics

10.6.2

Basic TX Schematics

10.7

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10.11

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

11 LFRX

11.1

The LFTX daughterboard utilizes two high-speed operational amplifiers to allow transmission from 0-30 MHz. The LFTX is ideal for applications in the HF band, or for applications using an external front end to up-convert and amplify the intermediate signal. The outputs of the LFTX can be processed independently, or as a single I/Q pair. Example applications include HF communications, radios with external front ends and direct signal generation below 30 MHz.

11.2

- DC-30Mhz coverage

11.3

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11.5

11.5.1

- 0-40 °C

11.6

11.6.1

LFRX Schematics

11.6.2

LFTX Schematics

11.7

AD813x - verify

LT3462

11.8

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11.11

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

12 TwinRX

12.1

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12.5

12.5.1

- 0-40 °C

12.6

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12.11

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

13 RFNoC

13.1

Current FPGAs, like the Xilinx Kintex-7 and Zynq-7000 series used in third generation USRP SDRs, have incredible computational capability, but taking advantage of that capability can be difficult when using traditional FPGA design flows. RFNoC is designed to allow you to efficiently harness the full power of the latest generations of FPGAs without being an expert firmware developer. It provides the capability to create FPGA applications as easily as you can create GNU Radio flowgraphs. This includes the ability to seamlessly transfer data to & from an FPGA, from the host PC in your application, dramatically improving the ease of FPGA off-loading. Having a system-level view of the entire SDR application running on both the FPGA and the host PC enables far superior development and debugging. Mixing and matching host-based and FPGA-based processing is transparent to you, and that processing can scale across multiple FPGAs and devices across a network.

13.2

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13.3

- FIFO
- FFT
- FIR
- fosphor (real-time spectrum analyzer)
- Decimator (Keep 1 in N)
- Log Power Calculator
- Radio Interface
- Vector IIR (moving average)
- Window multiplier (for FFT)
- OFDM: Burst detection + synchronization, equalizer, packet demodulator

13.4

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14 B205mini Getting Started

14.1

- USRP B200 / B210 / B200mini / B205mini
- USB 3.0 Cable
- Universal power supply (B210 only)

14.2

Make sure that your kit contains all the items listed above. If any items are missing, please contact your sales agent or Ettus Research Technical support immediately.

14.3

- A host computer with an available USB 2.0 or 3.0 port

14.4

All Ettus Research products are individually tested before shipment. The USRP? is guaranteed to be functional at the time it is received by the customer. Improper use or handling of the USRP? can easily cause the device to become non-functional. Listed below are some examples of actions which can prevent damage to the unit:

- Never allow metal objects to touch the circuit board while powered.
- Always properly terminate the transmit port with an antenna or 50? load.
- Always handle the board with proper anti-static methods.
- Never allow the board to directly or indirectly come into contact with any voltage spikes.
- Never allow any water, or condensing moisture, to come into contact with the boards.
- Always use caution with FPGA, firmware, or software modifications.

14.5

In order to use your Universal Software Radio Peripheral (USRP?), you must have the software tools correctly installed and configured on your host computer. A step-by-step guide for doing this is available at the Basic Installation Instructions Application Note. Release 3.8.4 or later of the USRP Hardware Driver, UHD, is required. It is recommended to use the latest stable version of UHD that is available.

If you have a USB stick with the LiveUSB SDR Environment installed on it, then you may boot your host computer from that. The LiveUSB SDR Environment does not require anything to be installed on your host computer, and contains a Linux-based environment with the UHD software and the GNU Radio framework already installed. More information about the LiveUSB SDR environment is available at the Live SDR Environment Getting Started page.

14.6

The included USB 3.0 cable provides power and data connectivity for the USRP Bus Series. The host-side of the cable must be plugged into either a USB 2.0 or 3.0 port. Note that the USB 2.0 link provides less bandwidth than the USB 3.0 link. Also note that an external DC power supply must be connected if using a GPSDO (B200/B210 only). More information about USB bandwidth constraints and power considerations is available on the USRP B200 and B210 - USB 3.0 Streaming Rate Benchmarks Application Note.

