StarFive 赛昉科技

VisionFive Single Board Computer Quick Start Guide

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Legal Statements

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Preface

About this guide and technical support information.

About this document

This document mainly provides the users with the necessary information about the StarFive VisionFive development board, including features, specifications, board appearance ,and pinout, as well as the guidelines to get started with the Fedora operating system.

Revision History

Table 0-1 Revision History

Version	Released	Revision
V1.0	2021-12-08	The first official release.
V1.1	2022-03-01	• Added new steps to use Ethernet to prepare software under Windows and Mac/Linux environments in the *Software Setup* section. • Updated the Fedora image file name as `Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw.zst`. • Added steps to recover bootloader for Mac/Linux. • Updated the description in Software Setup.

Notes and notices

The following notes and notices might appear in this guide:

-  **Tip:**
  Suggests how to apply the information in a topic or step.
-  **Note:**
  Explains a special case or expands on an important point.
-  **Important:**
  Points out critical information concerning a topic or step.
-  **CAUTION:**
  Indicates that an action or step can cause loss of data, security problems, or performance issues.
-  **Warning:**
  Indicates that an action or step can result in physical harm or cause damage to hardware.

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1. Features and Specifications

VisionFive is the first generation of affordable RISC-V computers designed to run Linux. It is fully open-source with open-source software, open hardware design, and RISC-V open architecture.

It is powered by RISC-V SiFive U74 Dual-Core 64-bit RV64GC ISA SoC with 8GB LPDDR4 RAM and has rich I/O peripherals such as USB 3.0 ports, 40-pin GPIO header, Gigabit Ethernet Connector, Micro-SD card slot and much more.

VisionFive also has rich AI features with Neural Network Engine and NVDLA Engine. It has onboard audio and video processing capabilities and has MIPI-CSI and MIPI-DSI connectors for video hardware. It has wireless capabilities with Wi-Fi and Bluetooth (BLE) and has a wide software compatibility including support for Fedora.

1.1. Features

- Truly open-source hardware, software, and RISC-V open architecture
- Powerful and rich AI features with Neural Network Engine and NVDLA Engine
- Abundant I/O peripherals
- Wireless connectivity with Wi-Fi and BLE
- Onboard video and audio processing
- Wide software compatibility including support for Fedora

1.2. Specifications

Table 1-1 Specifications

Specification	Details
Processor	• RISC-V SiFive U74 Dual-Core 64-bit RV64GC ISA SoC with 2MB L2 cache @ 1.0 GHz • Vision DSP Tensilica-VP6 for computing vision @ 600MHz • NVDLA Engine (configuration 2048 MACs @ 800MHz) • Neural Network Engine (1024MACs @ 500MHz)
Memory	8GB LPDDR4
Wireless Connectivity	• 2.4 GHz Wi-Fi (IEEE 802.11b/g/n) • Bluetooth 4.2 (BLE)
Video Processing	• 2 x MIPI-CSI (up to 4K@30 fps), 1 x MIPI-DSI (up to 4K@30fps) • 1 x HDMI 2.0 (up to 1080p@60 fps display) • Video Decoder (H264/H265) up to 4K@60fps; Support Dual stream decoding for 2K@30 fps each • Dual channels of ISP, each channel support up to 4K@30FPS • Support MIPI-CSI TX for video output after ISP and AI processing • JPEG encoder/decoder
Dedicated Audio Processing DSP and Sub-system	• Ultra-low power Voice Activity Detector for audio bit-stream as a Voice Trigger • On-chip Audio DAC • Support DMIC and AMIC, up to 4 channels
Peripherals	• 4 x USB 3.0 ports • 40 Pin GPIO Header (28 x GPIO, I2C, I2S, SPI, UART)

Table 1-1 Specifications (continued)

Specification	Details
	• Gigabit Ethernet Connector • 3.5 mm Audio jack (4-pole stereo audio output) • Micro-SD card slot for system boot and data storage • Support TRNG and OTP • Support DMAC, QSPI, and other peripherals • Reset button and Power Button
Power Supply	• Minimum: 5 V / 1.5 A • Recommended: 5 V / 3 A
Power Connector	USB Type-C port or 40-pin GPIO header
Dimensions	100 mm x 72 mm

2. Hardware Overview

This chapter describes the hardware overview of VisionFive.

