WS125 Robotic Development Kit

Hardware Manual

Rev.1.00
Oct.24, 2025

Abstract

This board is a Robotic Development Kit for the Arm®-based high-end RZ/V2H MPU from Renesas Electronics. This manual describes the hardware functions of WS125 Robotic Development Kit (RDK).

Target Device

RZ/V2H Group

Related Document

- RZ/V2H Group User's Manual: Hardware

Contents

1. Overview

1.1 Robotic Development Kit Overview

WS125 Robotic Development Kit is a solution with Renesas new generation MPU RZ/V2H 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.

1.2 Hardware Block Diagram

The WS125 Robotic Development Kit block diagram is shown in Figure 1-1.

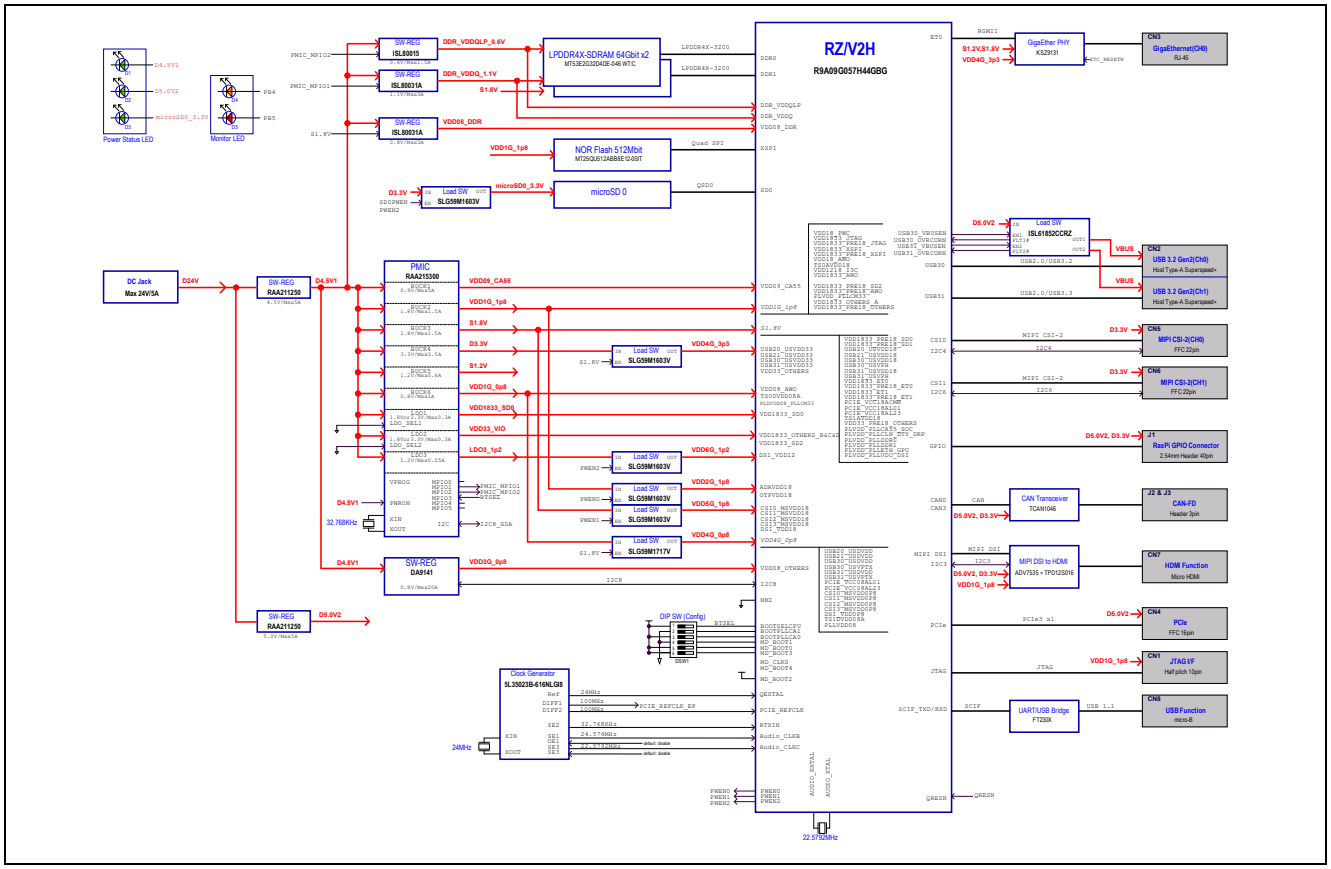

Figure 1-1 Robotic Development Kit Block Diagram

The WS125 Robotic Development Kit image is shown in Figure 1-2.

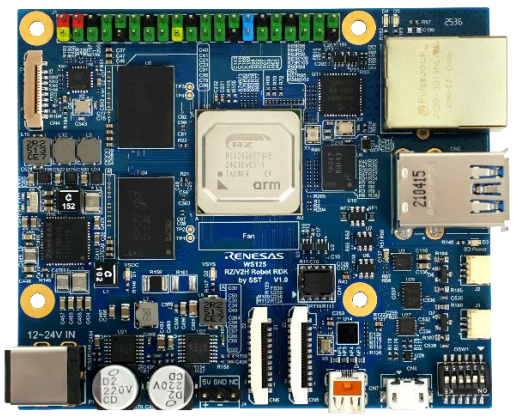

Figure 1-2 Robotic Development Kit Image

2. General Specifications

Table 2-1 Specification's summary

Items		Description
RZ/V2H	CPU	4 x Arm Cortex-A55 (1.8GHz) 2 x Arm Cortex-R8 (800MHz) 1 x Arm Cortex-M33 (200MHz)
	DRP	Vision/Dynamically Reconfigurable Processor
	DRP-AI	Hardware AI Accelerator (8 dense TOPS, 80 sparse TOPS)
	Package	R9A09G057H44GBG: 1368-pin FCBGA
Memory		LPDDR4 1600MHz (8GB) x 2
SD Card		64GB SanDisk
QSPI Flash ROM		64MB
Interfaces		DC Jack (12-24V/2A)
		JTAG (10-PIN)
		MIPI CSI-2 4-Lane x2 (22-pin/0.5mm)
		HDMI
		USB3.2 Type A x2
		USB Micro-B (SCIF)
		10/100/1000 Base-T RJ45
		Micro SD
		PCIe 3.0 Root Complex (16-pin/0.5mm)
		CAN-FD x2
		40-pin RasPi GPIO Header