14.7

Once the software tools are installed on the host computer, or using the LiveUSB SDR Environment, verify the correct operation of the USRP by running the various utility programs on the host computer. More information is available at the Verifying USRP Operation Application Note.

14.8

Technical support for USRP hardware is available through email only. If the product arrived in a non−functional state or you require technical assistance, please contact s?upport@ettus.com?. Please allow 24 to 48 hours for response by email, depending on holidays and weekends, although we are often able to reply more quickly than that.

We also recommend that you subscribe to the community mailing lists. The mailing lists have a responsive and knowledgeable community of hundreds of developers and technical users who are located around the world. When you join the community, you will be connected to this group of people who can help you learn about SDR and respond to your technical and specific questions. Often your question can be answered quickly on the mailing lists. Each mailing list also provides an archive of all past conversations and discussions going back many years. Your question or problem may have already been addressed before, and a relevant or helpful solution may already exist in the archive.

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The support page on our website is located at h?ttp://www.ettus.com/support?. The Knowledge Base is located at ?http://www.ettus.com/kb?.

14.9

Every country has laws governing the transmission and reception of radio signals. Users are solely responsible for insuring they use their USRP system in compliance with all applicable laws and regulations. Before attempting to transmit and/or receive on any frequency, we recommend that you determine what licenses may be required and what restrictions may apply.

14.10

If you have any non−technical questions related to your order, then please contact us by email at orders@ettus.com?, or by phone at +1−408−610−6399 (Monday−Friday, 8 AM 5 PM, Pacific Time). Please be sure to include your order number and the serial number of your USRP.

14.11

Terms and conditions of sale can be accessed online at the following link: http://www.ettus.com/legal/terms-and-conditions-of-sale

15 X310 Getting Started

ADD - https://www.ettus.com/kb/detail/usrp-x300x310-getting-started-guide-1-page

Getting started X300/X310

15.1

- USRP X300/X310
- 1 Gigabit Ethernet Cable
- SFP Adapter for 1 GigE
- Power Supply and US Cord
- USB 2.0 JTAG Debug Cable
- Four SMA-Bulkhead Cables
- Getting Started Guide

15.2

Make sure that your kit contains all the items listed above. If any items are missing, please contact your sales agent or Ettus Research Technical support immediately.

15.3

- add

15.4

All Ettus Research products are individually tested before shipment. The USRP? is guaranteed to be functional at the time it is received by the customer. Improper use or handling of the USRP? can easily cause the device to become non-functional. Listed below are some examples of actions which can prevent damage to the unit:

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15.6

This USRP X300/X310 supports multiple, high-speed, low-latency interface options. This kit includes all of the components necessary to communicate with the device through a 1 Gigabit Ethernet interface. To setup the device, follow these basic instructions:

- Configure the host Ethernet adapter to use an IP address of "192.168.10.1" and a subnet mask of "255.255.255.0".
- Slide the SFP Adapter into the SFP "Port 0".
- Using the supplied Ethernet cable, connect the adapter to a host computer.
- The Green Led above SFP "Port 0" should illuminate.
- To test communications, ping the USRP device at address "192.168.10.2"

For more detailed on network setup, please see: http://interfaces.ettus.com

15.7

The USRP X300/X310 also supports 10 Gigabit Ethernet and PCI-Express. To use these interfaces, we recommend our high-speed interface kits. For more information about these interface kits, please visit: http://interfaces.ettus.com

15.8

The USRP X300/X310 and compatible RF daughterboards are shipped separately. To operate the device you will need to install the RF daughterboards and supplied bulkhead cables. This can be accomplished by removing the top plate of the USRP X300/X310, which is secured with two screws. After installation, the daughterboards and cables should be secured with the hardware provided. The device must be powered off when installing daughterboards to avoid potential damage.

15.9

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- NOTE: This USRP product is a piece of test equipment.

