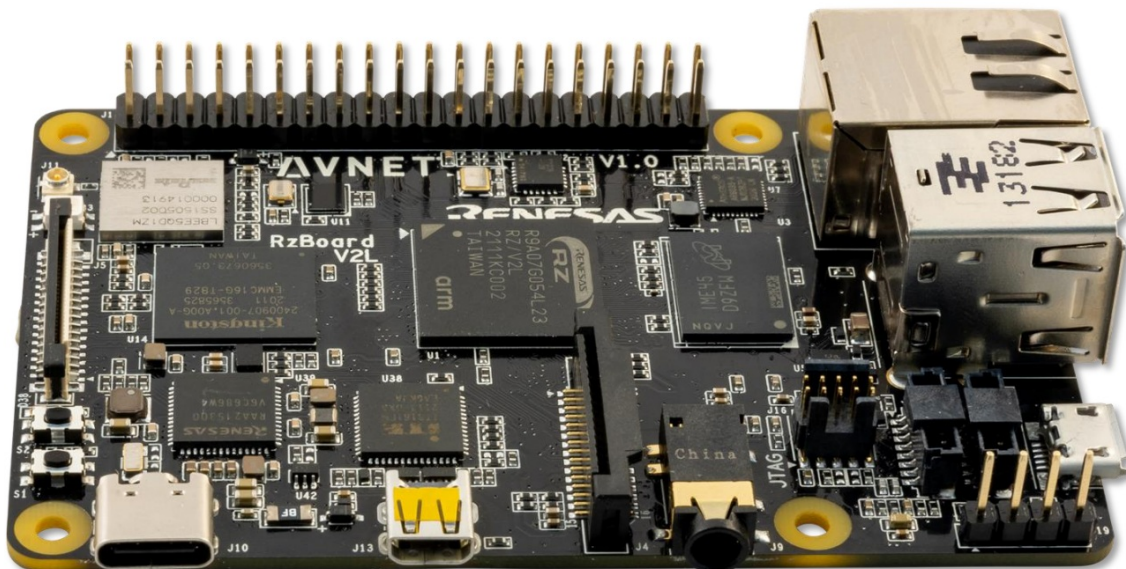


AVNET RZBoard V2L AI Accelerated Development Board User Guide

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RZBoard V2L AI Accelerated Development Board



RZBoard V2L
Hardware User Guide
v1.0 October 05, 2022

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Document Control

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Document Distribution:	Public

Version History

Version	Date	Comment
1.0	10/5/2022	Initial public release (Rev 1.2 production PCB)

Hardware Checklist

Hardware items recommended for application development are the following

#	Item Description
1	Computer (Windows / Linux / Mac) with installed development tools (see below)
2	Avnet RZBoard V2L board
3	USB to Serial Cable (or use of VCOM interface from debugger probe)
4	1x fly-lead (to select SCIF download boot mode)
5	Segger J-LINK debugger (or other debugger from the subset supported)
6	5V 2A power adapter (plus USB type-A to USB-C cable)
7	USB current monitor dongle <i>(optional)</i>
8	MaaXBoard MIPI-DSI 7" capacitive-touch 720 x 1280 display <i>(optional)</i> p/n: AES-ACC-MAAX-DISP1
9	MaaXBoard MIPI-CSI Camera, 5 MP, OV5640 image sensor <i>(optional)</i> p/n: AES-ACC-MAAX-CAM1

Table 1 – Hardware Checklist

Software Checklist

Listed below are software items mentioned in this document

#		Item Description
1	Renesas E2 Studio IDE (version 2022-07 or later)	https://www.renesas.com/us/en/software-tool/e-studio
2	teraterm-4.106.exe	Use for console communication and SCIF download mode
3	flashwriter_RZBoard.mot	FlashWriter tool. Use to flash SREC images into eMMC or QSPI
4	bl2_bp-RZBoard.srec	BL2 bootloader SREC image, ARM TFA (Trusted Firmware-A)
5	fip-RZBoard.srec	BL31 and uboot combined bootloader SREC image (ARM TFA)
6	core-image-RZBoard-20220920085823.rootfs.wic	Linux kernel images & root filesystem (Linux system image, write this to eMMC or SD card)
7	https://github.com/Avnet/RZBoard	Linux kernel source

Table 2 – Software Checklist

Introduction

RZBoard V2L is a power efficient, vision-AI accelerated development board in a popular single board computer format with well supported expansion interfaces. Based on the Renesas RZ/V2L processor, this platform is ideal for development of cost-efficient vision-AI and a range of energy-efficient edge AI applications. It's RZ/V2L processor has two 1.2GHz Arm® Cortex®-A55 cores plus a 200MHz Cortex-M33 core, a MALI 3D GPU and Image Scaling Unit. This processor SoC further differentiates itself with an onchip DRP-AI accelerator plus H.264 video (1920 x 1080) encode/decode function, making it ideal for implementing cost-effective embedded-vision applications.

