Reference Hardware Manual

Version	Date
1.0	May 25, 2020
1.1	Feb 26, 2021

Panasonic Corporation

Revision History

Date	Version	Comment
May 25, 2020	1.0	Initial Release
Fed 26, 2021	1.1	- Added WLAN/BT function - Added Certification list (WLAN/BT)

Reference Documents

No.	Document Filename	Version	Release Date
1	RH_Design_Control_ver.1.0.pdf	1.0	May 25, 2020

Contents

Figures and Tables

1. Overview

1.1. Introduction

Reference Hardware is a model designed to provide a basis targeted to In-Vehicle Infotainment system developments.

The SoC used on this hardware sample is R-Car H3 of Renesas Electronics Corporation.
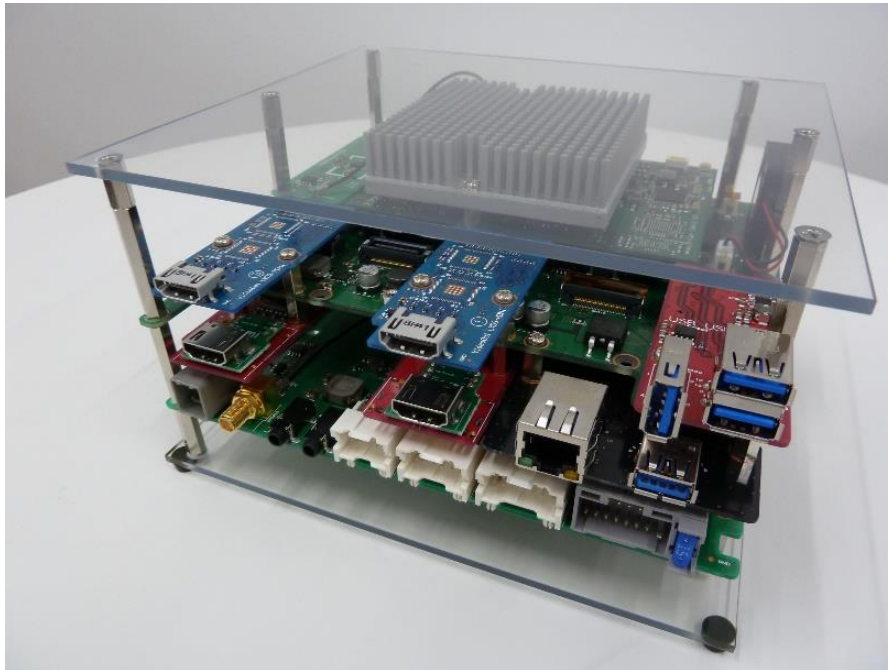
Figure 1 Reference Hardware (Actual Sample)
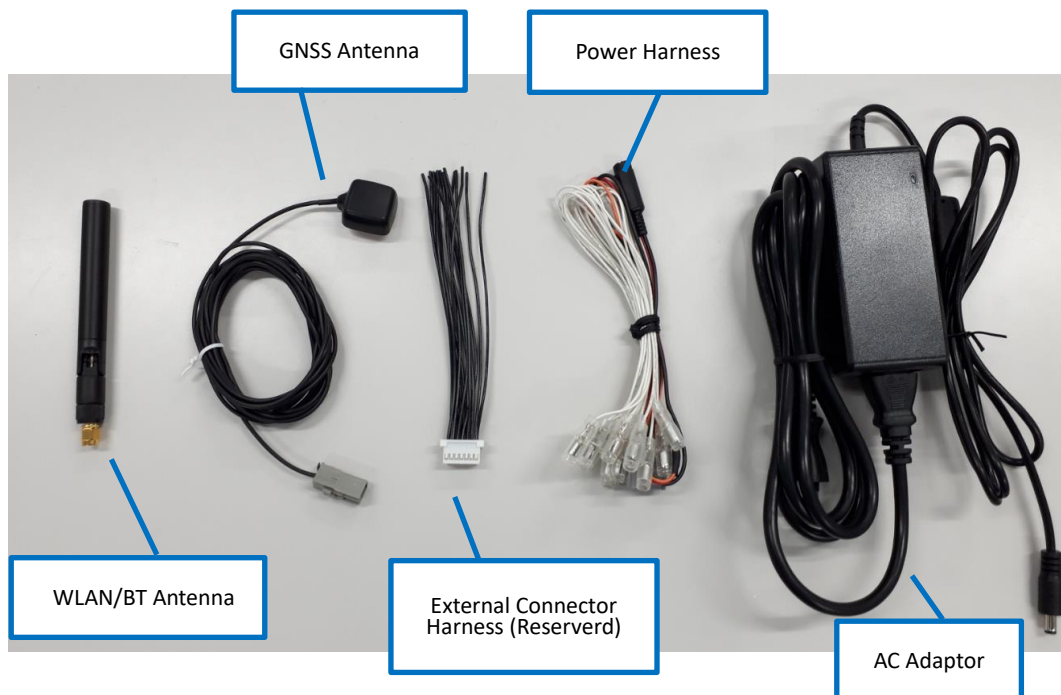
Figure 2 Package Contents
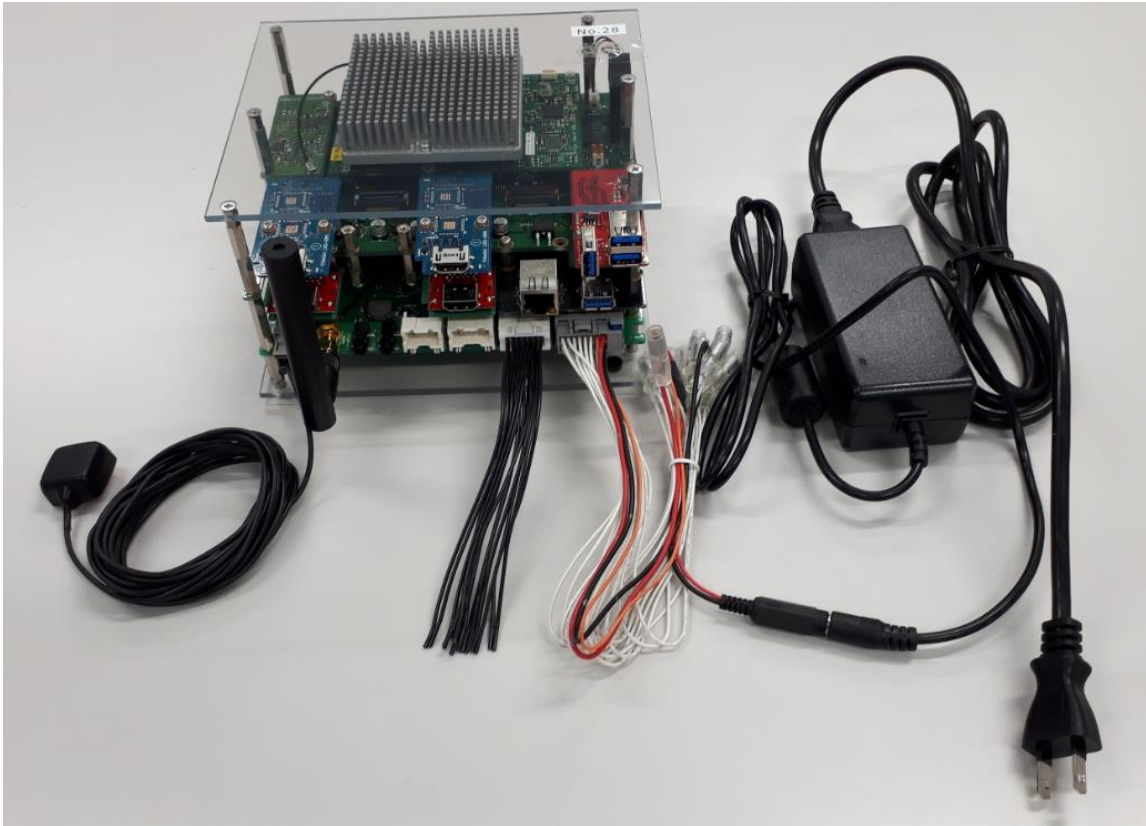
Figure 3 Reference Hardware (Wiring)

1.2. System Specifications

The specifications of this Reference Hardware are indicated in the table below.