15.11

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15.12

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16 N210 Getting Started

Getting started N200/N210

16.1

- USRP N200/N210
- 1 Gigabit Ethernet Cable
- Power Supply
- 2 SMA-Bulkhead Cables

16.2

Make sure that your kit contains all the items listed above. If any items are missing, please contact your sales agent or Ettus Research Technical support immediately.

16.3

- A host computer with an available 1-GigE port

16.4

All Ettus Research products are individually tested before shipment. The USRP? is guaranteed to be functional at the time it is received by the customer. Improper use or handling of the USRP? can easily cause the device to become non-functional. Listed below are some examples of actions which can prevent damage to the unit:

- Never allow metal objects to touch the circuit board while powered.
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- Never allow any water, or condensing moisture, to come into contact with the boards.
- Always use caution with FPGA, firmware, or software modifications.

16.5

In order to use your Universal Software Radio Peripheral (USRP?), you must have the software tools correctly installed and configured on your host computer. A step-by-step guide for doing this is available at the Basic Installation Instructions Application Note. Release 3.8.4 or later of the USRP Hardware Driver, UHD, is required. It is recommended to use the latest stable version of UHD that is available.

If you have a USB stick with the LiveUSB SDR Environment installed on it, then you may boot your host computer from that. The LiveUSB SDR Environment does not require anything to be installed on your host computer, and contains a Linux-based environment with the UHD software and the GNU Radio framework already installed. More information about the LiveUSB SDR environment is available at the Live SDR Environment Getting Started page.

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16.7

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16.8

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16.9

Terms and conditions of sale can be accessed online at the following link: http://www.ettus.com/legal/terms-and-conditions-of-sale

17 E312 Getting Started

17.1

17.1.1

- Power supply
- 2x SMB-to-SMA adapter
- 1 Gigabit Ethernet cable
- USB2-to-microUSB cable
- Imaged microSD card
- Getting started guide

17.1.2

- Power supply
- 2x SMB-to-SMA adapter
- 1 Gigabit Ethernet cable
- USB2-to-microUSB cable
- Imaged microSD card
- Getting started guide

17.2

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17.3

- A host computer with an available USB 2.0 or 3.0 port

17.4

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17.6

Connecting the USRP power supply to the devices will cause the unit to turn on and boot−up. If this is the first time powering on the device, allow the battery to fully charge before disconnecting the AC power source. Once the device has completed the boot process, you are ready to start using the device over your preferred method of connectivity (Serial Console, Network, or USB peripherals)!

17.7

17.8

The easiest way to first communicate with your E312 device is by using the USB Serial Console. Connect a micro−USB cable to the Serial Console port on the E312 and connect the other end to a PC. The console will appear as an ?FTDI Serial Device? − thus, it will likely appear as a ttyUSB device in Linux or a COM port on Windows. In Windows, you will need to edit the properties of the device in ?Device Manager? and ?Enable VCP?. On the PC, open a serial terminal to the E312 using the following parameters: B?aud Rate:?115200, D?ata:?8−bit, P?arity: None, S?top:?1−bit, F?low Control:?None.

For additional information about using the serial console and instructions for communicating with the device over other methods (such as connecting with SSH over the network or using and LCD screen, keyboard, and mouse), please refer to the UHD Manual online: http://files.ettus.com/manual/

17.9

By default, the E312 device will run a DHCP client on its 1 Gigabit Ethernet port. Assuming your network resolves hostnames (depends on your routers / switches), if you connect the device to your network, you should see it appear with the hostname e?ttus−e300.?You can then access the device over SSH.

If the hostname does not resolve, you can discover the IP address by logging into the device over the serial connection, or checking your network?s DHCP tables.

Once you have logged in to the device, you can reconfigure the network settings (e.g., you could configure it for a static IP address, if you wish).

17.10

When you first log in to the device, the user is ?root? and the password is empty (no password).

17.11

The USRP E312 is equipped with an integrated 3.7V, 3200mAh lithium−ion battery cell. After unboxing the USRP E312 , plug in the power adapter to an AC power source and fully charge the battery. This process with take approximately 2 hours. Do not leave the USRP E312 unit plugged in for more than 24 hours.