Note: Recommend using the system's built-in SanDisk 64GB SD card for high-speed data transfer.

Table 2-2 Board size

Item	Specification	Remarks
Robotic Development Kit board	85 (W)×72 (D)×1.6(T) (mm)	NO include protrusions, NO include component height

The main interfaces in Robotic Development Kit description are shown in Figure 2-1.

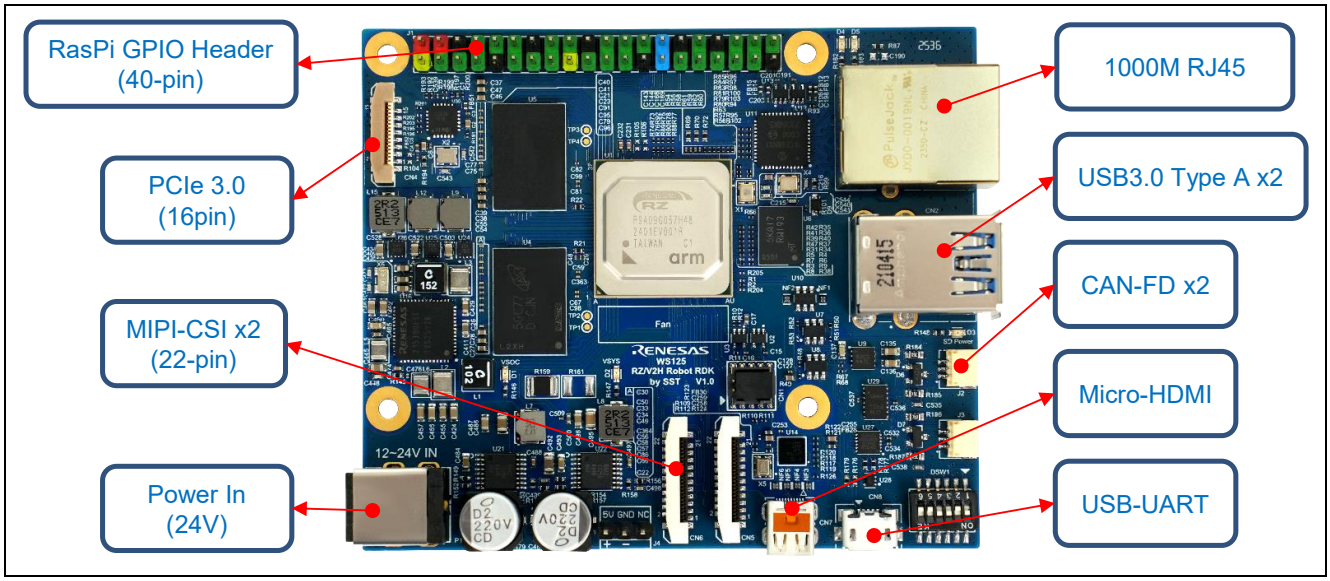

Figure 2-1 Robotic Development Kit (front)

The Robotic Development Kit image (back) is shown in Figure 2-2.

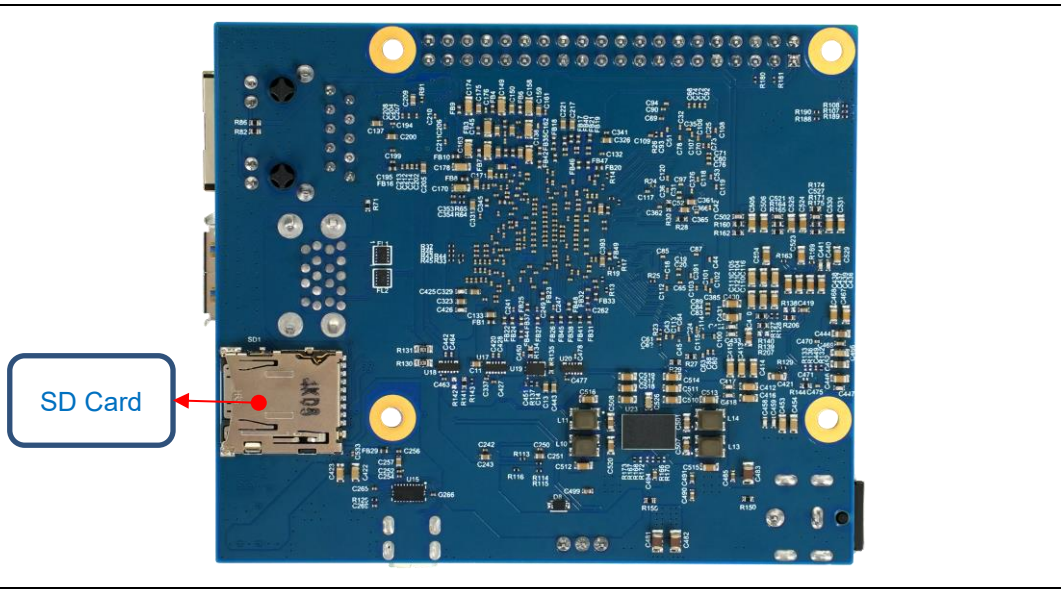

Figure 2-2 Robotic Development Kit (back)

3. Interface Description

3.1 Power Supply

The Robotic Development Kit board is powered by external 12~24V DC, with two 4.5V~30V, 5A, DC/DC Synchronous Step-Down Regulator RAA211250GS.

