Ultra96-V2 Getting Started Guide

Version 1.1

Document Control

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Prior Version History

Version	Date	Comment
1.0	25 Jun 2019	Initial Ultra96-V2 Getting Started Guide (30 May 2019 image)
1.1	01 Oct 2019	Updated based on 17 Sep 2019 image

Contents

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1 Getting Started with Ultra96-V2

The Avnet Ultra96-V2 enables hardware and software developers to explore the capabilities of the Zynq® UltraScale+™ MPSoC. Designers can create or evaluate designs for both the Zynq Processor Subsystem (PS) and the Programmable Logic (PL) fabric.
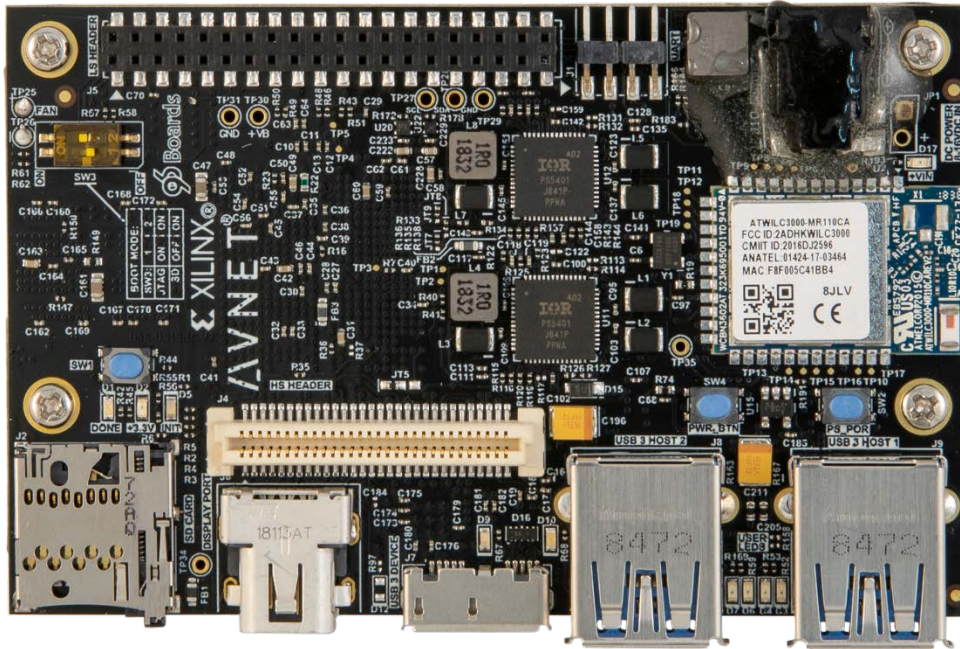

Figure 1 – Ultra96-V2

This Getting Started Guide will outline the steps to setup the Ultra96-V2 hardware. It documents the procedure to run a Linux design running on the Quad-core ARM Cortex-A53 MPCore Processing System (PS).

2 What's Inside the Box?
- Ultra96-V2 development board
- 16GB microSD card with SD adapter and jewel case
- Voucher for SDSoC license from Xilinx
- Quick Start Instruction card

2.1 Required add-on item:
- External 96Boards compliant power supply kit
  - Avnet recommended supply:
    - AES-ACC-U96-4APWR (12V, 4A, International plugs)
    - http://avnet.me/96boardpower4A

2.2 Optional add-on items:
- USB-to-JTAG/UART pod for Ultra96-V2
  - AES-ACC-U96-JTAG
  - http://avnet.me/Ultra96JTAG
- 96Boards Click Mezzanine for adding Click boards to the Ultra96-V2
  - Mezzanine only -- AES-ACC-U96-ME-MEZ
  - Starter kit including 3 Click boards -- AES-ACC-U96-ME-SK
  - http://avnet.me/ClickMezzanine
- miniDP-to-HDMI adapter or cable
  - Must be an <u>Active</u> adapter or cable
- Wireless keyboard/mouse
- USB-to-Ethernet Adapter

See the **<u>Ultra96-V2 Compatible Accessories</u>** document and http://avnet.me/Ultra96_Accessories for other suggestions.

3 What's on the Web?

Ultra96-V2 is a community-oriented kit, with all materials being made available through the http://avnet.me/ultra96-v2 community website.

3.1 Official Documentation:
- Getting started guide
- Hardware user guide
- Schematics
- Bill of materials
- Mechanical drawing
- 3D Model
- Board definition files for Vivado integration available at https://github.com/Avnet/bdf.
- Programmable logic (PL) master user constraints

3.2 Tutorials and Reference Designs:
- TBD

3.3 Trainings and Videos:
- Live and On-Demand Technical Training Courses at http://avnet.me/TTC

4 Ultra96-V2 Key Features

- Zynq UltraScale+ MPSoC ZU3EG SBVA484

- Memory
    - Micron 2 GB (512M x32) LPDDR4 Memory
    - microSD Socket
        - Ships with Delkin Utility MLC 16GB card

- Wi-Fi / Bluetooth

- DisplayPort

- 1x USB 3.0 Type Micro-B upstream port

- 2x USB 3.0 Type A downstream ports

- 40-pin Low-speed expansion header

- 60-pin High speed expansion header

- Mounted on thermal bracket with fan (Oct. 2019 and earlier) or heatsink (after Oct 2019)

Note that there is no on-board, wired Ethernet interface. All communications must be done via USB, Wi-Fi, JTAG, or expansion interface.
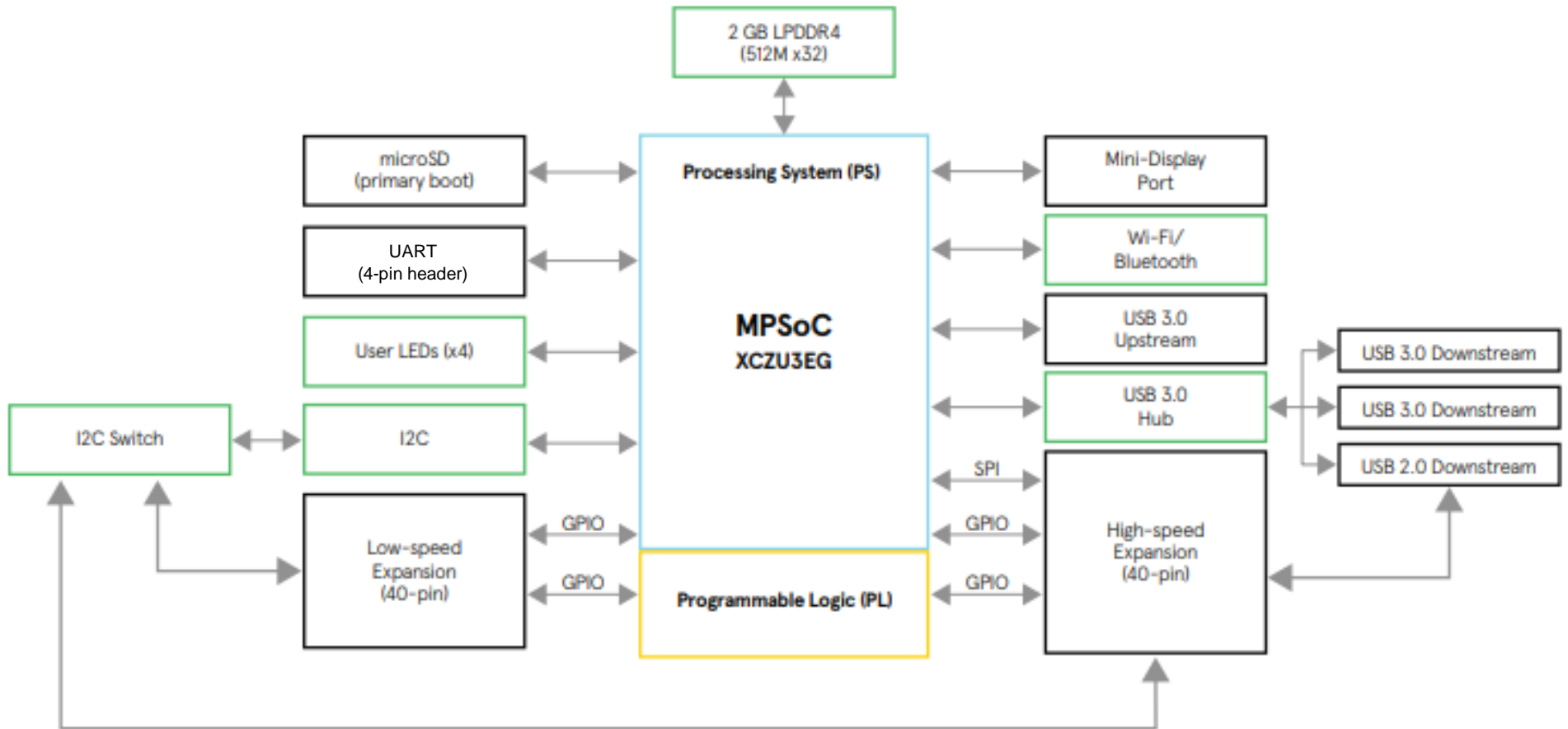
Figure 2 – Ultra96-V2 Block Diagram

5   Ultra96-V2 Basic Setup and Operation

The functionality of the Ultra96-V2 is determined by the application booted from the non-volatile memory – by default that is the microSD Card. This *Getting Started Guide* allows system developers to exercise and demonstrate multiple circuits through PetaLinux, including:

- SSH Terminal Access
- GPIO LEDs
- Wi-Fi

In addition to the items included in the kit, you will also need the following to complete the exercises in this tutorial.

