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# **RZ/V2H Robotic Development Kit**

## **User Manual**

***Release 0.1***

**Renesas Electronics Corporation**

**Oct 18, 2025**



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**CHAPTER  
ONE**

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## **GETTING STARTED**

### **1.1 Overview**

WS125 Robotic Development Kit is a solution with Renesas new generation **RZ/V2H MPU** for AI application, which has AI inference processing performance of up to 80TOPS with multi-core CPU to run multiple OS simultaneously for high performance AI image processing.

It is also equipped with many interfaces that make it suitable for development and integration into a variety of robotic applications.

#### **1.1.1 Software Environment**

<b>Category</b>	<b>Description</b>
<b>OS Support</b>	Yocto 5.1 (Styhead) and Ubuntu 24.04 (available in headless and LXDE versions).
<b>ROS 2 Distribution</b>	ROS 2 Jazzy

### 1.1.2 Hardware Environment

Items	Description
<b>RZ/V2H</b>	<ul style="list-style-type: none"><li>• <b>CPU</b><ul style="list-style-type: none"><li>– 4 × Arm Cortex-A55 (1.8GHz)</li><li>– 2 × Arm Cortex-R8 (800MHz)</li><li>– 1 × Arm Cortex-M33 (200MHz)</li></ul></li><li>• <b>DRP</b><ul style="list-style-type: none"><li>– Vision/Dynamically Reconfigurable Processor</li></ul></li><li>• <b>DRP-AI</b><ul style="list-style-type: none"><li>– Hardware AI Accelerator (8 dense TOPS, 80 sparse TOPS)</li></ul></li><li>• <b>Package</b><ul style="list-style-type: none"><li>– R9A09G057H44GBG: 1368-pin FCBGA</li></ul></li></ul>
<b>Memory</b>	LPDDR4 1600MHz (8GB) × 2
<b>SD Card</b>	64GB SanDisk
<b>QSPI Flash ROM</b>	64MB
<b>Interfaces</b>	<ul style="list-style-type: none"><li>• DC Jack (12–24V / 2A)</li><li>• JTAG (10-pin)</li><li>• MIPI CSI-2 4-Lane ×2 (22-pin / 0.5mm)</li><li>• HDMI</li><li>• USB3.2 Type-A ×2</li><li>• USB Micro-B (SCIF)</li><li>• 10/100/1000 Base-T RJ45</li><li>• Micro SD</li><li>• PCIe 3.0 Root Complex (16-pin / 0.5mm)</li><li>• CAN-FD ×2</li><li>• 40-pin RasPi GPIO Header</li></ul>

For more details about RZ/V2H RDK's specification, visit the *WS125 Robotic Development Kit Hardware Manual* (TODO: Add link to the Official PDF file).

#### RZ/V2H RDK Board Image View:

The following image shows the top/bottom view of the RZ/V2H Robotics Development Kit (RDK) board, highlighting its main connectors and interfaces.

