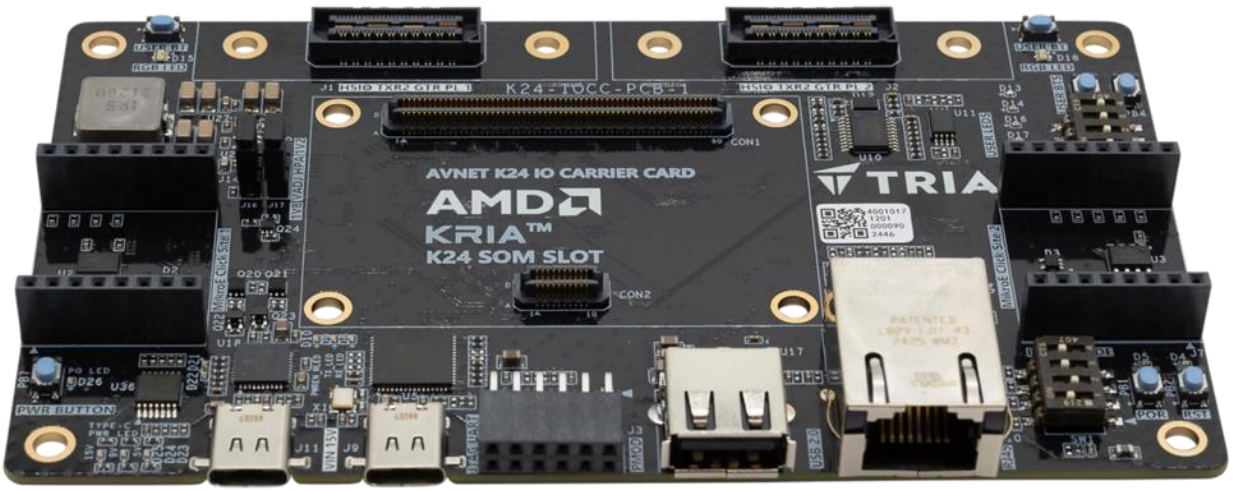


K24 Development Kit
Getting Started Guide

Version 1.2

LIT# K24-IO-DK-GSG-V1P2

Contents

Figures

1 Document Control

Document Version: 1.2

Document Date: 5 February 2025

2 Version History

Version	Date	Comment
1.0	09/30/2024	Initial Release
1.1	01/14/2025	Updated with production photo
1.2	02/05/2025	Updated Website Links

3 Pertinent Info

The K24 Development Kit is a solution that incorporates the AMD Kria™ K24 SOM based on Zynq UltraScale+ MPSoC and a carrier board targeted for broad use in many applications:

- Offers an AMD based Development Kit in Commercial (0ºC to 70ºC) temperature grade for engineers to adopt in development, proof-of-concept, and production projects.
- Combines programmable logic designs with quad-core ARM® Cortex®-A53 MPCore™ and dual-core Arm Cortex-R5F MPCore in a convenient and expandable board.
- Allows expansion to a variety of sensors and peripherals through the Mikroe Click Board™, HSIO (High-Speed IO), and Digilent Pmod™ expansion connectors.
- Designers can create or evaluate designs for both the Zynq Processor Subsystem (PS) and / or the Programmable Logic (PL) fabric.

  The following figure is a high-level block diagram of the K24 Development Kit and the peripherals attached to the AMD Kria K24 SOM.

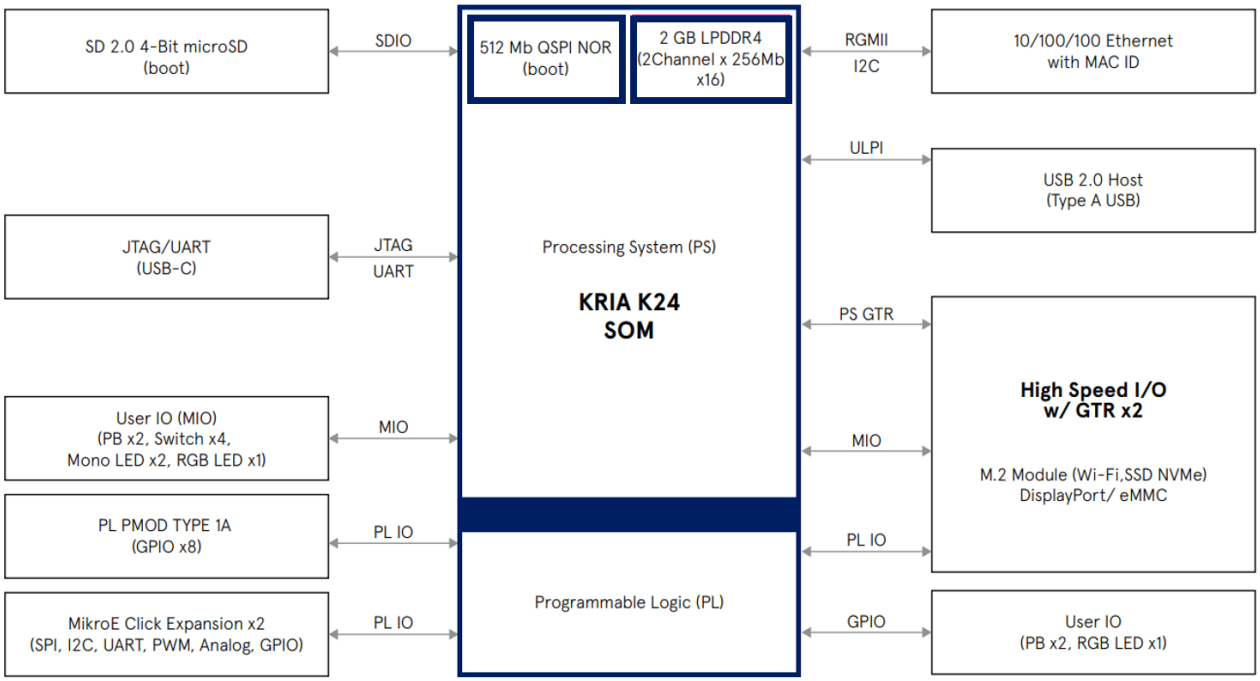


Figure 1 – Development Kit Block Diagram

The following figure provides an overview of the physical connections, their designators, and relative position on the K24 Development Kit. The image is of the prototype of the K24 IO Carrier Card but still depicts the proper location of the identified components.