The status LED in the power button indicates the power and charge status of the battery:

Off: Indicates device is off and not charging.

- Slow Blinking Green: Indicates device is off and charging.
- Fast Blinking Green: Indicates device is on and charging.
- Solid Green: Indicates device is on and not charging (Battery is finished charging).
- Solid Orange: Indicates device is on and discharging.
- Fast Blinking Orange: Indicates device is on, discharging, and charge is below 10% charge.
- Fast Blinking Red: Indicates an error code:

1. Low Voltage Error
2. Regulator Low Voltage Error
3. FPGA Power Error
4. DRAM Power Error
5. 1.8V Power Rail Error
6. 3.3V Power Rail Error
7. Daughterboard / TX Power Error
8. Charger Error
9. Charger Temperature Error
10. Battery Low Error
11. Fuel Gauge Temperature Error
12. Global (Enclosure) Temperature Error

The battery life of the USRP E312 in idle mode is approximately 5 1/2 hours. The battery will enable the USRP E312 to operate for approximately 2 hours 20 minutes, when transmitting and receiving on both channels (2x2 MIMO), with maximum gain settings, at 5 GHz center frequency, and 1 MS/s sample rate. When the power button status LED is in the ?Fast Blinking Orange? mode, plug the USRP E312 into an AC power source as soon as possible to recharge the battery.

If the power button status LED indicates a ?Low Voltage Error? (codes 1, 2, 3, 4, 5, 6, 7) or a ?Battery Low Error? (code 10), plug the USRP E312 into an AC power source as soon as possible to recharge the battery.

When the power button status LED indicates at ?Temperature Error? or ?Charger Error? (codes 8, 9, 11, or 12), power off the USRP E312 unit and allow it to cool down to room temperature. Then, plug in the USRP E312 to and AC power source and fully charge the battery.

If error codes persist after cooling down and/or recharging the USRP E312 , please contact support@ettus.com

17.12

In order for the battery gauge to give a usable indication of remaining charge it needs to be calibrated. The procedure for calibration is as follows:

1. Completely charge the battery.
2. Type: ?echo 3200000 >/sys/class/power_supply/BAT/charge_now
3. Unplug AC power.
4. Replug AC power, and wait until charging completes.

17.13

To ensure proper use of the battery, please read the the battery specification sheet. This document is provided at the Ettus Research website at: http://files.ettus.com/e3x2_battery/e3x2_battery_spec_sheet.pdf

Because batteries utilize a chemical reaction, battery performance will deteriorate over time even if stored for a long period of time without being used. In addition, if the various usage conditions such as charge, discharge, ambient temperature, etc. are not maintained within the specified ranges, the life expectancy of the battery may be shortened or the device in which the battery is used may be damaged by electrolyte leakage.

17.13.1

- Do not expose the battery to flame or dispose of it in a fire.
- Do not put the battery in a charger or equipment with the wrong terminals connected.
- Do not short circuit the battery.
- Avoid excessive physical shock or vibration.
- Do not disassemble or deform the battery.
- Do not immerse in water.
- Do not use the battery mixed with other different make, type, or model batteries.
- Keep out of the reach of children.
- Do not use the battery if it appears damaged.

17.13.2

- Always charge the battery while it is installed in the USRP E312 and only use the DC power supply provided in the USRP E312 kit.
- Do not leave the battery charging for longer than 24 hours.
- Never use a modified or damaged USRP E312 DC power supply to charge the battery.

17.13.3

- Store the battery in a cool, dry, and well−-ventilated area.

17.13.4

- Regulations vary for different countries. Dispose of the battery in accordance with local regulations.

17.14

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17.17

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18 OctoClock Getting Started

Getting started OctoClock

18.1

18.2

18.3

18.4

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18.7

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19 WBX Getting Started

19.1

- WBX Daughterboard
- Two MCX-Bulkhead cables

19.2

19.3

19.4

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The support page on our website is located at h?ttp://www.ettus.com/support?. The Knowledge Base is located at ?http://www.ettus.com/kb?.