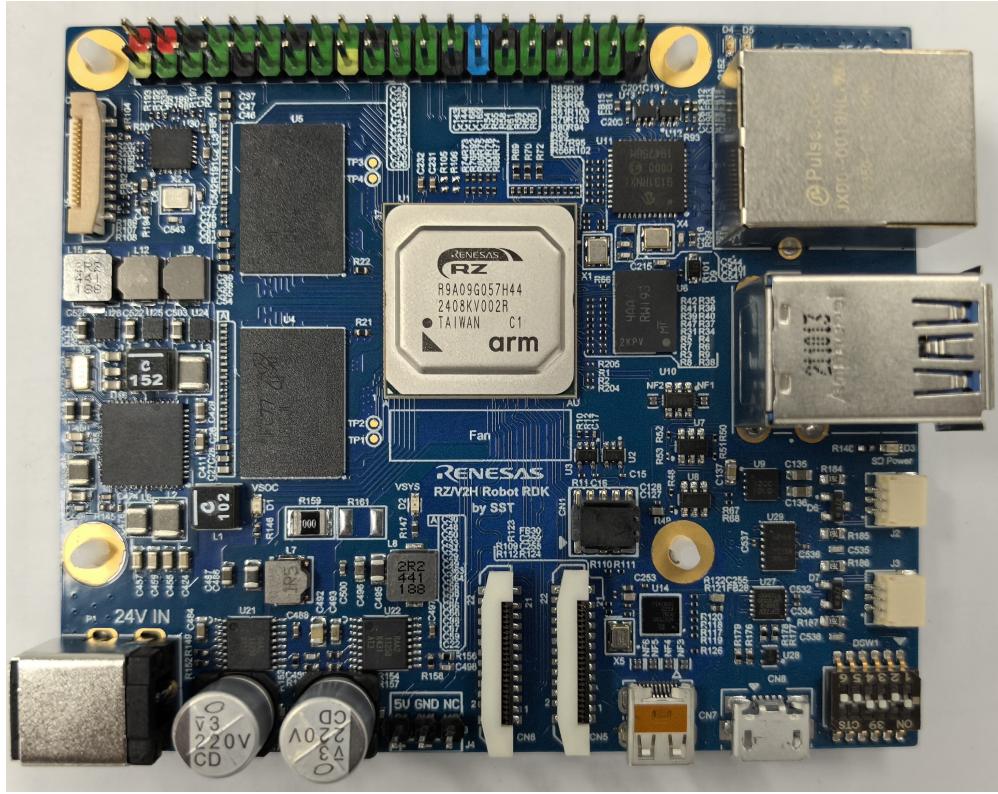


Fig. 1: RZ/V2H RDK Board Top View (TODO: replace with actual image from China team)

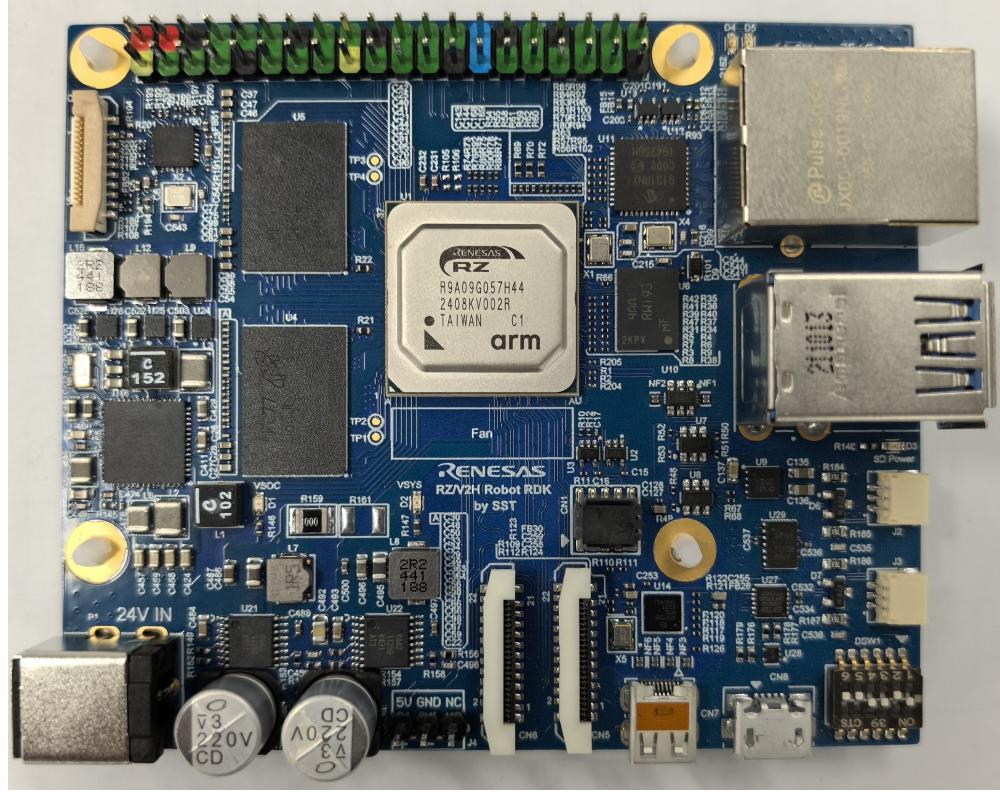


Fig. 2: RZ/V2H RDK Board Bottom View (TODO: replace with actual image from China team)

## 1.2 Quick setup guide

This quick start guide focuses on booting the board using a **microSD card**, which is the most straightforward method. Other advanced boot methods, such as **xSPI flash**, are also supported.