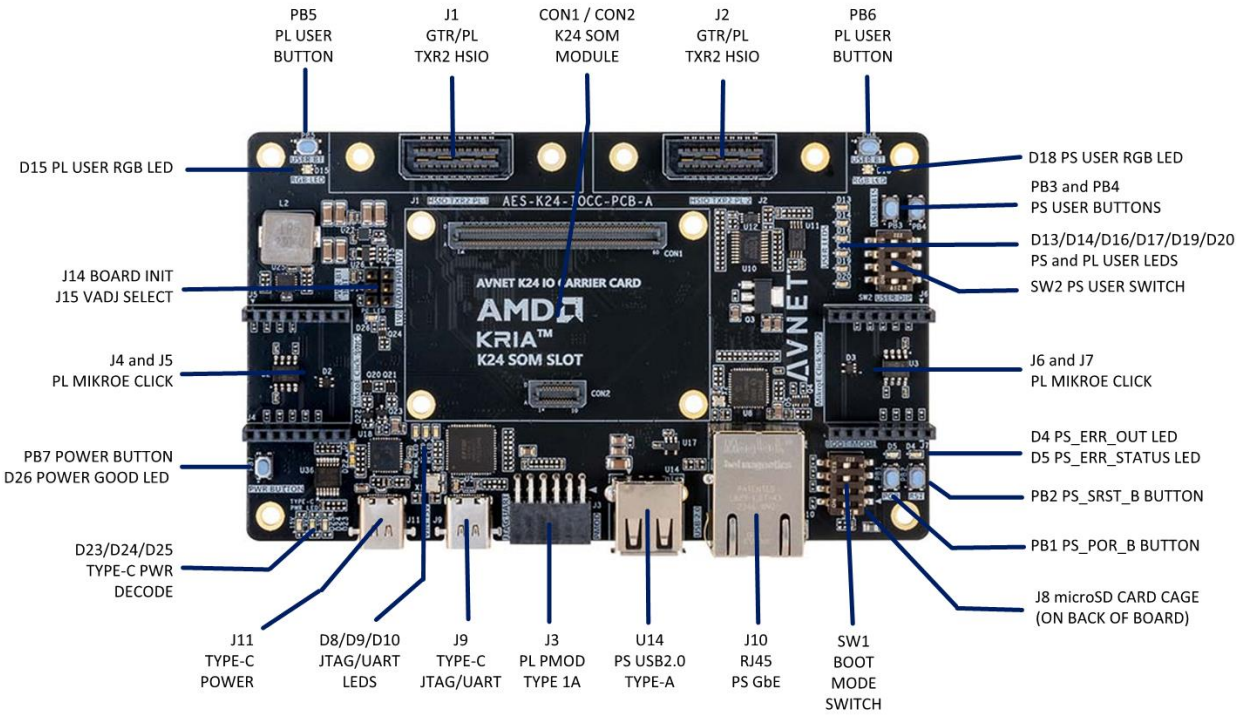


Figure 2 – Interfaces and Connectors

The Getting Started Guide will outline the steps to setup the K24 Development Kit hardware. It documents the procedure to run the Out-of-Box design that targets the ARM® Cortex™-A53.

3.1 What's In The Box

The K24 Development Kit includes the AMD Kria K24 SOM and the K24 IO Carrier Card. The K24 Development Kit includes the following in the box:

- K24 System-On-Module (no eMMC)
- K24 IO Carrier Card
- Quick Start Card

Customers need to acquire an appropriate Type-C power supply, Type-C cables, Ethernet cable, and microSD card. Customer will also need to procure or produce appropriate modules that target the various expansion interfaces. Here are links to companies that provide such products:

- Type-C AC/DC Power Supply 15V/3A (45W): **Advantech PSA-A45WM-U Power Supply**
- Avnet HSIO: **Avnet Add-On Products - High Speed IO Modules**
- MikroE Click Board: **https://www.mikroe.com/click**
- Opal Kelly SYZYGY: **https://docs.opalkelly.com/syzygy-peripherals/**

3.2 What's On The Web

The K24 Development Kit has documentation that is made available to users through the Avnet Board product page and various community support websites. Here are links to the various online content:

- **http://avnet.me/k24-dk**
- **http://avnet.me/k24-dk-forum**
- **http://avnet.me/board-support-site**

3.3 Available Documentation

- Getting Started Guide
- Hardware User Guide
- Board Definition Files
- Master User Constraint File
- Net Length Report
- Schematics *
- Bill of Materials *
- Mechanical Drawing *
- 3D Model *
- Carrier Card Source Databases **

* Denotes FAE involvement to gain access to these documents. Contact your local Avnet FAE.
** Denotes FAE involvement and execution of Non-Disclosure Agreement (NDA). Contact your local Avnet FAE.

3.4 Tutorials and Reference Designs

Any tutorials and reference designs that are available to targets this platform can be located at the links below.

- Out of Box Design – Part of this Getting Started Guide
- Avnet Boards Training and Courses
    - **http://avnet.me/tria-boards-training**

3.5 Trainings and Videos

Any trainings and videos that are available to target this platform can be located at the links below.

- Community based boards trainings and videos
    - **http://avnet.me/community-boards-training**

4 Getting Started

The functionality of the K24 Development Kit is determined by the application booted from the non-volatile memory. In the case of the K24 Development Kit there are two options for booting: the K24 SOM on-board QSPI and the K24 IO Carrier Card SD card interface. For this Getting Started tutorial, the user will be programming the K24 Development Kit with an Out-of-Box image from the K24 IO Carrier Card SD card interface. The programming will occur on the K24 SOM's on-board QSPI. This program will allow the end user to quickly bring up the board with a network connection and run an application built using FreeRTOS.