19.5

Every country has laws governing the transmission and reception of radio signals. Users are solely responsible for insuring they use their USRP system in compliance with all applicable laws and regulations. Before attempting to transmit and/or receive on any frequency, we recommend that you determine what licenses may be required and what restrictions may apply.

19.6

If you have any non−technical questions related to your order, then please contact us by email at orders@ettus.com?, or by phone at +1−408−610−6399 (Monday−Friday, 8 AM 5 PM, Pacific Time). Please be sure to include your order number and the serial number of your USRP.

19.7

Terms and conditions of sale can be accessed online at the following link: http://www.ettus.com/legal/terms-and-conditions-of-sale

20 SBX Getting Started

Getting started SBX

20.1

- SBX Daughterboard

20.2

20.3

20.4

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21 CBX Getting Started

21.1

- CBX Daughterboard

21.2

21.3

21.4

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21.7

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22 UBX Getting Started

22.1

- UBX Daughterboard

22.2

22.3

22.4

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23 BasicRX Getting Started

23.1

- BasicRX or BasicTX Daughterboard

23.2

23.3

23.4

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24 LFRX Getting Started

24.1

- LFTX or LFRX Daughterboard

24.2

24.3

24.4

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24.7

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25 TwinRX Getting Started

Getting Started TwinRX

25.1

- TwinRX Daughterboard

25.2

25.3

25.4

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26 Live SDR Environment Getting Started

26.1

- The next major release of the Ettus Research Live SDR Environment, version 4.0, is scheduled for April 2016.

The Live SDR Environment is a bootable ISO image file that can be put onto a USB flash drive or a DVD, and runs directly from the USB or DVD, without having to install anything, and without modifying the local disk of the system. It contains a number of pre-installed applications as well as up-to-date versions of GNU Radio and UHD enabling support for the latest USRP SDR models. It is free and uses entirely open-source software, and is based on Linux Ubuntu 14.04.

The current version of the Ettus Research Live SDR Environment, version 3.0, contains older versions of UHD and GNU Radio, and does not support several recently released USRP SDR devices. Therefore, we recommend using the GNU Radio Live SDR Environment, which is maintained by the GNU Radio project. It is similarly configured to the Ettus Research Live SDR Environment and contains current versions of UHD and GNU Radio, but it is less USRP focused.

26.2

The current GNU Radio Live SDR Environment may be obtained from the GNU Radio Project at the link below:

https://gnuradio.org/redmine/projects/gnuradio/wiki/GNURadioLiveDVD

Both Live SDR Environments may be put onto any standard DVD, or onto a USB 3.0 flash drive with at least 16 GB capacity. A USB 2.0 drive may also be used, but the system will take longer to boot, load and run programs, and respond to user interaction.

26.3

There are TWO separate ways you can create your own LiveUSB stick:

(1) This will create a new partition table on the stick, create the file systems and copy the files over to them.

- You will have less to download using this method.

Download the follow files:

```
fat.zip
casper-rw.tar.bz2
create_live_sdr_fs.sh
```

Make the creation script executable:

```
chmod +x create_live_sdr_fs.sh
```

and run:

```
sudo ./create_live_sdr_fs.sh /dev/sdX fat.zip casper-rw.tar.bz2
```

where /dev/sdX is your USB stick.

(2) This will create a bit-for-bit copy of the 'master' LiveUSB stick.

- This option only really makes sense if you have a 16GB USB stick, or know how to expand partitions and file systems (if you have a larger capacity USB stick and wish to grow the persistent file system, for example).
- **WARNING: With this method you must have a USB stick containing *at least* as many raw bytes as the disk image (~16 GB)!**

Only download the raw disk image:

```
X.X.img.bz2
```

where X.X is the LiveUSB release number (e.g. 3.0 would be 3.0.img.bz2)

and *either* run:

```
bunzip -c X.X.img.bz2 | sudo dd of=/dev/sdX bs=1M
```

- or* if you wish to have a progress bar AND have 'pv' installed:

```
pv -p -e -t -r X.X.img.bz2 | bunzip2 -c | sudo dd of=/dev/sdX bs=1M
```

where /dev/sdX is your USB stick, and X.X.img.bz2 is the file you downloaded.

