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Getting Started with the Ettus Research™ USRP™ E312 SDR



Kit Contents:

- USRP E312 Series Module
- Two SMB-to-SMA Adapters
- USB 2.0 Type A to Micro-B Cable
- Getting Started Guide (this document)
- USRP Power Supply
- Ethernet Cable
- Imaged Micro-SD Card

Basic Hardware Setup

In many configurations of the USRP E312 series devices, the micro-SD card will be provided already installed in the unit.

If the micro-SD card is not already installed, you need to insert the card into the micro-SD card slot on the front of the USRP E312 series device. The micro-SD card contains the file system that the processor requires to boot.

Powering On the Hardware

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, Ethernet network, or USB interface).

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Page 1 of 8



Turning the Device Off/On

You can also power the device on and off by pressing the power button. To power the device off, hold the power button down until the button's LED turns off (this will take a couple of seconds). To turn the device on, hold down the power button until the LED turns on.



To avoid damaging the file system and causing any corruption, do **not** turn the device off with the power button without first shutting down the system. Use this command to cleanly and properly shut the system down:

```
shutdown -h 0
```

Serial Console Connectivity

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: **Baud Rate:** 115200, **Data:** 8-bit, **Parity:** None, **Stop:** 1-bit, **Flow 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/>

Network Connectivity

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 `ettus-e3xx-sg1` or `ettus-e3xx-sg3`. 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).



Logging In

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

Battery

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 will 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, and then plug in the USRP E312 into an 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

Calibration Procedure:

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.

Battery Safety Information



To ensure proper use of the battery, please read 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.



Handling:

- 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.

Charge and Discharge:

- 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.

Storage:

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

Disposal:

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

Proper Care and Handling

All Ettus Research products are individually tested before shipment. The USRP E312 is guaranteed to be functional at the time it is received by the customer. Improper use or handling of the USRP E312 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.



Use extreme caution when connecting the transmit port to the receive port in a loop-back configuration. The transmitter is capable of output powers that can damage the receiver unless necessary precautions are taken. The use of a 30dB attenuator is strongly recommended when using in a loop-back configuration.



The USRP E312 is a piece of test equipment that can transmit and receive on many frequencies. Each country has important legal implications to consider concerning radiated RF energy. See “Legal Considerations” in this document before using this device.

Example Programs

The UHD driver includes several example programs, which may serve as test programs or the basis for your application program. These example programs are already installed on the E312 device, and the source code can be obtained from the UHD repository on GitHub at:

<https://github.com/EttusResearch/uhd/tree/master/host/examples>

Verifying the Operation of the Device

You can quickly verify the operation of your USRP E312 by running the rx_ascii_art_dft UHD example program.

The rx_ascii_art_dft utility is a simple console-based, real-time FFT display tool. It is not graphical in nature, so it can be easily run over an SSH connection within a terminal window, and does not need any graphical capability, such as X Windows, to be installed. It can also be run over a serial console connection, although this is not recommended, as the formatting may not render correctly.

You can run a simple test of the E312 device by connecting an antenna and observing the spectrum of a commercial FM radio station in real-time. Please follow the steps listed below.

1. Attach an antenna to the RX2-A antenna port of the E312.



2. Log into the E312 from an external host computer over Ethernet using an SSH client.
3. At a terminal prompt running on the E312, run:

```
/usr/lib/uhd/examples/rx_ascii_art_dft --freq 88.1e6 --rate 400e3  
--gain 30 --ref-lvl -60
```
4. Modify the command-line argument "--freq" above to specify a tuning frequency for a strong local FM radio station.
5. You should see a real-time FFT display of 400 KHz of spectrum, centered at the specified tuning frequency.
6. Type "Q" or Ctrl-C to stop the program and to return to the Linux command line.
7. You can adjust the size of your terminal window and then re-run the command to enlarge or shrink the FFT display.
8. You can run with the "--help" option to see a description of all available command-line options.

Technical Support and Community Knowledge Base

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 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/discuss-gnuradio> .

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/openbts-discuss> .

The support page on our website is located at <http://www.ettus.com/support> .

The Knowledge Base is located at <http://www.ettus.com/kb> .

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.

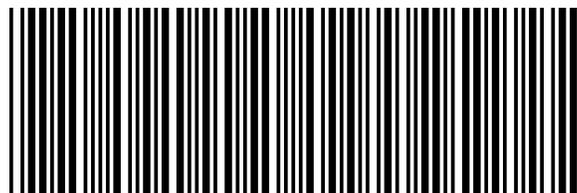
Sales and Ordering Support

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 +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.

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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