Reminder: In addition to the items included in the box, you will also need the following to complete the Getting Started tutorial.

- **Type-C AC/DC Power Supply 15V/3A (45W): Advantech PSA-A45WM-U Power Supply**
- **Type-C Debug Cable for USB-UART Communications**
- **Router or Open Ethernet Port on Host Windows PC**
- **Ethernet Cable**

4.1 Out-of-Box Example Design

The K24 Development Kit has an example Petalinux base BSP and a FreeRTOS design used as it's Out-of-Box experience. Typically, this FreeRTOS design would be programmed to the Kria K24 SOM's on-board QSPI at the factory. In the case of this product, the Kria K24 SOM is provided straight from the factory and has not been opened. As such, the Kria K24 SOM does not contain the Out-of-Box design.

In this Getting Started tutorial, we will boot the K24 Development Kits Petalinux base BSP from SD Card and program the QSPI of the Kria K24 SOM with the Out-of-Box design that exists on the SD cards contents.

- **http://avnet.me/k24-dk-prod-base-bsp-sdcard**

4.2 Prepare SD Card

We need to prepare an SD Card with the contents of the Petalinux base BSP archive that was downloaded in section 4.1. Extract the archive to a location on your computer and follow the **Balena Etcher Instructions** document to program the WIC file to an SD card that is large enough to support the size of the WIC file.

- **http://avnet.me/balena-etcher-instructions**

4.3 Hardware Setup

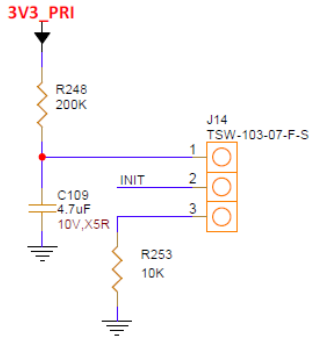
There are a few tasks required to ensure the hardware is setup appropriately to run the Out-of-Box FreeRTOS design.

1) Check that the appropriate headers are shunted on the K24 IO Carrier Card. There are two headers located on the board. One header is the BOARD INIT header, **J14**, which determines if the board is powered up with the power push button, **PB7**, or powered up with the insertion of the Type-C cable into the power connector, **J11**. The last header is a voltage select header, **J15**, that is used to select +1.8V or +1.2V for the +VCCO_HPA rail for the Kria K24 SOM.

As a user you may determine how you want to power the board with the BOARD INIT header. By default, the board should arrive with **J14** shunted to utilize the power button, **PB7**. To do this, **J14** should be shunted from pin 2 to pin 3.

For the Out-of-Box design, +VCCO_HPA should be set to +1.8V by shunting pin 2 to pin 3 on **J15**.

Both headers are described in the following figures:



J14	Result
PIN 1/2	Board powers up when power applied
PIN 2/3	User must press Power On button (Default)

Figure 3 – Board INIT Header

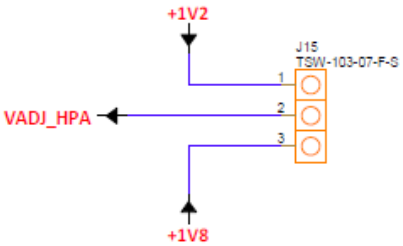


Figure 4 – VCCO_HPA Select Header

Both headers appear to the left of the Kria K24 SOM on the K24 IO Carrier Card just below HSIO expansion connector **J1**. **J14** and **J15** are highlighted in red in the following figure with Pin 1 pointed at with an arrow.

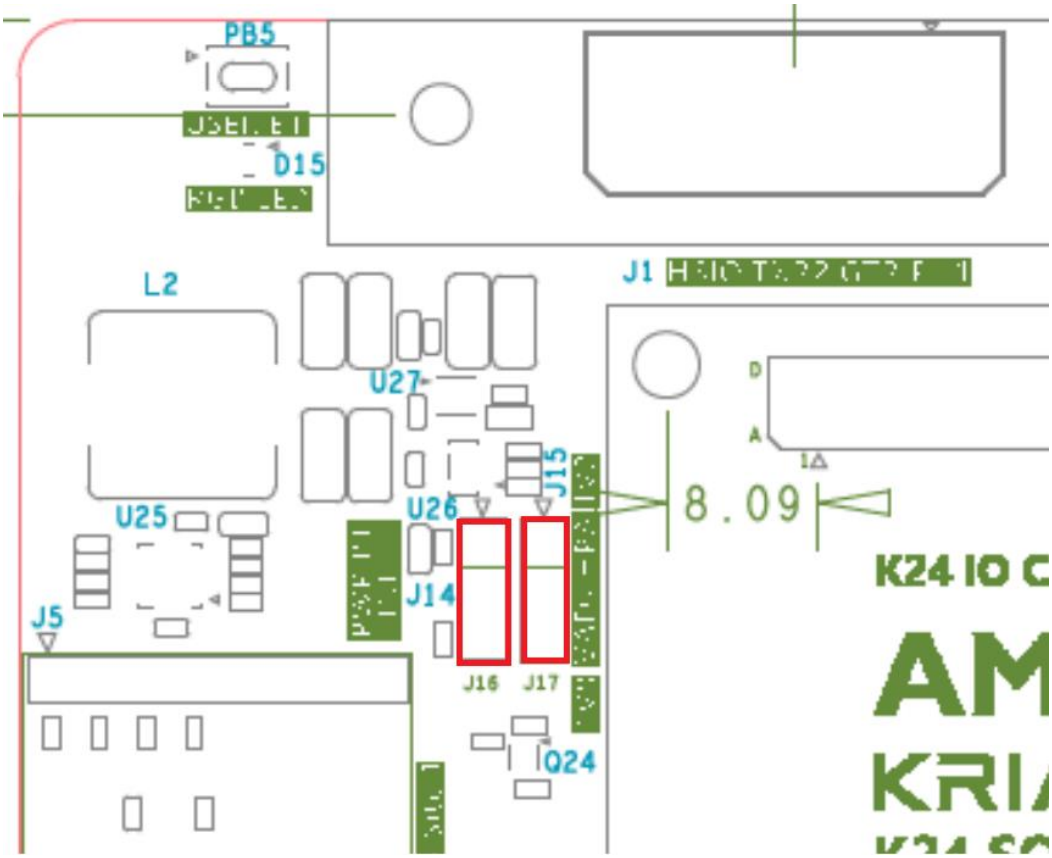


Figure 5 – Header Locations on Carrier Card

2) The AMD Kria K24 SOM should be mounted to K24 SOM Slot on the K24 IO Carrier Card.