PLEASE DOUBLE-CHECK THE DEVICE YOU WRITE TO - YOU COULD PERMANENTLY DESTROY YOUR DATA!

For support, please contact <support@ettus.com>

27 RFNoC Getting Started

Getting started RFNoC

https://github.com/EttusResearch/uhd/wiki/RFNoC:-Getting-Started

https://github.com/EttusResearch/uhd/wiki/RFNoC:--Specification

28 or GNU Radio

28.1

- https://gnuradio.org/redmine/projects/gnuradio/wiki/AcademicPapers
- http://ieeexplore.ieee.org/Xplore/home.jsp

29 Suggested Reading

- https://www.dsprelated.com/freebooks/mdft/
- https://www.dsprelated.com/freebooks/filters/
- What is I/Q Data?

30 Email

30.1

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31 Irc

Community based support channels are hosted on the Freenode IRC network for both USRP and GNU Radio.

IRC Tutorial

Server: irc.freenode.net

Channels:

#usrp - webchat

#gnuradio - webchat

32 Mailing Lists

32.1

Discussions involving the USRP hardware and the UHD software itself are best addressed through the usrp-users mailing list at http://usrp-users.ettus.com . This is a test

32.2

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32.3

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33 Technical FAQ

33.1

For the UHD Getting Started documentation please refer to:

uhd.ettus.com

UHD Manual

For the GNU Radio Getting Started documentation please refer to:

http://gnuradio.org/redmine/projects/gnuradio/wiki

For information specific to the USRP E100 series please refer to:

http://ettus-apps.sourcerepo.com/redmine/ettus/projects/usrpe1xx/wiki

33.2

Our current USRP product line includes the Bus Series with the USRP1and USRP B100, the Embedded Series with the USRP E100 and E110 hardware and the Networked Series including the USRP N200 and N210 software defined radios. There are many factors to consider when selecting the appropriate USRP model. Several specifications to differentiate each USRP device are listed below.

33.2.1

- 16 MHz of RF bandwidth with 8 bit samples
- 8 MHz of RF bandwidth with 16 bit samples (RX Only)
- USB 2.0 high speed connectivity
- MIMO with a single USRP device the motherboard has two daughterboard slots (2 RX + 2 TX connectors)
- FPGA: Altera Cyclone
- ADCs: 12-bits 64 MS/s
- DACs: 14-bits 128 MS/s

33.2.2

- 16 MHz of RF bandwidth with 8 bit samples
- 8 MHz of RF bandwidth with 16 bit samples
- USB 2.0 high speed connectivity
- Motherboard has one RTX daughterboard slot (1 RX + 1 TX connectors)
- Onboard FPGA processing
- FPGA: Xilinx Spartan 3A-1400 FPGA
- ADCs: 12-bits 64 MS/s
- DACs: 14-bits 128 MS/s
- Ability to lock to external 5 or 10 MHz clock reference
- TCXO Frequency Reference (~2.5ppm)
- Flexible clocking from 10 MHz to 64 MHz
- FPGA code can be changed with Xilinx® ISE® WebPACK? tools

33.2.3

- (EOL ? this product is no longer available for sale through Ettus Research)
- 50 MHz of RF bandwidth with 8 bit samples
- 25 MHz of RF bandwidth with 16 bit samples
- Gigabit Ethernet connectivity
- MIMO capable - requires two or more USRP2 devices as motherboard has one daughterboard slot (1 RX + 1 TX connectors)
- Onboard FPGA processing
- FPGA: Xilinx Spartan XC3S2000
- ADCs: 14-bits 100 MS/s
- DACs: 16-bits 400 MS/s
- Ability to lock to external 5 or 10 MHz clock reference

