Digilent Part Number: 6002-410-021

B200/B210/B200mini/B205mini

From Ettus Knowledge Base

Contents

Digilent Part Number: 6002-410-021

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Device Overview

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.

Key Features

B200

- 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

B210

- 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

B200mini

- 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

B200mini-i

- 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

B205mini-i
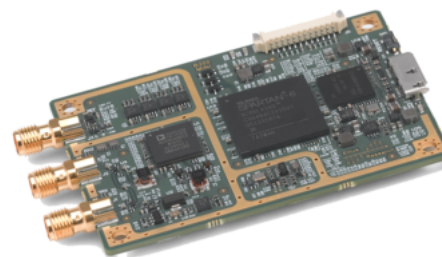
Digilent Part Number: 6002-410-021

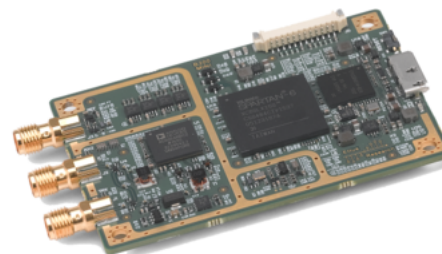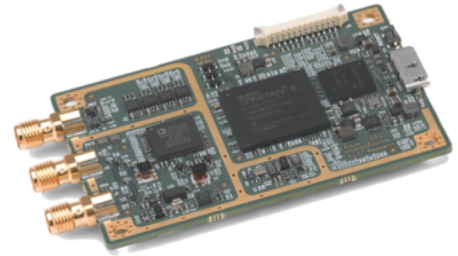- Industrial-grade Xilinx Spartan-6 XC6SLX150 FPGA
- Analog Devices AD9364 RFIC direct-conversion transceiver
- Frequency range: 70 MHz – 6 GHz
- Up to 56 MHz of instantaneous bandwidth
- Full duplex, SISO (1 Tx & 1 Rx)
- Fast and convenient bus-powered USB 3.0 connectivity

Frontend Specifications

Tuning

The RF frontend has individually tunable receive and transmit chains. On the B200 and B200 mini, there is one transmit and one receive RF frontend. On the B210, both transmit and receive can be used in a MIMO configuration. For the MIMO case, both receive frontends share the RX LO, and both transmit frontends share the TX LO. Each LO is tunable between 50 MHz and 6 GHz.

Gains

All frontends have individual analog gain controls. The receive frontends have 76 dB of available gain; and the transmit frontends have 89.8 dB of available gain. Gain settings are application specific, but it is recommended that users consider using at least half of the available gain to get reasonable dynamic range.

Bandwidths

The analog frontend has a seamlessly adjustable bandwidth of 200 kHz to 56 MHz.

Generally, when requesting any possible master clock rate, UHD will automatically configure the analog filters to avoid any aliasing (RX) or out-of-band emissions whilst letting through the cleanest possible signal.

If you, however, happen to have a very strong interferer within half the master clock rate of your RX LO frequency, you might want to reduce this analog bandwidth. You can do so by calling uhd::usrp::multi_usrp::set_rx_bandwidth(bw).

The property to control the analog RX bandwidth is bandwidth/value.

UHD will not allow you to set bandwidths larger than your current master clock rate.

RF Specifications

Digilent Part Number: 6002-410-021

The USRP B200/B210/B200mini/B205mini are derived from the Analog devices AD936x integrated transceiver chip, the overall RF performance of the device is largely governed by the transceiver chip itself.

RF Performance

- 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
- Maximum Input Power: 0 dBm

Input/Output Impedance

All RF Ports are matched to 50 Ohm with −10dB or better return loss generally. Detailed test is pending.

Input Power Levels

- The maximum input power for the B200/B210/B200mini/B205mini is 0 dBm.