2.1. Board Appearance

Figure 2-1 Top View of VisionFive

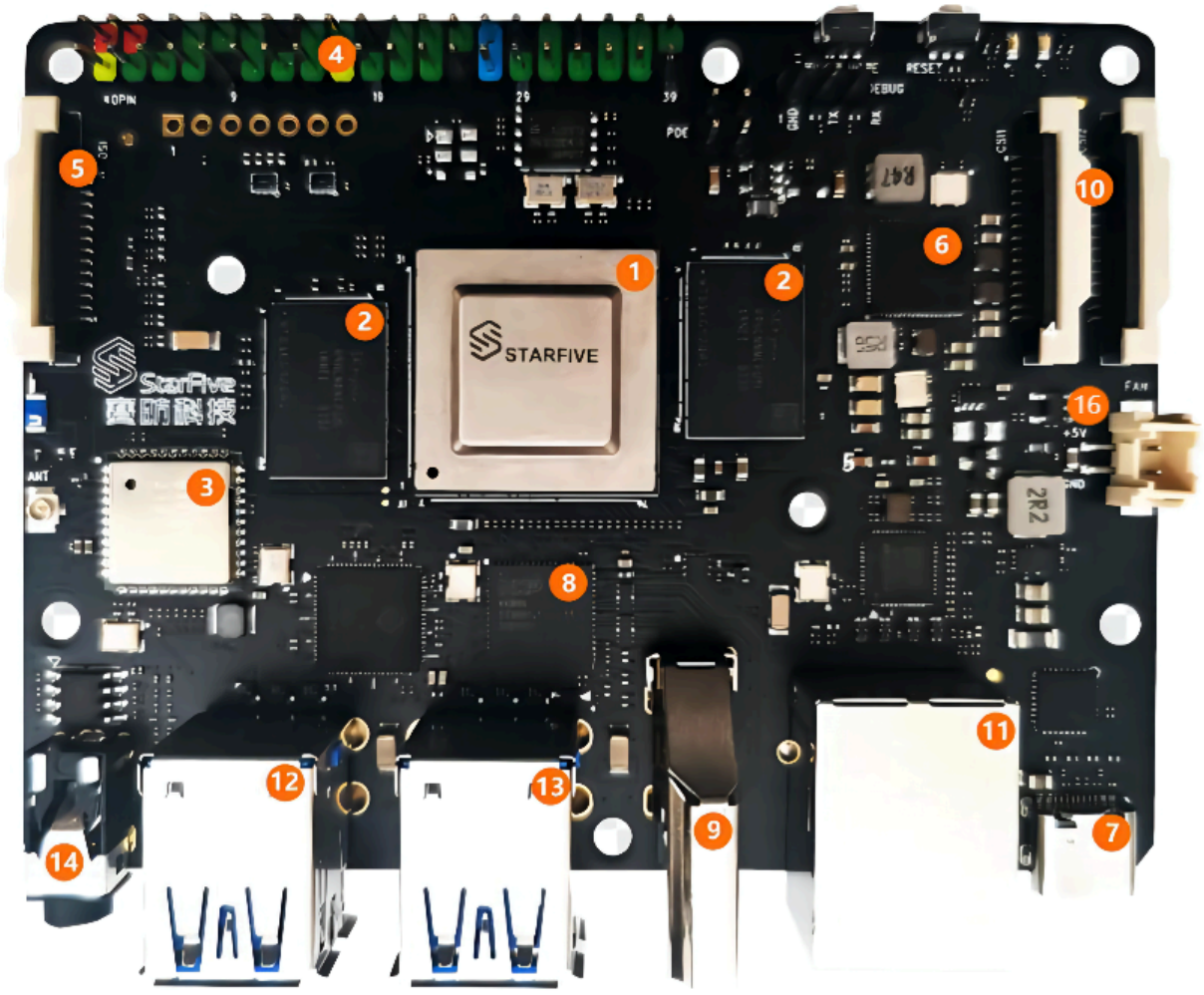


Figure 2-2 Bottom View of VisionFive

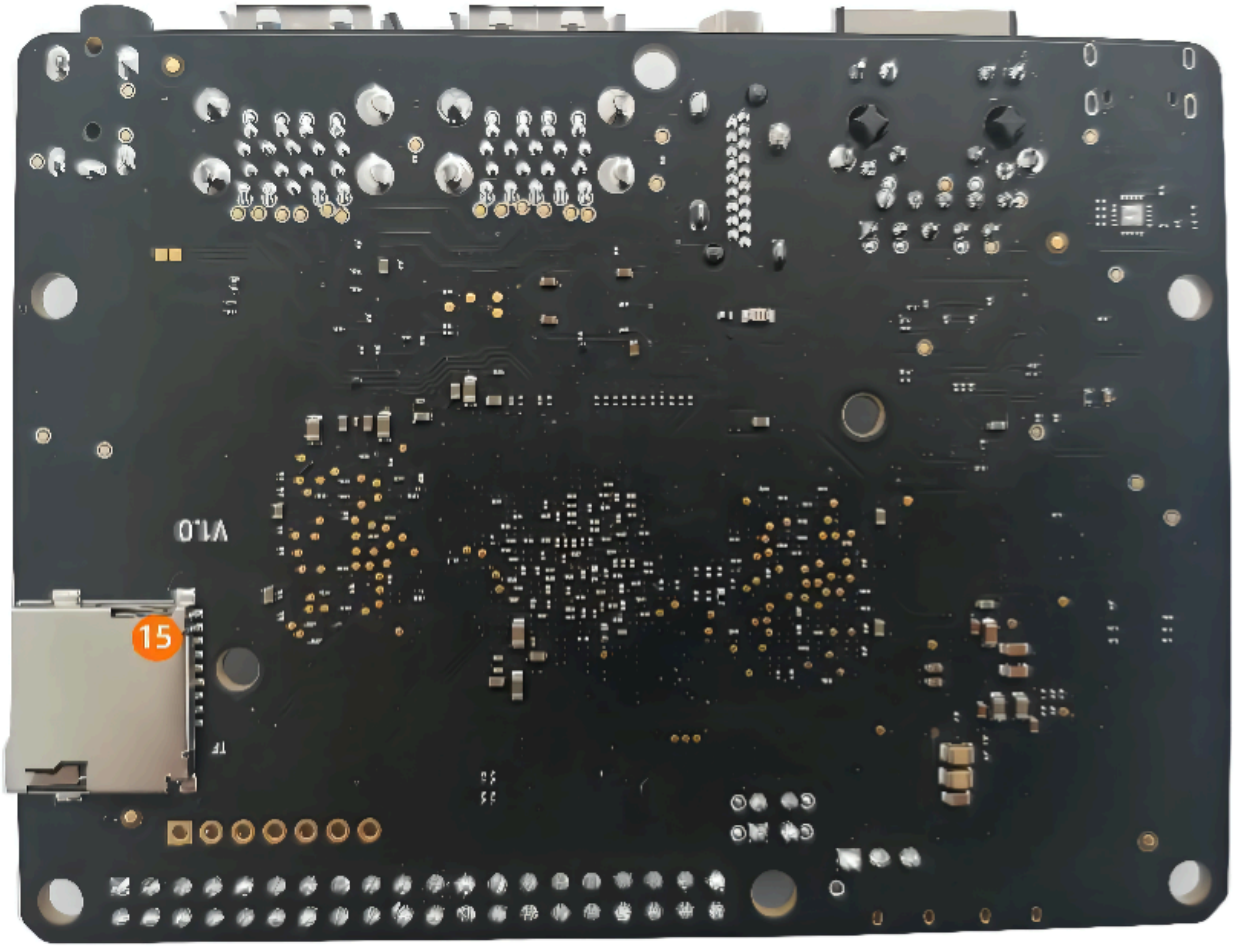


Table 2-1 Interface Description

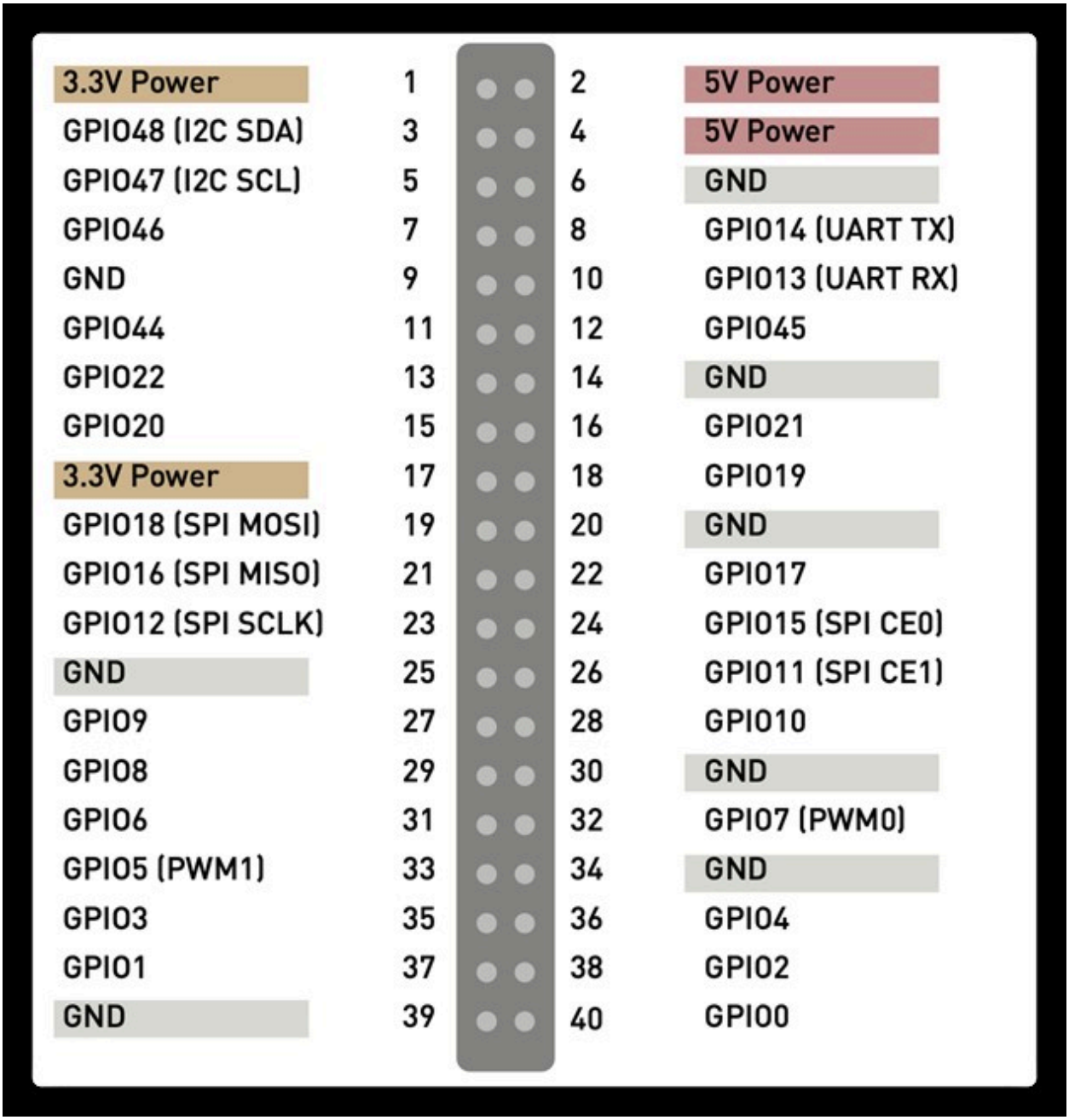
No.	Description	No.	Description
1	RISC-V SiFive U74 Dual-Core 64-bit RV64GC ISA SoC	9	HDMI 2.0 Connector
2	4 GB LPDDR4 RAM	10	2 x MIPI-CSI Connector
3	2.4 GHz Wi-Fi and Bluetooth 4.2 (BLE)	11	Gigabit Ethernet (RJ45 Connector)
4	40 Pin GPIO Header	12	2 x USB 3.0 Host Type-A
5	MIPI-DSI Connector	13	2 x USB 3.0 Host Type-A
6	PMIC	14	3.5 mm Audio Jack (4-pole stereo audio output)
7	USB Type-C Connector	15	Micro-SD SDXC Card Slot
8	LCD to HDMI IC	16	Fan Header for a 2-pin 5 V Fan

Note:
The recommended current for this board is 3 A. The reason is as the following: The onboard components need about 1 A, the 4 USB ports can draw a total of 1 A combined, one USB port alone can also draw 1 A and the remaining current is for the expansion header and others.

2.2. Pinout Diagram

The following is the pinout diagram:

Figure 2-3 Pinout Diagram



Note:

- Each GPIO pin can safely draw a maximum current of 39 mA, whereas the maximum current draw when all GPIOs are combined should be less than 100 mA. Please take this into account or otherwise, you will end up destroying the GPIO pins.
- All GPIOs can be configured to support different functions including but not limited to SDIO, Audio, SPI, I2C, UART, and PWM. For the instructions, refer to the StarFive 40-Pin GPIO Header User Guide.

3. Getting Started

This chapter provides steps to get started with VisionFive.

It contains the following sections:

- Required Hardware *(on page 13)*
- Connecting a Fan *(on page 13)*
- Flashing Fedora OS to a Micro-SD Card *(on page 14)*
- Logging in to Fedora *(on page 16)*

3.1. Required Hardware

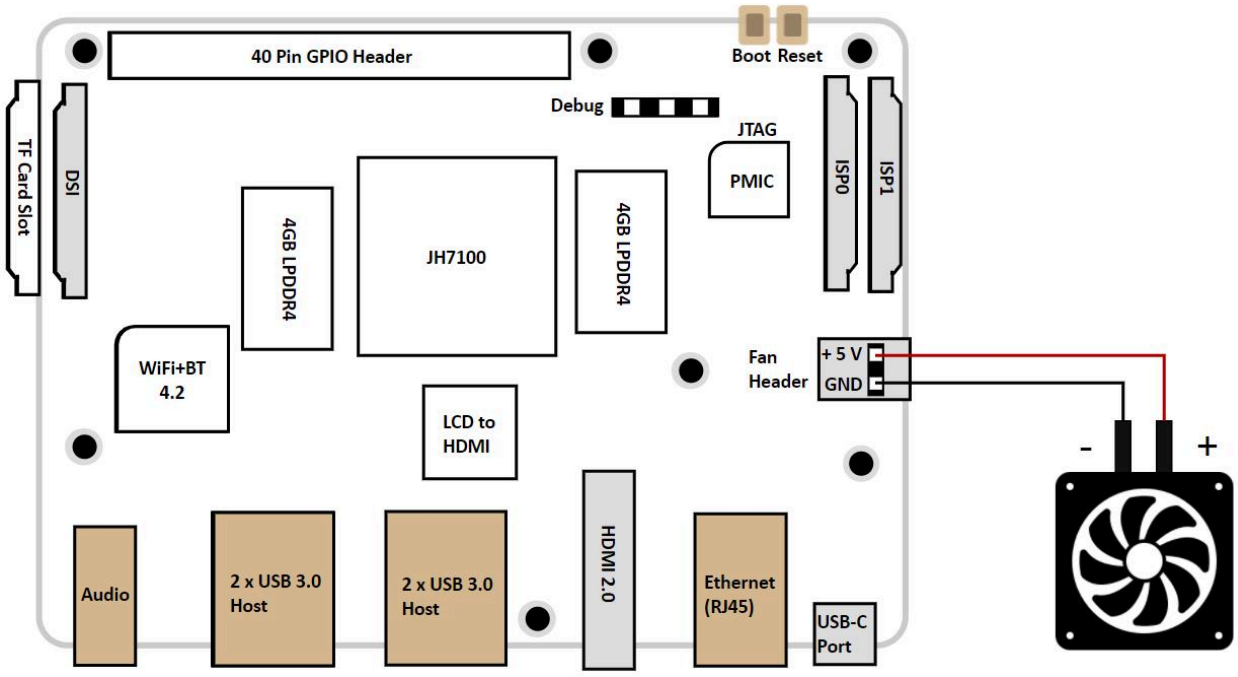
You need to prepare the following hardware before getting started with VisionFive:

- VisionFive
- 16GB (or more) micro-SD card
- micro-SD card reader
- Computer (PC/Mac/Linux)
- USB to serial converter (3.3 V I/O)
- Ethernet cable
- Power adapter (5 V / 3 A)
- USB Type-C Cable

3.2. Connecting a Fan

You can connect a 2-pin 5 V fan to the board as follows:

Figure 3-1 Connecting a Fan



3.3. Flashing Fedora OS to a Micro-SD Card

Now we need to burn Fedora (which is a Linux distribution) to a micro-SD card so that it can run on the VisionFive. Follow the steps below according to your operating system.

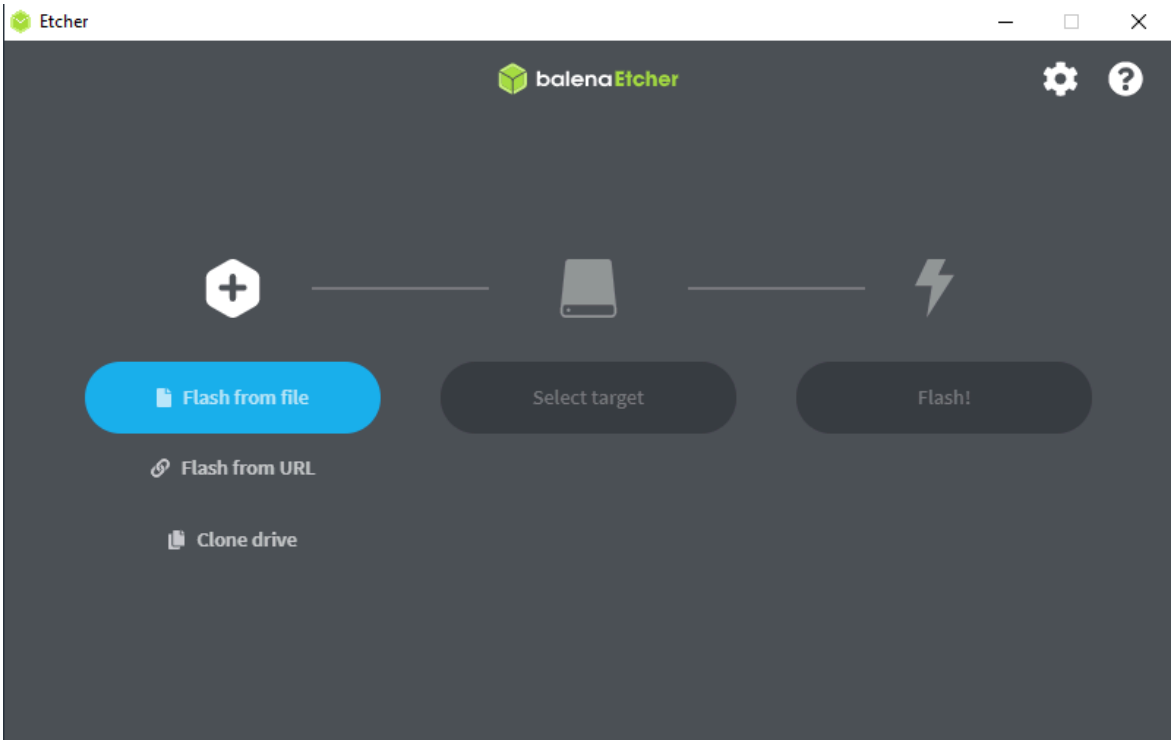
Start by downloading the Fedora image from here.

3.3.1. For Windows

1. Insert a micro-SD card to the computer through a micro-SD card reader, or by a built-in card reader on a laptop.
2. Download Zstandard-CLI software by visiting the links below:
    - Zstandard-CLI for windows 32-bit
    - Zstandard-CLI for windows 64-bit
3. Click here to visit the GitHub repo.
4. Extract the `.zip` file.
5. Copy the latest file (e.g.: `Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw.zst`) and paste it into the zstd directory that you just extracted.
6. Open **Windows Powershell** and navigate to the zstd directory.
   Example:
   ```
   cd D:\Downloads\zstd
   ```
7. Type the following command to unzip the Fedora image:
   ```
   ./zstd.exe -d Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw.zst -o
    Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw
   ```
   Result:

   Now your image file is named as `Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw`.
8. Visit this link to download BalenaEtcher. We will use BalenaEtcher software to flash the Fedora image to a micro-SD card.
9. Install BalenaEtcher and open it.

Figure 3-2 Install BalenaEtcher



10. Click on **Flash from file** and select the location of the image that we just unzipped:
    `Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw`
11. Click **Select target** and select the connected micro-SD card.
12. Click **Flash!**

3.3.2. For Mac/Linux

1. Insert a micro-SD card to the computer through a micro-SD card reader, or by a built-in card reader on a laptop.
2. Open a terminal window on Mac/Linux.
3. Type the following to update the packages list.

```
sudo apt-get update
```

> **Tip:**
> If you are a Mac user, type `brew update`.

4. Type the following to install zstd package which we will use to unzip our Fedora image file:

```
sudo apt-get install zstd
```

> **Tip:**
> If you are a Mac user, type `brew install zstd`.

5. Navigate to the location of the downloaded Fedora image directory before.

   Example Command:

```
cd Downloads/
```

6. Run the following command to unzip the Fedora image.

```
zstd -d  Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw.zst
```

7. Burn the Fedora image to the micro-SD card by running the following command.

```
sudo dd if=Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw of=/dev/sdX bs=8M
 status=progress && sync
```

Tip:

- If you are a Mac user, burn the Fedora image to the micro-SD card by running: `sudo dd if=Fedora-riscv64-jh7100-developer-xfce-Rawhide-20211226-214100.n.0-sda.raw of=/dev/sdX bs=8M && sync`
- `of=/dev/sdX` corresponds to the location of the connected micro-SD card. You can find this by running the `lsblk` command.
- The whole burning process will take about 20 minutes.

3.4. Logging in to Fedora

3.4.1. Using Xfce Desktop over HDMI

After installing Fedora, you can log in to Fedora OS on VisionFive using Xfce Desktop over HDMI.

Steps:

1. After the HDMI of the display screen is connected, insert the micro-SD card with the Fedora image into the VisionFive and power on.
2. After the desktop login system is displayed, you can use the keyboard and mouse on VisionFive.
3. Enter the credentials as follows:
   - **Username**: riscv (default)
   - **Password**: starfive

Result:

You will see the following interface:

Figure 3-3 UI Example

3.4.2. Using SSH over Ethernet

After installing Fedora, you can log in to Fedora OS on VisionFive through an SSH connection over the local network.

1. Insert the micro-SD card with the Fedora image into the VisionFive and power on.
2. Connect one end of an Ethernet cable to the RJ45 connector on the VisionFive and the other end of the cable to a router.
3. After a successful Ethernet connection, your router will assign an IP address to the VisionFive and it will be connected to the Internet.

3.4.2.1. For Windows

1. Log in to your router (usually you need to enter `192.168.1.1` on the web browser to enter the router).
2. Go to DHCP configuration and find the IP address of the VisionFive.

   Tip:
   You can easily find the IP address of the VisionFive by referring to its host name, `fedora-starfive`.

3. Download and install Putty by visiting this link.

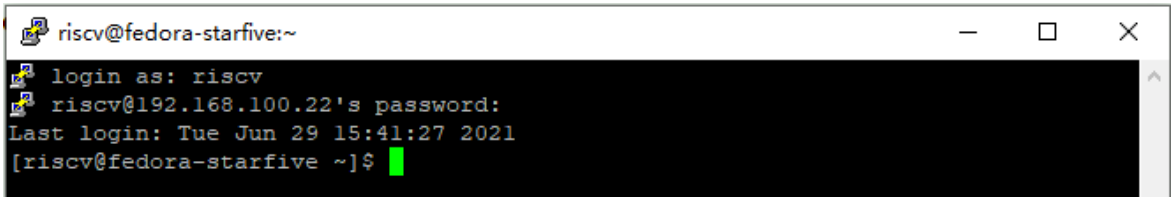
   Tip:
   Putty is an SSH and telnet client through which you can connect to the Carrier Board. You can skip this step if you already have Putty installed.