The **TFTP + NFS boot** method is supported as well but is not covered in detail here.

### 1.2.1 Preparing the SD Card

To boot the RZ/V2H RDK board using a microSD card, you must first flash a bootable Linux image onto it.

#### Requirements

- **Balena Etcher:** GUI-based tool to flash image
- **microSD card:** at least 16 GB recommended
- **Provided bootable Linux images:**

File name	Target OS	Host platform support
ubuntu-lxde-image.wic.gz	Ubuntu 24.04 with GUI LXDE support	Windows / macOS / Linux
ubuntu-core-image.wic.gz	Ubuntu 24.04 headless	Windows / macOS / Linux

## Flash using Balena Etcher

Balena Etcher is a user-friendly GUI tool to flash OS images to SD cards and USB drives. It provides a simple and safe method.

### 1. Install Balena Etcher

Download and install the software from the [Balena Etcher Official Website](#).

### 2. Flashing the Image

- Once Etcher is open:

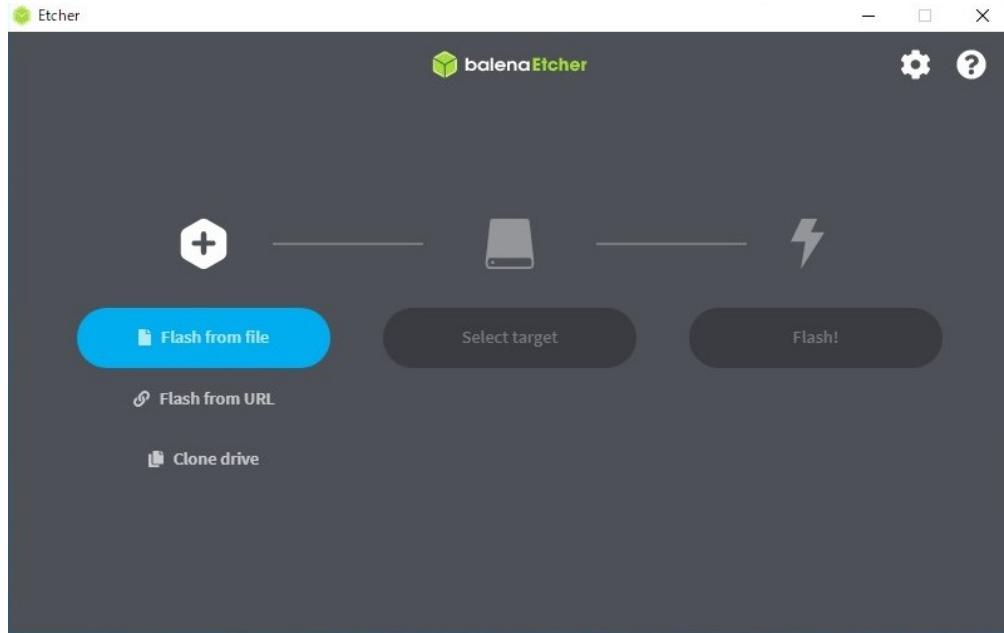


Fig. 3: Balena Etcher Application

- Select Image:** Click “Flash from file” and choose your image file (e.g., ubuntu-lxde-image.wic.gz)
- Select Target:** Insert your SD card into the host machine and choose the correct device.

#### Note

Please confirm the SD card device name carefully. Double-check to avoid overwriting your main disk.

- Flashing:** Click “Flash” to begin. Etcher will:
  - Write the image
  - Validate the image
  - Automatically unmount the SD card
- Finish:** Remove the SD card safely after Etcher reports successful completion.