Table 1 System Specifications

Block	Specifications
CPU	R-CAR H3 SiP
Memories	・ 8GByte LPDDR4 ・ 16MByte QSPI FlashROM ・ 64GByte eMMC
Connectors	・ External Connectors x 4 (Power,GPIO,CAN,etc) ・ WLAN antenna/GPS antenna ・ Line Out Jack/Mic In Jack ・ Debug USB/Debug UART ・ MicroSD Card Socket ・ USB3.0 x 2 / USB2.0 x 2 ・ RJ-45 Ethernet ・ HDMI(Video Out) x 2/HDMI(Video In) x 2
Board configuration	・ SoC Board ・ Control Board ・ Vehicle Board ・ VideoOut Board x 2 ・ VideoIn Board x 2 ・ USB Board ・ Ether Borad ・ GNSS Board ・ WLAN/BT Board
Product specification	・ Dimensions：154mm x 178mm x 101mm (Excluding protrusions) ・ Weight：1000g ・ External Power supply　DC=10.5V-16V@Max 10A ・ Operating ambient temperature　-10°C-60°C
Accessories	・ AC Adaptor ・ Power Harness (DC-Jack to External Connector) ・ External Connector Harness (Reserved) ・ GNSS Antenna ・ WLAN/BT Antenna

1.3. System Block Diagram

The following image shows a block diagram of this Reference Hardware system.
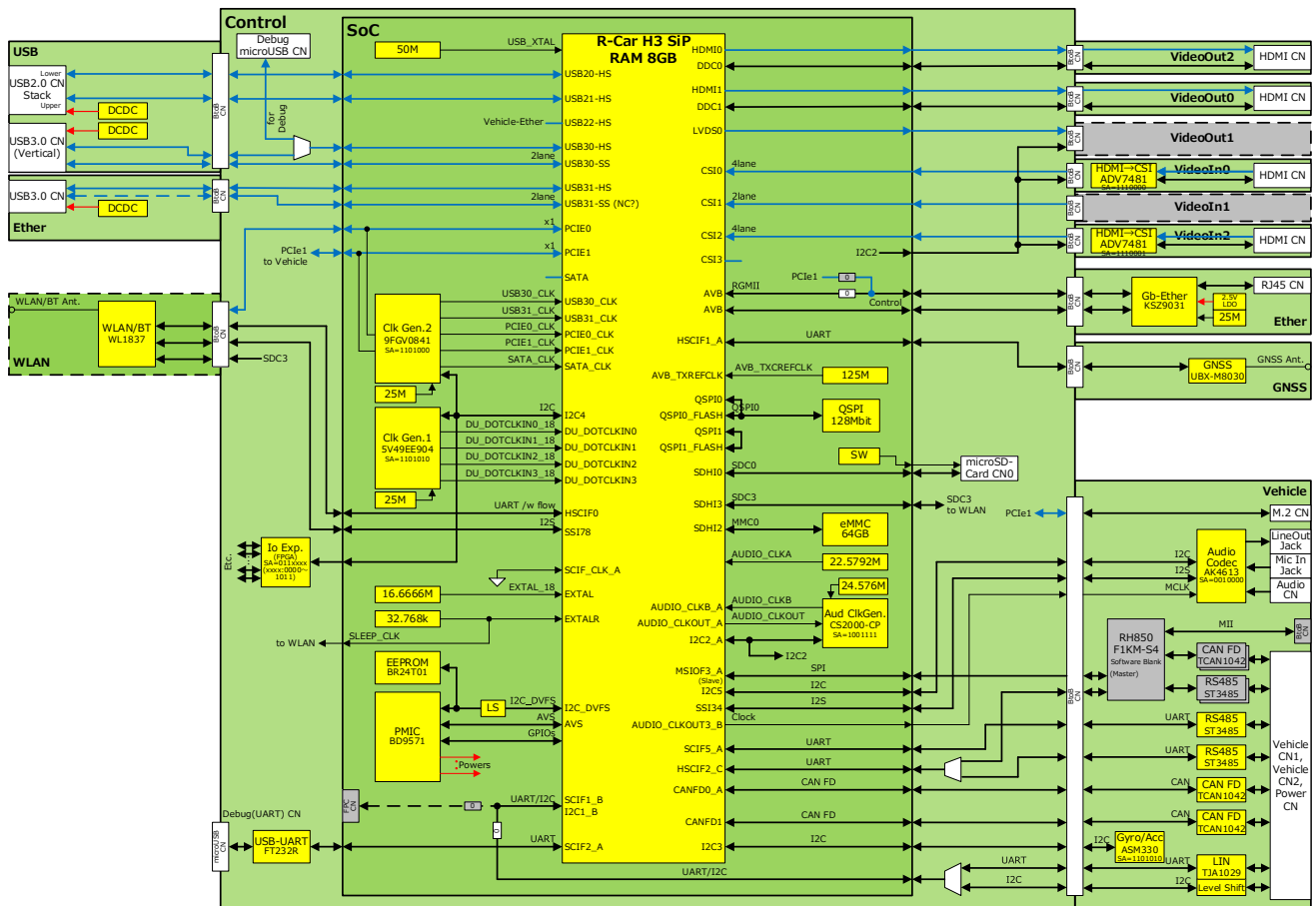
Figure 4 System Block Diagram

1.4. Electrical Specification

The following tables show electrical conditions of this Reference Hardware.

Table 2 Absolute Maximum Rating

	min	typ	max	unit	Description
Input Voltage	-0.3		20	V	
Storage Temperature Range	-20		85	℃	

Table 3 Functional Specification

	min	typ	max	unit	Description
Input Voltage	10.5	12	16	V	
Ambient Temperature	-10	25	60	℃	

2. External Interface

The interfaces for external devices are shown in this section.

2.1. External Ports Placement

The following image shows the placement of ports for this Reference Hardware which interface with system devices.
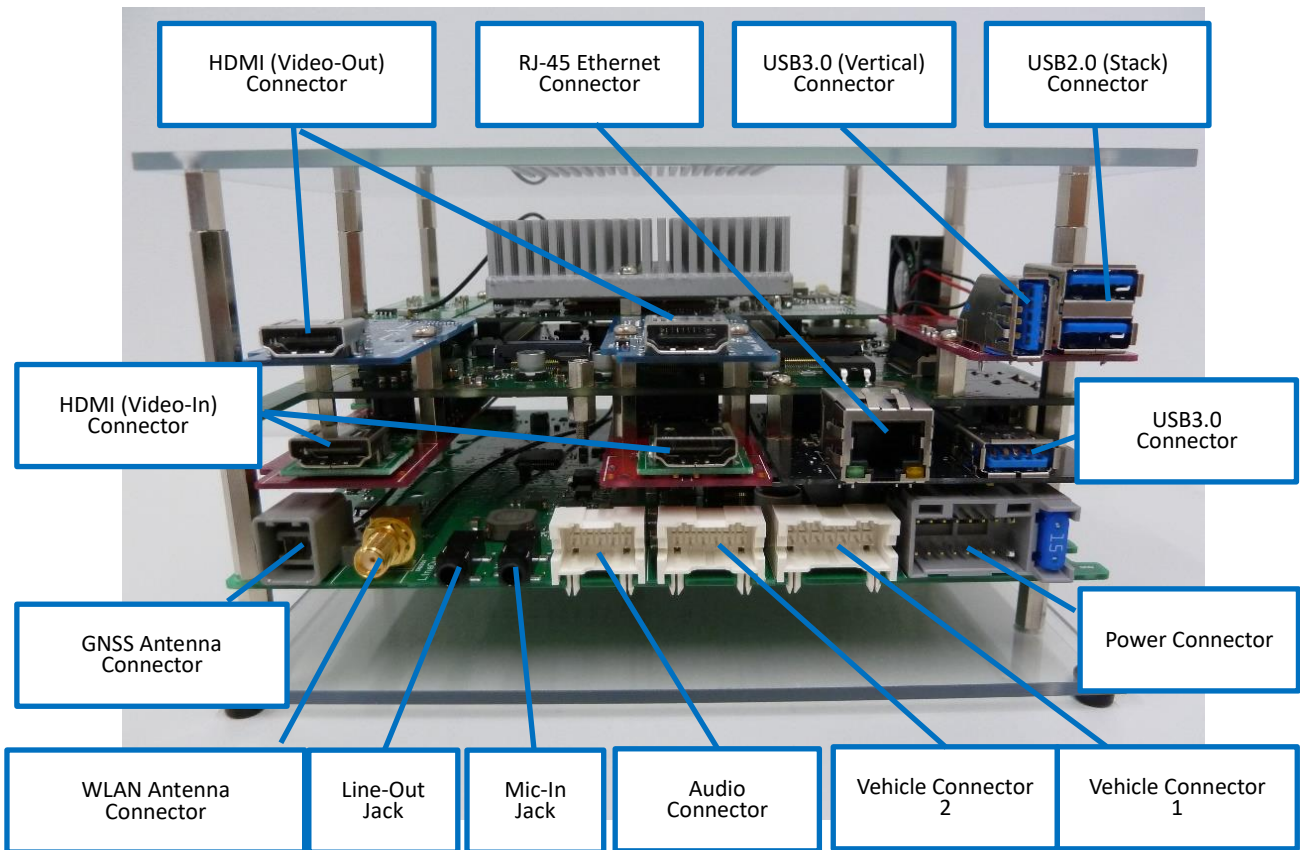
Figure 5 External Ports (Back Side)
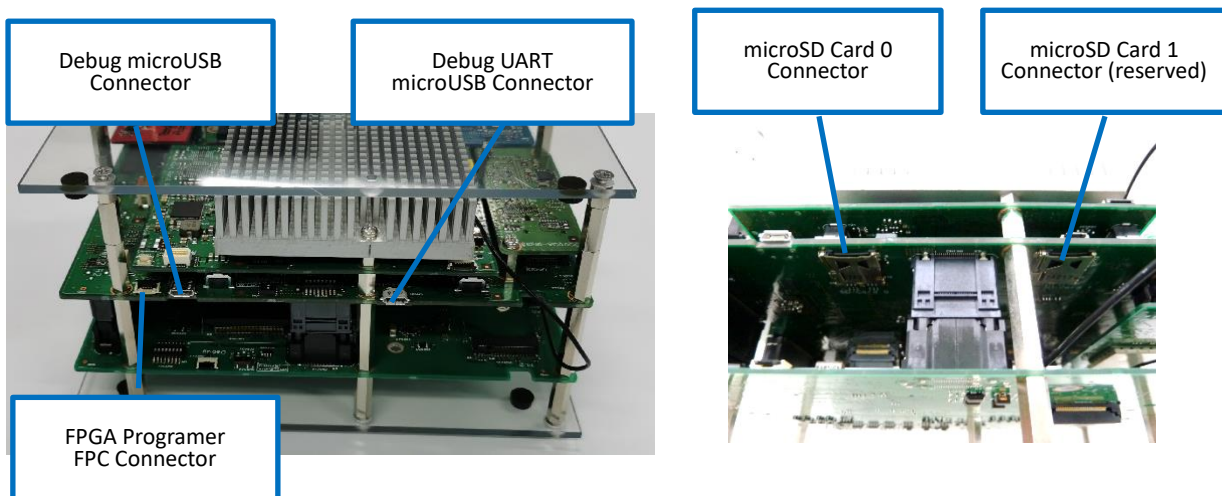
Figure 6 External Ports (Front Side)

2.2. Power Connector

The following table shows power supply, communication and general IO interfaces of usages intended for vehicles.