3) The appropriate cables should be attached to the K24 IO Carrier Card. The cables required to run the Out-Of-Box design are as follows:

   - Ethernet Cable should be attached from host PC ethernet interface to the K24 IO Carrier Card RJ45 connector, **J10**.
   - USB Type-C Cable should be attached from host PC USB interface to the K24 IO Carrier Card Type-C USB JTAG/UART connector, **J9**.
   - USB Type-C Power Supply Cable should be attached from appropriate power supply (15V/3A) and attached to the K24 IO Carrier Card Type-C USB Power Supply connector, **J11**.

4) Install the SD Card with the Petalinux base BSP design contents on it into the SD Card interface, **J8**, on the bottom of the K24 IO Carrier Card.

5) Set the Boot Mode Switch, **SW1**, to boot from SD card initially. This will allow the Petalinux base BSP design to boot from the SD card. SD card mode is set by toggling the Boot Mode Switch to set **SW1[4-1] to ON-OFF-ON-OFF** which will set the **MODE[3:0]** pins to **0x0101**.

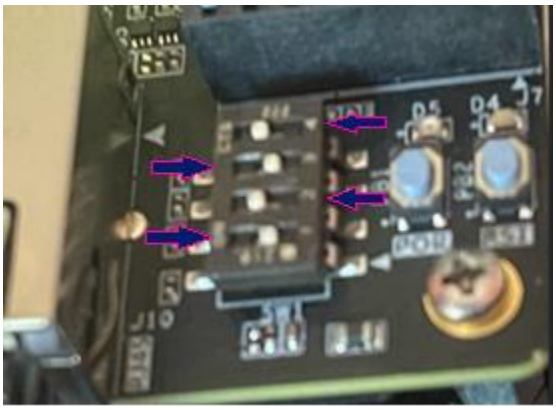


Figure 6 – SD Card Boot Mode Settings

The following figure depicts the fully connected K24 Development Kit ready to run the Petalinux base BSP design. The image is of the prototype of the K24 IO Carrier Card but still depicts the proper locations for cable connections.

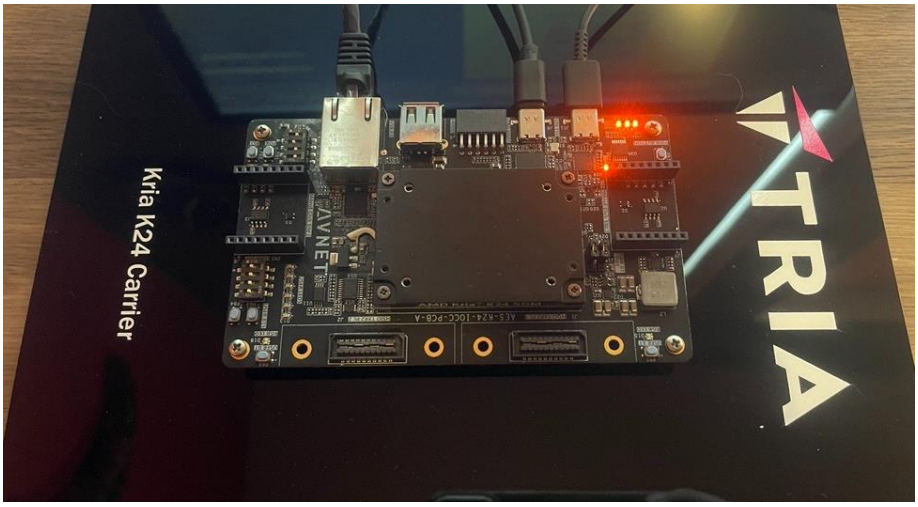


Figure 7 – Cable Locations on Carrier Card

4.4 Terminal Setup

1) A terminal program is required. Tera Term was used in this example which can be downloaded from the Tera Term project. Install Tera Term or another terminal program of your choice to a host Windows PC.

    - **https://teratermproject.github.io/index-en.html**

2) When you connect the K24 Development Kit USB-Type-C JTAG/UART port **J9** to your host Windows PC with the board having been powered on (see Powering On section), the proper drivers, if installed, will give you confirmation of the available COM ports in the Device Manager of Windows as show in the following figure. Review available COM ports prior to power on so the user may identify the newly assigned COM ports for the attached K24 Development Kit.

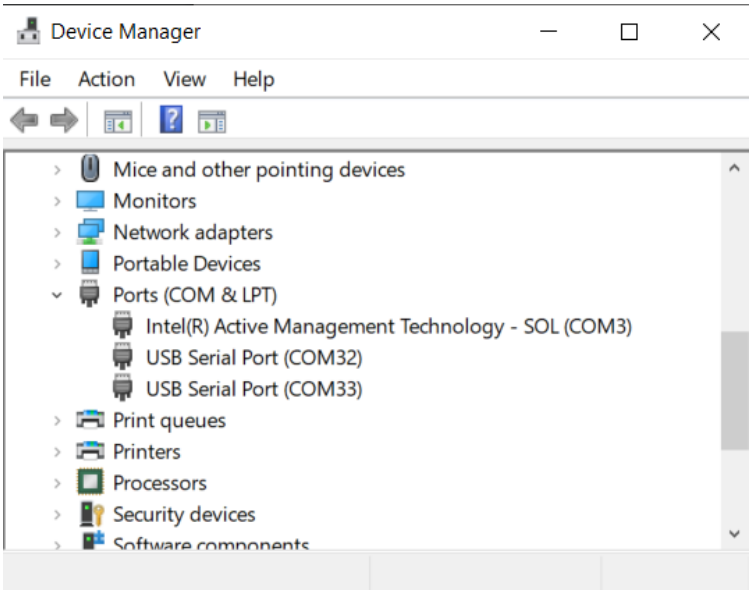


Figure 8 – USB-JTAG/UART COM Port Assignments

3) If the drivers are not installed, then you must manually install the driver for the FT2232H device. Visit the FTDI website and download the appropriate driver for your operating system.