- Ultra96 USB-to-JTAG/UART Pod (required for terminal access)
  - or
- Monitor (requires connection to miniDP port), keyboard, mouse

An Ultra96-V2 image in its expected out-of-box configuration is shown below along with various topology components highlighted.
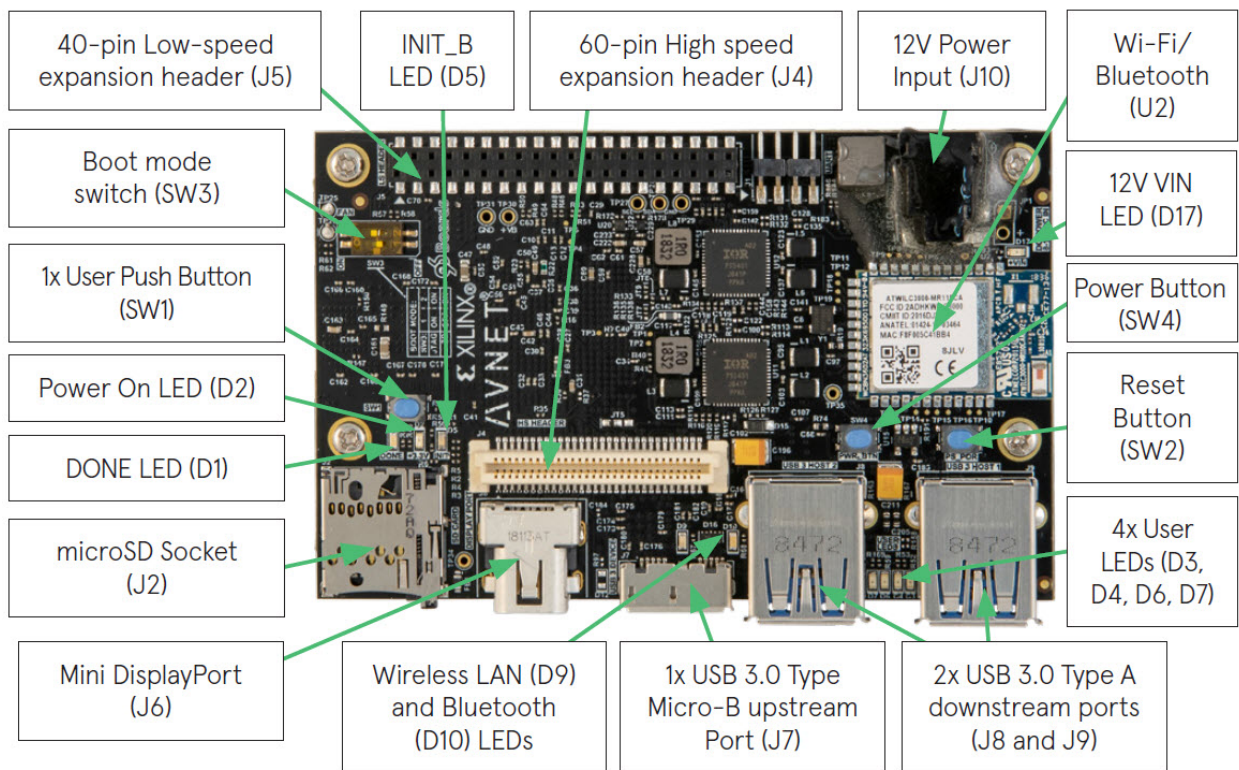

Figure 3 – Ultra96-V2 Topology

6 Example Design

The Ultra96-V2 example design must first be written to the 16GB microSD Card, which ships blank.

1. Please download the image and instructions at http://avnet.me/ultra96-v2-oob
2. Complete the process to write the image to your 16GB card.
3. Insert the microSD card into the Ultra96-V2 card cage J2.

7 Hardware Setup

1. A terminal program is required. TeraTerm was used in this example which can be downloaded from the TeraTerm project on the SourceForge Japan page: ttssh2.sourceforge.jp Install TeraTerm or another terminal program of your choice.

2. Set the Ultra96-V2 boot mode switch SW3 to SD Card boot mode as shown below with Switch 1 in the OFF position and Switch 2 in the ON position.
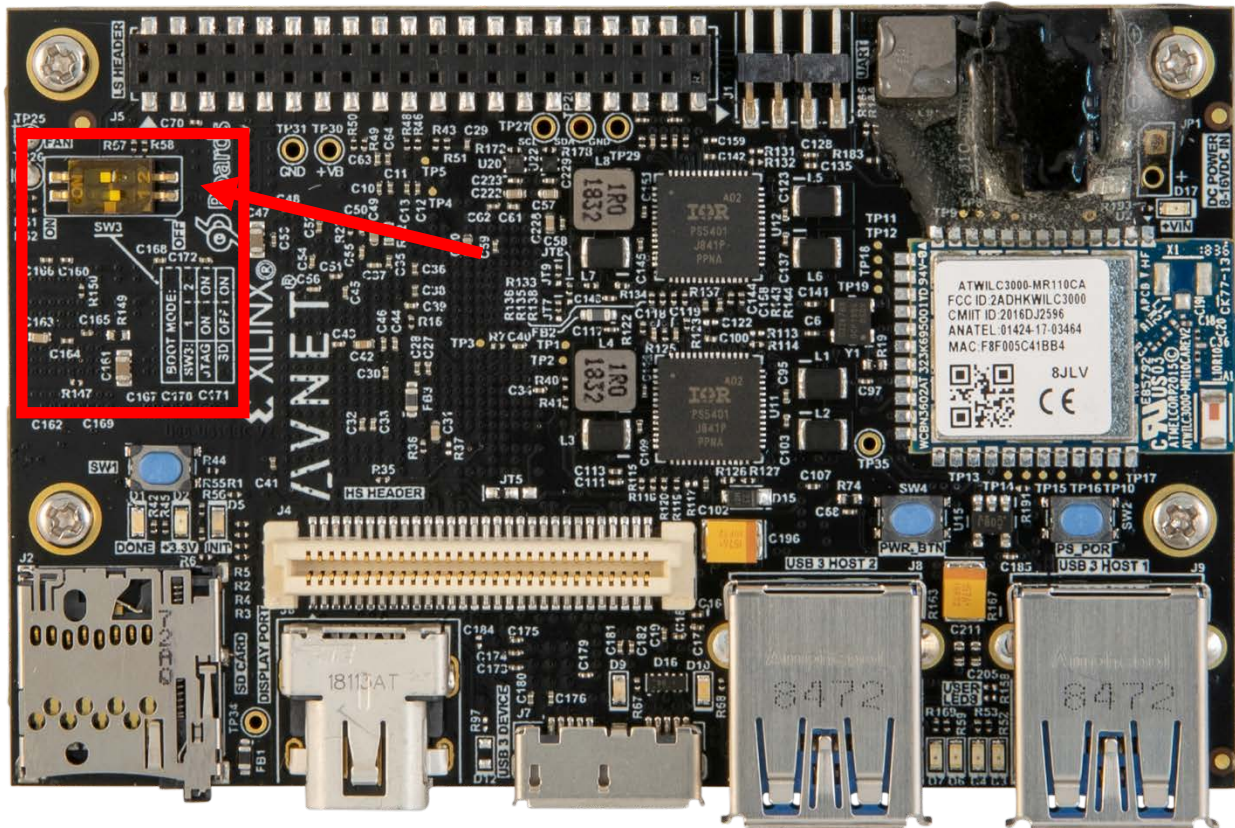