Wiring harnesses required for the connections are included in this product package.

A 15A fuse is contained in the power supply line.

The ampacity of the signal lines 4A.

To activate this Reference Hardware, 9V~+B power supply voltage should be applied to the ACC signal after applying +B power supply.

Table 4 Power Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	Reserved (for general-use signal input (1))	RH850	P0_7	
2	Reserved (for general-use signal output (1))	RH850	AP0_12	
3	Reserved (for general-use signal input (2))	RH850	P0_8	
4	Reserved (for general-use signal output (2))	RH850	AP0_13	
5	Reserved (for general-use signal input (3))	RH850	P1_9	
6	Reserved (for general-use signal output(3))	RH850	AP0_14	
7	Reserved (for general-use signal input(4))	RH850	P1_10	
8	Reserved (for general-use signal output(4))	RH850	AP0_15	
9	External Power Supply Output (1)	LDO	VOUT	8.25V Output (Max. 1A)
10	Reserved (for vehicle speed signal input)	RH850	P8_5	
11	External Power Supply Output (2)	LDO	VOUT	+B Power Supply (Max. 0.4A)
12	Reserved	RH850	RLIN34TX/RX	
13	ACC	Voltage Detect	VIN	Detected when 9V or higher
14	LIN	R-Car H3 RH850	TX1_B/RX1_B RLIN29TX/RX	Converted by LIN driver See 4.1.4. for connection setting
15	+B Power Supply	Each Power Source	VIN	Input Power Supply Typ:12V
16	GND	GND	-	
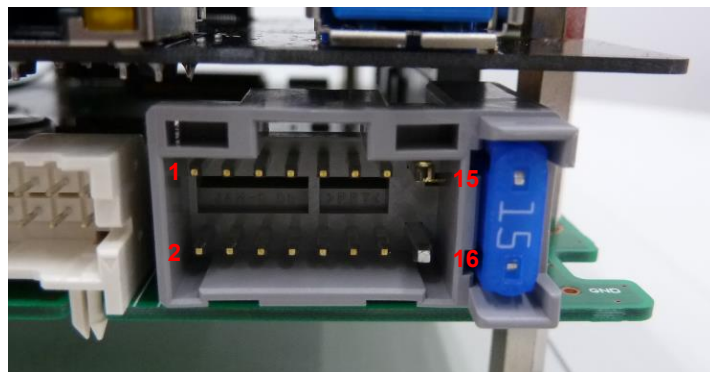
Figure 7 Power Connector

2.3. Vehicle Connector 1

Vehicle Connector 1 is a communication interface intended for vehicle use.

Part Number: S14B-XADSS-N

Manufacturer: J.S.T.MFG.CO., LTD. (JST)

Table 5 Vehicle Connector #1 Pinout

Pin	Signal	Connected Device	Connected Terminal	Description
1	CAN+(1)	R-Car H3	CANFD0_TX_A/RX_A	Converted by CAN driver
2	RS485+(1)	R-Car H3 RH850	TX5_A/RX5_A RLIN35TX/RX	Converted by RS485 driver See 4.1.4. for connection setting
3	CAN-(1)	R-Car H3	CANFD0_TX_A/RX_A	Converted by CAN driver
4	RS485-(1)	R-Car H3 RH850	TX5_A/RX5_A RLIN35TX/RX	Converted by RS485 driver See 4.1.4. for connection setting
5	CAN+(2)	R-Car H3	CANFD1_TX/RX	Converted by CAN driver
6	RS485+(2)	R-Car H3 RH850	HTX2_C/HRX2_C RLIN36TX/RX	Converted by RS485 driver See 4.1.4. for connection setting
7	CAN-(2)	R-Car H3	CANFD1_TX/RX	Converted by CAN driver
8	RS485-(2)	R-Car H3 RH850	HTX2_C/HRX2_C RLIN36TX/RX	Converted by RS485 driver See 4.1.4. for connection setting
9	Reserved CAN+(3)	RH850	CAN6TX/RX	Converted by CAN driver
10	Reserved CAN+(4)	RH850	CAN7TX/RX	Converted by CAN driver
11	Reserved CAN-(3)	RH850	CAN6TX/RX	Converted by CAN driver
12	Reserved CAN-(4)	RH850	CAN7TX/RX	Converted by CAN driver
13	GND	GND	-	
14	GND	GND	-	
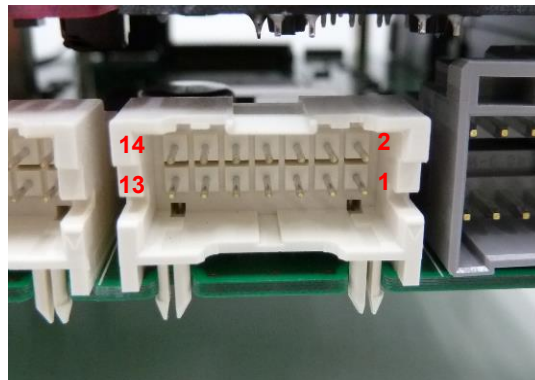
Figure 8 Vehicle Connector 1

2.4. Vehicle Connector 2

Vehicle Connector 2 is a communication and general IO interface intended for vehicle use.

Part Number：S12B-XADSS-N

Manufacturer: J.S.T.MFG.CO., LTD. (JST)

Table 6 Vehicle Connector 2 Pin Assignment

Pin	Signal	Connected Device	Connected Terminal	Description
1	Reserved　(general-use signal input(5))	RH850	P1_11	
2	Reserved　(general-use signal output(5))	RH850	AP0_3	
3	Reserved　(general-use signal input(6))	RH850	P2_0	
4	Reserved　(general-use signal output(6))	RH850	AP0_2	
5	Reserved　(general-use signal input(7))	RH850	JP0_3	
6	Reserved　(general-use signal output(7))	RH850	AP0_1	
7	SCL_EXT	R-Car H3	SCL1_B	
8	Reserved　(general-use signal output(8))	RH850	AP0_0	
9	SDA_EXT	R-Car H3	SDA1_B	
10	IEBUS+	RH850	RLIN32TX/RX	Converted by IEBus driver See 4.1.4. for connection setting
11	GND	GND	-	
12	IEBUS-	RH850	RLIN32TX/RX	Converted by IEBus driver See 4.1.4. for connection setting
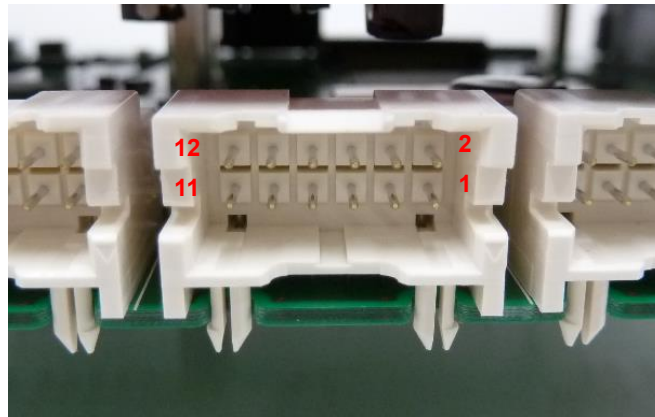
Figure 9 Vehicle Connector2

2.5. WLAN Antenna Connector

WLAN Antenna Connector is an interface for antenna connection intended for WLAN/Bluetooth.

Part Number: 142-0701-501

Manufacturer: Cinch Connectivity Solutions Johnson

Table 7 WLAN Antenna Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	WLAN_ANT	WLAN Board	Antenna	
2	GND	GND	-	
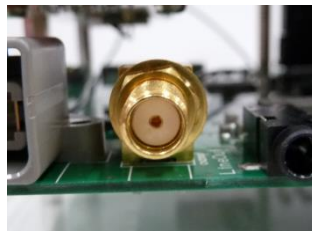
Figure 10 WLAN Antenna Connector

2.6. GNSS Antenna Connector

GNSS Antenna Connector is an interface intended for the antenna connection for GPS.

Part Number：CNB-01AH

Manufacturer：：J.S.T.MFG.CO.LTD. (JST)

Table 8 GNSS Antenna Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	GNSS_ANT	GNSS Board	Antenna	
2	GND	GND	-	
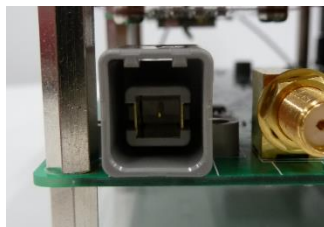
Figure 11 GNSS Antenna Connector

2.7. Line-Out Jack

Line-out Jack is an interface intended for audio signal output (analog signal)

Part Number：SJ-3523-SMT

Manufacturer:：CUI

Table 9 Line-Out Jack Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	GND	GND	-	
2	AUDIO_OUT_L(1)	Audio Codec	LOUT1	Audio Codec converts I2S to analog signal
3	AUDIO_OUT_R(1)	Audio Codec	ROUT1	Audio Code converts I2S to analog signal
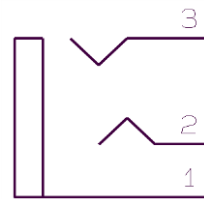
Figure 12 Line-Out Jack

2.8. Mic-In Jack

Mic-in jack is an interface intended for sound signal input from microphone (analog signal).