4. Open Putty to log in to Fedora.
5. Select **SSH** under the **Connection Type**.
6. Configure the settings as follows:
   - **Host Name**: IP address of your VisionFive
   - **Port**: 22
7. Click **Open**.
8. Enter the credentials as follows:
   - **Username**: riscv
   - **Password**: starfive

Result:

Now you have connected with the VisionFive via SSH using windows!

Figure 3-4 Example Output



3.4.2.2. For Mac/Linux

1. Log in to your router (usually you need to enter **192.168.1.1** on the web browser to enter the router).
2. Go to DHCP configuration and find the IP address of the VisionFive.

Tip:
You can easily find the IP address of the VisionFive by referring to its host name, **fedora-starfive**.

3. Open a terminal window and type the following:

```
ssh riscv@192.168.1.xxx
```

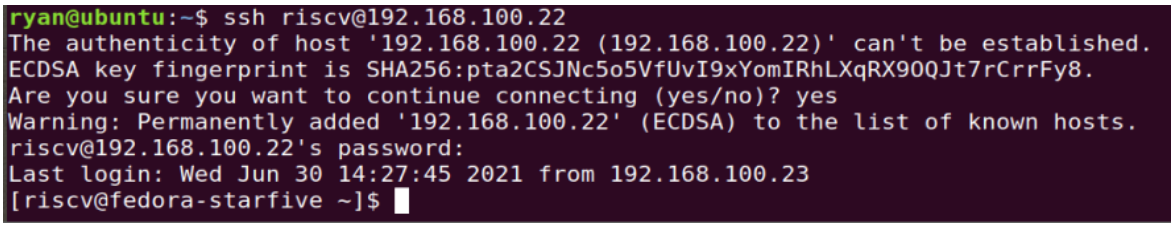
Tip:
`192.168.1.xxx` is the IP address of VisionFive.

4. Type the password as starfive in the prompt.
Result:

Now you have connected with the VisionFive via SSH using Mac/Linux!

Tip:
`192.168.1.xxx` is the IP address of VisionFive.

Figure 3-5 Example Output



3.4.3. Using a USB to Serial Converter

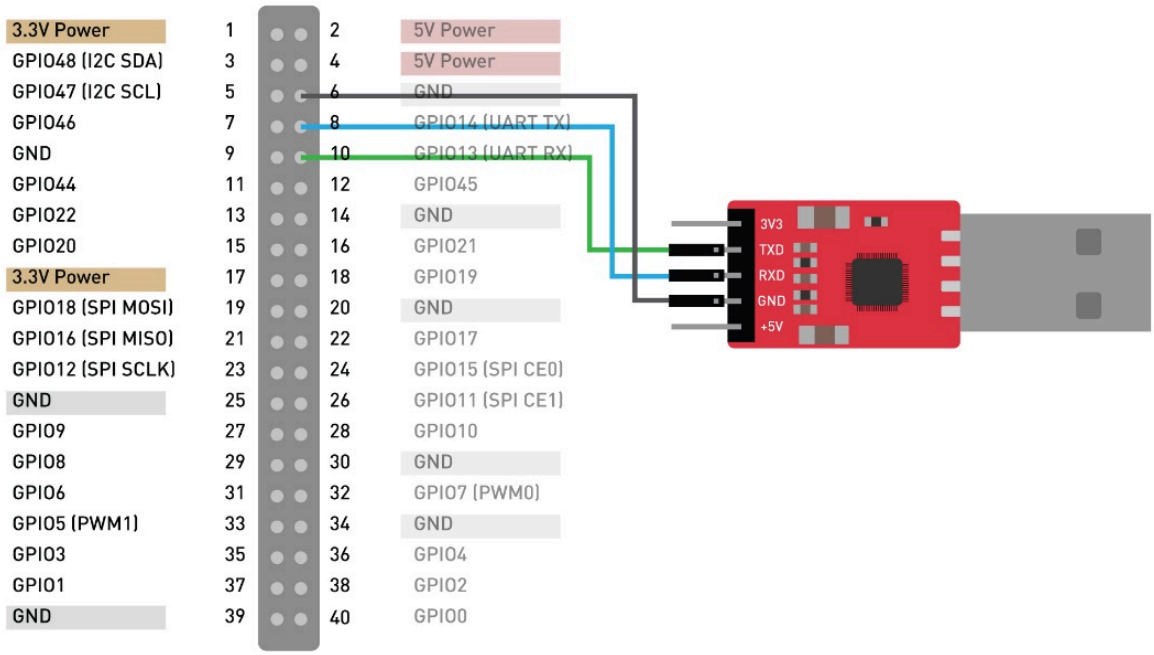
You can log in to Fedora OS on VisionFive using a USB-to-Serial converter. Please follow the following steps:

3.4.3.1. For Windows

Steps:

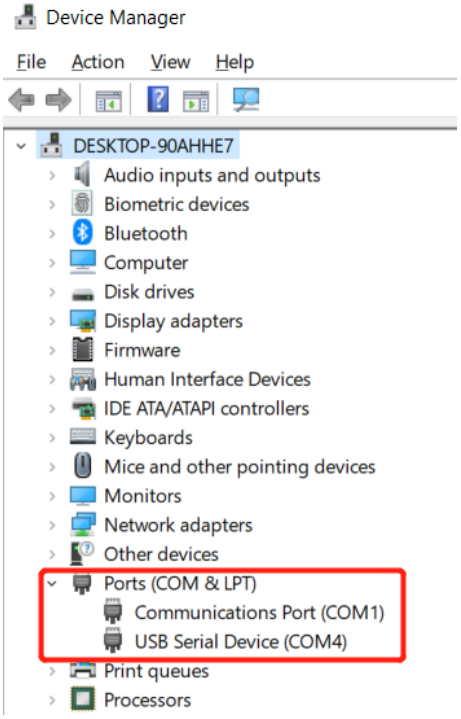
1. Insert the micro-SD card with the Fedora image burnt into VisionFive.
2. Connect one end of the USB Type-C cable to the USB Type-C port on the VisionFive, and connect the other end of the cable to the power adapter.
3. Connect the jumper wires from the USB to Serial Converter to the 40-Pin GPIO header of the VisionFive as follows.

Figure 3-6 Connecting Jumper Wire



4. Connect the USB-to-Serial converter to the PC.
5. Open Device Manager by typing **Device Manager** in the windows search box.
6. Click the drop-down arrow from **Ports (COM & LPT)** and find the name of the connected serial port (e.g.: **COM4**).

Figure 3-7 Example



7. Download and install Putty by visiting this link.

Tip:
Putty is an SSH and telnet client through which you can connect to the Carrier Board via SSH. You can skip this step if you already have Putty installed.

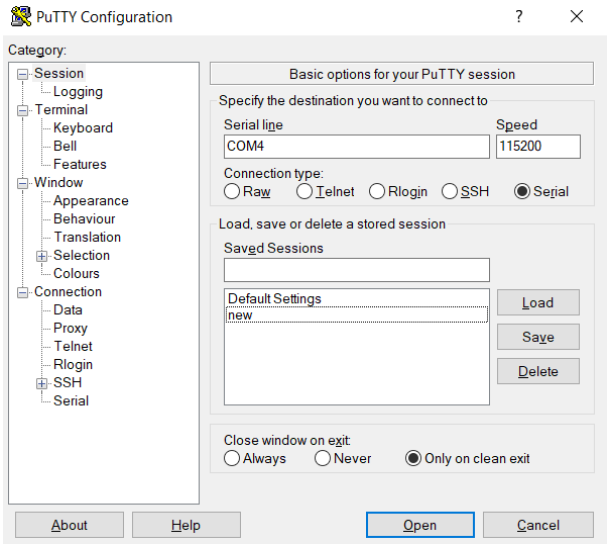
8. Open Putty to connect the PC to the Carrier Board.

    a. Select **Serial** under the **Connection Type**.

    b. Configure the settings as follows:

    - **Serial line**: COM4 (choose your COM port)
    - **Speed**: 115200

Figure 3-8 Example Configuration



    c. Click **Open**.

9. Power on the VisionFive.

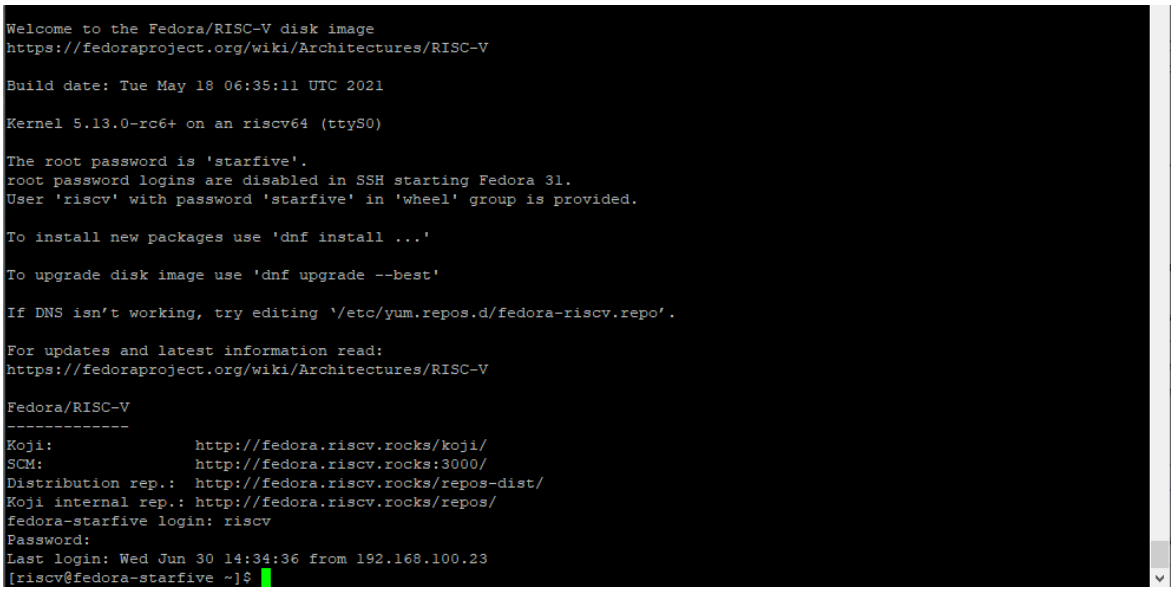
10. Type username and password in the prompt as follows:

    - **Username**: riscv
    - **Password**: starfive

Result:

Now you have connected with the VisionFive via serial communication using windows!

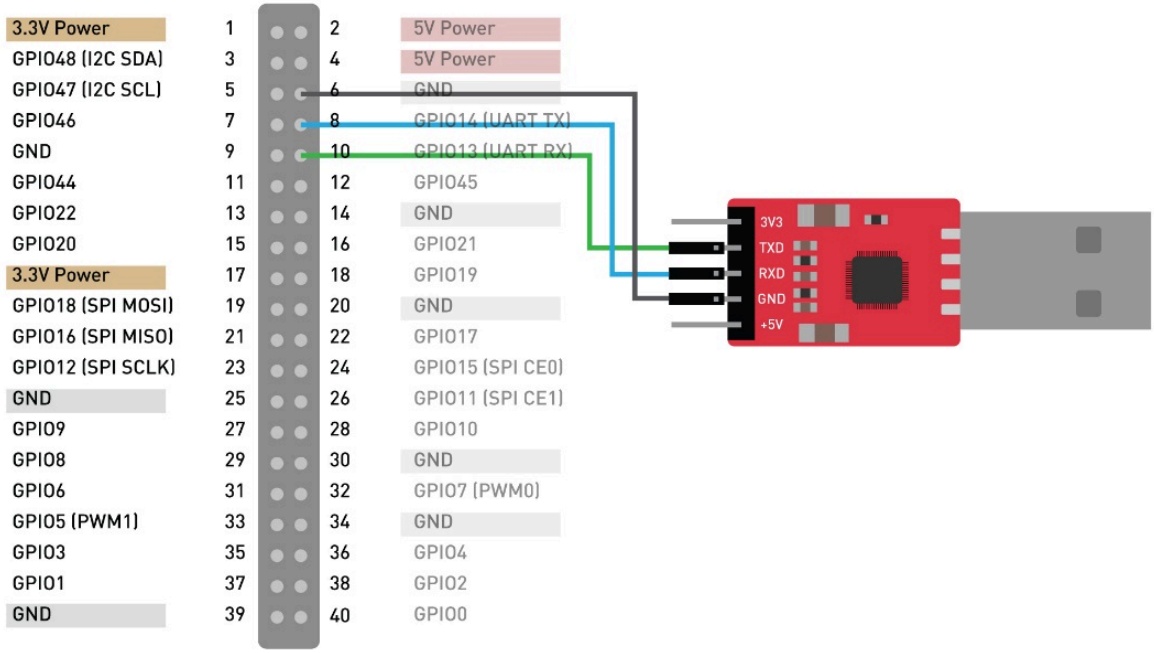
Figure 3-9 Example Output



3.4.3.2. For Mac/Linux

1. Insert the micro-SD card with the Fedora image burnt into VisionFive.
2. Connect one end of the USB Type-C cable to the USB Type-C port on the VisionFive, and connect the other end of the cable to the power adapter.
3. Connect the jumper wires between the USB-to-Serial converter and the 40-Pin GPIO header of the VisionFive as follows.