### 1.2.2 Boot Mode Configuration (DIP Switch)

Before powering up the RZ/V2H RDK, make sure the board's boot mode is configured correctly using the DIP switches.

DSW1	RZ/V2H Pin	Default Setting	Operation
1	BTSEL (BOOSTSELCPU)	ON = High: 1	Select the coldboot CPU: <ul style="list-style-type: none"> <li>• High: <b>CA55</b> (<i>default</i>)</li> <li>• Low: <b>CM33</b></li> </ul>
2, 3	BOOTPLLCA_1 BOOTPLLCA_0	OFF = High: 1 ON = High: 1	Input the CA55 frequency at CA55 coldboot. <b>BOOT_PLLCA[1:0]:</b> <ul style="list-style-type: none"> <li>• Low:Low → 1.1 GHz</li> <li>• Low:High → 1.5 GHz (0.9 V)</li> <li>• High:Low → 1.6 GHz (0.9 V)</li> <li>• High:High → 1.7 GHz (0.9 V) (<i>default</i>)</li> </ul>
4 5	MD_BOOT1 MD_BOOT0	ON = Low: 0 OFF = Low: 0	Input boot mode select signal. <b>MD_BOOT[1:0]:</b> <ul style="list-style-type: none"> <li>• Low:Low → SD (<i>default</i>)</li> <li>• Low:High → eMMC</li> <li>• High:Low → xSPI</li> <li>• High:High → SCIF download</li> </ul>
6	MD_BOOT3	OFF = Low: 0	Select JTAG debug mode: <ul style="list-style-type: none"> <li>• Low: normal mode (<i>default</i>)</li> <li>• High: JTAG</li> </ul>

#### ⚠ Attention

Always power off the board before changing boot switches.

### 1.2.3 Boot Mode Support

The board supports multiple boot options, including:

Boot Source	Description	DSW1 Setting
microSD	Boot from SD card	SD mode
xSPI	Boot from xSPI flash	xSPI mode

#### 💡 Tip

The serial port is powered by the **board's power supply**, not by the **USB port** from the PC. Early boot messages might not appear automatically in the terminal (including U-Boot console and SCIF terminal). To view them, manually reset the board by connecting **JTAG QRESN (PIN10)** to **GND**, as shown below.