Part Number ：SJ-3523-SMT

Manufacturer:：CUI

Table 10 Mic-In Jack Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	GND	GND	-	
2	MIC_IN_L(1)	Audio Codec	LIN1	Audio Codec converts analog to I2S
3	MIC_IN_R(1)	Audio Codec	RIN1	Audio Codec coverts to I2S
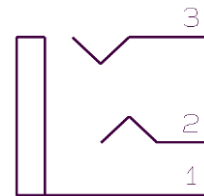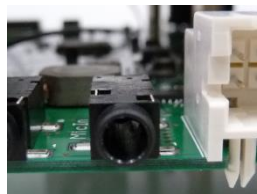
Figure 13 Mic-In Jack

2.9. Audio Connector

Audio connector is an interface intended for audio (analog signal) connection

Part Number ：S10B-XADSS-N

Manufacturer:：J.S.T.MFG.CO.,LTD. (JST)

Table 11 Audio Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected To	Connected Terminal	Description
1	GND	GND	-	
2	MIC_IN_R(2)	Audio Codec	ROUT2	Audio Codec converts analog to I2S
3	GND	GND	-	
4	MIC_IN_L(2)	Audio Codec	LOUT2	Audio Codec converts analog to I2S
5	GND	GND	-	
6	AUDIO_OUT_R(2)	Audio Codec	RIN2	Audio Codec converts I2S to analog
7	GND	GND	-	
8	AUDIO_OUT_L(2)	Audio Codec	LIN2	Audio Codec converts I2S to analog
9	GND	GND	-	
10	Reserved beep signal	RH850	P8_12	
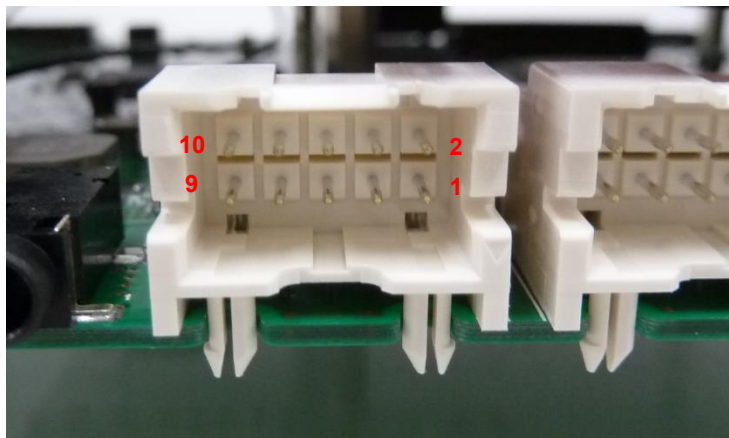
Figure 14 Audio Connector

2.10. USB3.0 (Vertical) Connector

USB3.0 (Vertical) connector is an USB interface supporting USB3.0

Part Number　：484040003
Manufacturer:：molex

Table 12 USB3.0 (Vertical) Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	VBUS	DCDC	VOUT	5V output
2	USB_HS_D-	R-Car H3	USB3HS0_DM	
3	USB_HS_D+	R-Car H3	USB3HS0_DP	
4	GND	GND	-	
5	USB_SS_RX-	R-Car H3	USB3S0_RX_M	
6	USB_SS_RX+	R-Car H3	USB3S0_RX_P	
7	GND	GND	-	
8	USB_SS_TX-	R-Car H3	USB3S0_TX_M	
9	USB_SS_TX+	R-Car H3	USB3S0_TX_P	
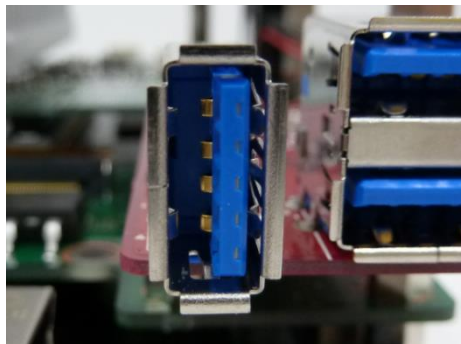
Figure 15 USB3.0 (Vertical) Connector

2.11. USB2.0 (Stack) Connector

USB2.0 (Stack) Connector is an USB(x2) interface supporting USB2.0

This wiring is applicable to USB3.0 as well. However, as the USB3.0 signal is not connected to this SoC board, only USB2.0 is supported.

Part Number ：484060001

Manufacturer:：molex

Table 13 USB2.0 (Stack) Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	VBUS(0)	DCDC	VOUT	Bottom, 5V output
2	USB_HS_D-(0)	R-Car H3	DM0	Bottom
3	USB_HS_D+(0)	R-Car H3	DP0	Bottom
4	GND	GND	-	
5	USB_SS_RX-(0)	-	-	Bottom, N/C
6	USB_SS_RX+(0)	-	-	Bottom, N/C
7	GND	GND	-	
8	USB_SS_TX-(0)	-	-	Bottom, N/C
9	USB_SS_TX+(0)	-	-	Bottom, N/C
10	VBUS(1)	DCDC	VOUT	Top, 5V output
11	USB_HS_D-(1)	R-Car H3	DM1	Top
12	USB_HS_D+(1)	R-Car H3	DP1	Top
13	GND	GND	-	
14	USB_SS_RX-(1)	-	-	Top, N/C
15	USB_SS_RX+(1)	-	-	Top, N/C
16	GND	GND	-	
17	USB_SS_TX-(1)	-	-	Top, N/C
18	USB_SS_TX+(1)	-	-	Top, N/C
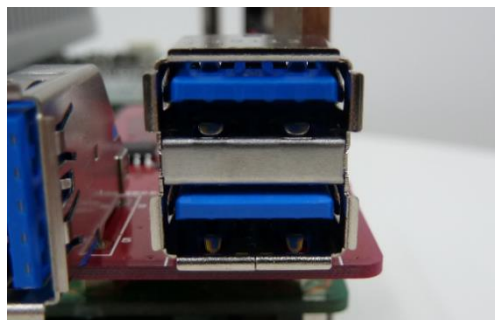
Figure 16 USB2.0 (Stack) Connector

2.12. USB3.0 Connector

USB3.0 Connector is an USB interface supporting USB3.0.

Part Number ：48392000x

Manufacturer:：molex

Table 14 USB3.0 Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	VBUS	DCDC	VOUT	5V output
2	USB_HS_D-	R-Car H3	USB3HS1_DM	
3	USB_HS_D+	R-Car H3	USB3HS1_DP	
4	GND	GND	-	
5	USB_SS_RX-	R-Car H3	USB3S1_RX_M	
6	USB_SS_RX+	R-Car H3	USB3S1_RX_P	
7	GND	GND	-	
8	USB_SS_TX-	R-Car H3	USB3S1_TX_M	
9	USB_SS_TX+	R-Car H3	USB3S1_TX_P	
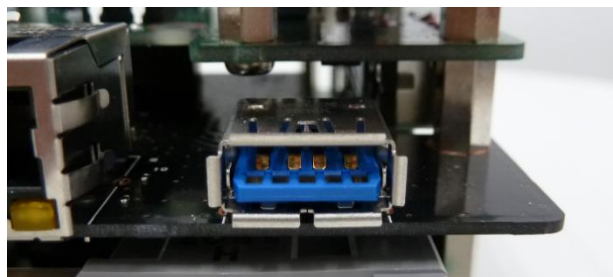
Figure 17 USB3.0 Connector

2.13. **RJ-45 Ethernet Connector**

RJ-45 Ethernet Connector is an interface supporting Ethernet (1000BASE-T).

MDI is used, but AUTO MDI/MDI-X are also supported.

Part Number ：HFJ11-１G41E-L12RL

Manufacturer:：Halo Electronics

Table 15 RJ-45 Ethernet Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	DA+	Ethernet Transceiver	MDI	Converted to RGMII by Ethernet transceiver and connected to R-Car H3
2	DA-			
3	DB+			
4	DB-			
5	DC+			
6	DC-			
7	DD+			
8	DD-			

Figure 18 RJ-45 Ethernet Connector

2.14. HDMI (Video Out) Connector

HDMI (Video Out) Connector is a HDMI interface for Video Out.

Part Number ：MD60X-19P

Manufacturer:：Hirose Electric Co., Ltd.