Figure 4 – Ultra96-V2 SW3 Boot Mode Switch Location

3. If you will be using a USB-to-JTAG/UART Pod, plug that into J1 and J3 before plugging in 12V power. Note that some Pods only have 3-pin and 7-pin receptacles, which is compatible with the 4-pin and 8-pin headers on Ultra96-V2 (align as seen in Figure 6 below).
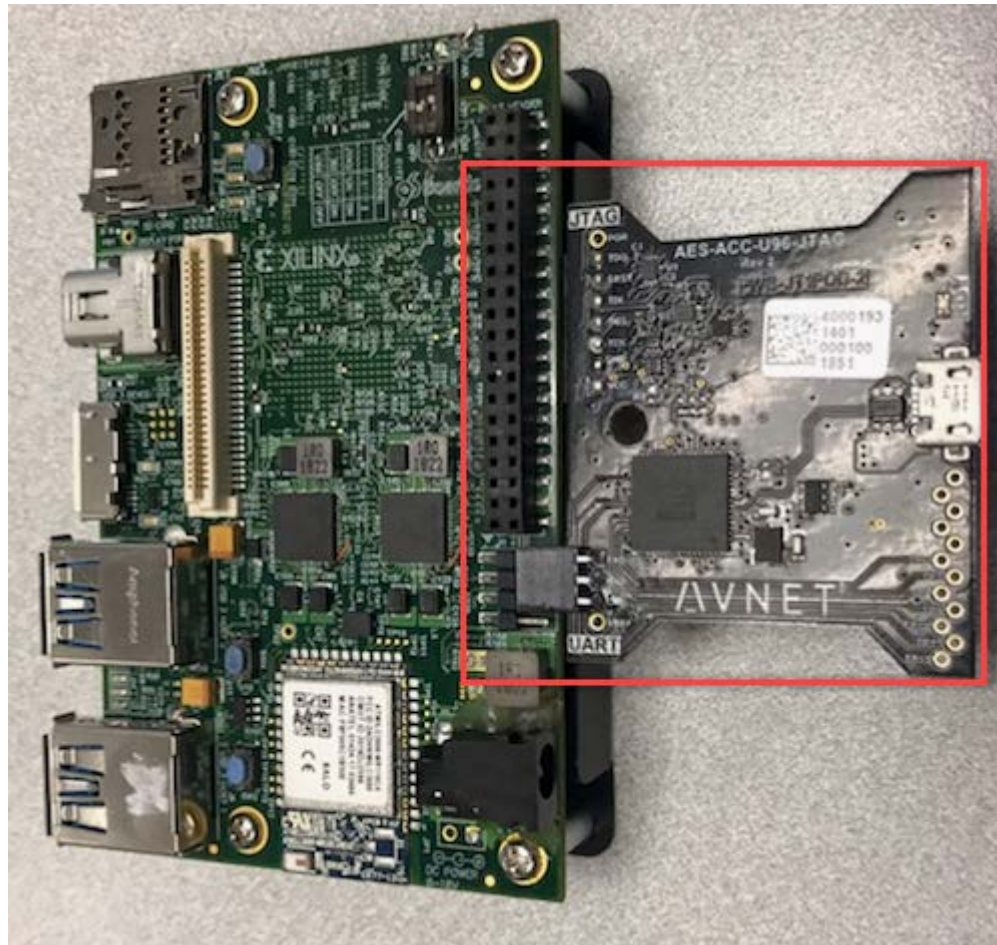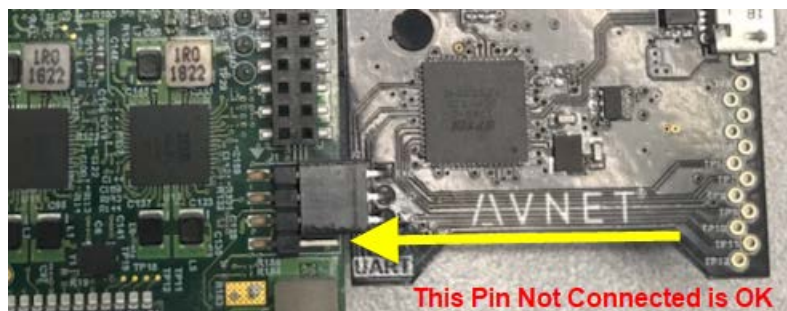

Figure 5 – Ultra96-V2 with JTAG/UART Pod

Figure 6 – JTAG/UART Pod Alignment

4. Plug in your 12V Barrel Jack power supply into a wall outlet and then connect the barrel jack to J10 on your Ultra96-V2. Green Vin status LED D17 will light, but the board is not yet powered on.

   Note: DC power supply is not included in the Ultra96-V2 kit but can be purchased separately.

The Ultra96 USB-to-JTAG/UART Pod ships with pre-programmed firmware that allows the JTAG interface to be recognized by Xilinx Vivado software. Additionally, most host machines will also automatically install the driver for the Serial Terminal interface.

5. Plug a microUSB cable between the Pod's microUSB Port (J1) and a host computer.
6. If the serial terminal drivers do not automatically install, you can manually install the driver for the FT2232H device. Visit www.ftdichip.com/Drivers/VCP.htm then download and install the appropriate driver for your operating system.
7. Launch your Serial Terminal with settings of 115200-8-N-1.

8 Power Up and Connect to Wi-Fi

1. Press and release the power button (SW4). The Green Power On LED (D2), Red INIT_B LED (D5) and the Green User LEDs should illuminate. After a few seconds, INIT_B LED will turn off and the Blue DONE LED (D1) will illuminate. You will immediately see output to the terminal screen as Linux boots. At ~30 seconds, the Green User LED D7 will blink in a heartbeat fashion.

2. You can ignore the battery and gpu warnings as shown below. Hit the enter key to get to the prompt.

```
** (matchbox-panel:2394): WARNING **: Failed to load applet "battery" (/usr/lib/
matchbox-panel/libbattery.so: cannot open shared object file: No such file or di
rectory).
[2570:2570:0829/024623:ERROR:gl_factory.cc(48)] Requested GL implementation is n
ot available.
[2570:2570:0829/024623:ERROR:gpu_child_thread.cc(348)] Exiting GPU process due t
o errors during initialization
[2384:2499:0829/024626:ERROR:browser_gpu_channel_host_factory.cc(123)] Failed to
 launch GPU process.
[2384:2499:0829/024626:ERROR:browser_gpu_channel_host_factory.cc(123)] Failed to
 launch GPU process.
```

Figure 7 – Ultra96-V2 Boot Warnings

3. Login using username = "root" and password = "root"

4. You should already be in the home directory /home/root. If not, then enter the following command:

```
cd /home/root
```

5. Now list the contents of that directory.

```
ls
```

6. You should observe that there are 4 files present. These files are scripts to make manually connecting to Bluetooth and Wi-Fi easier. However, we will not use them.
    a) ble.sh
    b) bt.sh
    c) wifi.sh
    d) wpa_supplicant.conf

7. From your Wi-Fi capable host machine, show the available Wi-Fi networks. You should see an Open network called Ultra96-V2_<MAC_ADDRESS> as shown below. Note that the MAC Address shown will be different than the image below as it will match your specific board's MAC Address.

Figure 8 – Ultra96-V2 As An Available Network

8. Select the Ultra96-V2 Network and Connect.

8. Once connected, open a browser on the connected machine, and browse to the IP address of the board, which is http://192.168.2.1. The browser page will show like below.
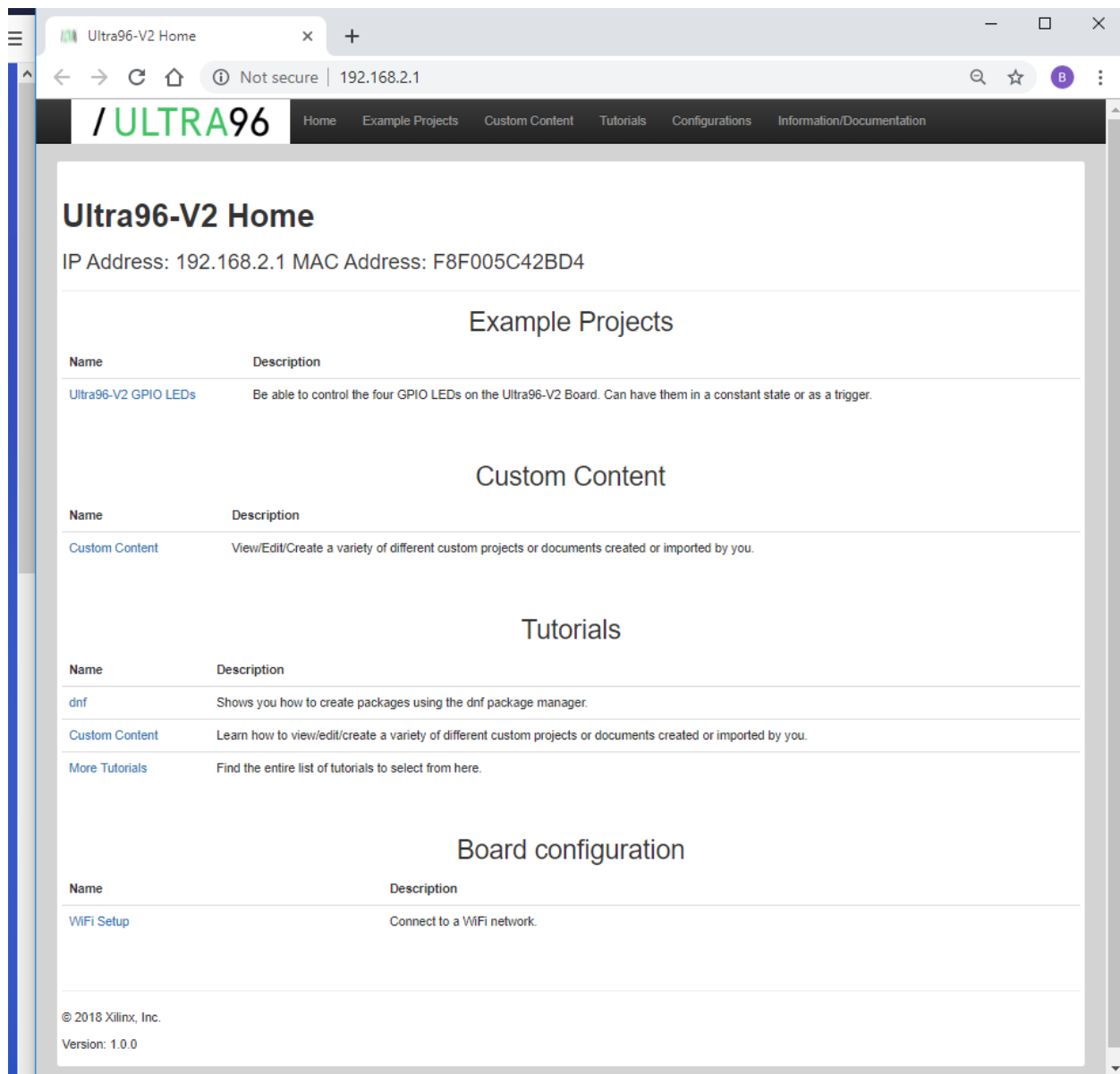
Figure 9 – Connected to Ultra96-V2 Webserver