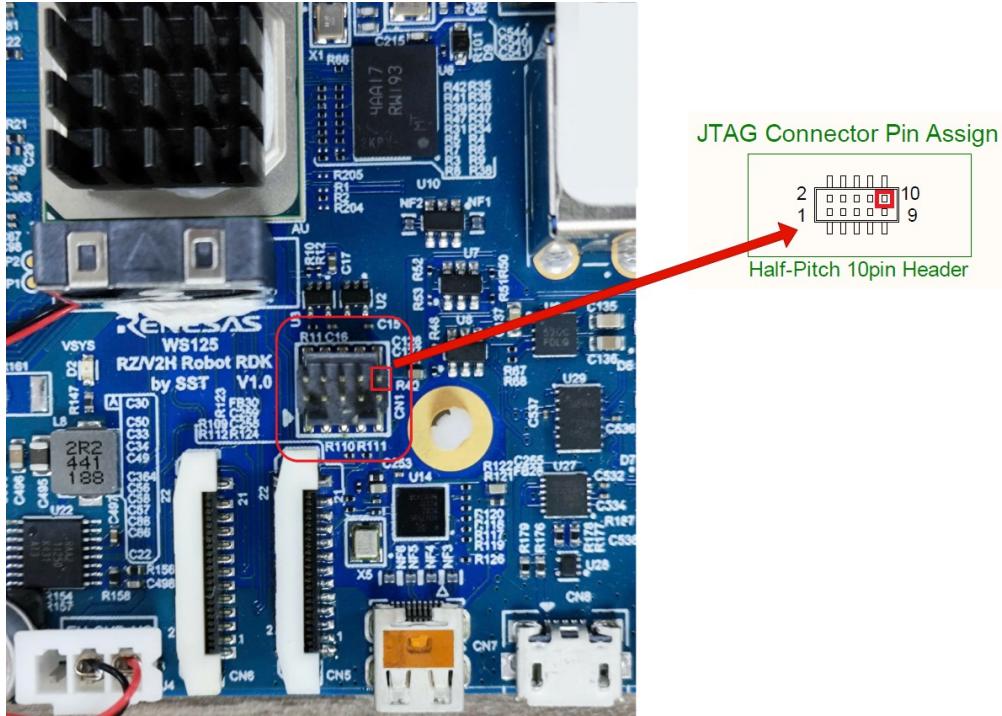


Fig. 4: JTAG Reset Pin Example

#### Option 1: SD Card Boot Mode

For **SD card boot mode**, the IPLs are already written to the SD card when flashing the image using Balena Etcher.

On the RZ/V2H RDK board, configure the **DSW1** switches as shown below:

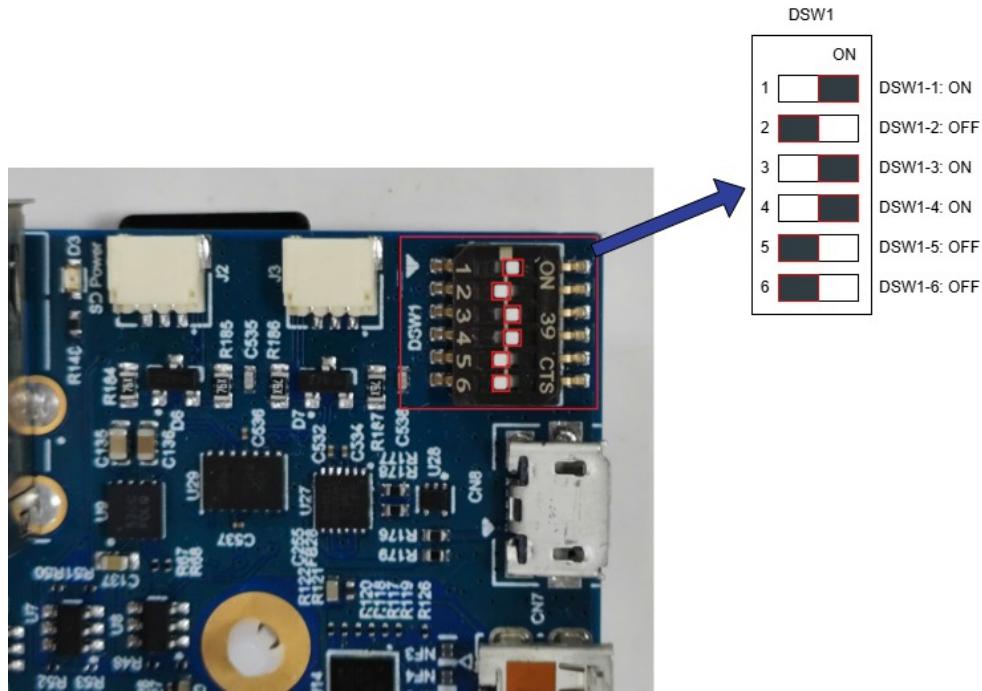


Fig. 5: DSW1 SD Card Boot Mode

After that, insert the SD card and connect the power supply (**Max 24V/5A**) to the board.

Open a terminal emulator (e.g., **Tera Term**) and connect to the **COM** port.

The COM port settings are the same as described in **Step 3** of *Write bootloaders to board*.

The board will start the boot process.

### 💡 Tip

If there is no output from the terminal, do *the JTAG reset tip* first, then reset the U-Boot environment variables:

```
env default -a  
saveenv  
boot
```

If you intend to use **SD card boot mode only**, proceed to *First Time Boot Setup* to complete the setup.

## Option 2: xSPI Boot Mode

### Board Setup Procedure

Follow the instructions below to set up the board.

#### 1. Install Terminal Emulator

### ℹ Note

If already installed, skip this step.