Table 16 HDMI (Video Out) Connector Pin Assignment and Connected Terminal (Right)

Pin	Signal	Connected Device	Connected Terminal	Description
1	HDMI_TX2+	R-Car H3	HDMI1_TMDSDATAP2	
2	GND	GND	-	
3	HDMI_TX2-	R-Car H3	HDMI1_TMDSDATAN2	
4	HDMI_TX1+	R-Car H3	HDMI1_TMDSDATAP1	
5	GND	GND	-	
6	HDMI_TX1-	R-Car H3	HDMI1_TMDSDATAN1	
7	HDMI_TX0+	R-Car H3	HDMI1_TMDSDATAP0	
8	GND	GND	-	
9	HDMI_TX0-	R-Car H3	HDMI1_TMDSDATAN0	
10	HDMI_CLK+	R-Car H3	HDMI1_TMDSCLKP	
11	GND	GND	-	
12	HDMI_CLK-	R-Car H3	HDMI1_TMDSCLKN	
13	HDMI_CEC	-		
14	NC	-		
15	SCL	R-Car H3	HDMI1_SCL	
16	SDA	R-Car H3	HDMI1_SDA	
17	GND	GND	-	
18	VDD_5V	LDO	VOUT	5V output
19	HPD	R-Car H3	HDMI1_HPD	

Table 17 HDMI (Video Out) Connector Pin Assignment and Connected Terminal (Left)

Pin	Signal	Connected Device	Connected Terminal	Description
1	HDMI_TX2+	R-Car H3	HDMI0_TMDSDATAP2	
2	GND	GND	-	
3	HDMI_TX2-	R-Car H3	HDMI0_TMDSDATAN2	
4	HDMI_TX1+	R-Car H3	HDMI0_TMDSDATAP1	
5	GND	GND	-	
6	HDMI_TX1-	R-Car H3	HDMI0_TMDSDATAN1	
7	HDMI_TX0+	R-Car H3	HDMI0_TMDSDATAP0	
8	GND	GND	-	
9	HDMI_TX0-	R-Car H3	HDMI0_TMDSDATAN0	
10	HDMI_CLK+	R-Car H3	HDMI0_TMDSCLKP	
11	GND	GND	-	
12	HDMI_CLK-	R-Car H3	HDMI0_TMDSCLKN	
13	HDMI_CEC	-		
14	NC	-		
15	SCL	R-Car H3	HDMI0_SCL	
16	SDA	R-Car H3	HDMI0_SDA	
17	GND	GND	-	
18	VDD_5V	LDO	VOUT	5V output
19	HPD	R-Car H3	HDMI0_HPD	

Figure 19 HDMI (Video Out) Connector

The interface of R-Car's HDMI0 is connected to the left HDMI connector and the interface of R-Car's HDMI1 is connected to the right HDMI Connector.

2.15. HDMI (Video In) Connector

HDMI (Video In) Connector is a HDMI interface for Video In.

Part Number : 47151-1101

Manufacturer: : molex

Table 18 HDMI (Video In) Connector Pin Assignment and Connected Terminal (Right)

Pin	Signal	Connected Device	Connected Terminal	Description
1	HDMI_TX2+	CSI Conversion IC	HDMI Input	Convert HDMI to CSI and connect to R-Car H3
2	GND			
3	HDMI_TX2-			
4	HDMI_TX1+			
5	GND			
6	HDMI_TX1-			
7	HDMI_TX0+			
8	GND			
9	HDMI_TX0-			
10	HDMI_TCLK+			
11	GND			
12	HDMI_TCLK-			
13	NC	-		
14	NC	-		
15	SCL	CSI Conversion IC	DDC_SCL	
16	SDA	CSI Conversion IC	DDC_SDA	
17	GND	GND	-	
18	VDD_5V	CSI Conversion IC	RX_5V	5V Input
19	HPD	CSI Conversion IC	HPD	HDMI Connection Detection

Table 19 HDMI (Video In) Connector Pin Assignment and Connected Terminal (Left)

Pin	Signal	Connected Device	Connected Terminal	Description
1	HDMI_TX2+	CSI Conversion IC	HDMI Input	Convert HDMI to CSI and connect to R-Car H3
2	GND			
3	HDMI_TX2-			
4	HDMI_TX1+			
5	GND			
6	HDMI_TX1-			
7	HDMI_TX0+			
8	GND			
9	HDMI_TX0-			
10	HDMI_TCLK+			
11	GND			
12	HDMI_TCLK-			
13	NC	-		
14	NC	-		
15	SCL	CSI Conversion IC	DDC_SCL	
16	SDA	CSI Conversion IC	DDC_SDA	
17	GND	GND	-	
18	VDD_5V	CSI Conversion IC	RX_5V	5V Input
19	HPD	CSI Conversion IC	HPD	HDMI connection detection

Figure 20 HDMI (Video In) Connector

The interface of R-Car's CSI2 is connected to the left HDMI connector and the interface of R-Car'sCSI0 is connected to the right HDMI connector.

2.16. microSD Card 0 Connector

microSD Card 0 Connector is an interface for microSD card.

Part Number: 502702-0892

Manufacturer:：molex

Table 20 microSD Card 0 Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	SDC_DATA2	R-Car H3	SD0_DAT2	
2	SDC_DATA3	R-Car H3	SD0_DAT3	
3	SDC_CMD	R-Car H3	SD0_CMD	
4	VDD_SDC	Load Switch	VOUT	SD card power supply (3.3V) On when R-Car H3 GP5_02=H
5	SDC_CLK	R-Car H3	SD0_CLK	
6	GND	GND	-	
7	SDC_DATA0	R-Car H3	SD0_DAT0	
8	SDC_DATA1	R-Car H3	SD0_DAT1	
9	SDC_DET	R-Car H3	SD0_CD	Card detection (L:Insert)
10	GND	GND	-	
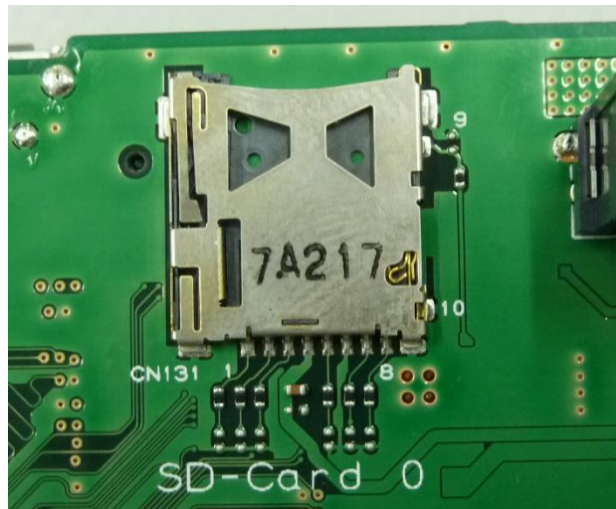
Figure 21 microSD Card 0 Connector

2.17. microSD Card 1 Connector

microSD Card 1 Connector is an interface for microSD card.

However, this is reserved connector as no signal is connected to this R-Car H3 Reference Hardware.

Part Number ：502702-0892

Manufacturer:：molex

Table 21 microSD Card 1 Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	SDC_DATA2	-		
2	SDC_DATA3	-		
3	SDC_CMD	-		
4	VDD_SDC	Load Switch	VOUT	
5	SDC_CLK	-		
6	GND	GND	-	
7	SDC_DATA0	-		
8	SDC_DATA1	-		
9	SDC_DET	-		
10	GND	GND	-	

Figure 22 microSD Card 1 Connector

3. Debug Interface

This section describes specification of the interfaces for the boards in this Reference Hardware.

3.1. Placement

The placement of board-to-board interfaces used on the Reference Hardware is shown below.

[Top Side]
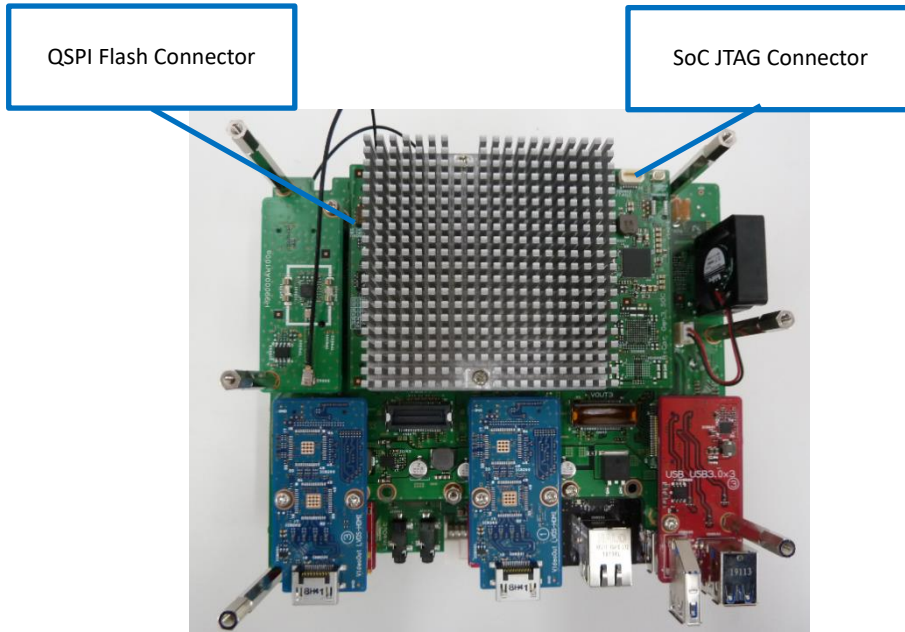
[Front Side]

[Left/Right Side]

DC Jack
(Reserved)