9 Ultra96-V2 GPIO LEDs Example Project

1. Next we want to access the Ultra96-V2 GPIO LEDs example project. From the Ultra96-V2 home page select **Ultra96 GPIO LEDs** example project

Ultra96-V2 Home

IP Address: 192.168.2.1 MAC Address: F8F005C42BD4

Example Projects

Name	Description
Ultra96-V2 GPIO LEDs	Be able to control the four GPIO LEDs on the Ultra96-V2 Board. Can have them in a constant state or as a trigger.

Figure 10 – Ultra96-V2 GPIO LEDs

The User LEDs are between the two USB Type-A connectors. The photo is zoomed in to show the four LEDs, which, from right to left are: D3, D4, D6, and D7.
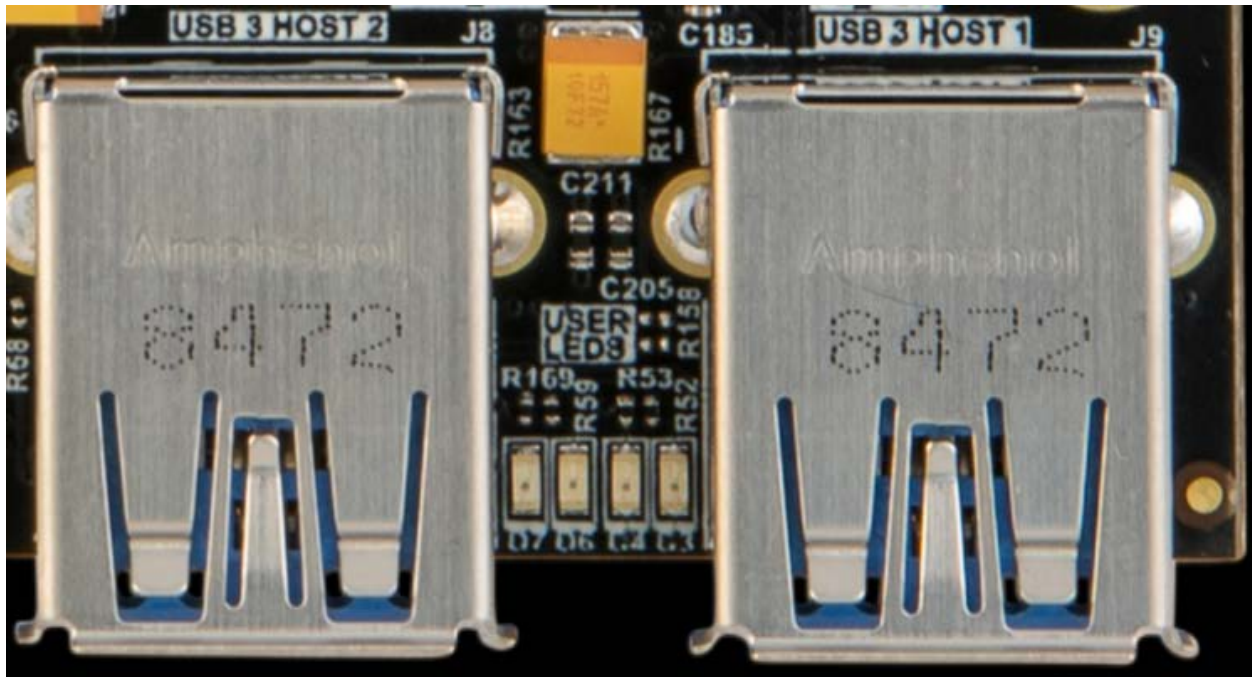
Figure 11 – Ultra96-V2 User LEDs

2. All LEDs will be at an unknown state to begin with. Select the drop down menus and begin changing the status of the GPIO LEDs. The LED blinking upon boot-up is D3, so consider changing that one first to "On."

Ultra96-V2 GPIO LEDs
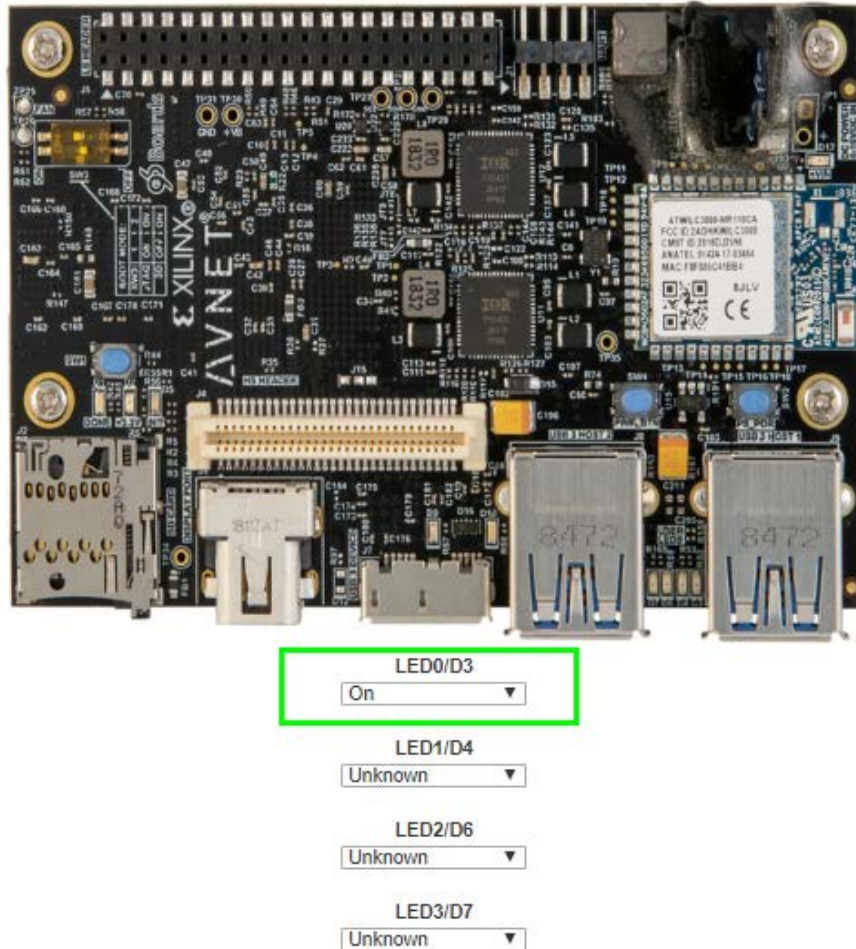
Figure 12 – LED0/D3 Changed to Steady-state ON