RF Performance Data

B200mini / B205mini

- Media:B200mini B205 RF Performance Data 20160119.pdf

B200 / B210

- Media:B200 RF Performance.pdf

Hardware Specifications

- Ettus Research recommends to always use the latest stable version of UHD

B200

- Current Hardware Revision: 6
- Minimum version of UHD required: 3.8.4
- B200 Rev 5 (AD9364−based board) requires minimum UHD 3.8.4

B210

- Current Hardware Revision: 5
- Minimum version of UHD required: 3.6.0

B200mini

- Current Hardware Revision: 2
- Minimum version of UHD required: 3.9.0

B200mini-i

- Current Hardware Revision: 2
- Minimum version of UHD required: 3.9.0

B205mini-i

- Current Hardware Revision: 1
- Minimum version of UHD required: 3.9.2

Physical Specifications

Dimensions

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

Weight

- B200mini 24.0 g
- B200/B210 350 g

Drawings

B200mini

- Board only
- B20xmini Enclosure

B200

Digilent Part Number: 6002-410-021

- Board only

B210

- Board only

B200/B210 Enclosure

- Enclosure

CAD/STP Models

B200mini

- B200mini with Enclosure
- Enclosure only
- Board only

B20xmini-i

- B20xmini-i Thermal Insert

B200

- Board only

B210

- Board only

B200/B210 Enclosure

- Enclosure

Environmental Specifications

Operating Temperature Range

- B200 / B210: 25 ℃
- B200mini - Board Only: 0 - 40 ℃
- B200mini - With Enclosure: -20 - 60℃

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- B200mini-i / B205mini-i – Board Only: 0 – 45 °C
- B200mini-i / B205mini-i – With I-Grade Enclosure: –40 – 75°C

Operating Humidity Range

- 10% to 90% non-condensing

Schematics

B200mini/B200mini-i/B205mini-i

B200mini/B200mini-i/B205mini-i Schematics

B200/B210

B200/B210 Schematics

Key Component Datasheets

Digilent Part Number: 6002-410-021

Part Number	Description	Schematic ID (Page)
Mini-Circuits TCM1-63AX+	Transformer	T1 (1,3); T2 (1,3)
Analog Devices AD9364	RF Transceiver	U1 (2)
Analog Devices AD9361	RF Transceiver	U2 (2,8)
AD9361/AD9364 Product Page	RF Transceiver	–
Xilinx Spartan-6 Product Page	FPGA	U1 (2,3,4,6); PG1 (6); U18B, U18C (7); U18D (8); U18E, U18F (9); U18G, U18H (10)
XC6SLX75 / XC6SLX150	FPGA	
ADF4001	Frequency Synthesizer	U101 (1)
CYUSB3014	FX3: SuperSpeed USB Controller	U3 (5,6); U13 (5)
EZ-USB FX3™ Product Page		
SKY13317	Antenna Switch	U801, U810 (8)
BD3150L50100A00	Balun	U802, U808, U809, U815 (8)
PGA-102+	Amplifier	U804, U817 (8)
VCTCXO	VCTCXO (B200mini only)	–
525L20DA40M0000	VCTCXO (B200/B210 only)	X100 (1)
Jackson Labs LC_XO Spec Sheet Manual	Optional GPSDO (B200/B210 only)	U100 (1)

Enclosures

Digilent Part Number: 6002-410-021

Digilent Part Number: 6002-410-021

- SMA connectors should be torqued to 4 inch-pounds

B200mini

- B200mini C-Grade Enclosure
- B200mini I-Grade Enclosure

B205mini

- B205mini I-Grade Enclosure

B200/B210

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

FPGA

- Utilization statistics are subject to change between UHD releases. This information is current as of UHD 3.9.4.

B200

```
Device utilization summary:
---------------------------

Selected Device : 6slx75fgg484-3


Slice Logic Utilization:
 Number of Slice Registers:          15781  out of  93296    16%
 Number of Slice LUTs:               19987  out of  46648    42%
    Number used as Logic:            15983  out of  46648    34%
    Number used as Memory:            4004  out of  11072    36%
       Number used as RAM:             972
       Number used as SRL:            3032

Slice Logic Distribution:
 Number of LUT Flip Flop pairs used:  24062
    Number with an unused Flip Flop:   8281  out of  24062    34%
    Number with an unused LUT:         4075  out of  24062    16%
    Number of fully used LUT-FF pairs: 11706  out of  24062    48%
    Number of unique control sets:      434

IO Utilization:
 Number of IOs:                        172
 Number of bonded IOBs:                155  out of    280    55%
    IOB Flip Flops/Latches:            124

Specific Feature Utilization:
 Number of Block RAM/FIFO:             144  out of    172    83%
```