RH850 Debug Connector
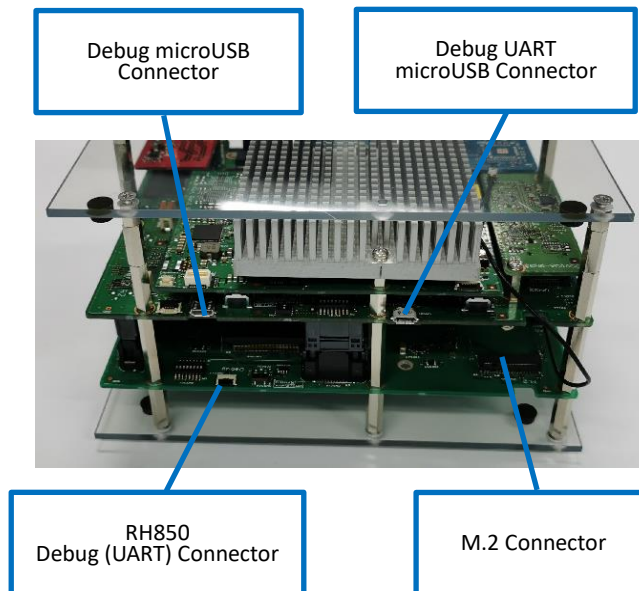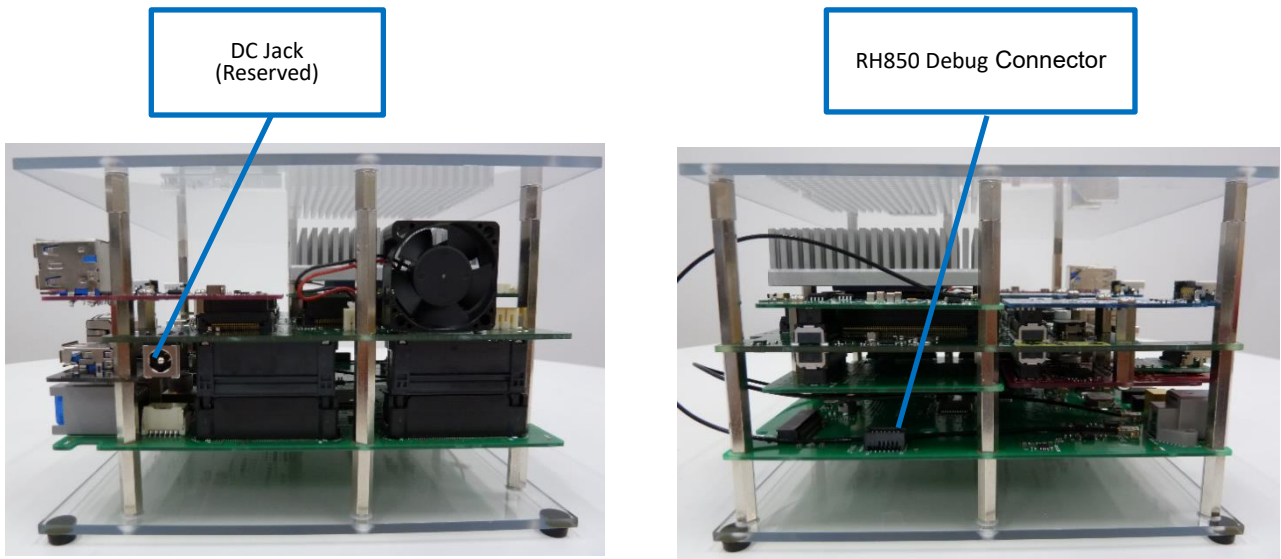
Figure 23 Debug Interface Placement

3.2. Debug UART microUSB Connector

Debug UART microUSB Connector is UART interface intended for SoC debugging.

UART is converted to USB in the Reference Hardware, PC can be connected to this connector using USB cable.

Part Number ：ZX62R-B-5P(30)

Manufacturer:：Hirose Electric

Table 22 Debug UART microUSB Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	VBUS		VCC	5V input
2	USB_D-	UART-USB (FT232R)	USBDM	Connecting USB converted from UART of SCIF2_A of R-Car H3
3	USB_D+		USBDP	
4	USB_ID	-		
5	GND	GND	-	

Figure 24 Debug UART microUSB Connector

3.3. Debug microUSB Connector

Debug microUSB Connector is USB interface intended for SoC debugging.

The port for USB3.0 referred in 2.10. cannot be used when this connector is in use.

Part Number ：ZX62D-AB-5P8

Manufacturer:：Hirose Electric Co., Ltd

Table 23 Debug microUSB Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	VBUS	USB SW R-Car H3	S USB3HS0_ID	5V input
2	USB_D-	R-Car H3	USB3HS0_DM	Connected to R-Car H3 by USB SW when VBUS input of pin 1 is applied.
3	USB_D+	R-Car H3	USB3HS0_DP	
4	USB_ID	-		
5	GND	GND	-	
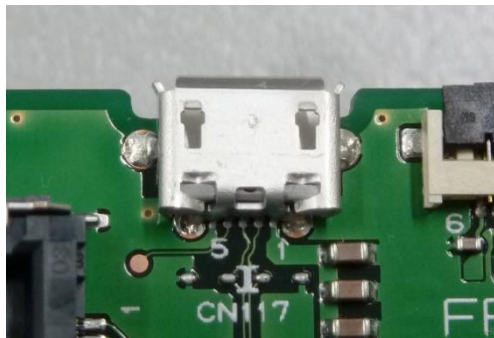
Figure 25 Debug microUSB Connector

3.4. SoC JTAG Connector

SoC JTAG Connector is an interface for JTAG for SoC(R-Car H3)

An additional conversion board is required when connecting to a development tool for R-Car H3.

Part Number ：SICA2P20S

Manufacturer:：Tokyo Eletech Corporation

Table 24 SoC JTAG Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal/Description	Pin	Signal	Connected Device	Connected Terminal/Description
1	NC	-		2	VDD_1.8V	PMIC	SW_VD18 1.8V output
3	GND	GND	-	4	TRST	R-Car H3	/TRST
5	GND			6	TDI	R-Car H3	TDI
7	GND			8	TMS	R-Car H3	TMS
9	GND			10	TCK	R-Car H3	TCK
11	GND			12	NC	-	
13	GND			14	TDO	R-Car H3	TDO
15	GND			16	SRST	R-Car H3	/PRESET
17	GND			18	NC	-	
19	GND			20	FILTER	10kΩ/0.1uF	against GND

Figure 26 SoC JTAG Connector

3.5. QSPI Flash Connector

QSPI Flash Connector is an interface for re-writing QSPI FlashROM.

Part Number ：IMSA-9637S-10Y902

Manufacturer:：IRISO Electronics CO., LTD

Table 25 QSPI Flash Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	QSPI_SPCLK	R-Car H3	QSPI0_SPCLK	
2	NC	-		
3	QSPI_SSL	R-Car H3	QSPI0_SSL	
4	QSPI_D0	R-Car H3	QSPI0_IO0	
5	GND	GND	-	
6	ICE_SRST	R-Car H3	/PRESET	
7	QSPI_D1	R-Car H3	QSPI0_IO1	
8	GPIO	R-Car H3	GP3_06	
9	VDD_1.8V	PMIC	SW_VD18	1.8V output
10	QSPI_D2	R-Car H3	QSPI0_IO2	

Figure 27 QSPI Flash Connector

3.6. **M.2 Connector**

M.2 Connector is a connector for M.2 (KEY ID M) card. The supporting interface is PCIe x 1.

Part Number　：1-2199230-6

Manufacturer:：TE Connectivity

Table 26 M.2 Connector Pin Assignment and Connected Terminal

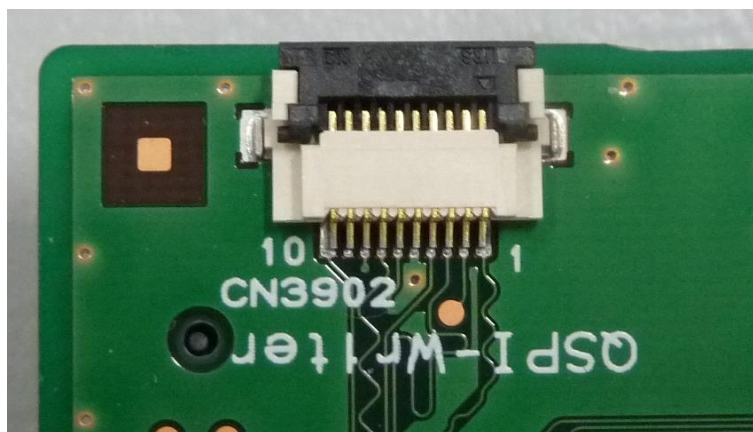| Pin	Signal	Connected Device	Connected Terminal /Description	Terminal No/ Signal		Connected Device	Connected Terminal /Description
1	GND	R-Car H3	GP6_16	2	3.3V	DCDC	VOUT 3.3V(Max.3A)
3	GND	GND	-	4	3.3V		
5	PETn3	-		6	NC	-	
7	PETp3	-		8	NC	-	
9	GND	GND	-	10	LED_1#	LED	See 4.2.1.
11	PERn3	-		12	3.3V	DCDC	VOUT 3.3V(Max.3A)
13	PERp3	-		14	3.3V		
15	GND	GND	-	16	3.3V		
17	PETn2	-		18	3.3V		
19	PETp2	-		20	NC	-	
21	GND	IO Exp3	bit5	22	NC	-	
23	PERn2	-		24	NC	-	
25	PERp2	-		26	NC	-	
27	GND	GND	-	28	NC	-	
29	PETn1	-		30	NC	-	
31	PETp1	-		32	NC	-	
33	GND	GND	-	34	NC	-	
35	PERn1	-		36	NC	-	
37	PERp1	-		38	NC(DEVSLP)	IO Exp3	bit1
39	GND	GND	-	40	SMB_CLK	-	
41	PETn0	R-Car H3	PCIE1_TX_M	42	SMB_DATA	-	
43	PETp0	R-Car H3	PCIE1_TX_P	44	ALERT#	-	
45	GND	GND	-	46	NC	-	
47	PERn0	R-Car H3	PCIE1_RX_M	48	NC	-	
49	PERp0	R-Car H3	PCIE1_RX_P	50	PERST#	IO Exp0	bit7
51	GND	GND	-	52	CLKREQ#	IO Exp0	bit2
53	REFCLKn	CLKGEN	DIF4	54	PEWAKE#	IO Exp0	bit3
55	REFCLKp			56	RESERVED	-	
57	GND	GND	-	58	RESERVED	-	
67	NC	-		68	SUSCLK	X'tal	32.768kHz
69	PEDET	IO Exp0	bit6	70	3.3V	DCDC	VOUT 3.3V(Max.3A)
71	GND	GND	-	72	3.3V		
73	GND	GND	-	74	3.3V		
75	GND	IO Exp0	bit5	-	-	-	