D4.5V1 (4.5V) is used for powering RZ/V2H related power supply. For more about the power tree of RZ/V2H, please refer to the *Figure 1.1 Robotic Development Kit Block Diagram*.

D5.0V2 (5V) is used for powering the system board's peripheral interfaces, such as USB ports.

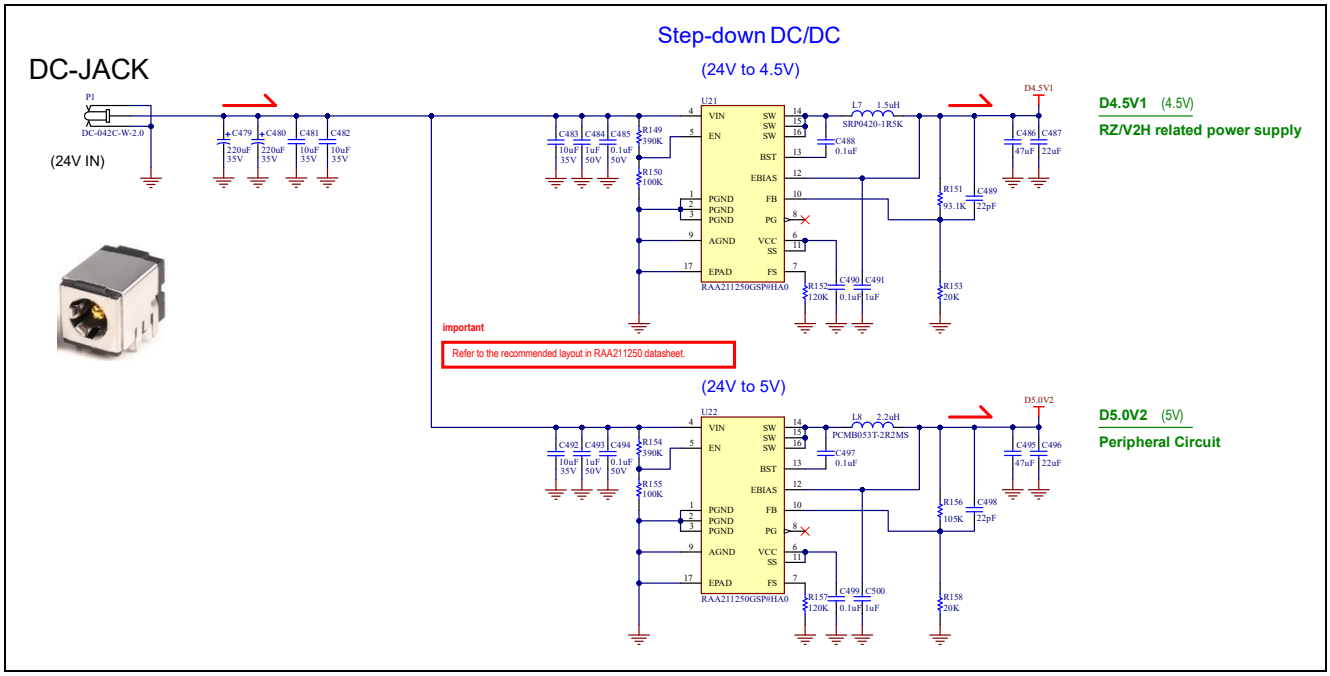

Figure 3-1 12~24V DC Power Supply

3.2 JTAG Interface

Cortex 10 pins 1.27mm pitch JTAG Connector Pinout, which is used for debugging Arm Cortex-R8 and Arm Cortex-M33 core. The 10-pin cable is Samtec, part number FFSD-05-D-12.00.01-N.

The Flexible Software Package (FSP) supports debugger connectivity. For more information, please refer to the FSP documentation.

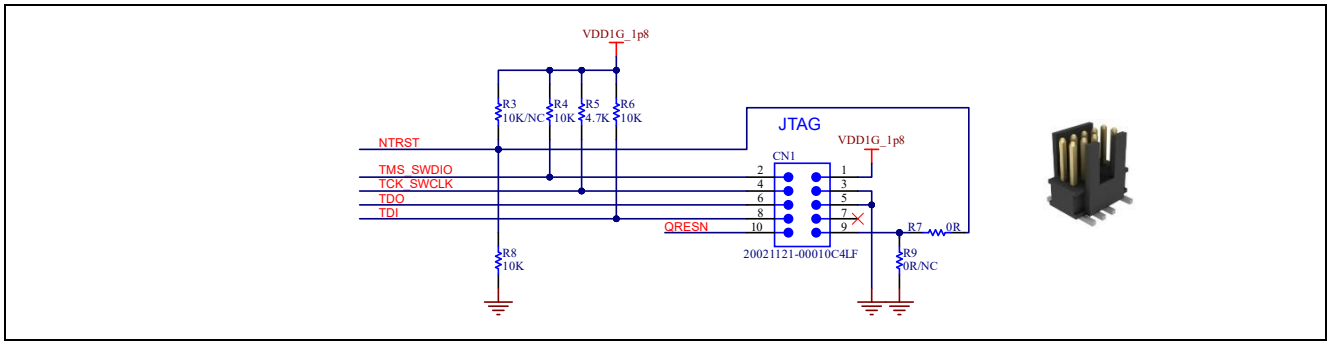

Figure 3-2 JTAG Interface

3.3 Dip Switch

Selection of the startup operating mode for RZ/V2H by Dip Switch DSW1. The options in the green box below are the default operating modes.