Digilent Part Number: 6002-410-021

```
   Number using Block RAM only:       144 Digilent Part Number: 6002-410-021
 Number of BUFG/BUFGCTRLs:              4  out of     16     25%
 Number of DSP48A1s:                   76  out of    132     57%
```

B210

```
 Device utilization summary:
 ---------------------------

 Selected Device : 6slx150fgg484-3


 Slice Logic Utilization:
  Number of Slice Registers:          29310  out of  184304   15%
  Number of Slice LUTs:               36486  out of   92152   39%
     Number used as Logic:            29279  out of   92152   31%
     Number used as Memory:            7207  out of   21680   33%
        Number used as RAM:            1752
        Number used as SRL:            5455

 Slice Logic Distribution:
  Number of LUT Flip Flop pairs used:  43635
     Number with an unused Flip Flop:  14325  out of   43635   32%
     Number with an unused LUT:         7149  out of   43635   16%
     Number of fully used LUT-FF pairs: 22161  out of   43635   50%
     Number of unique control sets:      723

 IO Utilization:
  Number of IOs:                        180
  Number of bonded IOBs:                163  out of     338   48%
     IOB Flip Flops/Latches:            148

 Specific Feature Utilization:
  Number of Block RAM/FIFO:             186  out of     268   69%
     Number using Block RAM only:       186
  Number of BUFG/BUFGCTRLs:               4  out of      16   25%
  Number of DSP48A1s:                   152  out of     180   84%
```

B200mini

```
 Device utilization summary:
 ---------------------------

 Selected Device : 6slx75csg484-3


 Slice Logic Utilization:
  Number of Slice Registers:          15949  out of   93296   17%
  Number of Slice LUTs:               19963  out of   46648   42%
     Number used as Logic:            16140  out of   46648   34%
     Number used as Memory:            3823  out of   11072   34%
        Number used as RAM:             972
        Number used as SRL:            2851

 Slice Logic Distribution:
  Number of LUT Flip Flop pairs used:  23859
     Number with an unused Flip Flop:   7910  out of   23859   33%
     Number with an unused LUT:         3896  out of   23859   16%
     Number of fully used LUT-FF pairs: 12053  out of   23859   50%
     Number of unique control sets:      429

 IO Utilization:
  Number of IOs:                        123
  Number of bonded IOBs:                114  out of     328   34%
     IOB Flip Flops/Latches:            147

 Specific Feature Utilization:
```
                                  Digilent Part Number: 6002-410-021

```
   Number of Block RAM/FIFO:         110  Digilent Part Number: 6002-410-021
      Number using Block RAM only:   110
   Number of BUFG/BUFGCTRLs:           6  out of     16    37%
   Number of DSP48A1s:                76  out of    132    57%
   Number of PLL_ADVs:                 1  out of      6    16%
```

B205mini

```
Device utilization summary:
---------------------------

Selected Device : 6slx150csg484-3


Slice Logic Utilization:
 Number of Slice Registers:          15949  out of  184304     8%
 Number of Slice LUTs:               19963  out of   92152    21%
    Number used as Logic:            16140  out of   92152    17%
    Number used as Memory:            3823  out of   21680    17%
       Number used as RAM:             972
       Number used as SRL:            2851

Slice Logic Distribution:
 Number of LUT Flip Flop pairs used: 23859
    Number with an unused Flip Flop:  7910  out of   23859    33%
    Number with an unused LUT:        3896  out of   23859    16%
    Number of fully used LUT-FF pairs: 12053  out of 23859    50%
    Number of unique control sets:     429

IO Utilization:
 Number of IOs:                        123
 Number of bonded IOBs:                114  out of     338    33%
    IOB Flip Flops/Latches:           147

Specific Feature Utilization:
 Number of Block RAM/FIFO:            110  out of     268    41%
    Number using Block RAM only:      110
 Number of BUFG/BUFGCTRLs:              6  out of      16    37%
 Number of DSP48A1s:                   76  out of     180    42%
 Number of PLL_ADVs:                    1  out of       6    16%
```

Interfaces and Connectivity

B200/B210/B200mini – USB 3.0

GPIO

Power on state

The hardware power on state and UHD initial state for the front-panel GPIOs is high-Z. For the B2xx, B2xxmini there are no external pull-ups/pull-downs for the GPIO pins, but the FPGAs do have them and they are configured as follows: B2xx: pull-up, B2xxmini: pull-up.