33.2.4

- 50 MHz of RF bandwidth with 8 bit samples
- 25 MHz of RF bandwidth with 16 bit samples
- Gigabit Ethernet connectivity
- MIMO capable - requires two or more USRP N200 devices as motherboard has one daughterboard slot (1 RX + 1 TX connectors)
- Onboard FPGA processing
- FPGA: Xilinx Spartan XC3SD1800A
- ADCs: 14-bits 100 MS/s
- DACs: 16-bits 400 MS/s
- Ability to lock to external 5 or 10 MHz clock reference
- TCXO Frequency Reference (~2.5ppm)
- Optional internal GPS locked reference oscillator
- FPGA code can be changed with Xilinx® ISE® WebPACK? tools

33.2.5

- 50 MHz of RF bandwidth with 8 bit samples
- 25 MHz of RF bandwidth with 16 bit samples
- Gigabit Ethernet connectivity
- MIMO capable - requires two or more USRP N210 devices as motherboard has one daughterboard slot (1 RX + 1 TX connectors)
- Onboard FPGA processing
- FPGA: Xilinx Spartan XC3SD3400A
- ADCs: 14-bits 100 MS/s
- DACs: 16-bits 400 MS/s

- Ability to lock to external 5 or 10 MHz clock reference
- TCXO Frequency Reference (~2.5ppm)
- Optional internal GPS locked reference oscillator
- FPGA code can only be changed with the paid version of the Xilinx® ISE® Design Suite tools

33.2.6

- Designed for embedded applications (runs a full distribution of Linux)
- 720 MHz OMAP3 (ARM Cortex A8 processor & TI C64x+ DSP)
- 512MB RAM
- 4GB microSD Card
- 100 Mbit Ethernet connectivity
- Motherboard has one RTX daughterboard slot (1 RX + 1 TX connectors)
- Onboard FPGA processing
- FPGA: Xilinx Spartan XC3SD1800A
- ADCs: 12-bits 64 MS/s
- DACs: 14-bits 128 MS/s
- TCXO Frequency Reference (~2.5ppm)
- Flexible clocking from 10 MHz to 64 MHz

33.2.7

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- ADCs: 12-bits 64 MS/s
- DACs: 14-bits 128 MS/s
- TCXO Frequency Reference (~2.5ppm)
- Flexible clocking from 10 MHz to 64 MHz

33.3

33.4

The GPSDO kit is compatible with a specific set of USRP models and revisions. Compatibility is determined by hardware characteristics, and therefore incompatible models cannot be upgraded to be made compatible. Before purchasing a GPSDO kit please verify whether it will be compatible with the USRP device you intend to use with it. The compatible models and revisions are:

33.4.1

- USRP N200 Rev 2.0
- USRP N200 Rev 3.0
- USRP N200 Rev 4.0

- USRP N210 Rev 2.0
- USRP N210 Rev 3.0
- USRP N210 Rev 4.0

33.4.2

- USRP E100 Rev 4.0
- USRP E110 Rev 4.0

Please note the USRP hardware revision is on the label on the back of the unit.

The GPSDO kit is not compatible with the USRP1, USRP2, USRP B100 and any revision of the USRP N200/210 and E100/110 series not listed above.

33.5

The available resources on the FPGA will vary depending on the code written for it. Based on the 27 March 2012 FPGA code build, the following resources are available:

33.5.1

- General Logic
- Memory: 3% free
- DSP Resources: The FPGA does not have DSP resources

33.5.2

- General Logic:
    - Flip Flops: 41% free
    - LUTs: 9% free
- Memory: 52% free
- DSP Resources: 64% free

33.5.3

- General Logic:
    - Flip Flops: 59% free
    - LUTs: 37% free
- Memory: 68% free

- DSP Resources: 76% free

33.5.4

- General Logic:
  - Flip Flops: 55% free
  - LUTs: 39% free
- Memory: 25% free
- DSP Resources: 67% free

33.5.5

- General Logic:
  - Flip Flops: 69% free
  - LUTs: 78% free
- Memory: 50% free
- DSP Resources: 78% free

33.5.6

- General Logic:
  - Flip Flops: 29% free
  - LUTs: 6% free
- Memory: 10% free
- DSP Resources: 13% free

33.6

The default username and password for the USRP E100 and USRP E110 of the Embedded Series is:

- Username: root
- Password: usrpe

33.7

All new hardware designed or updated after the release of the UHD (USRP Hardware Driver) will only be supported by UHD.