Figure 3-10 Connecting Jumper Wires



4. Connect the USB-to-Serial converter to the PC.
5. Open a terminal window on Mac/Linux.
6. Update the packages list by typing the following command.

```
sudo apt-get update
```

7. Install minicom by typing the following command.

```
sudo apt-get install minicom
```

8. View the connected serial devices.

```
dmesg | grep tty
```

Figure 3-11 Example Output

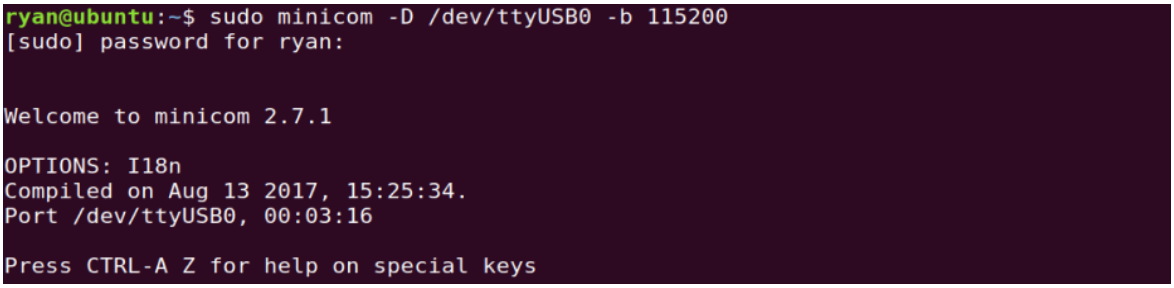
```
ryan@ubuntu:~$ dmesg |grep tty
[    1.066754] printk: console [tty0] enabled
[    2.587393] 00:05: ttyS0 at I/O 0x3f8 (irq = 4, base_baud = 115200) is a 16550A
[436488.744116] usb 3-2: pl2303 converter now attached to ttyUSB0
```

9. Connect to the serial device by typing the following command.

```
sudo minicom -D /dev/ttyUSB0 -b 115200
```

Note:
The baud rate is set to 115200.

Figure 3-12 Example Output

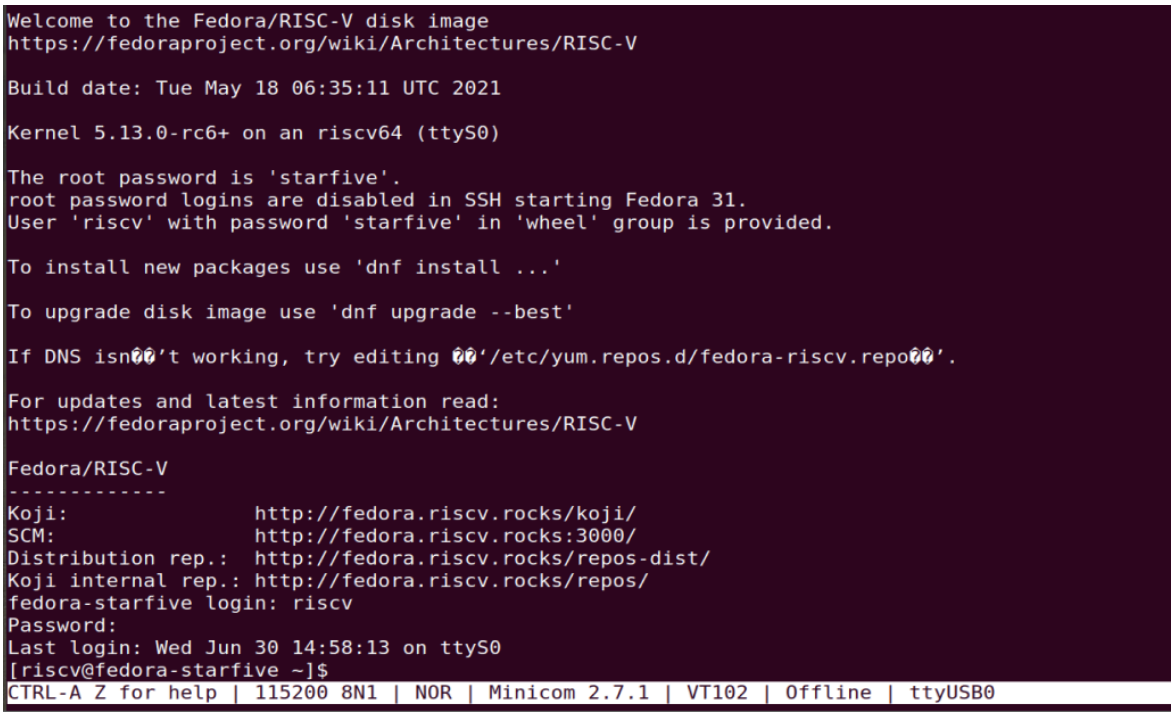


10. Power on the VisionFive.
11. Type username and password in the prompt as follows:
    - **Username**: riscv
    - **Password**: starfive

Result:

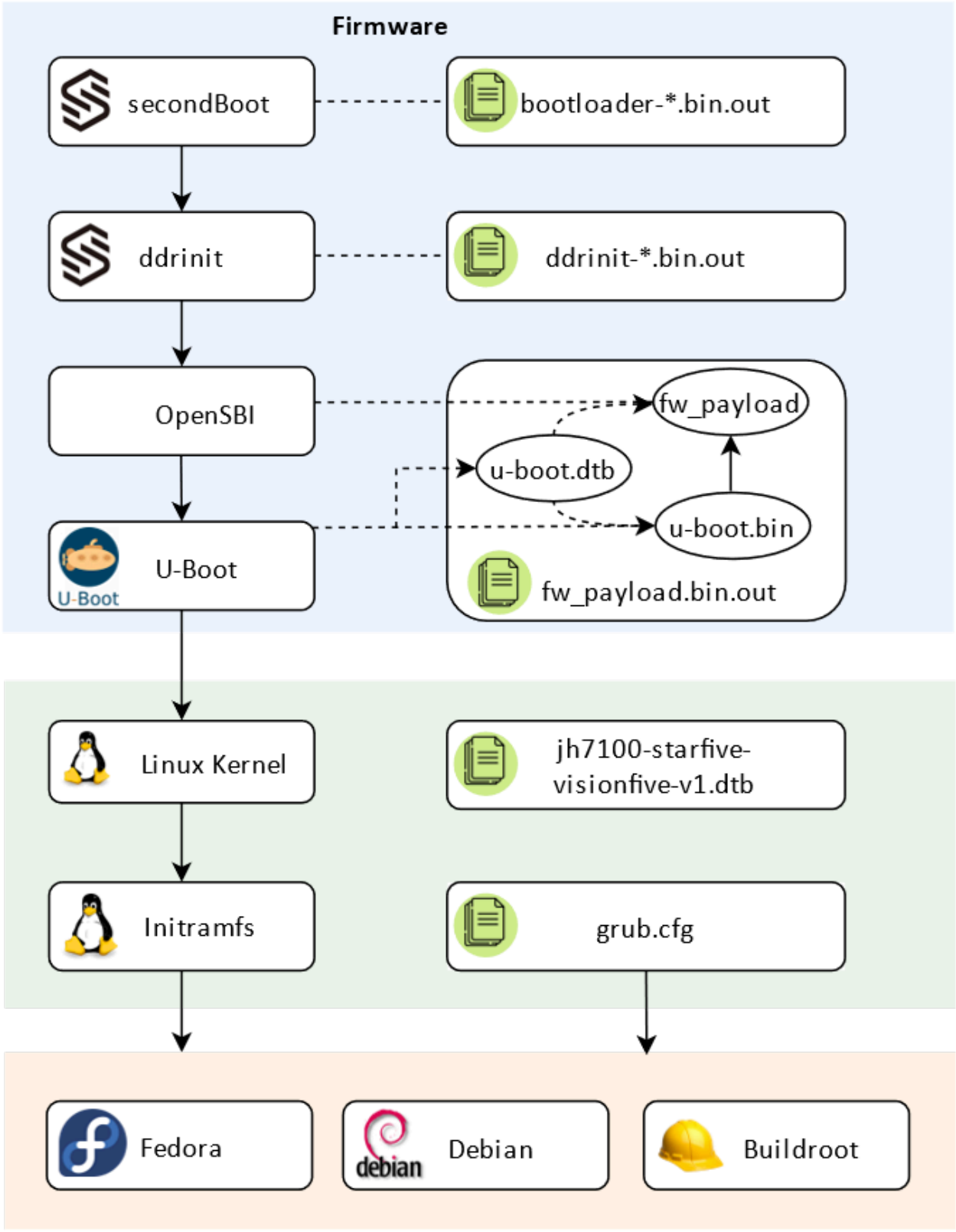
Now you have connected with the VisionFive via serial communication using Mac/Linux!

Figure 3-13 Example Output



4. Appendix A: VisionFive Boot Flow

Figure 4-1 VisionFiveBoot Flow



5. Appendix B: Updating Firmware and u-boot

This chapter provides steps to update firmware and u-boot.

It contains the following sections:

- Using Pre-Built Binary Packages *(on page 24)*
- Hardware Connection *(on page 24)*
- Software Setup *(on page 25)*

5.1. Using Pre-Built Binary Packages

Tip:

Follow the GitHub repo. Update the firmware and U-Boot if there is an update notice. Refer to the Appendix D: GitHub Repository *(on page 43)* chapter in this document for the link to the repo.

Please visit the following links to download the bootloader, ddr init and u-boot files.

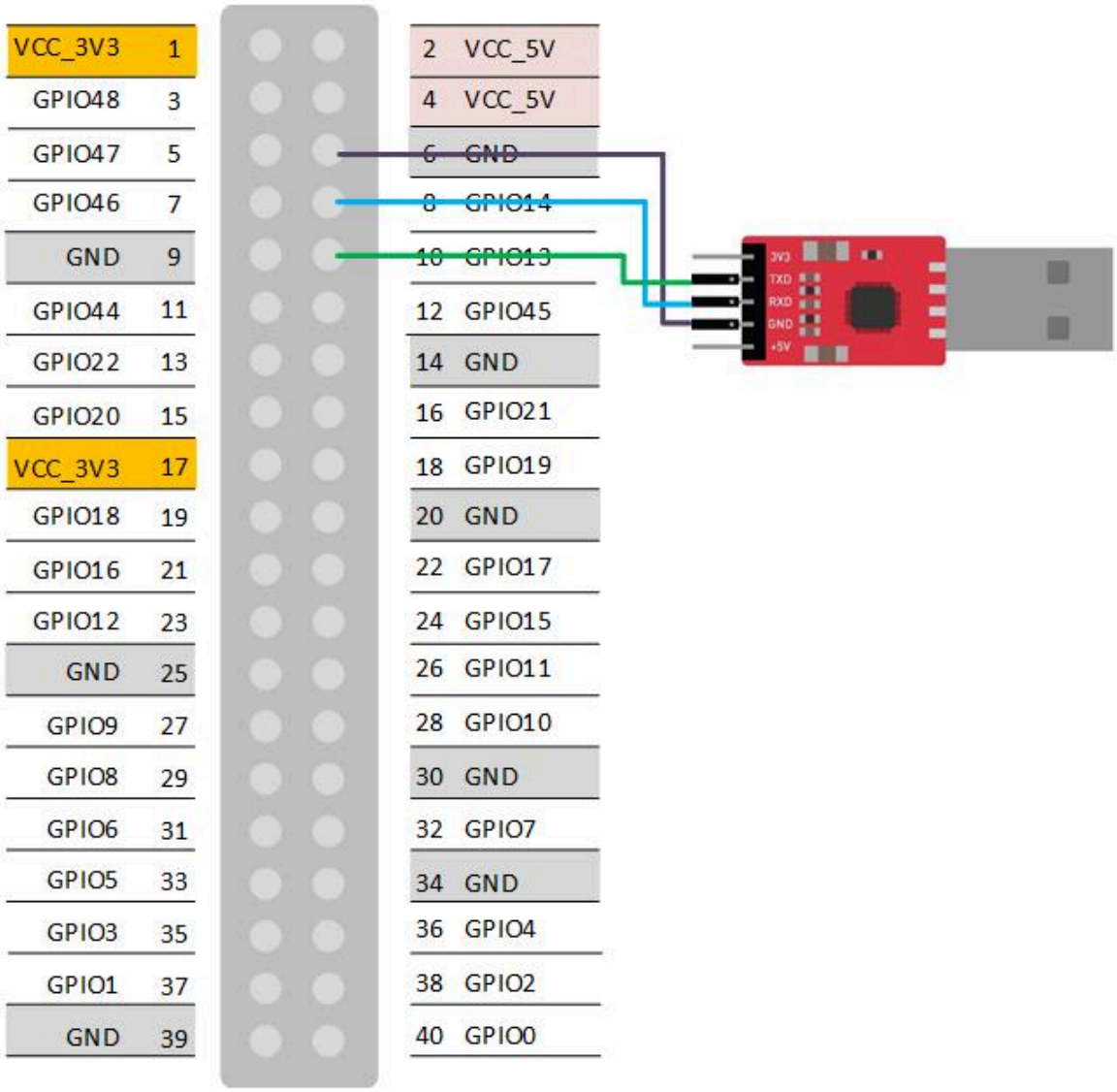
- bootloader
- ddr init
- u-boot

5.2. Hardware Connection

To connect hardware, perform the following:

1. Connect one end of the USB Type-C cable to the USB Type-C port on the VisionFive, and connect the other end of the cable to the power adapter.
2. Connect the jumper wires between the USB-to-Serial converter and the 40-Pin GPIO header of the VisionFive as follows.

Figure 5-1 Connecting the Jumper Wires



3. Connect the power adapter to a power socket.

5.3. Software Setup

Before you update the Bootloader, ddr init and u-boot, you need to have a serial communication software on your computer to communicate with the VisionFive.

Follow the steps below according to your operating system.

For Windows:

1. Install Tera Term for windows as described in Installing Tera Term *(on page 26)*.
2. Update bootloader, `u-boot`, and `ddr init` by:
    - using Xmodem as described in the Using Xmodem *(on page 27)* section.
    - or using Ethernet as described in the Using Ethernet *(on page 28)* section.