   - **http://www.ftdichip.com/Drivers/VCP.htm**

4) Prior to installing drivers manually, unplug the Type-C cables from the K24 Development Kit. After the Kit is unplugged from the PC you can unzip and install the FT2232H driver.

5) At this point you should reboot your PC if you manually installed the FT2232H driver and then proceed to plug in the Type-C cables for power to **J11** and the Type-C cable for the USB JTAG/UART to **J9**.

4.5 Powering On

The K24 Development Kit requires a 15V / 3A Type-C power supply to power the kit. The power supply and Type-C cable is not included in the kit. The power supply Type-C connector plugs into the Type-C power receptacle (**J11**) to supply the +15V power source to K24 Development Kit.

NOTE: If a 15V Type-C power supply is supplied to the Type-C power receptacle (J11), LED D25 will illuminate with LED D23 and D24. If LED D25 is not illuminated, the Type-C power supply is not providing 15V and the board will not power up.

To power up the K24 Development Kit a user must push the **PB7** Power Button to turn power on to the board (depending on the state of the BOARD INIT header **J14**).

- When **J14** is shunted pin 2 to pin 3, the board powers up and down with the **PB7** Power Button being exercised.

- When **J14** is shunted pin 2 to pin 1, the board powers up when power is applied to the Type-C power receptacle, **J11**, and the board powers down when power is removed from the Type-C power receptable, **J11**.

When the board is powered on properly, you will see a GREEN power good LED, **D26**, illuminate on the K24 IO Carrier Card and three GREEN LEDs illuminated along the right edge of the Kria K24 SOM.

4.6 Program QSPI

With the K24 Development Kit mode switch set to SD card boot, the prepared SD card containing the K24 Petalinux base BSP design installed into the SD card cage, and the K24 Development Kit powered on after toggling **PB7**, the board will start to boot and complete at a command prompt where we will have to provide a username to login. The user will know the Petalinux base BSP design has successfully booted as one of the USER LEDs, **D13,** will be toggling as a heartbeat for the design.

USERNAME: root

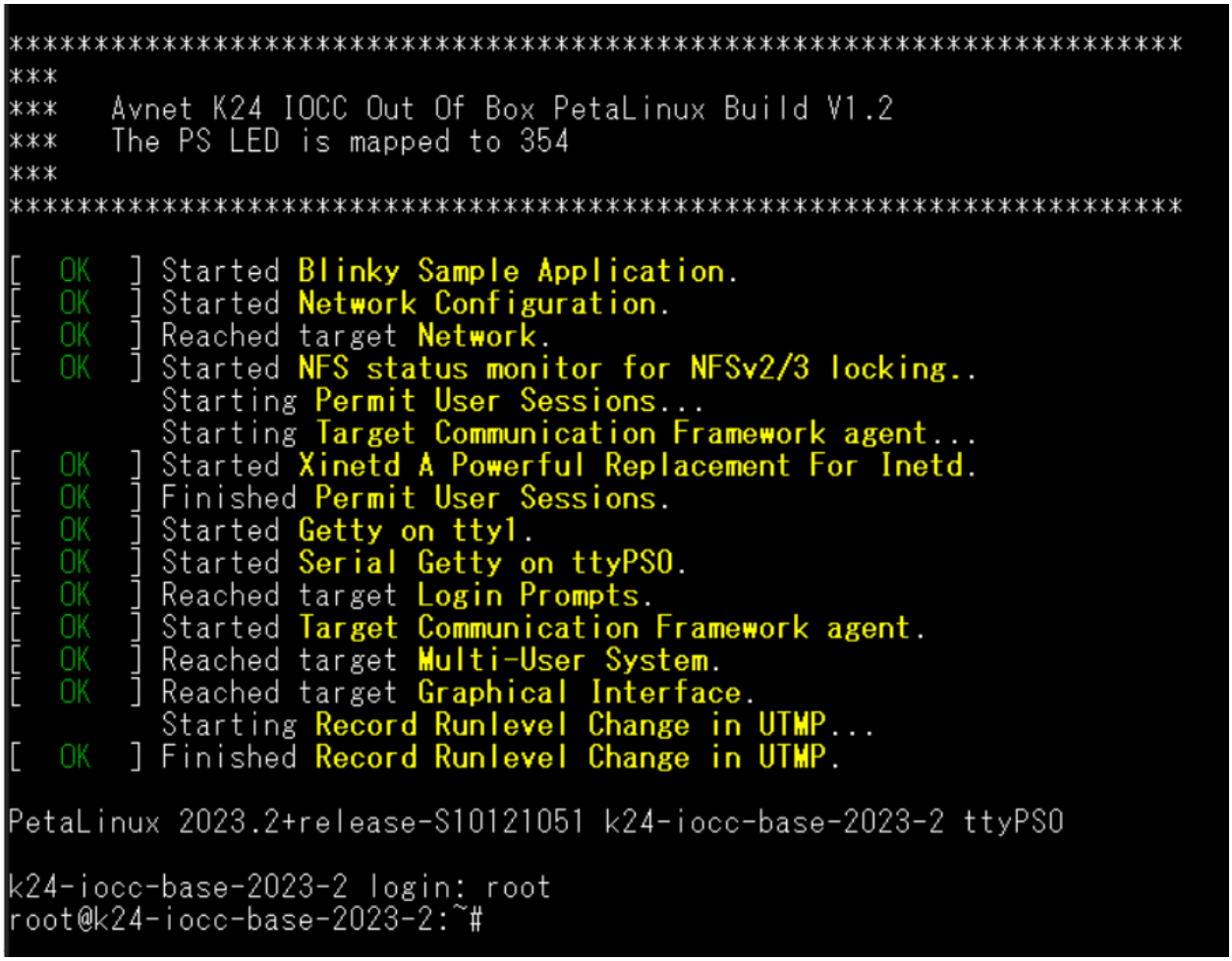


Figure 9 – Petalinux Base BSP Login

At this point we are logged into the Petalinux base BSP design and can now run the application that will program the Kria K24 SOMs on-board QSPI with the Out-of-Box Example Design. At the command prompt please type in the following command:

Type at Command Prompt: ./flash-programming.sh

The Out-of-Box Example Design will be programmed to the K24 SOMs on-board QSPI flash memory. The terminal will inform you when the process is complete. At the point we can issue a command to properly shut down the Linux environment prior to powering down the board.

Type at Command Prompt: shutdown now

```
PetaLinux 2023.2+release-S10121051 k24-iocc-base-2023-2 ttyPS0

k24-iocc-base-2023-2 login: root
root@k24-iocc-base-2023-2:~# ./flash-programming.sh
Installing Out of the Box Image on Flash memory
Erasing blocks: 142/142 (100%)
Writing data: 9045k/9045k (100%)
Verifying data: 9045k/9045k (100%)

--------- Out of the Box Image successfully installed on Flash memory ---------

root@k24-iocc-base-2023-2:~# shutdown now
```

Figure 10 – Out of Box Design Programmed

```
[  OK  ] Stopped Create Static Device Nodes in /dev.
[  OK  ] Reached target System Shutdown.
[  OK  ] Reached target Late Shutdown Services.
[  OK  ] Finished System Power Off.
[  OK  ] Reached target System Power Off.
[  705.075904] reboot: Power down
```

Figure 11 – Board Ready to Remove Power

4.7 Powering Off and QSPI Boot Mode

To get to the next step of booting the Out-of-Box design, the user will need to power cycle the board. To power down the K24 Development Kit a user must HOLD the **PB7** Power Button to turn power off to the board (depending on the state of the BOARD INIT header **J14**) until the board powers down.

- When **J14** is shunted pin 2 to pin 3, the board powers up and down with the **PB7** Power Button being exercised.
- When **J14** is shunted pin 2 to pin 1, the board powers up when power is applied to the Type-C power receptacle, **J11**, and the board powers down when power is removed from the Type-C power receptable, **J11**.

After the board is powered down, we can change the setting of the Boot Mode Switch, **SW1**, to QSPI boot mode.

- Set the Boot Mode Switch, **SW1**, to boot from QSPI. This will allow the Out-of-Box design to boot from the QSPI. QSPI boot mode is set by toggling the Boot Mode Switch to set **SW1[4-1] to ON-ON-OFF-ON** which will set the **MODE[3:0]** pins to **0x0010**.

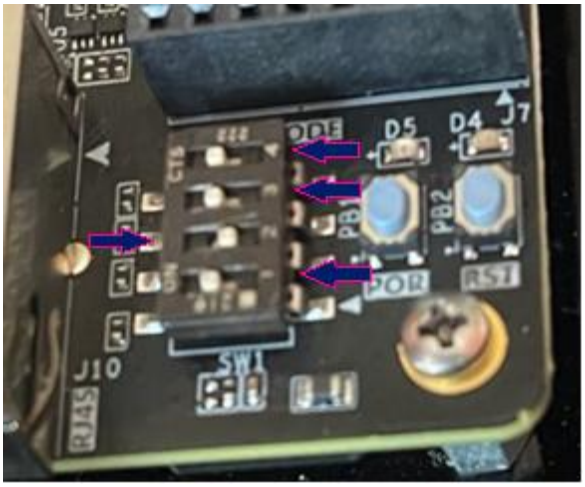


Figure 12 – QSPI Boot Mode Settings

4.8 Boot FreeRTOS

Prior to booting the FreeRTOS Out-of-Box Example Design, we need to ensure that the point-to-point network connection that we are using for this design is setup properly for communication. In this tutorial we happen to be utilizing a Windows laptop. For this to function we need to setup a local LAN with the Windows laptop's ethernet port having an IP Address of **192.168.2.1.**

To-do this in Windows you must go to the **Network & Internet Settings** and **Change Adapter Options** setting. From there a user can select the appropriate ethernet port adapter and right-click on the ICON to get to the **Properties** settings.

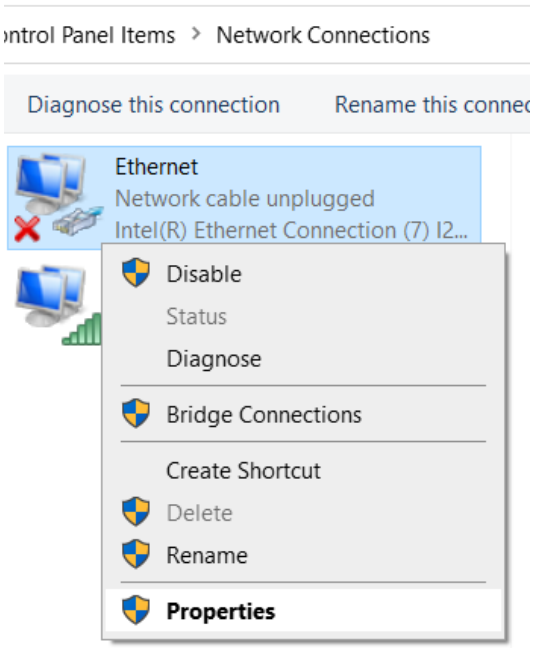


Figure 13 – Ethernet Adapter Properties

Now you must highlight the **TCP/IPv4** Settings and select the **Properties** button so that we can set the appropriate IP address.