DSW1 Setting

DSW1	RZ/V2H pin	default Setting	operation
1	BTSEL (BOOSTSELCPU)	ON = High:1	Select the coldboot CPU. High : CA55 * default Low : CM33
2 3	BOOTPLLCA_1 BOOTPLLCA_0	OFF = High:1 ON = High:1	Input the CA55 frequency at the CA55 coldboot. BOOT_PLLCA[1..0] Low :Low : 1.1GHz Low :High : 1.5GHz (0.9V) High:Low : 1.6GHz (0.9V) High:High : 1.7GHz (0.9V) * default
4 5	MD_BOOT1 MD_BOOT0	ON = Low:0 OFF = Low:0	Input the boot mode select signal. MD_BOOD[1..0] Low :Low : SD * default Low :High : eMMC High:Low : xSPI High:High : SCIF download Note1. Enable CA55 coldboot only
6	MD_BOOT3	OFF = Low:0	Select JTAG debug mode Low : normal mode, * default High: JTAG

Figure 3-3 Operating Mode

3.4 MIPI CSI-2 Interface

Robotic Development Kit has two MIPI CSI-2 interfaces (CN5 and CN6).

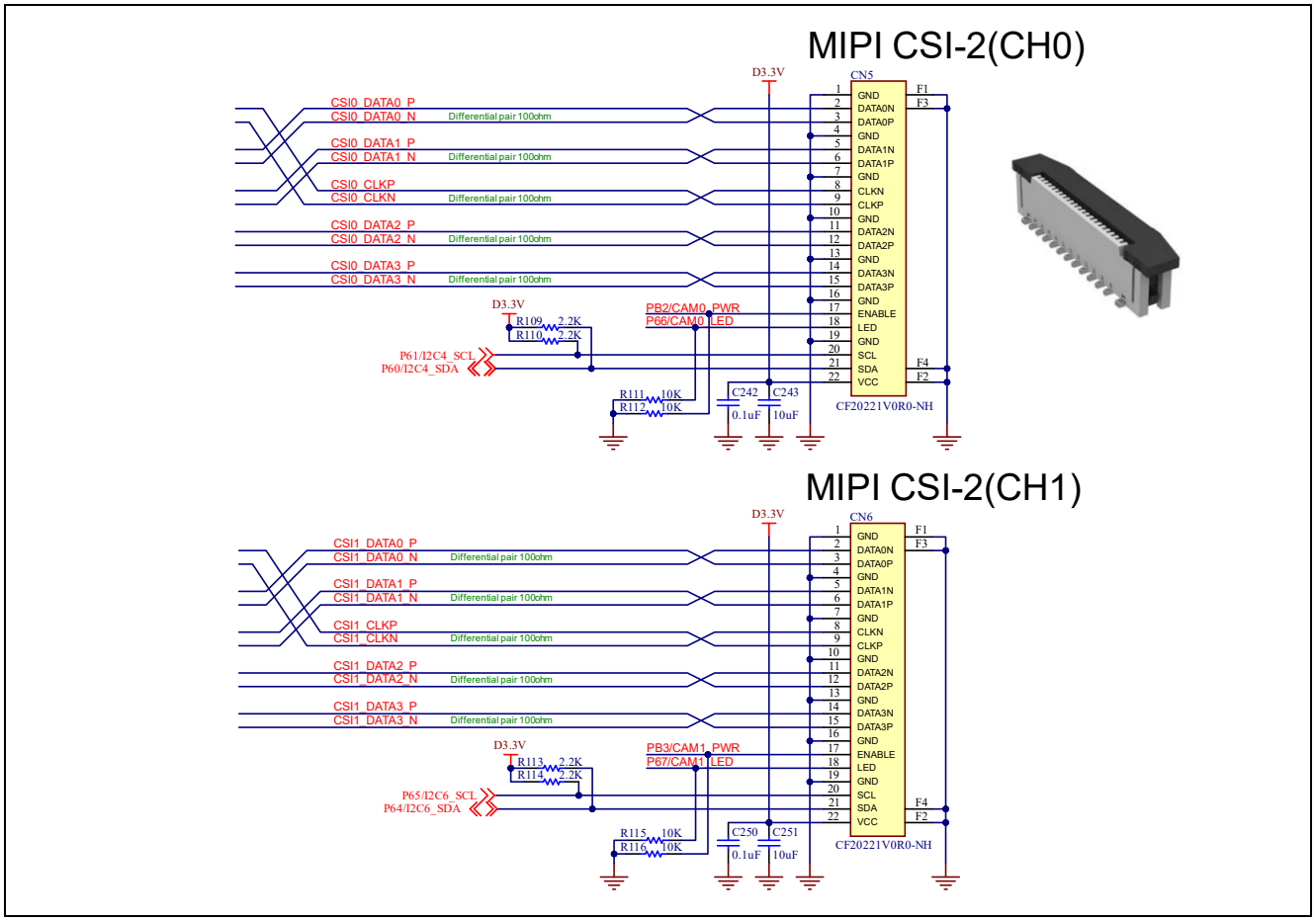

Figure 3-4 MIPI CSI-2 Interface

3.5 HDMI Interface

RZ/V2H has a MIPI DSI interface. Robotic Development Kit converts MIPI DSI to an HDMI signal and outputs it to the CN7 HDMI connector.