For Mac/Linux:

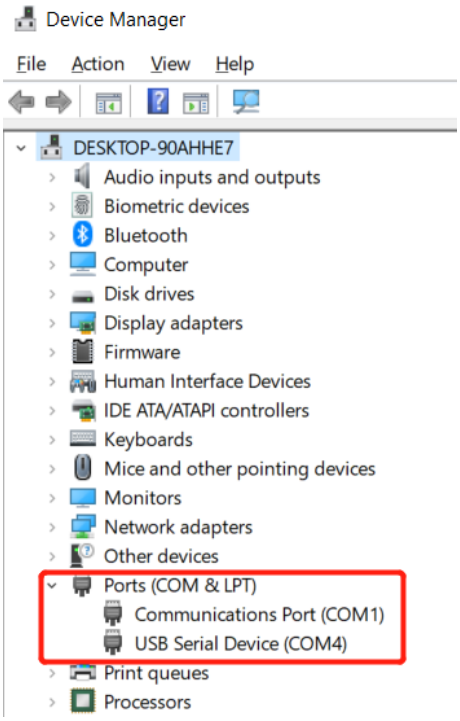
1. Install minicom on Mac/Linux as described in Installing Minicom *(on page 31)*.
2. Update `bootloader`, `u-boot`, and `ddr init` by:
    - using Xmodem as described in the Using Xmodem *(on page 32)* section.
    - or using Ethernet as described in the Using Ethernet *(on page 34)* section.

5.3.1. For Windows

5.3.1.1. Installing Tera Term

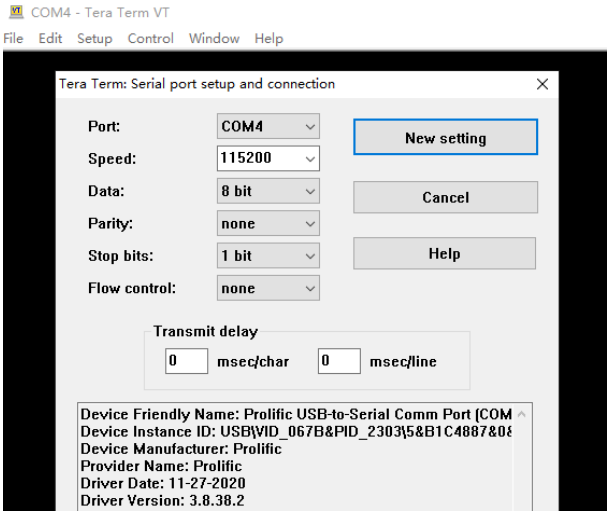
1. Download Tera Term by visiting this link.
2. Install Tera Term on the PC.
3. Connect the USB-to-Serial converter to the PC.
4. Open Device Manager by typing **Device Manager** in the windows search box.
5. Click the drop-down arrow from **Ports (COM & LPT)** and find the name of the connected serial port (e.g.: **COM4**).

Figure 5-2 Example



6. Open Tera Term software.
7. Navigate to **Setup > Serial port ...**
8. Configure the settings as follows:

- **Port**: COM4 (choose your COM port)
- **Speed**: 115200 **Figure -**
- **Figure 5-3 Example**

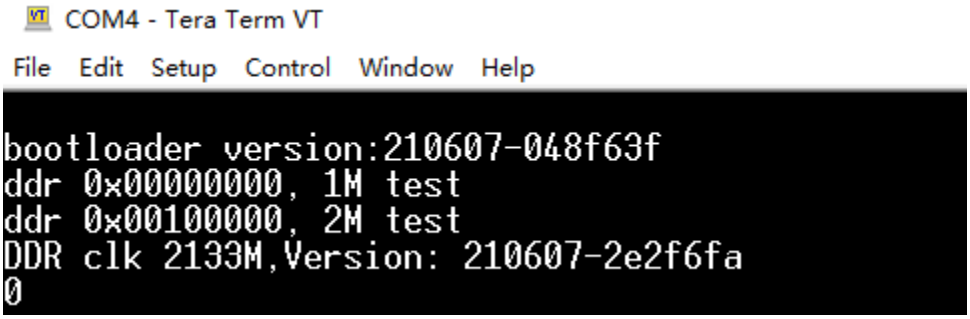


9. Click **New > open**.

5.3.1.2. Using Xmodem

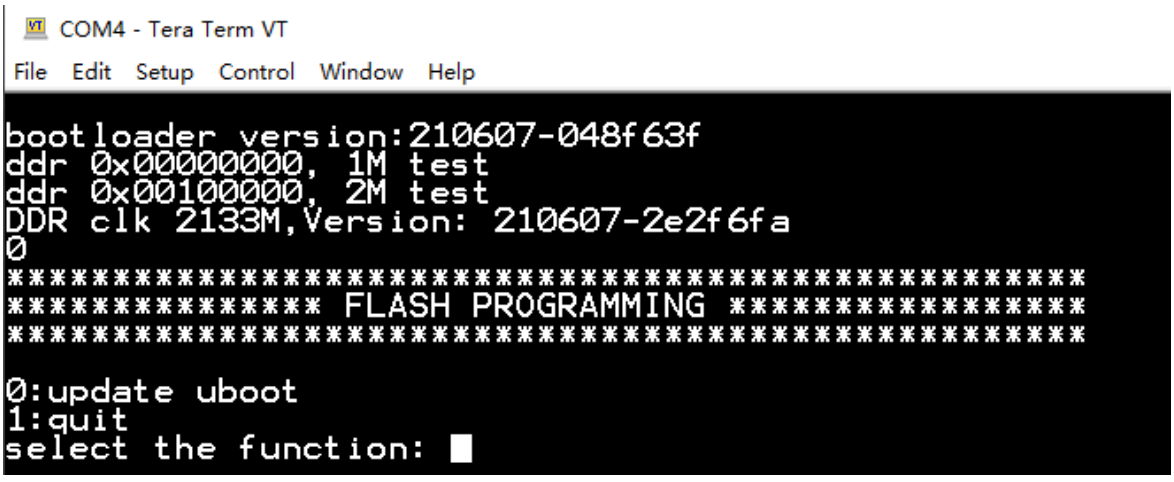
1. After the hardware connections mentioned above, power on the VisionFive and you will see the startup information as follows.

Figure 5-4 Startup Information Example



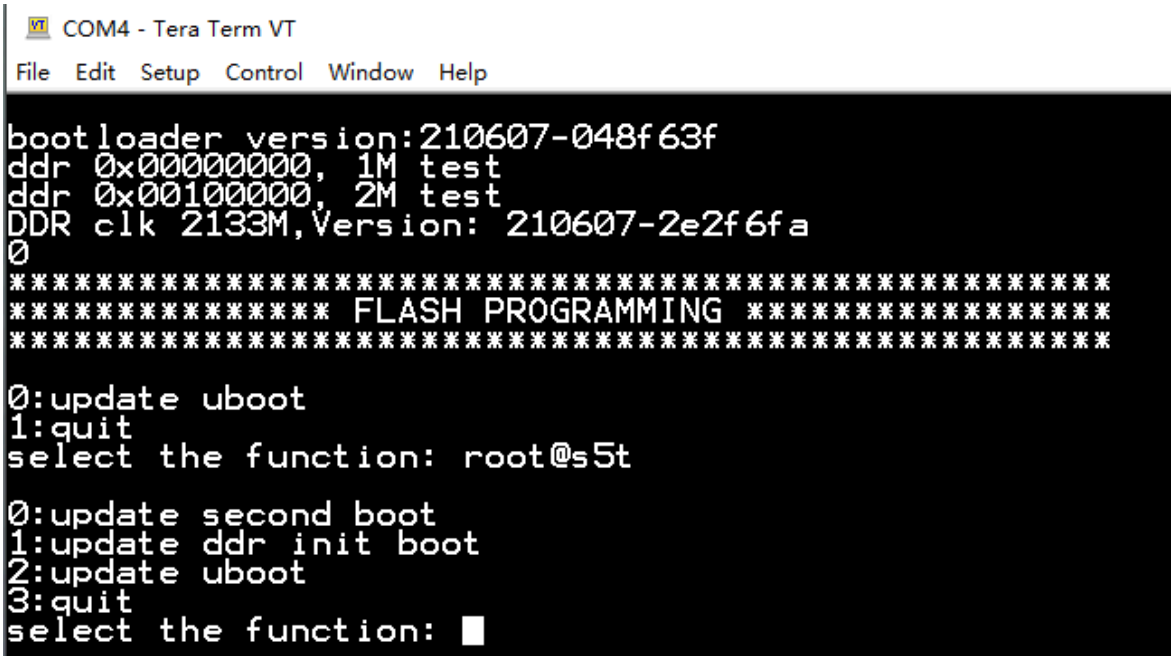
2. Press any key as soon as it starts up to enter the **upgrade menu**. In this menu, you can only update u-boot.

Figure 5-5 Update Uboot



3. Type `root@s5t` and press `Enter` to enter the extended version of the upgrade menu. In this menu, you can update u-boot, bootloader, and ddr init.

Figure 5-6 Example Output

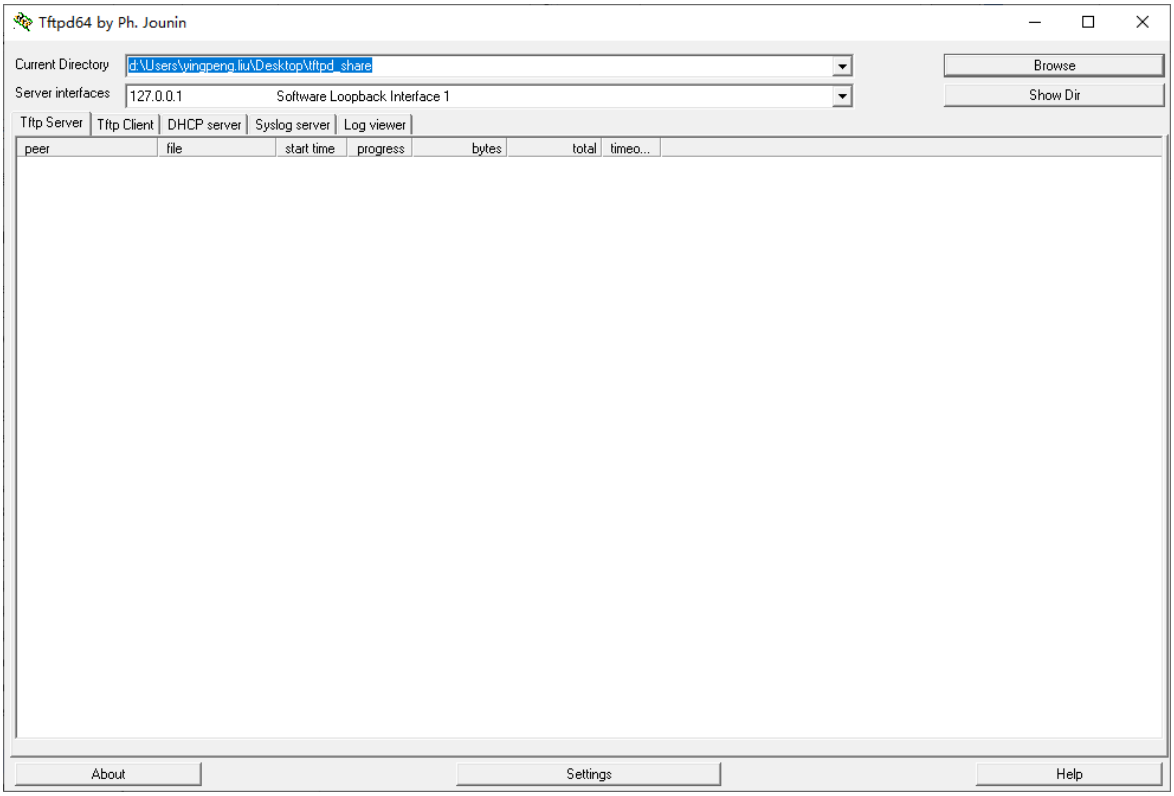


4. Type **0** and press `Enter` to update the bootloader.
5. Navigate to **File > Transfer > XMODEM > Send...** and choose the `.out` file from the `.zip` file we downloaded before: `bootloader-JH7100-211102.bin.out`.
6. Repeat the Step 4 *(on page 28)* and 5 *(on page 28)* to update the ddr init as well according to the following:
    - Type **1** - update ddr init [Filename: `ddrinit-2133-211102.bin.out`]
7. Repeat the Step 4 *(on page 28)* and 5 *(on page 28)* to update the u-boot as well according to the following:
    - Type **2** - update u-boot [Filename: `fw_payload.bin.out`]

5.3.1.3. Using Ethernet

1. Connect one end of an Ethernet cable to the VisionFive RJ45 connector, and connect the other end of the cable to a router.
2. Download TFTPD64 from tftpd64.
3. Install TFTPD64 on your PC.
4. Open TFTPD64 and configure the **Current Directory**, which specifies the file path to store `bootloader`, `ddr init`, and `u-boot` files. The following figure shows an example configuration:

Figure 5-7 Example Settings



5. Power on the VisionFive and wait until it enters the u-boot mode.
6. Configure the environment variables by executing:

```
setenv ipaddr 192.168.120.200;setenv serverip 192.168.120.12
```

Note:
Generally, the default IP of a router is 192.168.120.1. In this case, use the server IP as the IP assigned by the DHCP server of the router and use the VisionFive IP as 192.168.120.xxx. However, if your router IP is different (for example, 192.168.2.1), make sure the server IP and VisionFive IP are in the same IP domain (for example, 192.168.2.xxx).

7. Check the connectivity by pinging the host PC from VisionFivee:

Example Command:

```
ping 192.168.120.12
```

Result: The following output indicates that the host PC and VisionFive have established communication on the same network.