3. Scroll to the bottom of the webpage and you will see a definition table for various LED selection options.

10 Example Projects
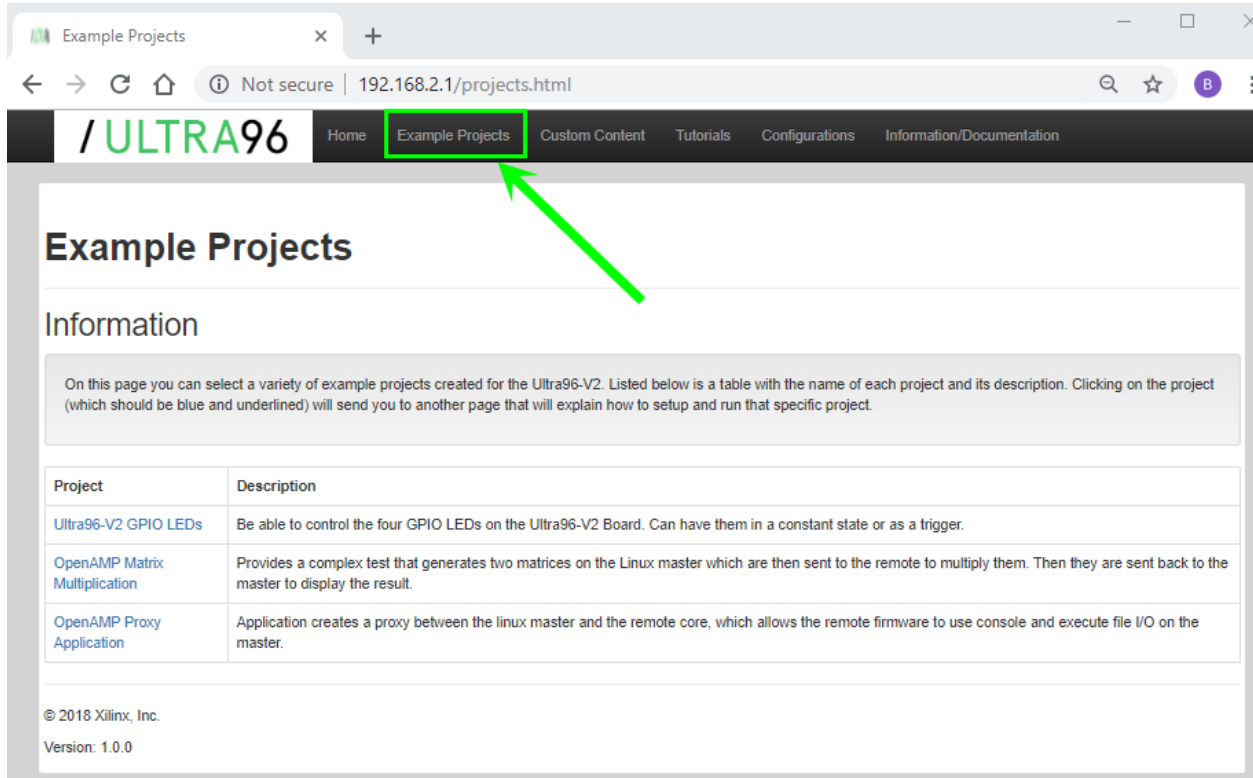
1. Click on the **Example Projects** tab to the right of the Ultra96 logo and Home.

Figure 13 – Example Projects Under Construction

We've already seen the GPIO LEDs operating, so we will skip that one.

2. Click on **OpenAMP Matrix Multiplication**. Then click the **Run Project** button.
3. An A53 processor generates two matrices, which are then sent to one of the R5s for processing. Scroll to the bottom of the Output area to see the results.
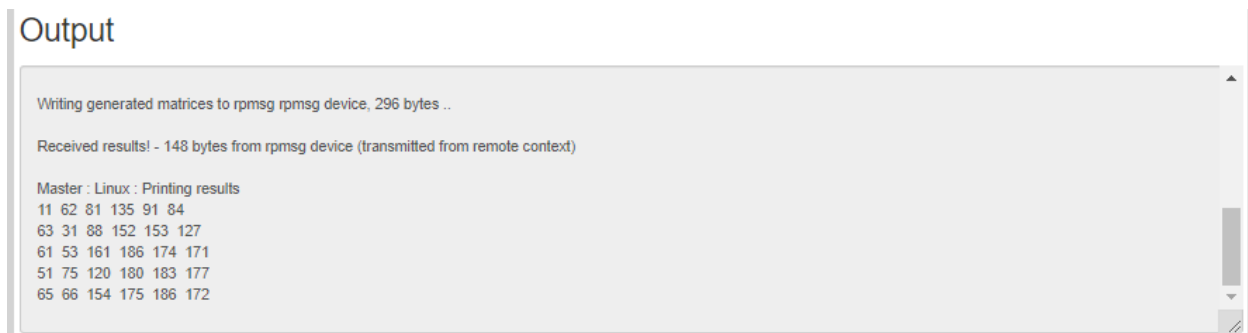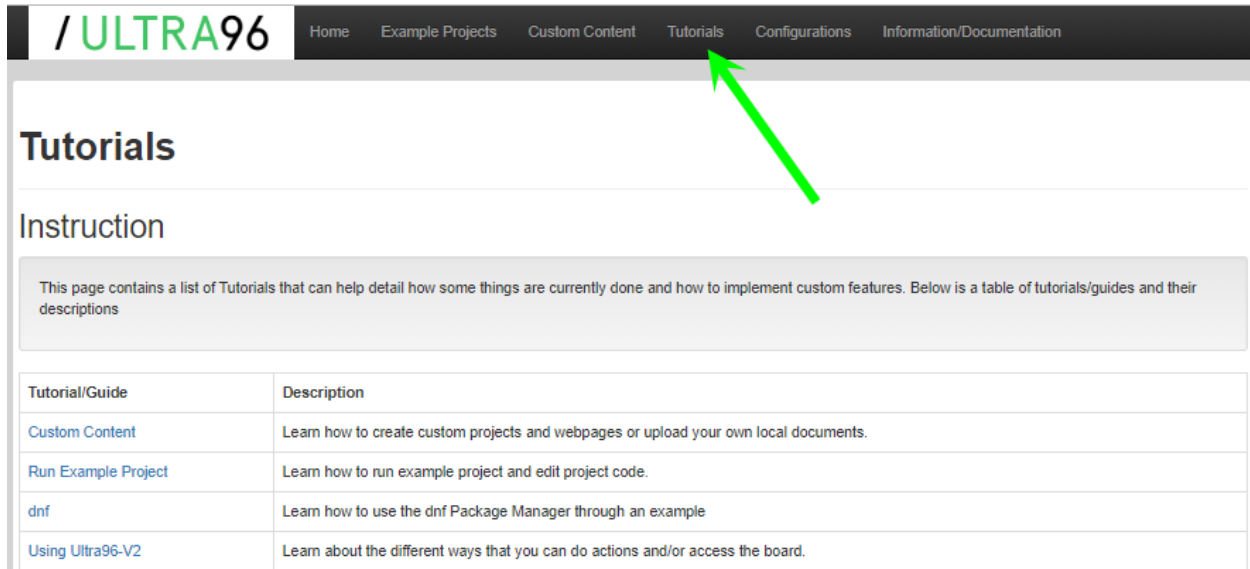
Figure 14 – OpenAMP Matrix Multiplication Output

11 Tutorials

1. Select the **Tutorials** tab at the top of the page. You will be redirected to the Tutorials page.

Figure 15 – Ultra96-V2 Tutorials

2. Click on **Custom Content**. This explains three ways to add custom content. Click **Tutorials** or back in your browser to go back.
3. Click **Using Ultra96-V2**.

4. This tutorial goes over the various ways you can interact with the Ultra96-V2. As of now we have interacted using the Webserver and UART on the Pod.

5. To explore your Ultra96-V2 over miniDP, you will need a compatible cable and monitor. For example, the following combinations work:

   - miniDP-to-DP cable with DisplayPort Monitor

   - Active miniDP-to-HDMI cable with HDMI Monitor

6. Read through the SSH section, it states we can access the Ultra96-V2 terminal using TeraTerm or a PuTTY terminal application.

7. Since we have already downloaded and installed TeraTerm at the beginning of this guide let's access the Ultra96-V2's Linux terminal over SSH using TeraTerm

12 Access Ultra96-V2 Linux Terminal over SSH

1. If connected via UART, click **File → Disconnect**

2. Open TeraTerm and then select **File → New connection…** as seen in the image below.
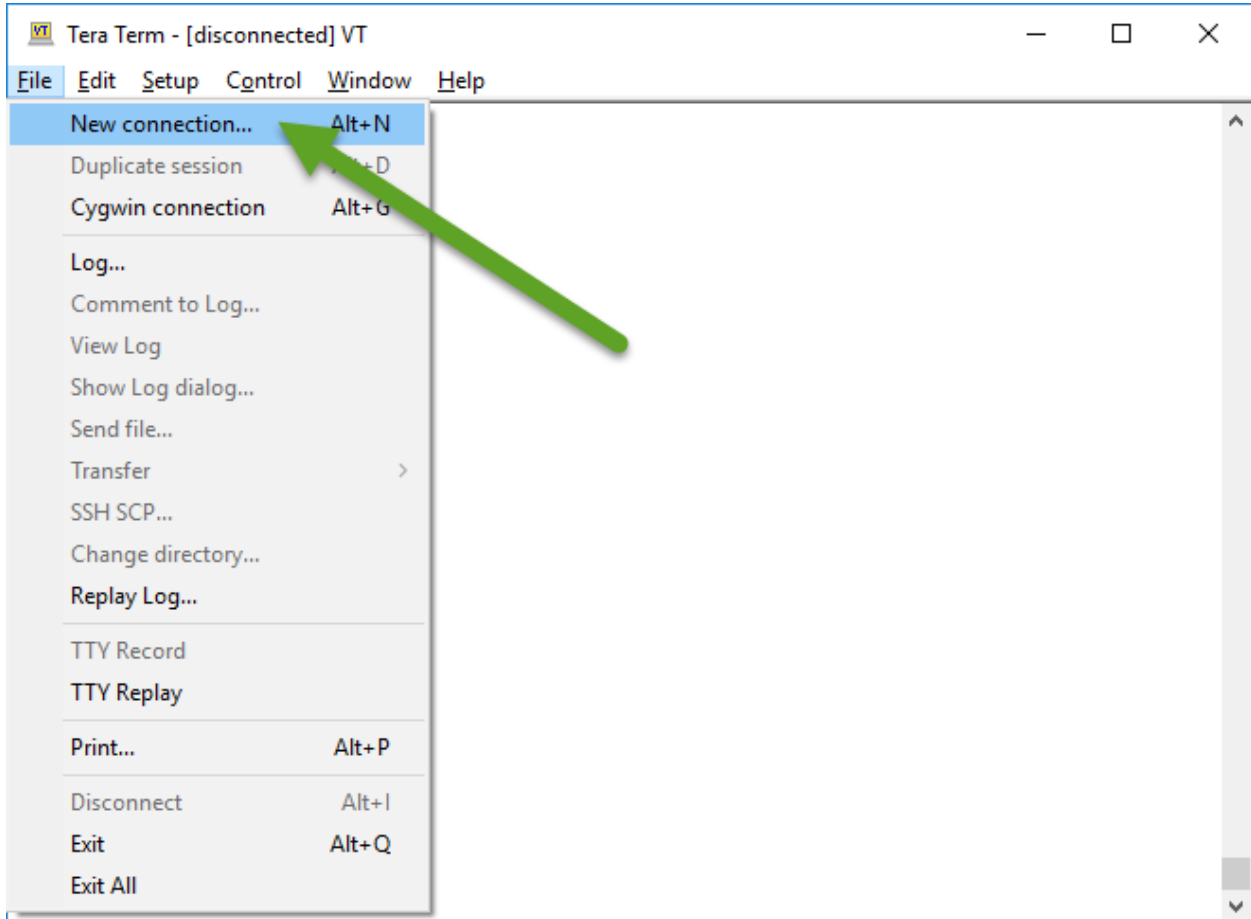