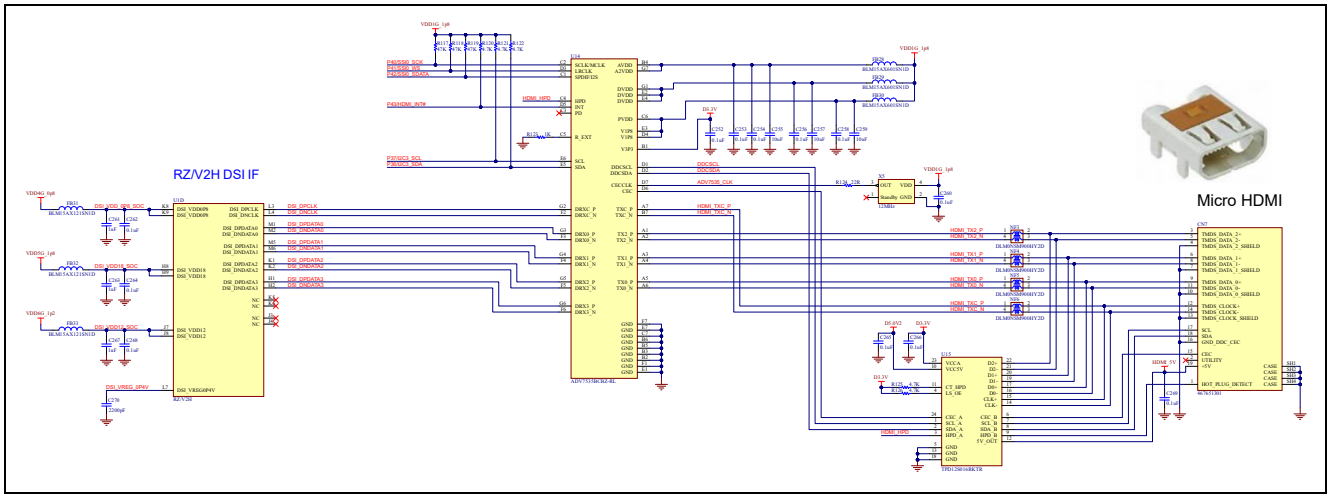

Figure 3-5 HDMI Interface

3.6 USB3.2 (TypeA x2) Interface

Robotic Development Kit has two USB3.2 Gen2 host interfaces. The USB Type-A connector (CN2) is connected to the USB 3.2 Gen2 interface of the RZ/V2H.

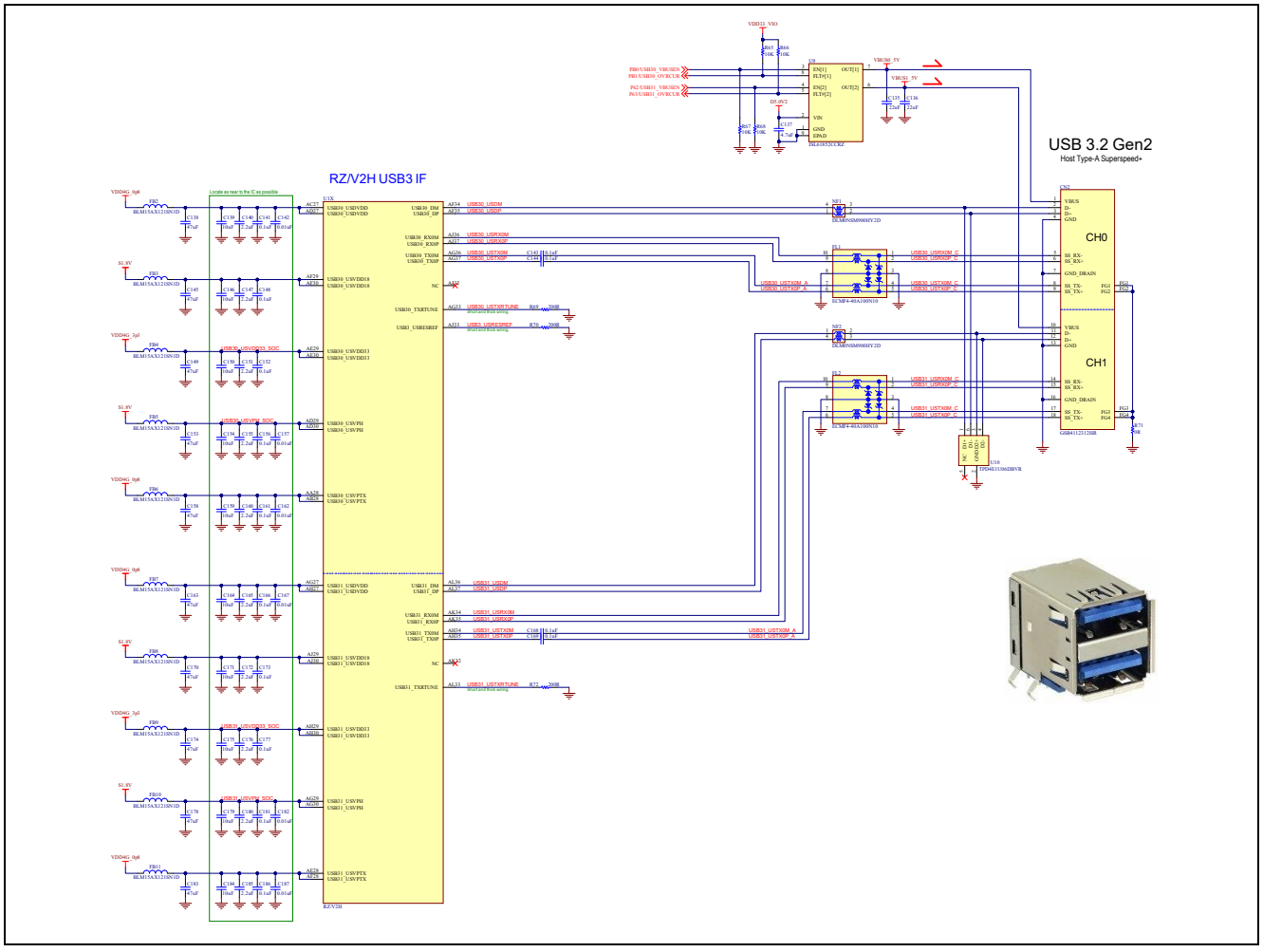

Figure 3-6 USB3.2 (TypeA x2) Interface

3.7 USB Micro-B Interface

Robotic Development Kit has an USB micro-B interface, which is used as UART-USB function for RZ/V2H.