Figure 5-8 Example Output

```
VisionFive #ping 192.168.120.12
Speed: 1000, full duplex
Using dwmac.10020000 device
host 192.168.120.12 is alive
VisionFive #
```

8. Connect to SPI Flash:

```
sf probe
```

Figure 5-9 Example Output

```
VisionFive #sf probe
SF: Detected gd25lq128 with page size 256 Bytes, erase size 4 KiB, total 16 MiB
```

Tip:

- In the commands of the following Step 9 *(on page 30)* to 11 *(on page 30)*:
  - `0x90000000` refers to the ddr address
  - `192.168.120.12` refers to the TFTP server IP
  - `0x0` refers to the SPI flash offset for `bootloader`.
  - `0x10000` refers to the SPI flash offset for `ddrinit`.
  - `0x40000` refers to the SPI flash offset for `u-boot`.
- If VisionFive fails to boot up after restart, refer to the Appendix C: Recovering the Bootloader *(on page 38)* chapter to recover.

9. Update `bootloader`:

```
tftpboot 0x90000000 192.168.120.12:bootloader-JH7100-211102.bin.out
sf update 0x90000000 0x0 ${filesize}
```

Figure 5-10 Example Output:

```
VisionFive #tftpboot 0x90000000 192.168.120.12:bootloader-JH7100-211102.bin.out
Speed: 1000, full duplex
Using dwmac.10020000 device
TFTP from server 192.168.120.12; our IP address is 192.168.120.200
Filename 'bootloader-JH7100-211102.bin.out'.
Load address: 0x90000000
Loading: ##################################################  9.2 KiB
         485.4 KiB/s
done
Bytes transferred = 9456 (24f0 hex)
VisionFive #sf update 0x90000000 0x0 ${filesize}
device 0 offset 0x0, size 0x24f0
0 bytes written, 9456 bytes skipped in 0.3s, speed 1613824 B/s
VisionFive #
```

10. Update `ddr init`:

```
tftpboot 0x90000000 192.168.120.12:ddrinit-2133-211102.bin.out
sf update 0x90000000 0x10000 ${filesize}
```

Figure 5-11 Example Output

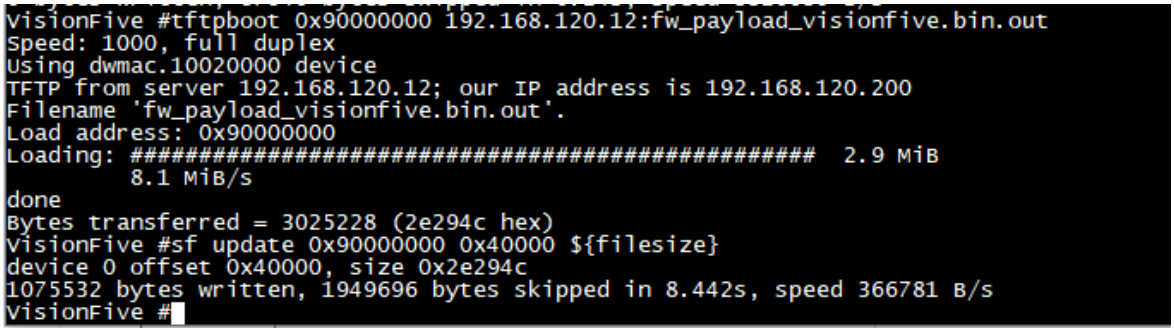
```
VisionFive #tftpboot 0x90000000 192.168.120.12:ddrinit-2133-211102.bin.out
Speed: 1000, full duplex
Using dwmac.10020000 device
TFTP from server 192.168.120.12; our IP address is 192.168.120.200
Filename 'ddrinit-2133-211102.bin.out'.
Load address: 0x90000000
Loading: ##################################################  85.5 KiB
         3.5 MiB/s
done
Bytes transferred = 87540 (155f4 hex)
VisionFive #sf update 0x90000000 0x10000 ${filesize}
device 0 offset 0x10000, size 0x155f4
0 bytes written, 87540 bytes skipped in 0.24s, speed 3320035 B/s
VisionFive #
```

11. Update `u-boot`:

```
tftpboot 0x90000000 192.168.120.12:fw_payload_visionfive.bin.out
sf update 0x90000000 0x40000 ${filesize}
```

Example Output:

Figure 5-12 Example Output



12. Restart VisionFive to make the updates take effect.

5.3.2. For Mac/Linux

5.3.2.1.Installing Minicom

1. Open a terminal window on Mac/Linux.
2. Type the following to update the packages list.

```
sudo apt-get update
```

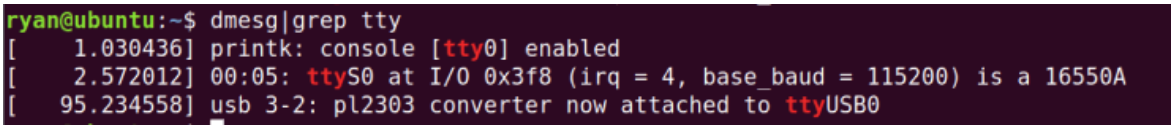
3. Type the following to install minicom.

```
sudo apt-get install minicom
```

4. Connect the USB-to-Serial converter to the PC.
5. Type the following in the terminal to view the connected serial devices.

```
dmesg | grep tty
```

Figure 5-13 Example Output



6. Connect to the serial device by typing the following.

```
sudo minicom -D /dev/ttyUSB0 -b 115200
```

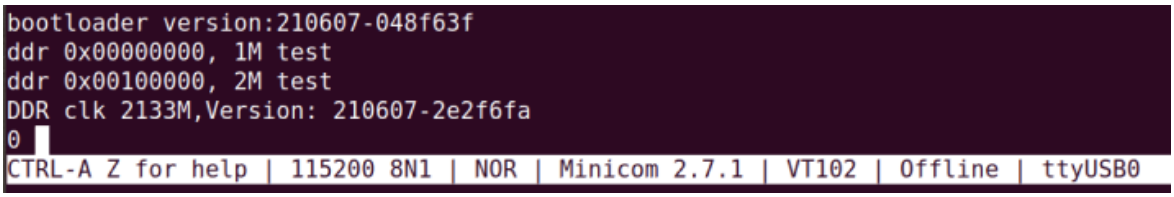
Tip:
The baud rate is set to 115200.

Figure 5-14 Example

5.3.2.2. Using Xmodem

1. After the hardware connections mentioned above, power on the VisionFive and you will see the startup information as follows.

   Figure 5-15 Example

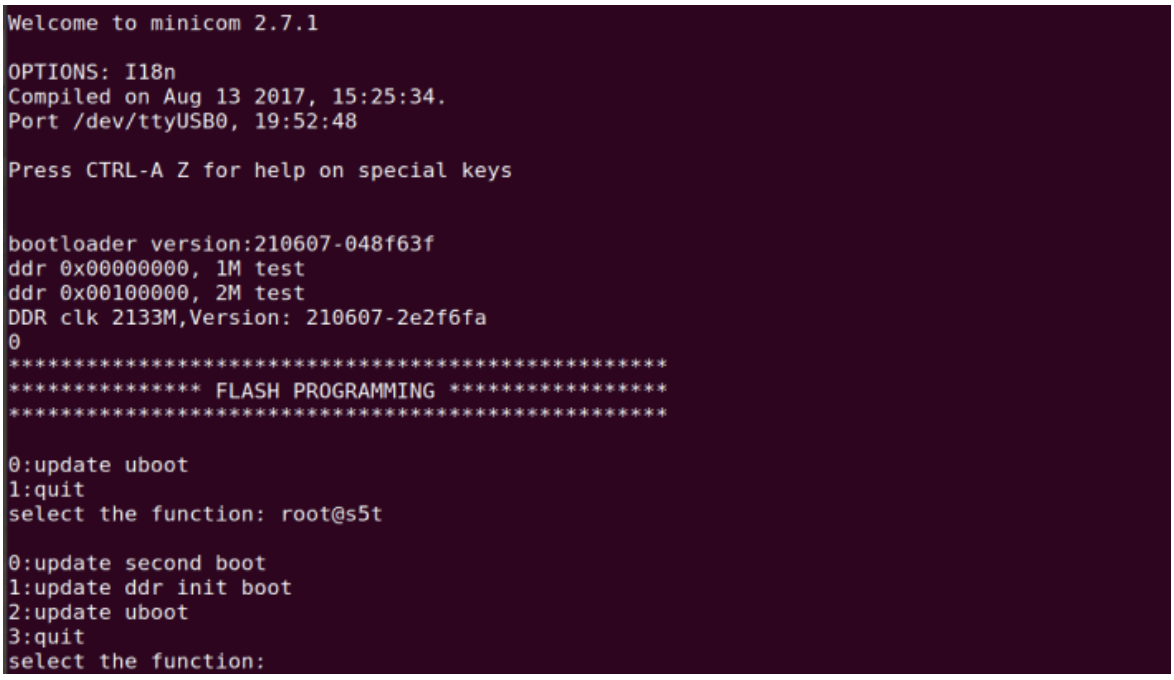


2. Press any key as soon as it starts up to enter the **upgrade menu**. In this menu, you can only update u-boot.

   Figure 5-16 Example

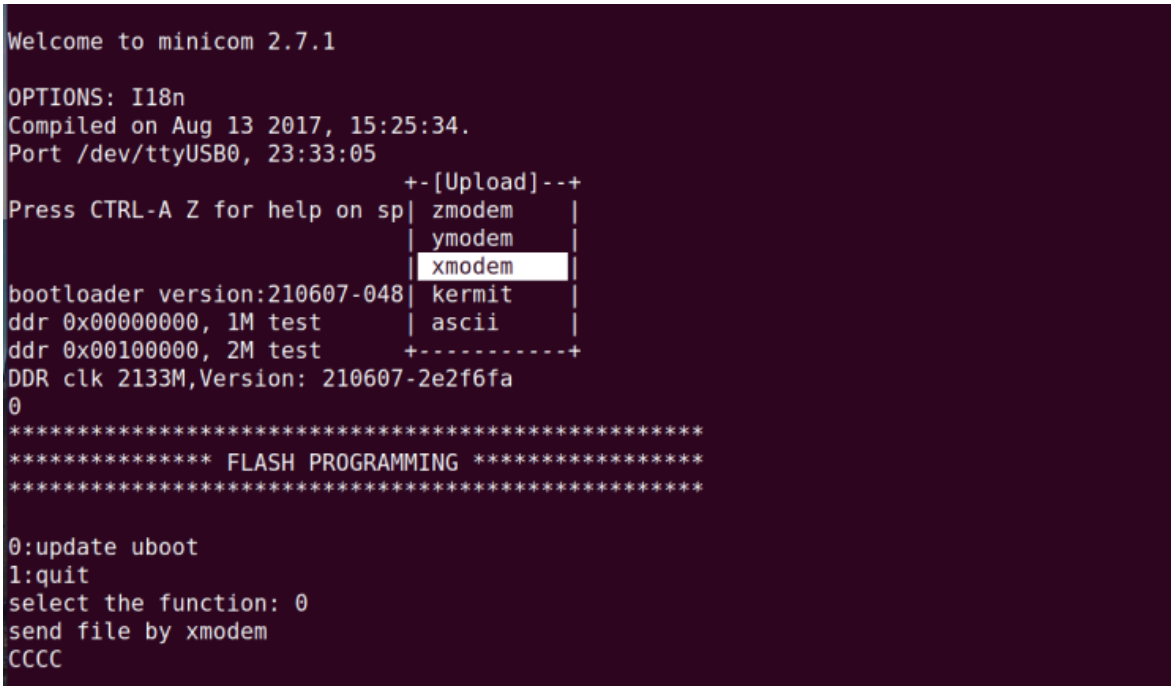
3. Type **root@s5t** and press **Enter** to enter the extended version of the upgrade menu, and in this menu, you can update u-boot, bootloader, and ddr init.

   Figure 5-17 Example



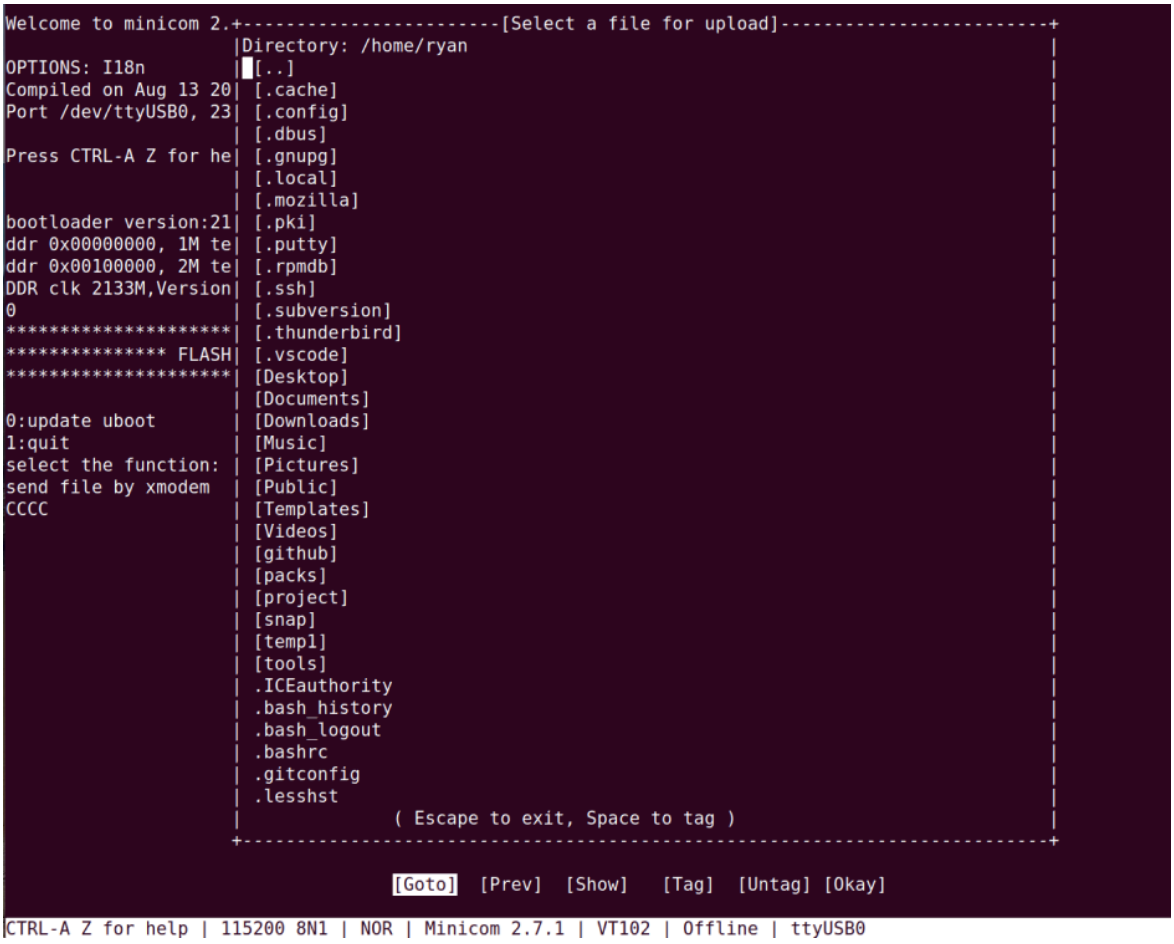
4. Type `0` and press `Enter` to update the bootloader.
5. Press `Ctrl+A` and then press `S` to enter **upload mode**.
6. Select **xmodem** and press **Enter**.