Figure 16 – TeraTerm New Connection

3. A new **TeraTerm: New connection** window will open. We now want to connect to Ultra96-V2 over SSH, select TCP/IP and then configure your Terminal settings to use the IP address that you discovered previously, similar to the below figure.
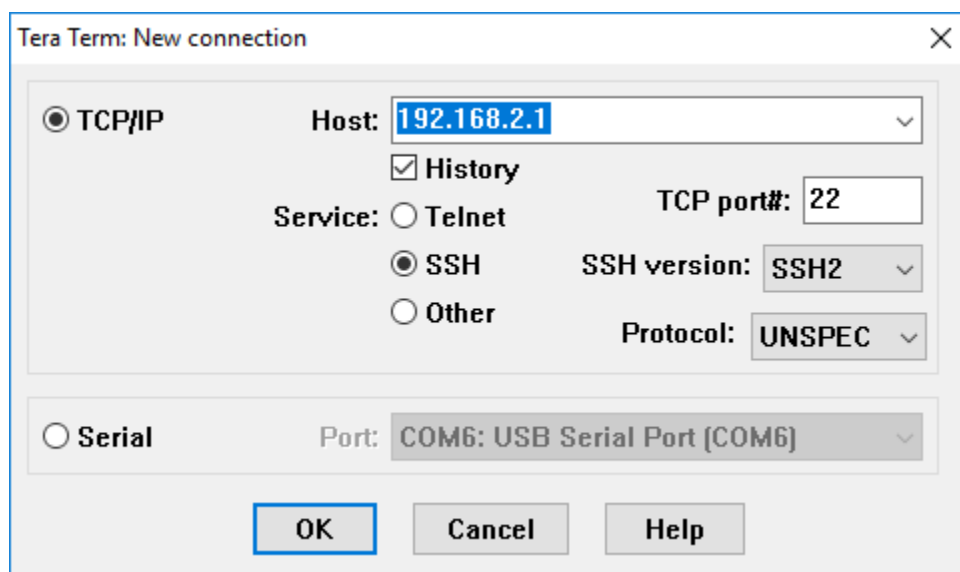

Figure 17 – SSH Terminal Settings

4. Select **OK**

5. If you get a SECURITY WARNING, click **Continue** to add this machine to the known hosts list.
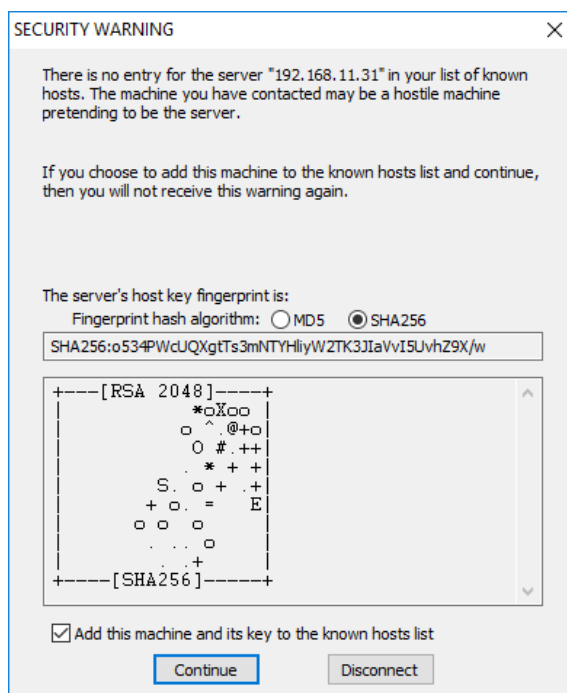
Figure 18 – Click Continue

6. You will then be prompted to enter *SSH Authentication* information. In our case it is looking for the Linux terminal's user name and passphrase which are **root** and **root**.

7. Please type in **root** for the *User name* and then type in **root** for the *Passphrase* as well. Then select **OK**.
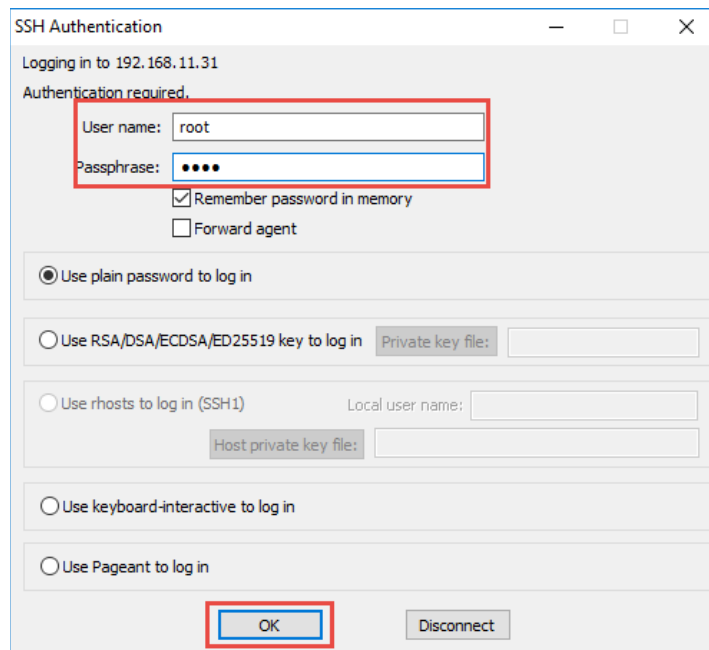
Figure 19 – SSH Authentication

8. You now have access to the Ultra96-V2 Terminal!
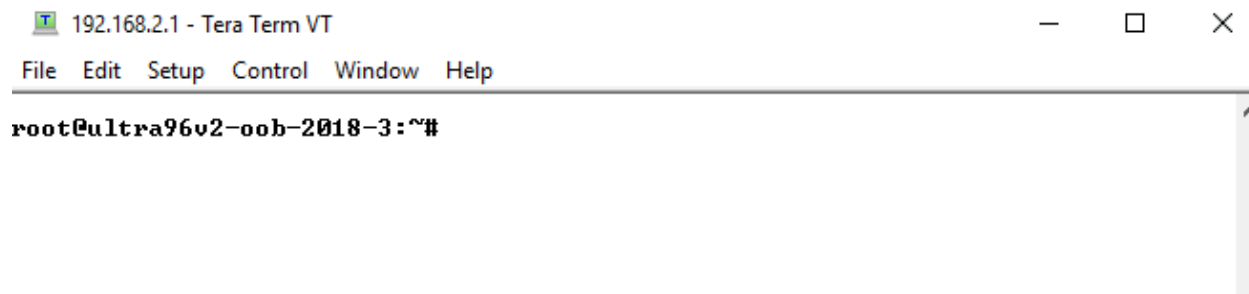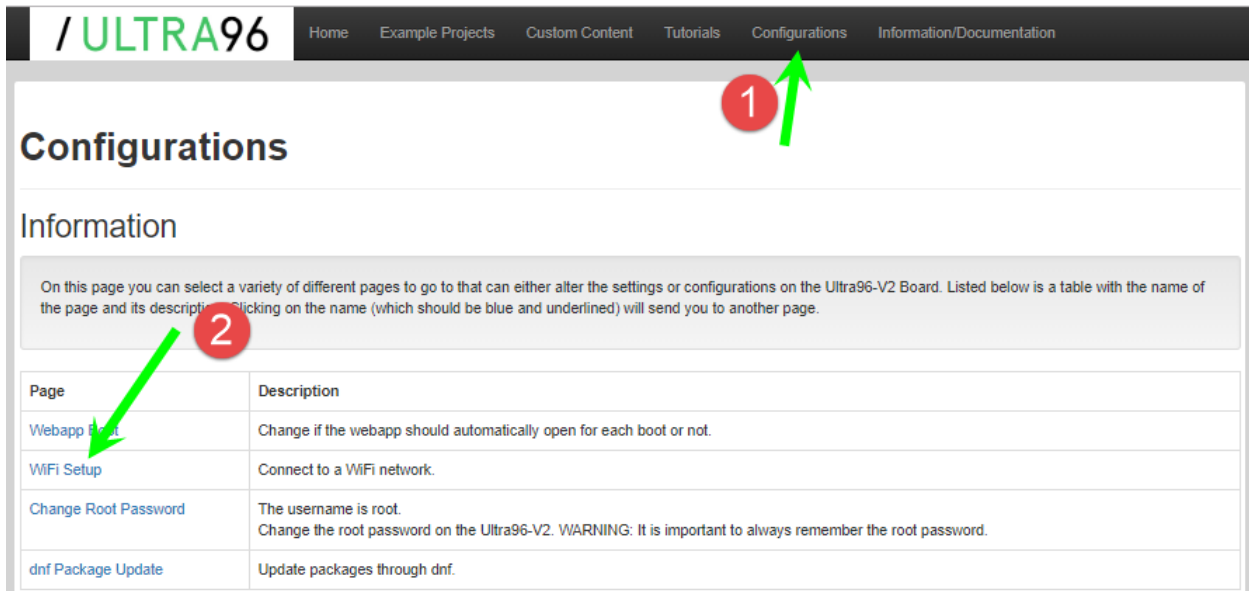
Figure 20 – Ultra96-V2 Terminal