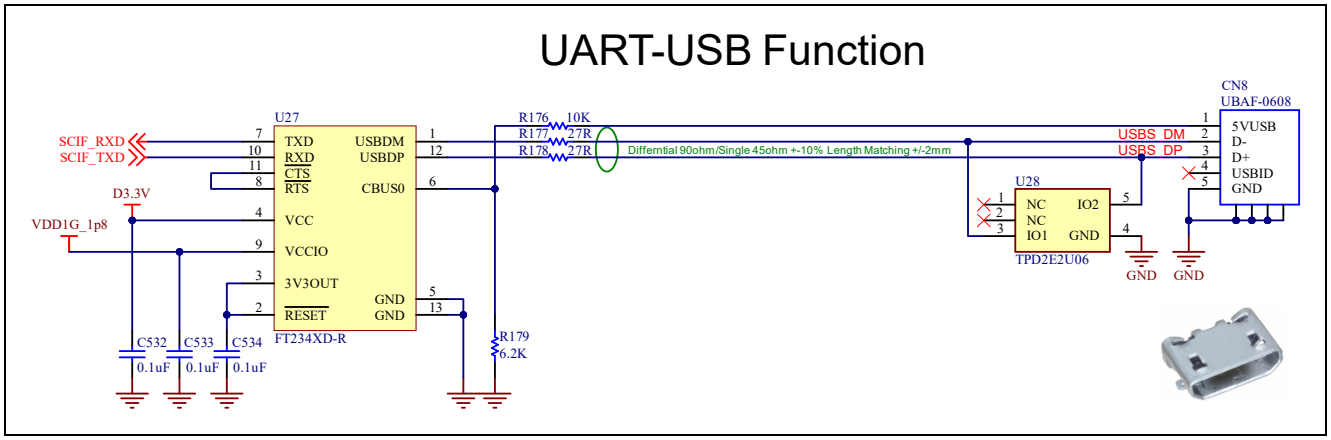

Figure 3-7 USB Micro-B Interface

3.8 Ethernet Interface

Robotic Development Kit has an Ethernet interface. The RJ-45 connectors (CN3) are connected to the Ethernet interface of the RZ/V2H via the Ethernet PHY IC.

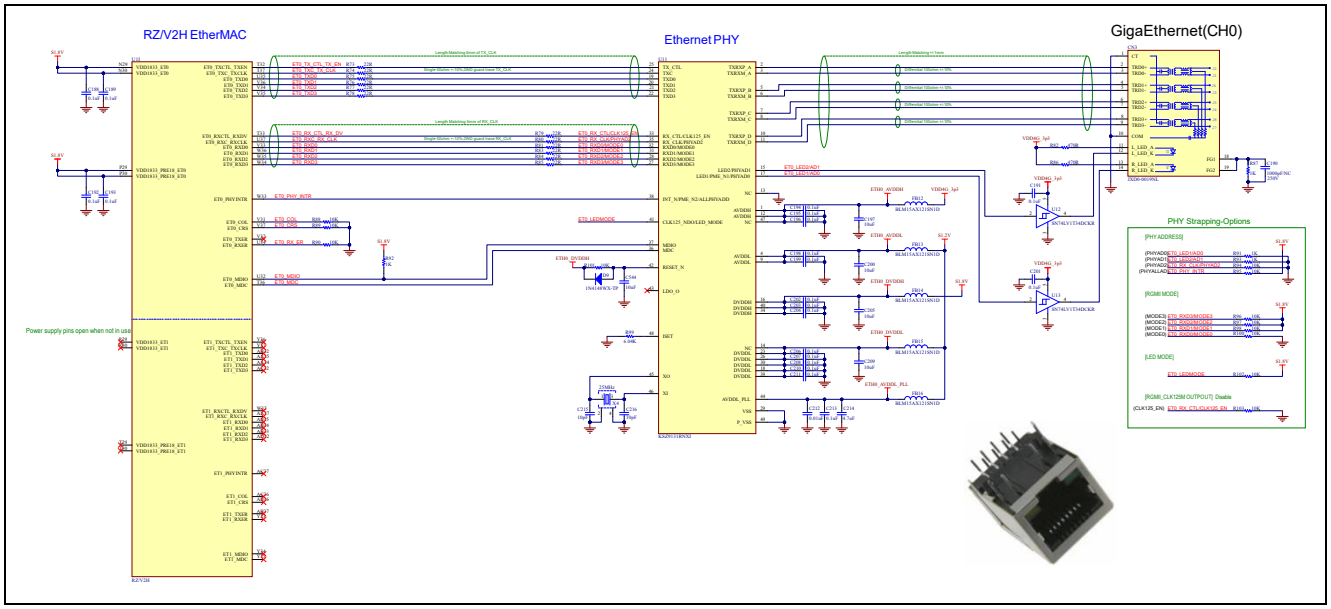

Figure 3-8 Ethernet Interface

3.9 SD Card Connector

Robotic Development Kit has a micro SD card connectors (SD1). SD1 is connected to the SD0 interface of RZ/V2H and can be used as a boot device.