Figure 5-18 Example



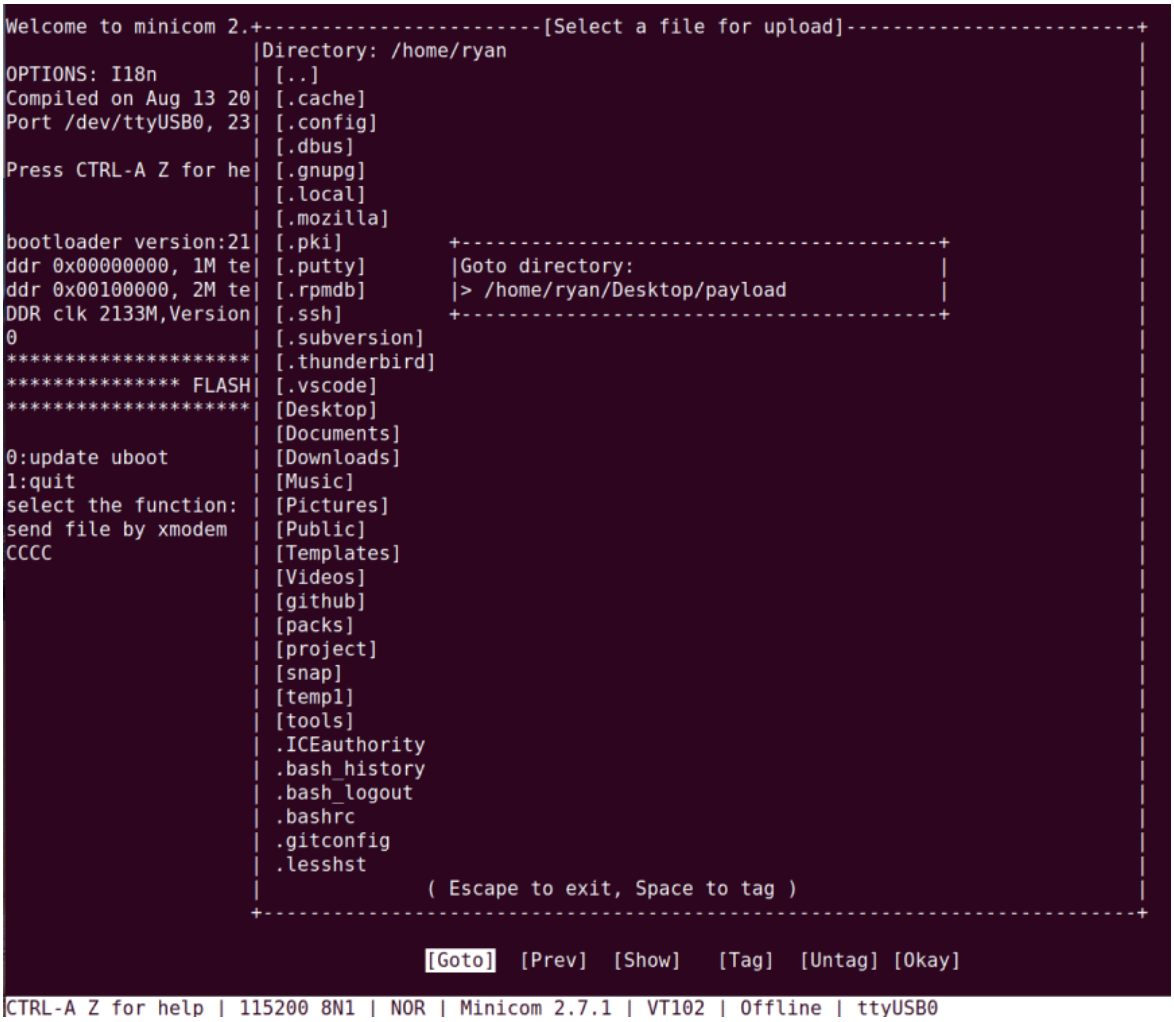
7. Select **Goto** from the bottom tab menu and press **Enter**.

Figure 5-19 Example



8. Enter the directory path and press `Enter`.

Figure 5-20 Example



9. Select `bootloader-JH7100-211102.bin.out` by navigating using `arrow keys`, press `Space` and press `Enter`.
10. Repeat the steps from 4 *(on page 32)* to 9 *(on page 34)* to update the ddr init as well according to the following:
    - Type **1** - update ddr init [Filename: `ddrinit-2133-211102.bin.out`]
11. Repeat the steps from 4 *(on page 32)* to 9 *(on page 34)* to update the u-boot as well according to the following:
    - Type **2** - update u-boot [Filename: `fw_payload.bin.out`]

5.3.2.3. Using Ethernet

1. Connect one end of an Ethernet cable to the VisionFive RJ45 connector, and connect the other end of the cable to a router.
2. Install a TFTP server on the host PC by executing:

```
sudo apt-get update
sudo apt install tftpd-hpa
```

3. Check the server status:

```
sudo systemctl status tftpd-hpa
```

4. Execute the following to enter the TFTP server:

```
sudo nano /etc/default/tftpd-hpa
```

5. Configure the TFTP server as follows:

```
TFTP_USERNAME="tftp"
TFTP_DIRECTORY="/home/user/Desktop/tftp_share"
TFTP_ADDRESS=":69"
TFTP_OPTIONS="--secure"
```

Note:
TFTP_DIRECTORY refers to the directory to store `bootloader`, `ddr init`, and `u-boot` files.

6. Restart the TFTP server by executing:

```
sudo systemctl restart tftpd-hpa
```

7. Power on the VisionFive and wait until it enters the u-boot mode.
8. Configure the environment variables by executing:

```
setenv ipaddr 192.168.120.200;setenv serverip 192.168.120.12
```

Note:
Generally, the default IP of a router is 192.168.120.1. In this case, use the server IP as the IP assigned by the DHCP server of the router and use the VisionFive IP as 192.168.120.xxx. However, if your router IP is different (for example, 192.168.2.1), make sure the server IP and VisionFive IP are in the same IP domain (for example, 192.168.2.xxx).

9. Check the connectivity by pinging the host PC from VisionFive:

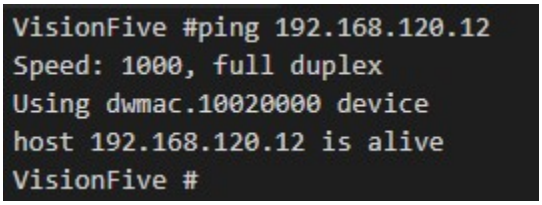
Example Command:

```
ping 192.168.120.12
```

Result:

The following output indicates that the host PC and VisionFive have established communication on the same network.

Figure 5-21 Example Output

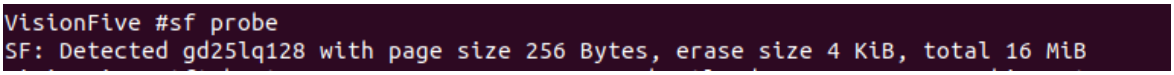


10. Connect to SPI Flash:

```
sf probe
```

Example Output:

Figure 5-22 Example Output



Tip:

- In the commands of the following Step 11 to 14:
  - `0x90000000` refers to the ddr address
  - `192.168.120.12` refers to the TFTP server IP
  - `0x0` refers to the SPI flash offset for `bootloader`.

- `0x10000` refers to the SPI flash offset for `ddrinit`.
- `0x40000` refers to the SPI flash offset for `u-boot`.

◦ If VisionFive fails to boot up after restart, refer to the Appendix C: Recovering the Bootloader *(on page 38)* chapter to recover.

11. Update `bootloader`:

```
tftpboot 0x90000000 192.168.120.12:bootloader-JH7100-211102.bin.out
sf update 0x90000000 0x0 ${filesize}
```

Example Output:

Figure 5-23 Example Output

```
VisionFive #tftpboot 0x90000000 192.168.120.12:bootloader-JH7100-211102.bin.out
Speed: 1000, full duplex
Using dwmac.10020000 device
TFTP from server 192.168.120.12; our IP address is 192.168.120.200
Filename 'bootloader-JH7100-211102.bin.out'.
Load address: 0x90000000
Loading: #################################################  9.2 KiB
         1.3 MiB/s
done
Bytes transferred = 9456 (24f0 hex)
VisionFive #sf update 0x90000000 0x0 ${filesize}
device 0 offset 0x0, size 0x24f0
0 bytes written, 9456 bytes skipped in 0.3s, speed 1613824 B/s
VisionFive #
```

12. Update `ddr init`:

```
tftpboot 0x90000000 192.168.120.12:ddrinit-2133-211102.bin.out
sf update 0x90000000 0x10000 ${filesize}
```

Example Output:

Figure 5-24 Example Output

```
VisionFive #tftpboot 0x90000000 192.168.120.12:ddrinit-2133-211102.bin.out
Speed: 1000, full duplex
Using dwmac.10020000 device
TFTP from server 192.168.120.12; our IP address is 192.168.120.200
Filename 'ddrinit-2133-211102.bin.out'.
Load address: 0x90000000
Loading: #################################################  85.5 KiB
         7 MiB/s
done
Bytes transferred = 87540 (155f4 hex)
VisionFive #sf update 0x90000000 0x10000 ${filesize}
device 0 offset 0x10000, size 0x155f4
0 bytes written, 87540 bytes skipped in 0.24s, speed 3320035 B/s
VisionFive #
```

13. Update `u-boot`:

```
tftpboot 0x90000000 192.168.120.12:fw_payload_visionfive.bin.out
sf update 0x90000000 0x40000 ${filesize}
```

Figure 5-25 Example Output

```
VisionFive #tftpboot 0x90000000 192.168.120.12:fw_payload_visionfive.bin.out
Speed: 1000, full duplex
Using dwmac.10020000 device
TFTP from server 192.168.120.12; our IP address is 192.168.120.200
Filename 'fw_payload_visionfive.bin.out'.
Load address: 0x90000000
Loading: #################################################  2.9 MiB
         8.3 MiB/s
done
Bytes transferred = 3025228 (2e294c hex)
VisionFive #sf update 0x90000000 0x40000 ${filesize}
device 0 offset 0x40000, size 0x2e294c
0 bytes written, 3025228 bytes skipped in 0.821s, speed 3759506 B/s
VisionFive #
```

14. Restart VisionFive to make the updates take effect.

Note:
The methods to compile and update u-boot are included in the VisionFive Single Board Computer Software Technical Reference Manual.

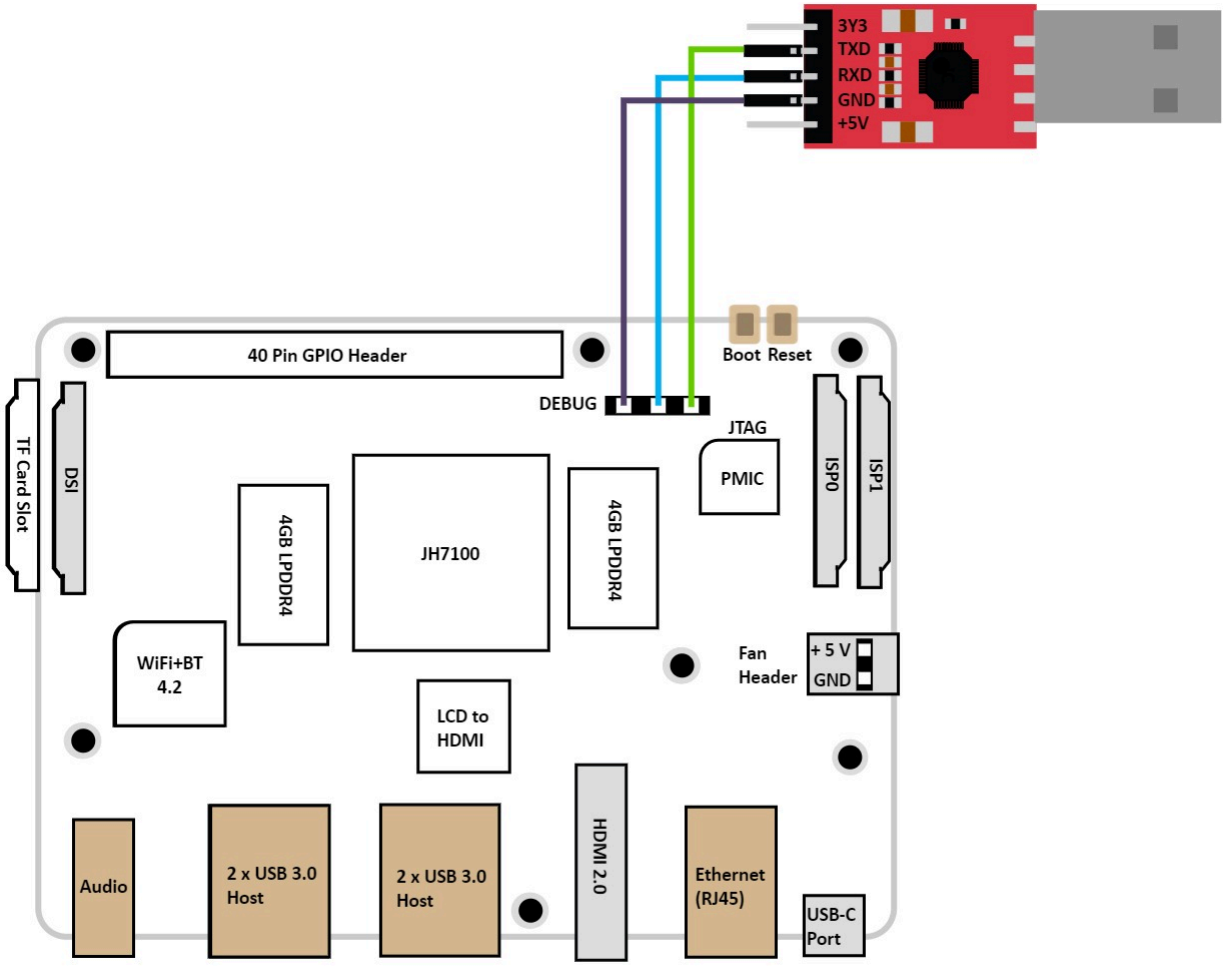
6. Appendix C: Recovering the Bootloader

The bootloader is stored inside the SPI flash storage. There may be situations where you accidentally emptied the flash or if the flash is damaged on your VisionFive. In these situations, it's better to reset the bootloader. Follow the steps below to load JH7100_recovery_boot.bin to on-chip SRAM, run it, and then flash bootloader, ddr init, and u-boot.