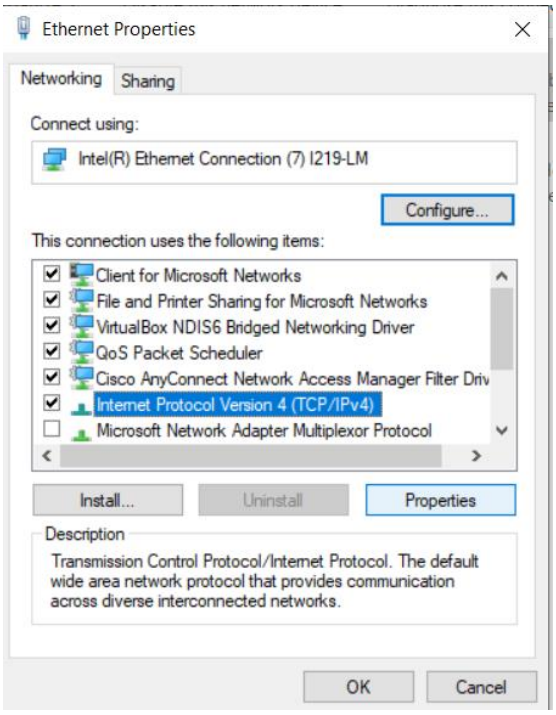


Figure 14 – TCP/IPv4 Properties

Here we can set the TCP/IPv4 properties by selecting the **USE THE FOLLOWING IP ADDRESS** radio button and then type in the IP address we are targeting which is **192.168.2.1**. Review the figure below:

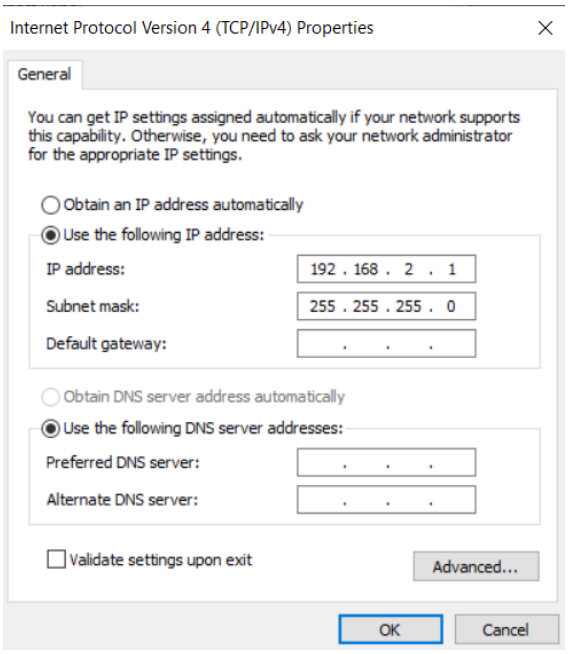


Figure 15 – Set IP Address

With the K24 Development Kit mode switch set to QSPI boot and the Windows IP address set to **192.168.2.1,** it is now time to power on the K24 Development Kit again by toggling **PB7.** The board will start to boot and complete with terminal appearing as follows:

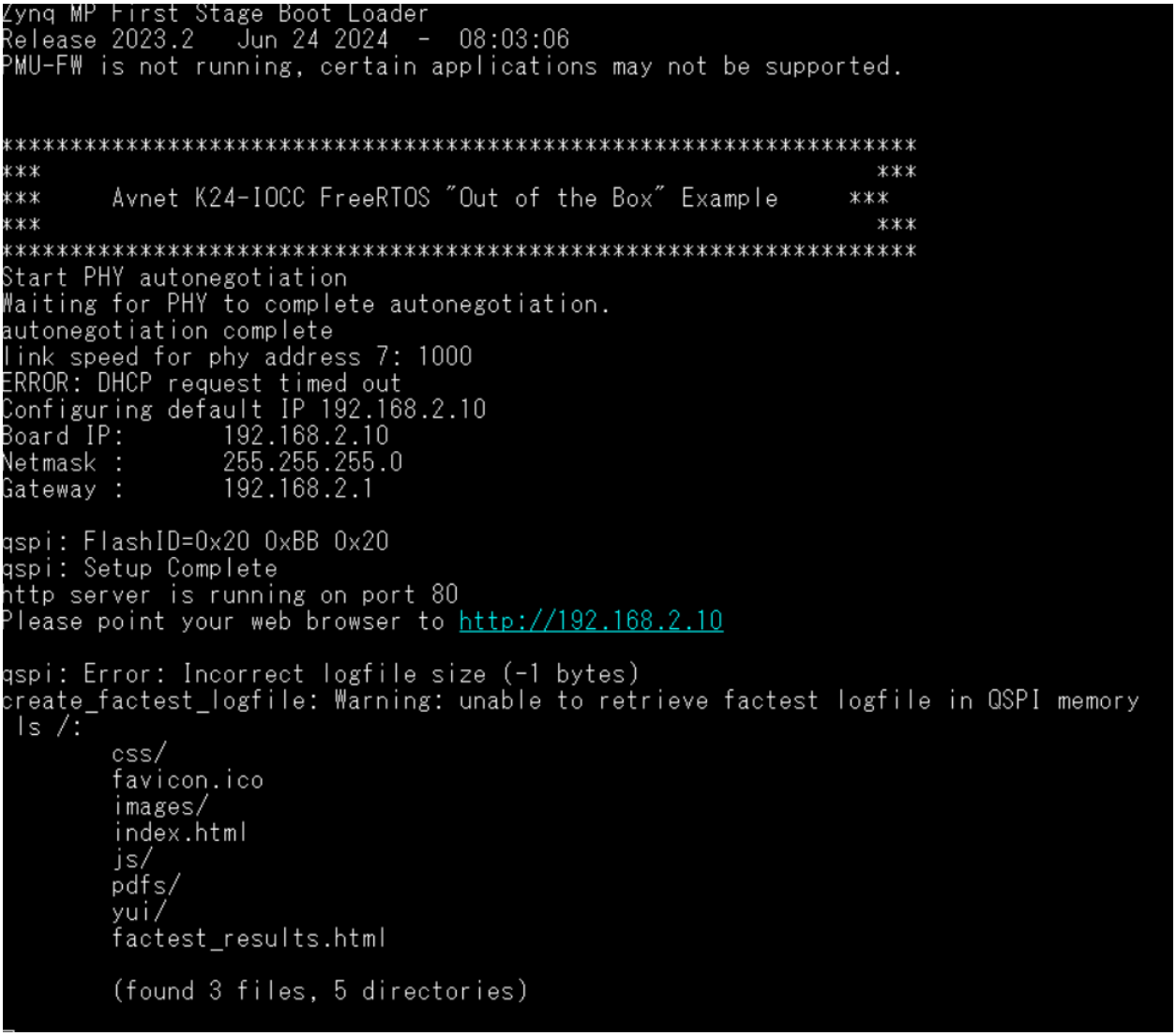


Figure 16 – Out-of-Box Design Boot

4.9 Using Out-of-Box Example Design

At this point, it is time to utilize the Out-of-Box Example Design. Open your favourite web browser and point the browser to the IP address of the K24 Development Kit: **192.168.2.10**

http://192.168.2.10

If everything has been successful to this point, the user will see the following web page in the web browser:

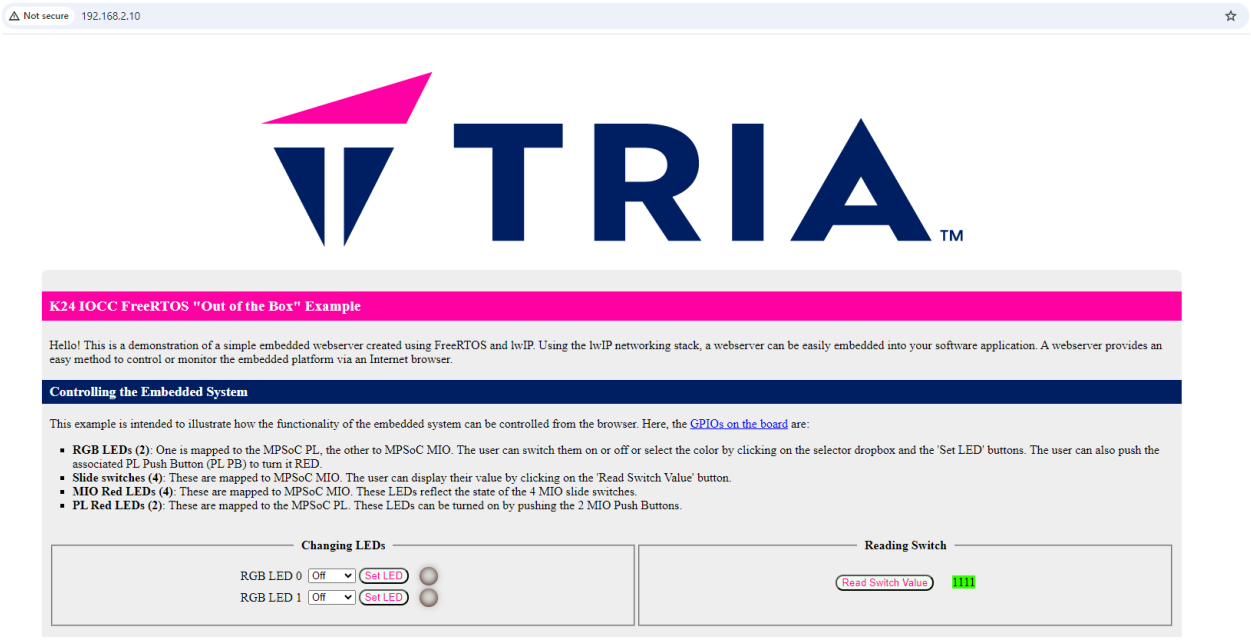


Figure 17 – Out-of-Box Design Web Page

In the webpage GUI, the user will be able to utilize a few features of the K24 Development Kit.

Within the GUI, the user will be able to set RGB LED colors of **D15** and **D18** with selections from OFF, RED, GREEN and BLUE and then setting the color with the **SET LED** button. The user will also be able to physically toggle User Switch **SW2** and read back the values from within the GUI using the **READ SWITCH VALUE** button.

On board, the user will be able to toggle the various User Push Buttons on the board (**PB3, PB4, P5, and PB6**) which will in turn illuminate various User LEDs on the board (**D15, D18, D19, and D20**)

Within the GUI, typically the Factory Test results are displayed. Since the factory did not pre-program the K24 on-board QSPI with these Factory Test results they are not included with this Out-of-Box design so a user will not see this information presented in the GUI.

Lastly, a user will see some links for documentation. Included in the Out-of-Box Design is the K24 Development Kit Product Brief. The other links provide point to locations not served by the Out-of-Box Design. The other links will need to be copied into a browser with WAN access.

4.10 Getting Started Complete

That completes this tutorial. The user may now power down the K24 Development Kit.

To power down the board a user must HOLD the **PB7** Power Button to turn power off to the board (depending on the state of the BOARD INIT header **J14**) until the board powers down.

- When **J14** is shunted pin 2 to pin 3, the board powers up and down with the **PB7** Power Button being exercised.
- When **J14** is shunted pin 2 to pin 1, the board powers up when power is applied to the Type-C power receptacle, **J11**, and the board powers down when power is removed from the Type-C power receptable, **J11**.

5 Getting Help and Support

If additional support is required, TRIA Technologies has many avenues to search depending on your needs.

For general questions regarding K24 Development Kit, please visit our website at **http://avnet.me/k24-dk**. Here you can find any available documentation, technical specifications, videos and tutorials, reference designs and other support.

Detailed questions regarding K24 Development Kit hardware design, software application development, using AMD tools, training and other topics can be posted on the K24 Development Kit Support Forum at **http://avnet.me/k24-dk-forum**. Avnet's technical support team monitors the forum during normal business hours in North America.

Those interested in available customization options on K24 Development Kit can send inquiries to **customize@avnet.com**.