The power supply VDD1833_SD0 of RZ/V2H is fixed to 1.8V for high-speed data transfer. It is recommended that using the system's built-in SanDisk 64GB SD card for high-speed data transfer.

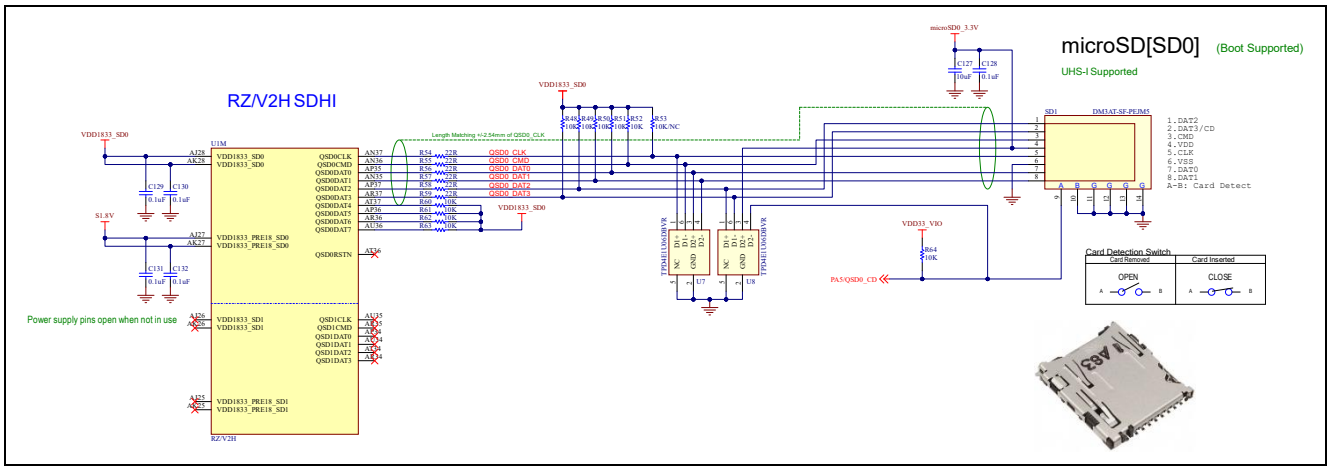

Figure 3-9 SD Card Connector

3.10 PCIe Connector

Robotic Development Kit has a PCIe connector, which works as Root Complex (PCIe 3.0).

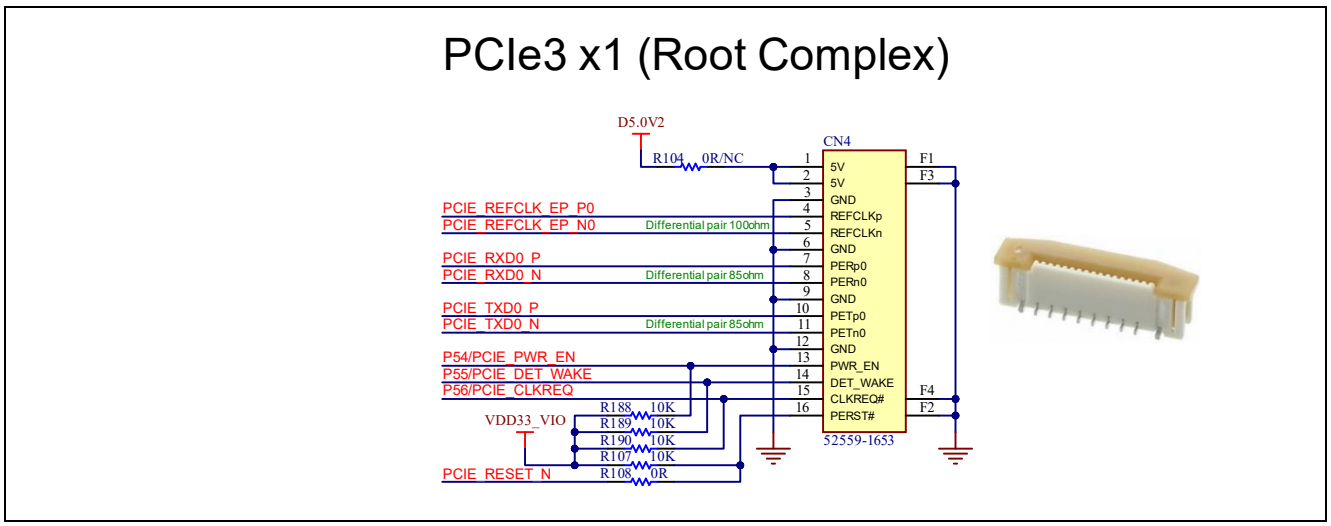

Figure 3-10 PCIe connector

3.11 CAN-FD Connector

Robotic Development Kit has two CAN-FD connectors (J2 and J3) with 3 pins 1.00mm pitch.