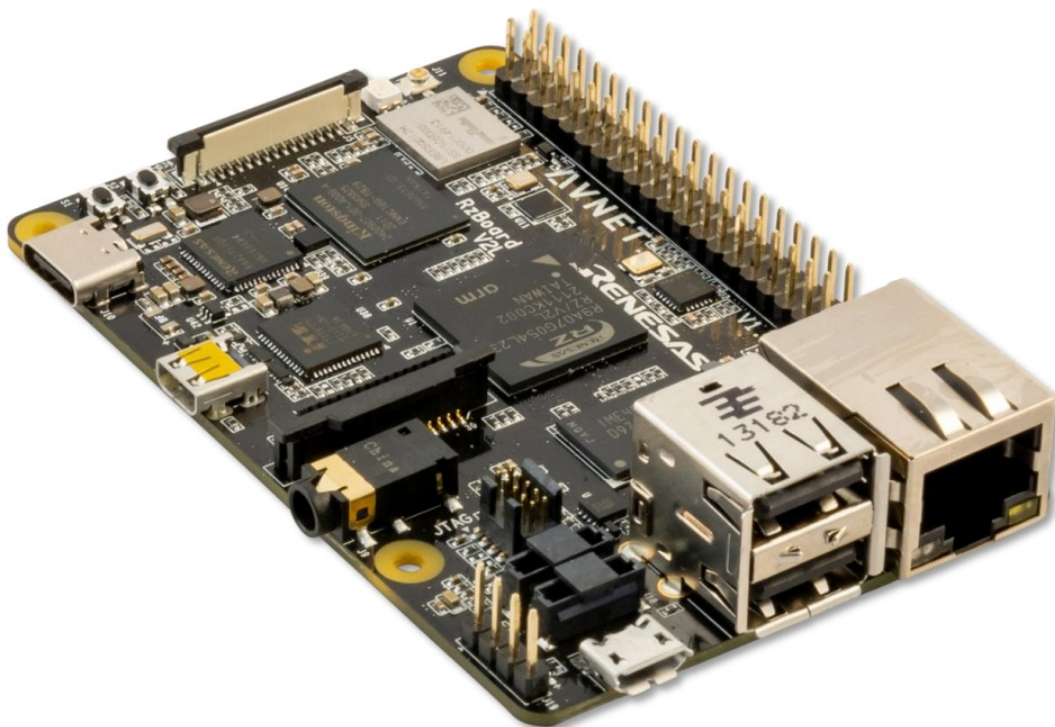
RZBoard V2L is engineered in a compact Raspberry Pi form-factor with a versatile set of expansion interfaces, including Gigabit Ethernet, 801.11ac Wi-Fi and Bluetooth 5, two USB 2.0 hosts and a USB 2.0 OTG interface, MIPI DSI and CSI camera interfaces, CANFD interface, Pi-HAT compatible 40-pin expansion header and Click Shuttle expansion header.

The board supports analog audio applications via it's audio codec and stereo headphone jack. It also provides five 12bit ADC inputs for interfacing with analog sensors. 5V input power is sourced via a USB-C connector and managed via a single-chip Renesas RAA215300 PMIC device.

Onboard memory includes 2GB DDR4, 32GB eMMC and 16MB QSPI flash memory, plus microSD slot for removable media.

Software enablement includes CIP Kernel based Linux BSP (maintained for 10 years+) plus reference designs that highlight efficient vision AI implementations using the DRP-AI core. Onboard 10-pin JTAG/SWD mini-header and 4-pin UART header enable the use of an external debugger and USB-serial cable.

Accessory options include a MIPI 7-inch display, MIPI CSI camera and 5V/3A USB Type C power supply.



5.1 RZBoard V2L Info

- Part# to order: AES-RZB-V2L-SK-G
- Product Page: <https://avnet.me/RZBoard-V2L>