- **Terminal Emulator:** Tera Term
- **Operating Environment:** Windows

## 2. Install the Serial Port Driver

**Note**

If already installed, skip this step.

- The serial communication between the Windows PC and **RZ/V2H RDK** requires: [FTDI Virtual COM Port \(VCP\) driver](#)

Download and install the Windows version (.exe).

## 3. Write Bootloaders to the Board

Copy the bootloaders file to your Windows PC.

File Name	Description
Flash_Writer_SCIF_RZV2H_DEV_INTERNAL_MEMC	Flash writer for RZ/V2H (used in SCIF download mode)
bl2_bp_spi-rzv2h-rdk.srec	Boot loader stage 2 binary
fip-rzv2h-rdk.srec	Firmware Image Package for RZ/V2H

- Connect the **Windows PC** and **Board** using a **Serial-to-MicroUSB** cable.
- Change the **DSW1** setting to **Boot Mode 3 (SCIF download)**.

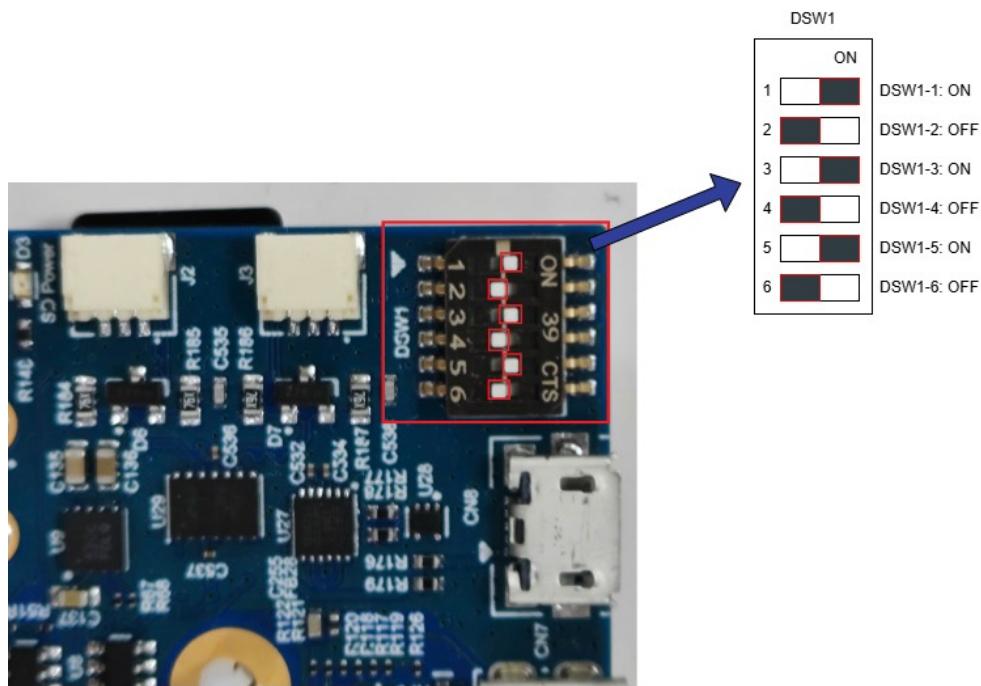


Fig. 6: DSW1 SCIF Download Mode

- Connect the power cable (**Max 24V/5A**).

- Open Tera Term and configure:

**Setup → Terminal:**

Item	Value
New-line	Receive: Auto / Transmit: CR

**Setup → Serial Port:**

Item	Value
Baud rate	115200
Data	8-bit
Parity	None
Stop	1-bit
Flow control	None
Transmit delay	0 msec/char

- Send files using “File → Send file...” and follow on-screen messages.  
 (Keep the original command sequences as-is for flashing.)