Output Current

The GPIOs are configured as LVCMOS33 outputs with pull-ups on the B2xx. The strength for LVCMOS and LVTTL on Spartan 6 is 12 mA if not otherwise specified.

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Timing Reference Input

B200mini/B200mini-i/B205mini-i

- 1-PPS or 10 MHz input

1-PPS

- Maximum: -5V / +5V
- Minimum: 0V / +2.5V

10 MHz

- Maximum: 0V / +5V
- Minimum: 0V / +1.8V

OR

- +10dBm ~ +27dBm

B200/B210

1-PPS

- Maximum: 5V

10 MHz

- Maximum: 15dBm (3.5Vpp into 50 ohms)

Certifications

RoHS

As of December 1st, 2010 all Ettus Research products are RoHS compliant unless otherwise noted. More information can be found at http://ettus.com/legal/rohs-information

China RoHS

Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation

Chinese Customers

National Instruments is in compliance with the Chinese policy on the Restriction of Hazardous Substances (RoHS) used in Electronic Information Products. For more information about the National Instruments China RoHS compliance, visit ni.com/environment/rohs_china.

Certifications for European Union

In order to ensure compliance with EU certifications for radio equipment, a ferrite bead (included in kits with NI part number 785825-01 and 785826-01) should be affixed onto the GPIO cable, if in use. This is achieved by opening the snap-on ferrite bead and enclosing it around the GPIO cable(s).

In addition to the part numbers listed above, these ferrite beads can be sourced through Fair-Rite using part number 0443164251.

Certificate of Volatility

B200/B210

- Media:volatility USRP B200 B210 r1.pdf

Downloads

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

FAQ

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?

The performance and throughput of USB 3.0 can vary between host controllers. Ettus Research recommends using the Intel Series 7, 8, and 9 USB controllers. In Linux, the command `lspci` will show the USB controller on the system.

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, OSX (MacOSX / macOS) 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.

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title=B200/B210/B200mini/B205mini&oldid=4907"

Category: Hardware Resources

- This page was last modified on 13 April 2020, at 15:17.

B200/B210/B200mini/B205mini Getting Started Guides

From Ettus Knowledge Base

Contents

Kit Contents

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

Verify the Contents of Your Kit

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.

You Will Need

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

Proper Care and Handling

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 50Ω 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.

⚠️   Never apply more than 0 dBm of power into any RF input.

⚠️   Always use at least 30dB attenuation if operating in loopback configuration

Install and Setup the Software Tools on Your Host Computer

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 Building and Installing the USRP Open-Source Toolchain (UHD and GNU

Radio) on Linux, OS X and Windows Application Notes. 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 Live 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 Live SDR Environment is available at the Live SDR Environment Getting Started Guides page.

Connect the USRP to the Host Computer

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).

Test and Verify the Operation of the USRP

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

Technical Support and Community Knowledge Base

Technical support for USRP hardware is available through email only. If the product arrived in a nonfunctional state or you require technical assistance, please contact support@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.

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.

Discussions involving the use of GNU Radio with USRP hardware and UHD software are best addressed through the discuss-gnuradio mailing list at https://lists.gnu.org/mailman/listinfo/discussgnuradio.

Discussions involving the use of OpenBTS® with USRP hardware and UHD software are best addressed through the openbts-discuss mailing list at https://lists.sourceforge.net/lists/listinfo/openbtsdiscuss.

The support page on our website is located at https://www.ettus.com/support. The Knowledge Base is located at https://kb.ettus.com.

Legal Considerations

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.

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

Sales and Ordering Support

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 +14086106399 (Monday-Friday, 8 AM – 5 PM, Pacific Time). Please be sure to include your order number and the serial number of your USRP.

Terms and Conditions of Sale

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

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