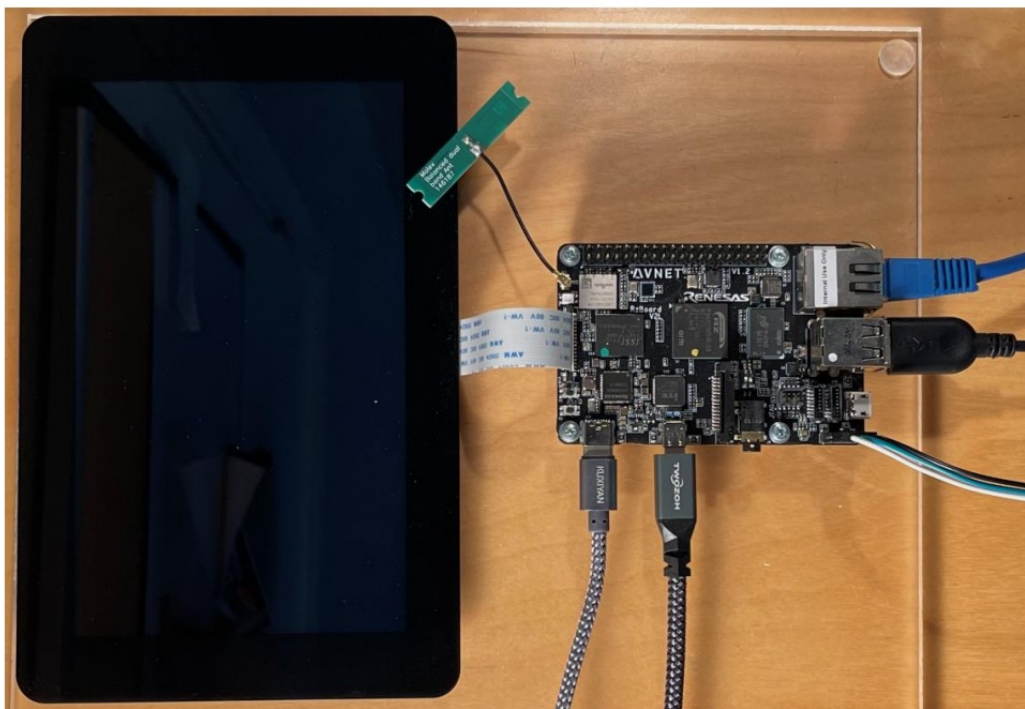
5.2 Items Included with RZBoard V2L

- RZBoard V2L board

- QuickStart Card
- Downloadable examples, reference designs and documentation

5.3 Important Reference Documents

- RZBoard V2L QuickStart Card (QSC)
- RZBoard V2L Product Brief
- RZBoard V2L Hardware User Guide (this document)
- RZBoard V2L Linux Yocto User Manual
- RZBoard V2L Linux Yocto Development Guide
- RZBoard V2L Schematic and BOM (available under NDA)
- Renesas [RZ/V2L Group User's Manual: Hardware](#) (*r01uh0936ej0100-rzv2l.pdf*)



Typical Hardware Setup (with optional 7-inch panel attached)

RZBoard V2L Architecture & Features

6.1 Features

Renesas RZ/V2L energy-efficient Vision-AI MPU with:

- RZ/V2L processor part number: R9A07G054L23GBG
- 2x Arm Cortex A55 (1.2 GHz)
- 1x Arm Cortex M33 (200 MHz)
- 1x Arm MALI G31 3D-GPU (500 MHz), plus Image Scaling Unit
- DRP-AI accelerator (1 TOPS/W class, capable of running Tiny YOLOv2 at 28fps)
- DRP Simple ISP machine-vision library functions (supports up to 1920 x 1080)
- H.264 Hardware Video Encode/Decode (1920 x 1080)
- 128KB ECC RAM

Avnet SBC development board in Raspberry-Pi / MaaXBoard form-factor includes:

- 2GB DDR4 (16-bit, single-channel, with in-line ECC)
- 16GB eMMC memory
- Micro SD removable storage
- 16MB QSPI NOR Flash
- 1G Ethernet wired network interface
- 801.11ac Wi-Fi wireless network interface and Bluetooth 5 interface
- U.FL connected external antenna
- 2x USB 2.0 Host and 1x OTG USB 2.0 interfaces
- CANFD interface (includes onboard CAN transceiver)
- MIPI DSI and HDMI display interfaces (selectable)
- MIPI-CSI camera interface
- 40-pin Pi-HAT compatible expansion header
- 16-pin MikroE Click Shuttle expansion header
- Renesas RAA215300 PMIC
- 8-pin WTB connector with 4x 12bit ADC inputs plus CAN-FD
- 8-pin WTB connector with UART and spare USB expansion CAN-FD
- 10-pin JTAG/SWD debugger header
- Audio Codec and audio jack stereo output and microphone input
- USB-Type C connector for 5V power input
- 1x User RGB LED, 1x power LED
- 2x button switches