#### 4. Setup U-Boot Configuration

1. Insert the microSD card to the board.
2. Change DSW1 to **Boot mode 2 (xSPI boot)**:

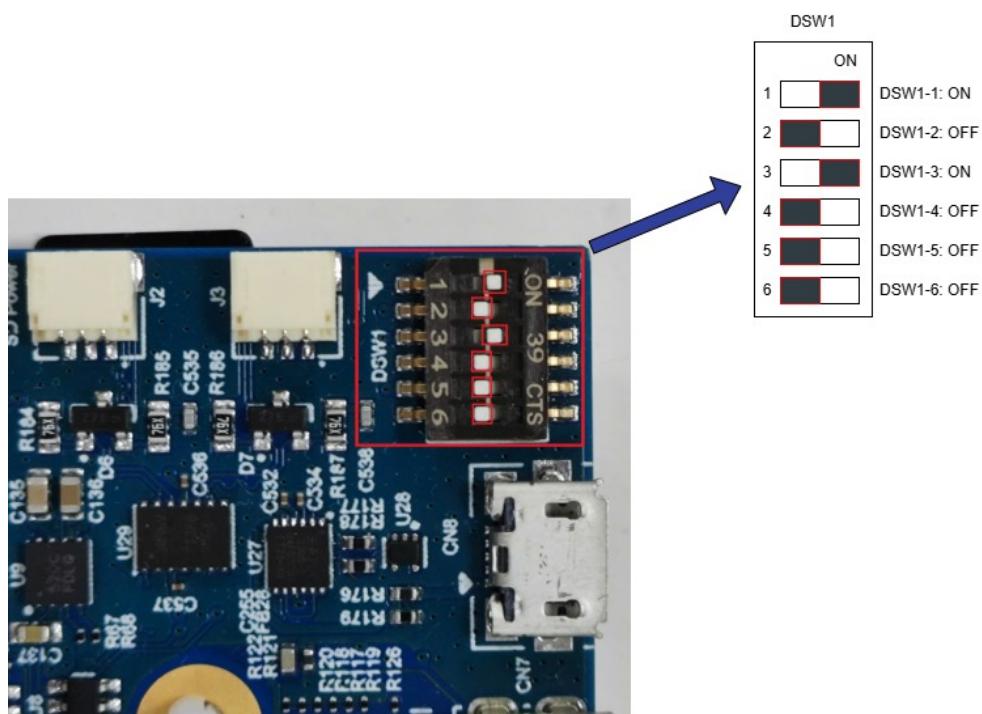


Fig. 7: DSW1 xSPI Boot Mode

3. Connect via **USB Serial to MicroUSB** cable.
4. Power on the board.
5. Open the terminal emulator and connect to the **COM** port (same configuration as before).
6. The board will boot.

 **Tip**

If there is no output from the terminal, do *the JTAG reset tip* first, then reset the U-Boot environment variables:

```
env default -a  
saveenv  
boot
```

#### 1.2.4 First Time Boot Setup

After powering on the board **for the first time**, connect to the serial console and check the boot log to verify that Ubuntu boots successfully.

 **Note**

This operation is required **only once**, immediately after flashing the root filesystem and booting the board for the first time.

Connect an Ethernet cable to the board and run:

```
# Check network  
ping 8.8.8.8 -c 3  
ping google.com -c 3
```

1. Perform apt update and resize the SD card:

```
sudo apt update  
sudo apt install parted  
sudo parted /dev/mmcblk0
```

Inside parted terminal:

```
> print  
> resizepart 2 100%  
> print  
> quit
```

Resize root filesystem:

```
sudo resize2fs /dev/mmcblk0p2
```

2. Setup **rosdep** for ROS2 package dependency management:

```
sudo rosdep init  
rosdep update
```

This completes the **Quick Setup Guide** for the RZ/V2H RDK board.

### 1.2.5 Reference

- Advanced Boot Options (xSPI): [Renesas RZ/V AI SDK Developer Guide](#)
- Balena Etcher Official Website: <https://www.balena.io/etcher>

## 1.3 RZ/V ROS2 Demos

ROS2 packages designed for computer vision applications on Renesas RZ/V MPU platforms, specifically targeting the RZ/V2H.

The packages provide AI-accelerated vision capabilities including object detection, pose estimation, and visualization tools.

TODO: Add links to individual demo documentation pages when available.