13 Connect to External Wi-Fi

To perform package updates or access anything from the Internet, the board must be connected to an external internet source.

1. Click **Configurations** and then **WiFi Setup**.

Figure 21 – WiFi Setup

2. Click the **Refresh Connections** button then click the pull-down for Network Name. Next, select a network available to you.

Figure 22 – Discovering Networks

3. If a passphrase is required, enter it into the *Network Passphrase* box, then click **Connect**.
4. Be patient as it can take several seconds for the connection to work. When successful, you should see the following message:
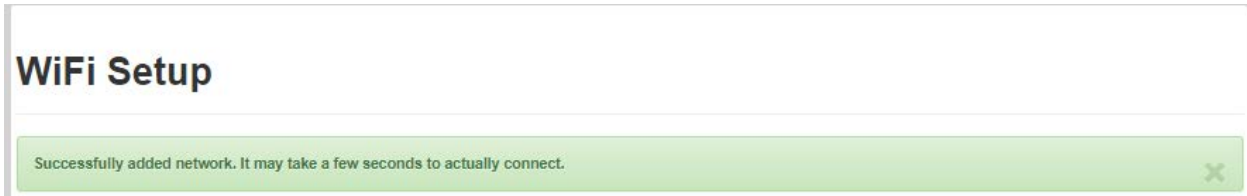

WiFi Setup

Successfully added network. It may take a few seconds to actually connect.   ✕

Figure 23 – Successfully Connected

At this point, the Access Point will no longer work. To connect back to the board, you must now connect to the IP addressed assigned by the external Wi-Fi router. You can do this by logging into the router, or you can use the terminal from the JTAG/UART Pod as shown below.

4. In the terminal, enter command 'ifconfig' to determine the assigned IP address.

Figure 24 – Determine IP Address Assigned to Ultra96-V2

5. Connect your host to the same Wi-Fi source. With both your host and Ultra96-V2 board connected to the same Wi-Fi source, point your browser to this new IP address, and you will be back to the same interactive browser page for Ultra96-V2.
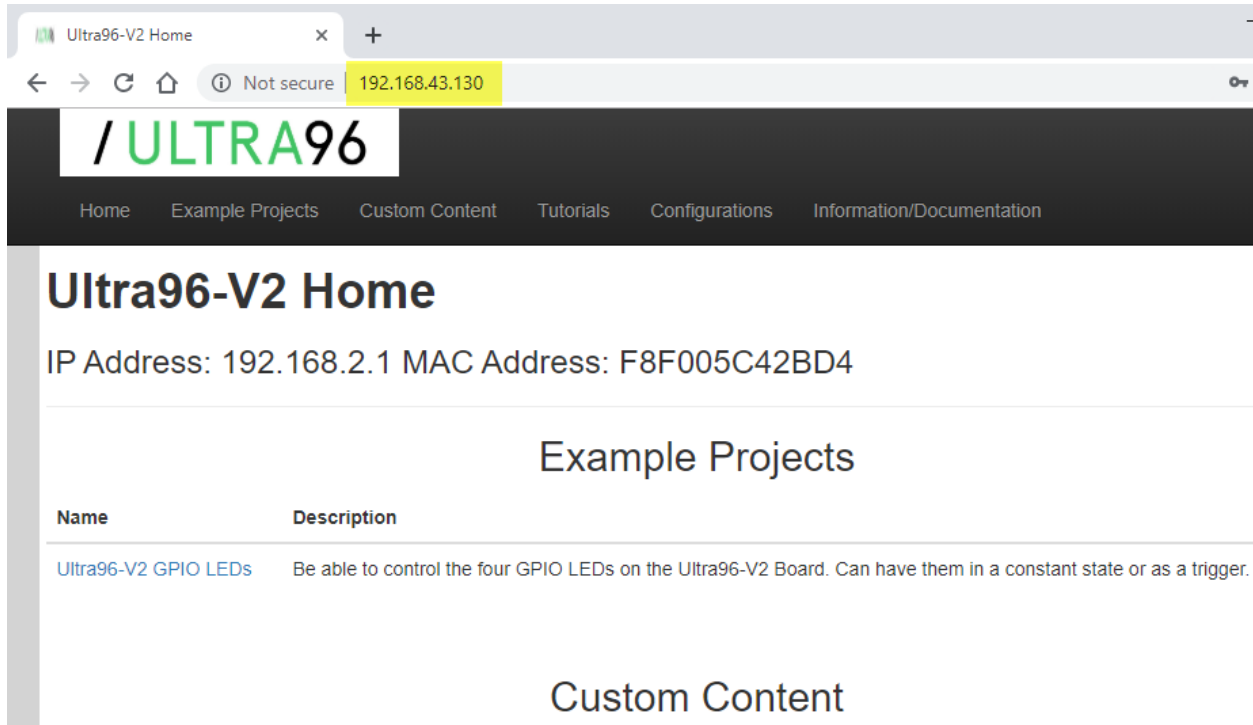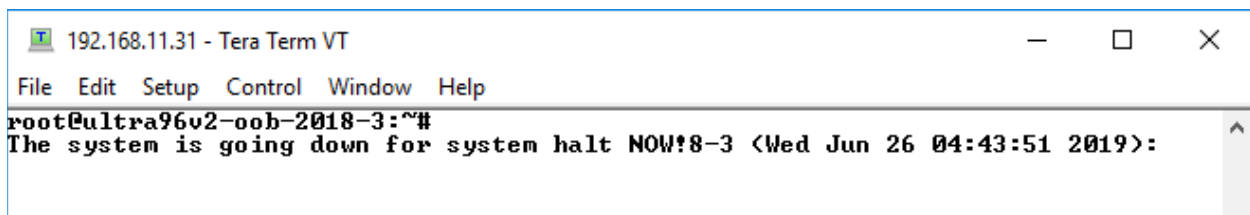

Figure 25 – Connected to Ultra96-V2 Via External Wi-Fi

14 Power Off

When you are done experimenting with your Ultra96-V2 and wish to power off the board, there are several ways to power off the board. You can do it from the command line with a 'shutdown -h now' command. However, we will have you take advantage of the on-board On/Off Controller that interacts with the MPSoC Power Management Unit to initiate a controlled shutdown.

1. Press and release the Power button (SW4) located on the top side of your Ultra96-V2 next to USB port J8.

2. You will notice your board does not power down immediately. It will take roughly 10-20 seconds for your board to completely power down. The reason behind this is it is adhering to the various power down sequencing requirements. See the message in the terminal as shown.

Figure 26 – Power Down Initiated Through Short Press of SW4

3. Please note, if you do not let your Ultra96-V2 power off as per the power down sequencing requirements (such as unplugging the barrel jack), your microSD Card may get corrupted or damaged.

4. To force poweroff of the Ultra96-V2, you can also press and hold SW4 for 10 seconds. This is useful for when the soft power-off doesn't work.

15 Getting Help and Support

15.1 Avnet Support

The Ultra96-V2 is a versatile development kit that allows evaluation of the Zynq MPSoC, which can help you adopt Zynq into your next design. All technical support is offered through http://avnet.me/Ultra96_Forum. Ultra96-V2 users are encouraged to participate in the forums and offer help to others when possible.