6.1. Hardware Setup

Connect the jumper wires between the USB-to-Serial converter and the DEBUG header of the VisionFive as follows.

Figure 6-1 Connecting the Debug Header



6.2. Software Setup

Before you recover the bootloader, you need to have a serial communication software on your computer to communicate with the VisionFive. We will use:

- a software called Tera Term for windows as described in For Windows *(on page 39)*
- a Bootloader recovery and updater tool for Mac/Linux as described in For Mac/Linux *(on page 40)*.

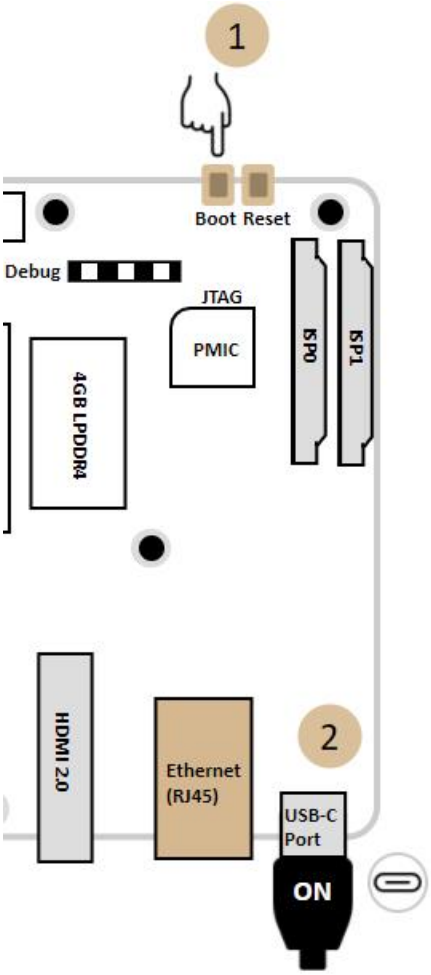
Follow the steps below according to your operating system.

6.2.1. For Windows

1. Open Tera Term software.
2. Navigate to **Setup > Serial port...** .
3. Configure the settings as follows.
    - **Port**: COM4 (choose your COM port)
    - **Speed**: 9600

    Note:
    The **Speed** value is 9600. This setting is for recovering the bootloader, ddr init, and u-boot of QSPI Flash.
4. Click on **New open**.
5. Press the **BOOT** button while turning on VisionFive.

Figure 6-2 Pressing the Boot Button



6. You will see the following output on Tera Term.

```
(C) SiFive
```

7. Type the following.

```
load 0x18000000
```

Result: You will see an output like this:

Figure 6-3 Example Output

8. Navigate to **File > Transfer > XMODEM > Send...** and choose the following file we downloaded before: `JH7100_recovery_boot.bin`.

   Result:

   You will see an output like this after the transfer is complete.

   ```
   Load file ok.
   ```

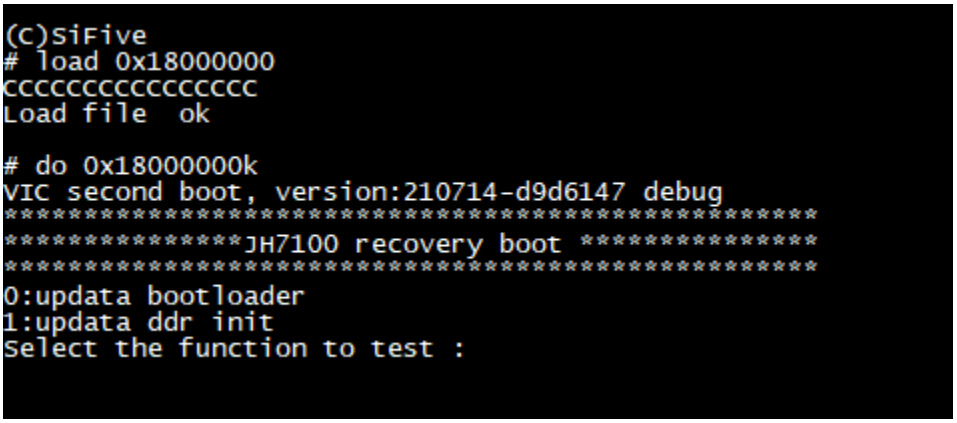
9. Type the following.:

   ```
   do 0x18000000
   ```

   Result:

   You will see an output like this:

   Figure 6-4 Example Output



10. Type `0` and press `Enter` to update the bootloader.
11. Navigate to **File > File > Transfer > XMODEM > Send...** and choose the following file from the .zip file we downloaded before: `bootloader-JH7100-211102.bin.out`
12. Repeat the steps 10 *(on page 40)* to 11 *(on page 40)* to update the ddr init according to the following.
    - Type **1** - update ddr init [Filename: ddrinit-2133-211102.bin.out]

6.2.2. For Mac/Linux

1. Clone the following GitHub repo which includes a bootloader recovery and updater tool.

   ```
   git clone https://github.com/xypron/JH71xx-tools/
   ```

2. Navigate to the cloned repo and build the tool.

   ```
   cd JH71xx-tools
   gcc -o jh7100-recover jh7100-recover.c
   ```

3. Copy `JH7100_recovery_boot.bin`, `bootloader` and `ddr init` to the `JH71xx-tools` directory.

   Note:
   This step is not a must, but it makes it more convenient in the following steps when we point to the file locations.

4. Type the following in the terminal to view the connected serial devices.

   ```
   dmesg | grep tty
   ```

Figure 6-5 Example Output

```
yingpeng@ubuntu:~$ dmesg | grep tty
[    0.682259] printk: console [tty0] enabled
[    2.315158] 00:05: ttyS0 at I/O 0x3f8 (irq = 4, base_baud = 115200) is a 16550A
[    2.546205] tty tty13: hash matches
[398692.719238] usb 3-2: ch341-uart converter now attached to ttyUSB0
```

5. Type the following and it will wait for bootloader mode.

```
sudo ./jh7100-recover -D /dev/ttyUSB0 -r jh7100_recovery_boot.bin -b bootloader-JH7100-211102.bin.out
 -d ddrinit-2133-211102.bin.out
```

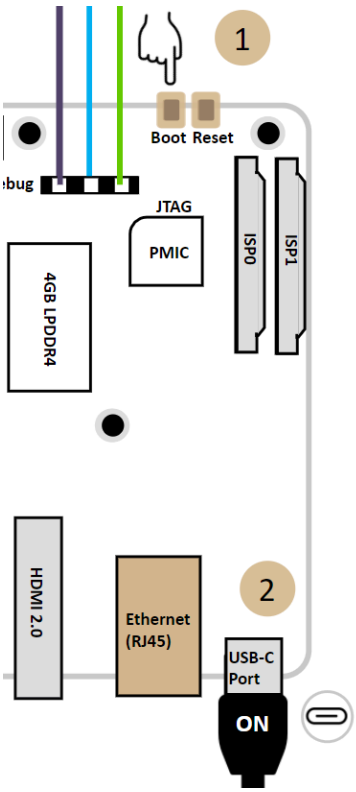
Figure 6-6 Example Output

```
yingpeng@ubuntu:~/Desktop/github/JH71xx-tools$ sudo ./jh7100-recover -D /dev/ttyUSB0 -r jh7100_recovery_boot.bin -b bootloader-JH7100-21
1102.bin.out -d ddrinit-2133-211102.bin.out
Waiting for bootloader mode on /dev/ttyUSB0...
```

Note:
You may change the serial port according to yours and also the file locations if you haven't moved them into the JH71xx-tools directory.

6. Press on the BOOT button while turning on VisionFive to enter bootloader mode.

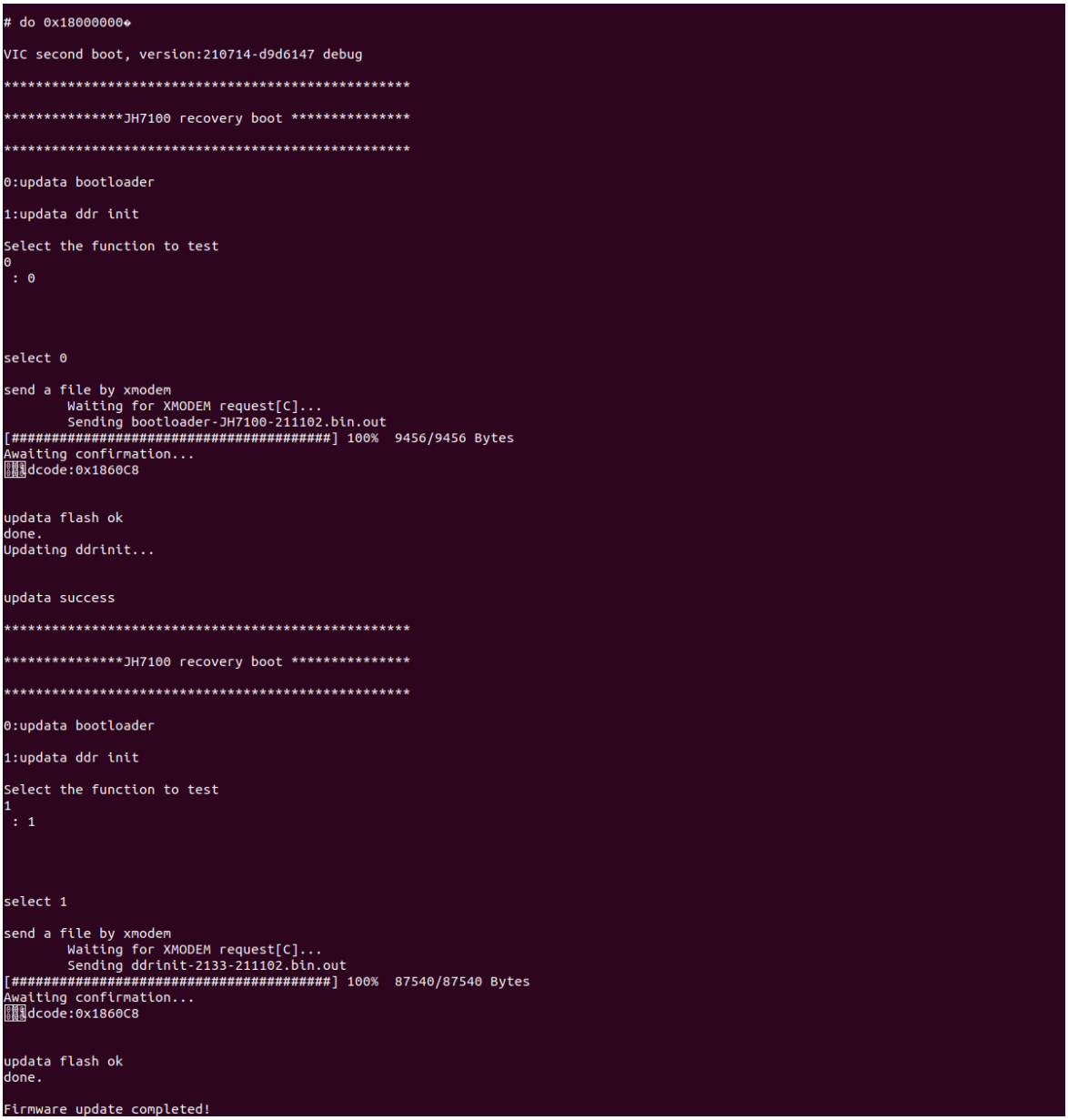
Figure 6-7 Pressing on the Boot Button



Example Result:

If you see the following output, you have successfully updated `bootloader` and `ddr init`.

Figure 6-8 Example Output



7. Appendix D: GitHub Repository

The following table describes the links to GitHub repository:

Table 7-1 GitHub Repository

Type	Item	Description	Repositories
StarFive firmware	Boot_recovery	Binary for recovering SPI flash	starfive-tech/bootloader_recovery
	secondboot	First stage bootloader	starfive-tech/JH7100_secondBoot
	ddrinit	First stage bootloader	starfive-tech/JH7100_ddrinit
RISC-V SBI	openSBI	RISC-V specific	riscv/opensbi
Bootloader	u-boot	Universal boot loader	starfive-tech/u-boot
Kernel	Linux	Linux Kernel	starfive-tech/linux
Distro	Fedora Image	Fedora 33 image	starfive-tech/Fedora_on_StarFive