Figure 28 M.2 Connector

The size of expansion board should meet the following board dimension limit
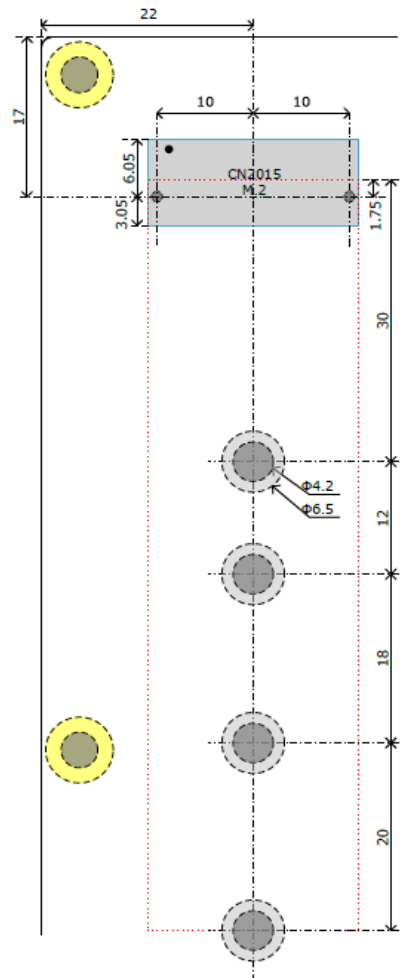
Figure 29 M.2 Card Size

3.7. **RH850 Debug Connector**

RH850 Debug Connector is a LPD interface intended for RH850 debugging

In this document, Renesas Technology Corporation E1 Emulator is assumed to use for a product development.

In that case, the connection with E1 emulator is enabled through the use of conversion board indicated in the following link.

https://www.renesas.com/jp/ja/doc/products/tool/doc/001/r20ut0162jj0200_e000010ckz.pdf

Part Number ：TFM-107-02-L-D

Manufacturer:：Samtec

Table 27 RH850 Debug Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	GND	GND	-	
2	LPDIO	RH850	JP0_0	
3	VDD_3.3V	LDO	VOUT	3.3V output
4	LPDCLK	RH850	JP0_2	
5	SYS_RESET_N	RH850	/RESET	
6	GND	GND	-	
7	NC	-		
8	NC	-		
9	LPDCLKO	RH850	JP0_5	
10	LPDO	RH850	JP0_1	
11	FLMD0	RH850	FLMD0	
12	NC	-		
13	NC	-		
14	GND	GND	-	
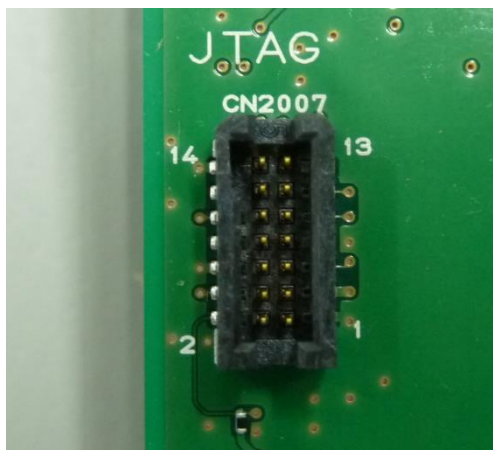
Figure 30 RH850 Debug Connector

3.8. RH850 Debug (UART) Connector

RH850 Debug (UART) Connector is UART interface intended for RH850 debugging

This is shared with K-LINE (1-Wired Serial) connected to Power Connector.

Part Number ：505110-0492

Manufacturer:：molex

Table 28 RH850 Debug (UART) Connector Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	VDD_3.3V	LDO	VOUT	3.3V output
2	K-LINE_RX	RH850	RLIN34RX	
3	K-LINE_TX	RH850	RLIN34TX	
4	GND	GND	-	
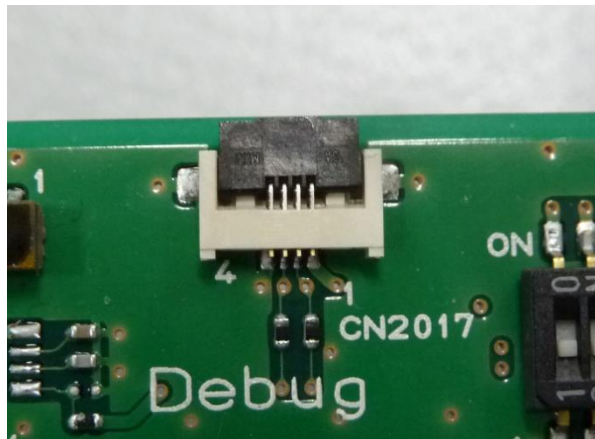
Figure 31 RH850 Debug (UART) Connector

3.9. DC Jack (Reserved)

DC Jack is an interface to provide the Control board with external power supply instead of supplying through Vehicle board. Do not use DC Jack when the Vehicle board is connected for supplying power.

Part Number ：2DC-G213-D42

Manufacturer:：Singatron

Table 29 DC Jack Pin Assignment and Connected Terminal

Pin	Signal	Connected Device	Connected Terminal	Description
1	＋B Power Supply	Each power source	VIN	Input power Typ:12V
2	GND	GND	-	
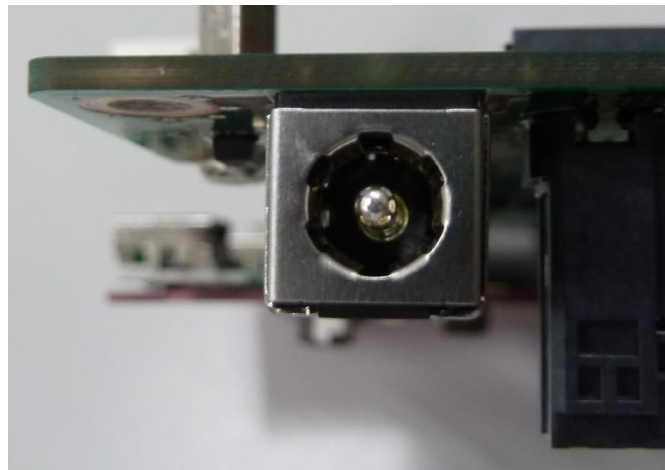
Figure 32 DC Jack

4. System Setting

4.1. Switch

The following information describes the settings of the switches on this Reference Hardware.

4.1.1. Switch Placement

Placement of Reference Hardware switches used on the Reference Hardware is shown below.

[Top Side]

[Front Side]

Figure 33 Switch Placement

4.1.2. BootMode Switch

CPU booting mode is configured according to the logics set to mode pins MD1 to 4.

Table 30 BootMode Configuration

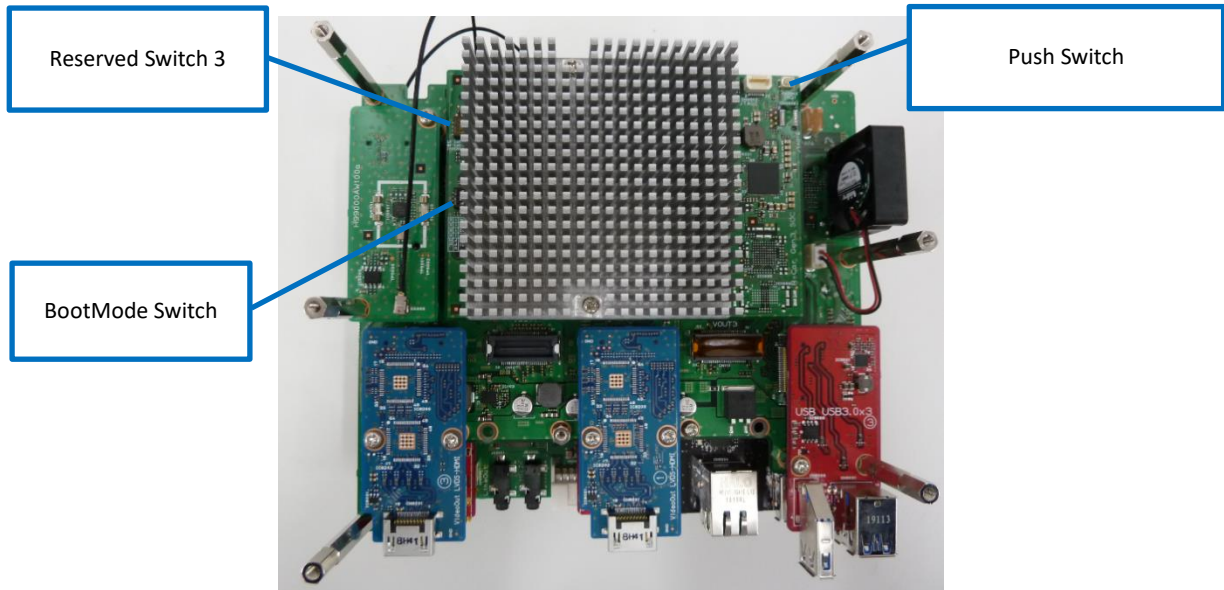| MD[4:1]	BootMode
0000	External ROM boot (area 0) *not supported by this Reference Hardware
0001	Reserved
0010	HyperFlash ROM boot at 160MHz using DMA
0011	HyperFlash ROM boot at 80MHz using DMA
0100	Serial Flash ROM boot at single read 40MHz using DMA
0101	Reserved
0110	Reserved
1000	Reserved
1001	Reserved
1010	HyperFlash ROM at 160MHz(320Mbps) using XIP mode
1011	HyperFlash ROM at 80MHz using XIP mode
1100	Reserved
1101	eMMC boot at 50MHz x8 bus widths using DMA
1110	USB download mode
1111	SCIF download mode

The default is SCIF download mode. The switch setting can be customized to suit the requirement.