To access Ultra96-V2 collateral, please visit the community support page at:

   http://avnet.me/ultra96-v2

To access the latest Ultra96-V2 documentation, click on the **Technical Documents** tab:
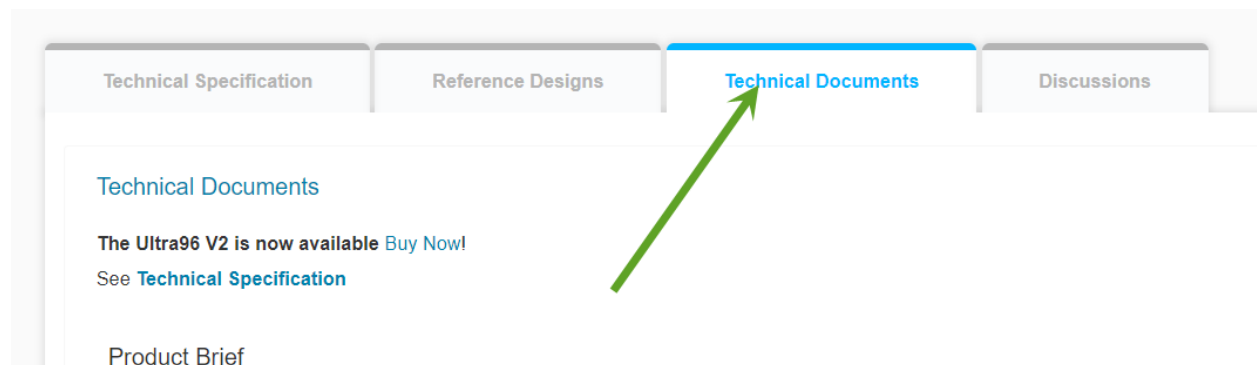
To access the latest reference designs for Ultra96-V2, click on the Reference Designs tab:
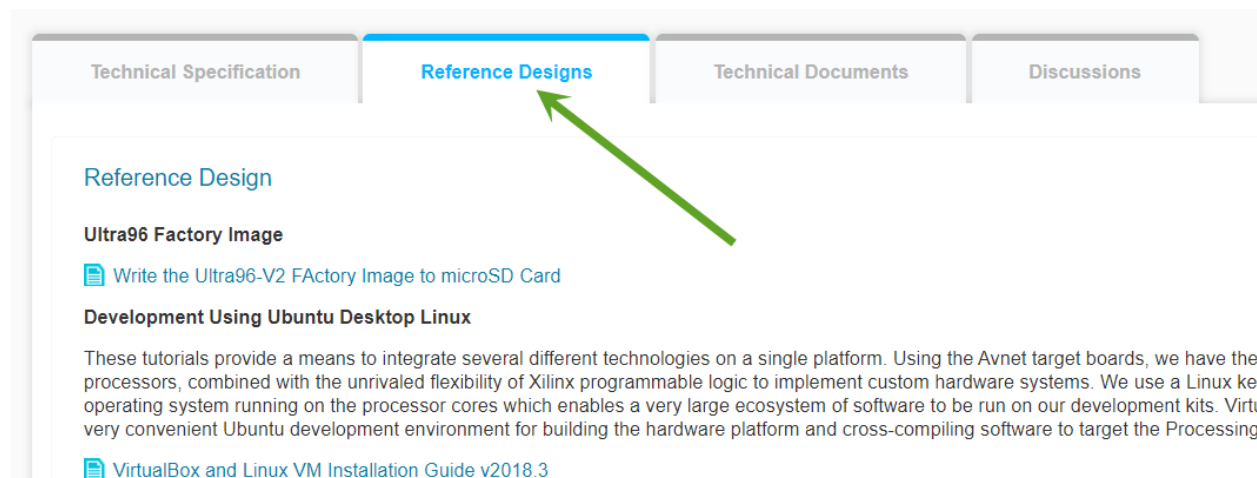
To access the Ultra96-V2 technical forums, go to http://avnet.me/Ultra96_Forum .

To view training and videos, go to http://avnet.me/TTC or http://avnet.me/TTC_on_Demand.

15.2 Xilinx Support

For questions regarding products within the Product Entitlement Account, visit the Contact Support site for Xilinx:

https://www.xilinx.com/support/service-portal/contact-support.html

For technical support including the installation and use of the product license file, contact Xilinx Online Technical Support at www.xilinx.com/support. The following assistance resources are also available on the website:

- Software, IP and documentation updates
- Access to technical support web tools
- Searchable answer database with over 4,000 solutions
- User forums

16 Installing and Licensing Xilinx Software
16.1 Install Vivado Design Suite, Design Edition
The Zynq device on the Ultra96-V2 is supported in Vivado Design Suite, Design Edition. Version 2018.1 or later is required to use the board definition file provided on the Avnet GitHub.

You must license your Vivado Design Suite, Design Edition with the license that came with your Ultra96-V2. To obtain your free license, visit the following website and insert the voucher code from the certificate included in your kit:

http://www.xilinx.com/getlicense

1. Log in
2. Fill out information at Product Licensing - Name and Address Verification, then click Next
3. Select your Account
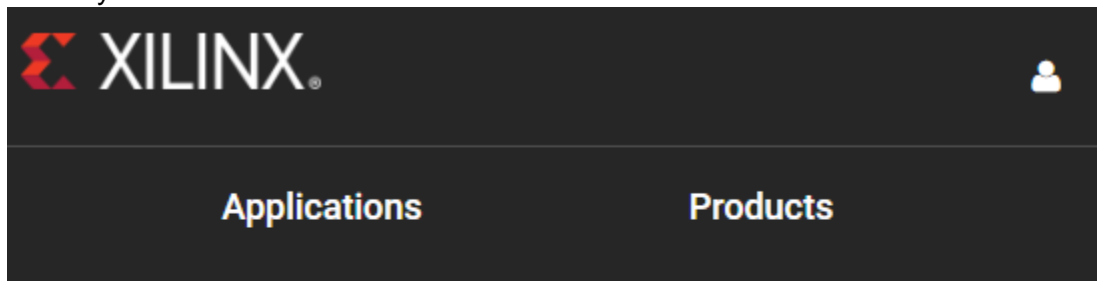
4. Enter your voucher code here, then click Redeem Now.

5. At the confirmation screen, click Yes.
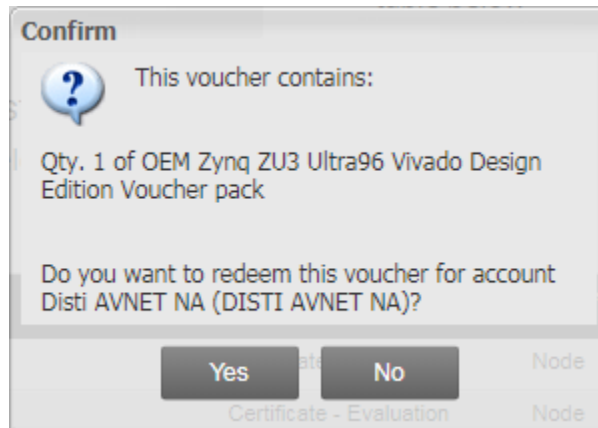
Figure 27 – Voucher Confirmation

6. Under Certificate Based Licenses, find OEM Zynq ZU3 Ultra96 Vivado Design Edition Voucher pack and check the box. Now click Generate Node-Locked License.

Figure 28 – Generate Node-Locked

7. Create or select your Host ID. Click Next.

Generate Node License

Fields marked with an asterisk * are required.

1 PRODUCT SELECTION

Product Selections *		Product	Type	Available Seats	Subscription End Date	Requested Seats	Borrowed Seats
	☑	OEM Zynq ZU3 Ultra...	Full	1/1	23 MAY 2019	1	

2 SYSTEM INFORMATION

License	Node
Host ID * ?	USHOM00NBE24974 - Windows 64-bit - Disk - 4003dac8 ▾

3 COMMENTS

Comments ?	

[Next] Cancel

Figure 29 – Select Host Information

8. Review the license request, then click **Next** again.

If a full seat of Vivado System or Design Edition has already been installed, then no further software will be needed. Please check online for any updates at:

www.xilinx.com/support/download/index.htm

For detailed instructions on installing and licensing the Xilinx tools, please refer to the latest version of **Vivado Design Suite User Guide *Release Notes, Installation, and Licensing (UG973)***.

17 Certification Disclaimer

Both CE and FCC certifications are necessary for system level products in those countries governed by these regulatory bodies.

Because Avnet boards are intended for evaluation kits only and destined for professionals (you) to be used solely at research and development facilities for such purposes, they are considered exempt from the EU product directives and normally are not tested for CE or FCC compliance.

If you choose to use your board to transmit using an antenna, it is your responsibility to make sure that 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.

This board should be used in a controlled lab environment by professional developers for prototype and development purposes only. The board included in the kit is not intended for production use unless additional end product testing and certification is performed.

18 Safety Warnings

This product shall only be connected to an external power supply that is 96boards compliant.

Only compatible plug-in modules shall be connected to Ultra96-V2. The connection of incompatible devices may affect compliance or result in damage to the unit and void the warranty.

This product shall be operated in a well-ventilated environment. If a case is used, it shall have adequate ventilation.

19 RF Certification

The frequency range is 2.412GHz ~ 2.472GHz (2.4GHz ISM Band).

The radio is IEEE 802.11 b/g/n (1x1) compliant for up to 72 Mbps PHY rate

The ATWILC3000-MR110CA has regulatory approval in more than 75 countries around the world. More information on RF certification for the Microchip ATWILC3000 module is available here:

http://ww1.microchip.com/downloads/en/DeviceDoc/ATWILC3000-MR110CA%20Worldwide%20Regulatory%20Information.pdf