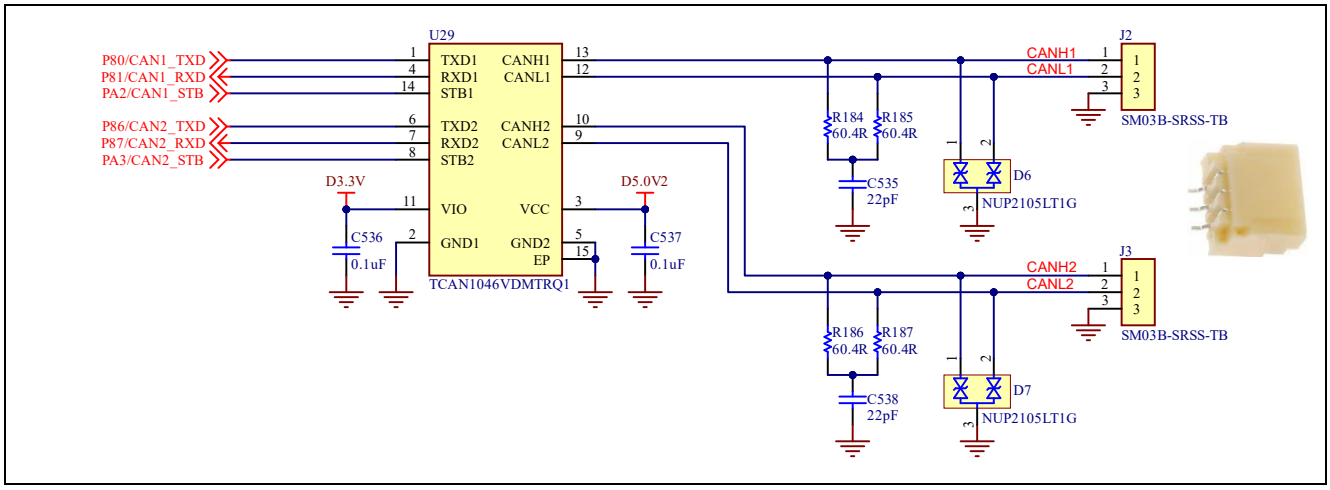

Figure 3-11 CAN-FD Connector

3.12 40-pin RasPi GPIO Header

Robotic Development Kit has a 40-pin RasPi GPIO Header with 2.54mm pitch, it is used for functional expansion based on RZ/V2H.

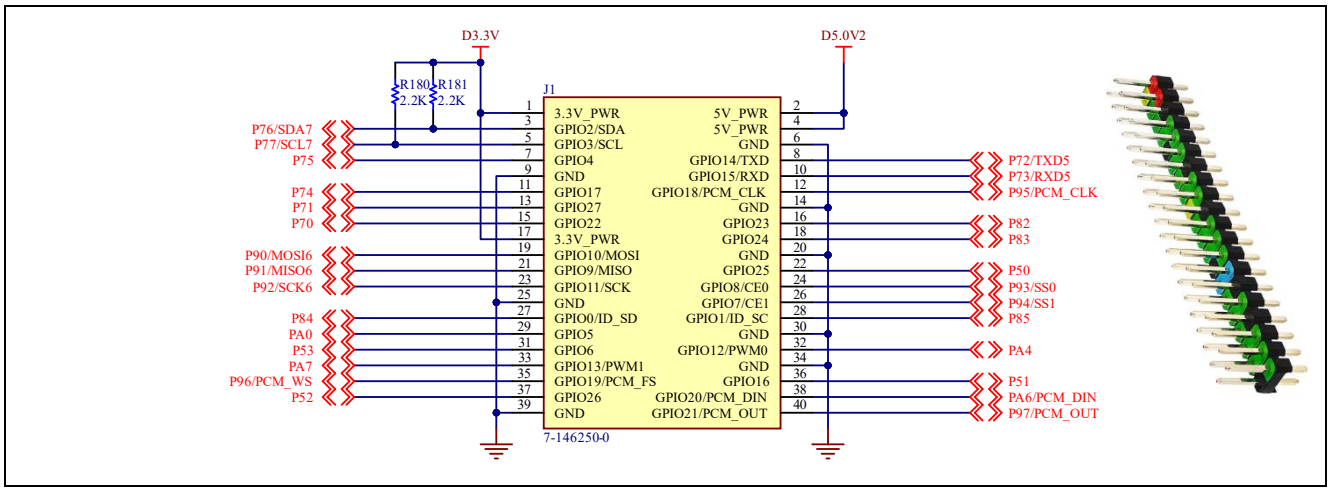

Figure 3-12 40-pin RasPi GPIO Header

4. BOM List for Renesas Key Parts

Renesas provides the complete design files for this Robotic Development Kit application, including SCH, PCB, BOM, etc.

Here are the Renesas Key parts used in Robotic Development Kit board, for more information, please refer to the related files from Renesas.

BOM List from Robotic Development Kit Board

Designator	Description	Manufacturer	Mfg Part Number	Qty
U1	Renesas MPU RZ/V2H CA55 Quad ISP&GPU	Renesas	R9A09G057H44GBG	1
U9	Dual USB Port Power Supply Controller 8-DFN	Renesas	ISL61852CCRZ	1
U16	9-Channel PMIC with RTC 56L QFN	Renesas	RAA215300A2GNP#HA2	1
U17, U18, U20	IC PWR SWITCH N-CHAN 1:1 14STDFN	Renesas	SLG59M1603V	3
U19	An Ultra-small, 4 mΩ, 5 A Load Switch with PG Output	Renesas	SLG59M1717V	1
U21, U22	4.5V to 30V, 5A, DC/DC Synchronous Step-Down Regulator	Renesas	RAA211250GSP#HA0	2
U23	High-Performance, 25 A/40 A Peak, DC-DC Converter	Renesas	DA9141-08F72	1
U24, U25	IC REG BUCK ADJUSTABLE 3A 8DFN	Renesas	ISL80031AFRZ-T7A	2
U26	DC-DC 1.5A Compact Adj Sync Buck Converter 2MHz	Renesas	ISL80015AIRZ-T	1
U30	VersaClock® 3S Programmable Clock Generator	Renesas	5L35023B-616NLGI8	1
U1	Renesas MPU RZ/V2H CA55 Quad ISP&GPU	Renesas	R9A09G057H44GBG	1
U9	Dual USB Port Power Supply Controller 8-DFN	Renesas	ISL61852CCRZ	1
U16	9-Channel PMIC with RTC 56L QFN	Renesas	RAA215300A2GNP#HA2	1

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Oct.24, 2025	–	First Edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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