Table 31 BootMode Switch Setting

Pin	Signal	Connected Device	Connected Terminal	ON	OFF	Default
1	MD1	R-Car H3	GP0_02	0	1	1(OFF)
2	MD2	R-Car H3	GP0_03	0	1	1(OFF)
3	MD3	R-Car H3	GP0_05	0	1	1(OFF)
4	MD4	R-Car H3	GP0_06	0	1	1(OFF)
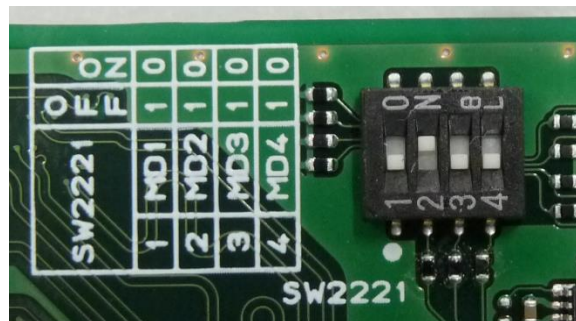
Figure 34 BootMode Switch

4.1.3. Power Supply Setting Switch

Power supply setting switch sets power supply voltage for Control board. The setting should be changed as needed, such as for changing the device, etc. The voltages of ADJ power supply and ADJ2 power supply can be changed by changing the resistor. The setting range is approximately from 1.2V to 2.5V.

Table 32 Power Supply Setting Switch

SW	Function	ON	OFF	Default
1	WLAN IO Voltage	1.8V	SoC IO Voltage (3.3V)	OFF
2	GNSS IO Voltage	1.8V	SoC IO Voltage (3.3V)	OFF
3	FPGA VOUT IO Voltage	1.8V	3.3V	OFF
4	FPGA VIN IO Voltage	1.8V	3.3V	OFF
5	FPGA USB IO Voltage	1.8V	3.3V	OFF
6	VOUT Core Voltage	ADJ Voltage (1.2V)	ADJ2 Voltage (1.5V)	OFF
7	VIN Core Voltage	ADJ Voltage (1.2V)	ADJ2 Voltage (1.5V)	OFF
8	Ether Core Voltage	ADJ2 Voltage (1.5V)	ADJ Voltage (1.2V)	OFF

Figure 35 Voltage Setting Switch

4.1.4. Connection Setting Switch

Connection Setting Switch configures CPU that controls serial interface for external devices. The default can be changed as needed.

Table 33 Connection Setting Switch

SW	Setting	ON	OFF	Default	Description
1	RH850-Soc I2C	OFF	ON	OFF	Determines whether RH850 and SoC(R-Car H3) are to be connected by I2C or not, but either setting is OFF on this Reference Hardware
2	Codec I2C	RH850	SoC	OFF	Sets up the connecting I2C for Audio Codec IC. 　ON：RH850　　　　RIIC1SCL/RIIC1SDA 　OFF：SoC　　　　　GP05_04/GP05_00（I2C2）
3	RS485(1)	RH850	SoC	OFF	Configures device connected to RS485(1) in Vehicle Connector1 See 2.2.
4	RS485(2)	RH850	SoC	OFF	Configures devices connected to RS485(2) in Vehicle Connector1 See 2.2.
5	IEBUS	RH850	SoC	OFF	Configures devices connected to IEBUS in Vehicle Connector2 See 2.4. for more information
6	Audio Power	RH850	SoC	OFF	Configures devices controlling Audio power supply External powers supply output (1) 　ON：RH850　　　　AP1_1 　OFF：R-Car H3　　PD(termination) External power supply output (2) 　ON：RH850　　　　AP1_2 　OFF：R-Car H3　　PD(termination) Audio CodeC Power Supply 　ON：RH850　　　　AP1_7 　OFF：R-Car H3　　/PRESET
7	SoC Boot	RH850	Hard	OFF	Selects either hardware or software of RH850, to control the SoC boot on this Reference Hardware.
8	LIN	RH850	SoC	OFF	Configures devices connected to LIN in Power Connector. See 2.2.

Figure 36 Connection Setting Switch

4.1.5. Push Switch

Push Switch is a push button switch that activates CPU interruption.
Pushing switch causes R-Car H3' GP2_1 terminal to be shorted to GND.

Figure 37 Push Switch

4.1.6. Reserve Switch 1

It is an unused SW. The default setting is All OFF. Do not change the setting

4.1.7. Reserve Switch 2

It is an unused SW. The default setting is All OFF. Do not change the setting

4.1.8. Reserve Switch 3

It is an unused SW. The default setting is All OFF. Do not change the setting

4.2. Miscellaneous

4.2.1. LED

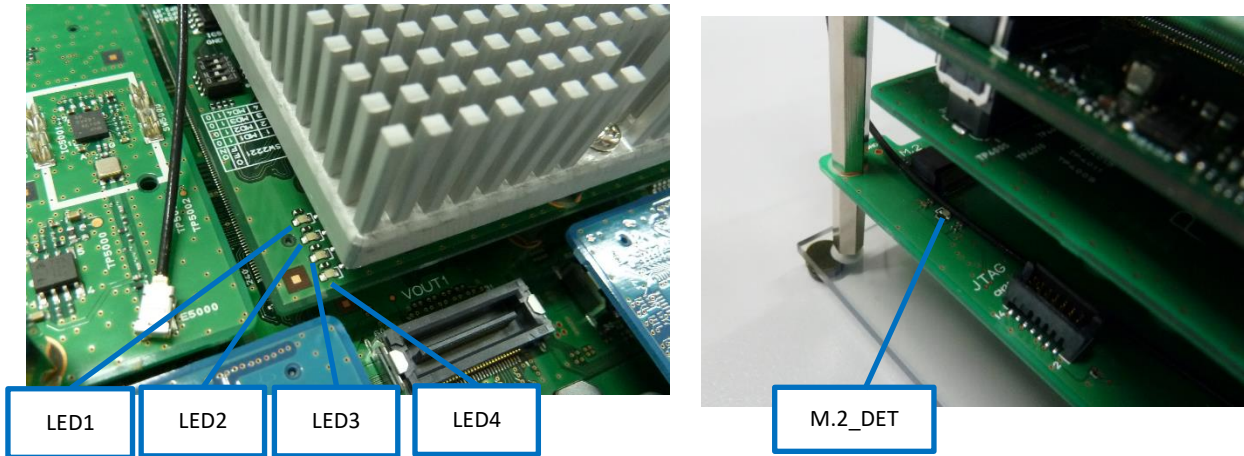The following information describes the position and usage of LED in this Reference Hardware.

Figure 38 LED Placement

Table 34 LED Listing

LED	Location Board	ON	OFF	Remark
LED1	SoC Board	GP2_06=High	GP2_06=Low	Connecting R-Car H3 PWM0/GP2_06
LED2	SoC Board	GP0_01=High	GP0_01=Low	Connecting R-Car H3 D1/GP0_01 The default is OFF to indicate boot mode signal MD0's state.
LED3	SoC Board	MD1=1 GP0_02=High	MD1=0 GP0_02=Low	Connecting R-Car H3 D2/GP0_02 The default is depends on Bootmode switch setting to indicate boot mode signal MD1's state.
LED4	SoC Board	MD2=1 GP0_03=High	MD2=0 GP0_03=Low	Connecting R-Car H3 D3/GP0_03 The default is depends on Bootmode switch setting to indicate boot mode signal MD2's state.
M.2_DET	Vehicle Board	M.2 Board Drive	else	Switch to ON when the board is connected to M.2 Connector and The board drives the LED.

R-Car H3's terminals, which controls LED1~4, is used as other function terminal.   Please refer *Reference Hardware Design Guideline for Control Board* for more detail.

5. Certification

5.1. WLAN/BT (WL1837/Texas Instruments)

The WLAN/BT device from TI(Texas Instruments) are certificated for FCC, IC, ETSI/CE, Japan MIC.   Table 35 shows the cirtification list for this module.   When connecting to a real network, please make sure the required certification in that country.

Table 35 WL1837 certification list

Regulatory Body	Specification	ID (If Applicable)
FCC(USA)	Part 15C + MPE FCC RF exposure	Z64-WL 18DBMOD
ISED(Canada)	RSS-102(MPE) and RSS-247(WiFi-Bluetooth)	451I-WL18DBMOD
ETSI/CE(Europe)	EN300328 v2.1.1 (2.4-GHz WiFi, Bluetooth)	-
	EN301893 v2.1.1 (5-GHz WiFi)	-
	EN62311:2008 (MPE)	-
	EN301489-1 v2.1.1 (general EMC)	-
	EN301489-17 v3.1.1 (EMC)	-
	EN60950-1:2006/A11:2009/A1:2010/A12:2011/A2:2013	-
MIC(Japan)	Article 49-20 of ORRE	201-140447

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