Currently the following daughterboards require the UHD driver:

- TVRX2, Dual 50-860 MHz receiver
- DBSRX2, 800-2400 MHz receiver
- SBX, 400 MHz to 4.4 GHz Transceiver

33.8

All daughterboards are compatible with all USRP models except for the first 500 USRP1 software defined radios manufactured in 2005. At that time all daughterboards had an onboard local oscillator so the USRP1 did not provide a clock signal required by most of the current daughterboards. The only daughterboards currently compatible with the first 500 USRP1 are the BasicRX, BasicTX, LFRX and LFTX as they do not require a clock signal.

To identify if you have one of the first 500 USRP1 devices, please refer to the serial number as it will be between 1 and 500.

Although unsupported, a workaround exists and can be accessed on the following page: USRP Serial Below 500 on GNU Radio

33.9

Yes, we have antennas for nearly every daughterboard which we sell. Please see the ordering page for pictures and specifications.

33.10

The UHD (USRP Hardware Driver) supports all Ettus Research hardware on the following operating systems:

- Linux (2.6 kernel, any distribution)
- Mac OSX (PPC and Intel)
- Windows 7/Vista/XP/2000
- NetBSD and FreeBSD

Primary development is done on Linux.

33.11

Yes. Schematics for select USRP devices and daughterboards are available. You can find them here:

http://files.ettus.com/schematics

33.12

The USRP hardware is sold as test equipment. If you choose to use your USRP hardware and daughterboards to transmit using an antenna, it is your responsibility to make sure you are in compliance with all laws for the country, frequency and power levels in which the device is used. Additionally, some countries regulate reception in certain frequency bands. Again, it is the responsibility of the user to maintain compliance with all local laws and regulations.

33.13

The most direct and easy way to create a complete radio system is to use one of our complete RF frontend daughterboards including the TVRX2, DBSRX2, WBX, SBX, RFX-series and XCVR2450.

However, you can use the BasicRX and BasicTX with your own external RF hardware. For reception, a gain and filtering must be added in the front of the BasicRX daughterboard. This can be done pretty easily with Mini-Circuits® parts, or the 10.7 MHz IF output of common scanners and receivers. The BasicRX board handles signals up to around 300MHz directly. For higher frequencies downconverting is needed.

33.14

Yes, the BasicTX will put out about 1mW up to about 50 MHz. A simple connectorized amplifier (Mini-Circuits®, for example) will achieve a greater range. You may also want to add some filtering.

33.15

All current USRP software defined radios require 6V at 3A. The USRP power supply shipped with all USRP software defined radios has the following specifications:

- Input: 90-264 Vac at 50 to 60Hz
- Output: 6Vdc at 3A
- Interchangeable input plugs provided: NA, EU, UK, AU
- Safety Approvals: UL/cUL, GS, CE, FCC, RCM
- EMC/EMI: FCC class B, CE, VCCI class II

The DC plug is a 2.1mm center conductor, 9.5mm barrel, 5.5mm outer diameter standard plug.

The USRP power supplies accept 90-264Vac at 50 or 60Hz, and come with interchangeable plugs that allow use in most parts of the world.

33.16

Not all SD Cards are compatible with the USRP2; therefore we recommend using the Kingston 2GB SD cards with part number KGS SD2GB as we have found they work reliably. For our customers' convenience, we still stock replacement SD cards available for $10. Please contact sales@ettus.com if you require a replacement SD card.

Add this please

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Legacy Product E100/E110

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