6.2 Block Diagram – Renesas RZ/V2L Processor

RZ/V2L Block Diagram

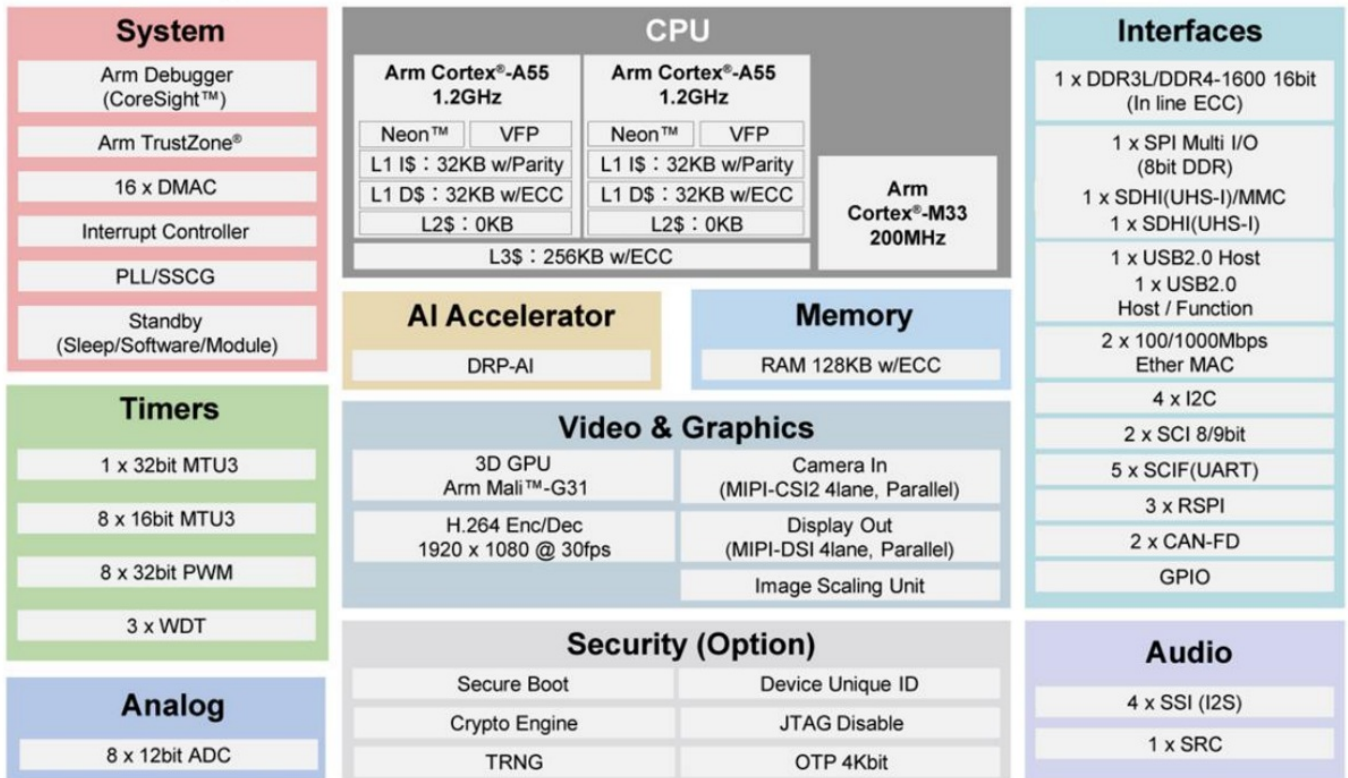
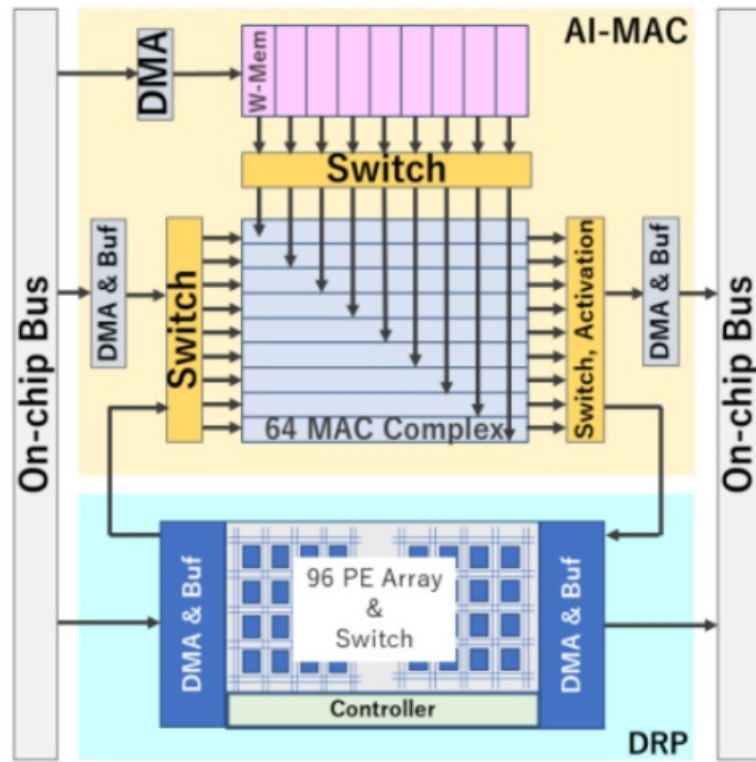


Figure 1 – RZ/V2L Processor Block Diagram

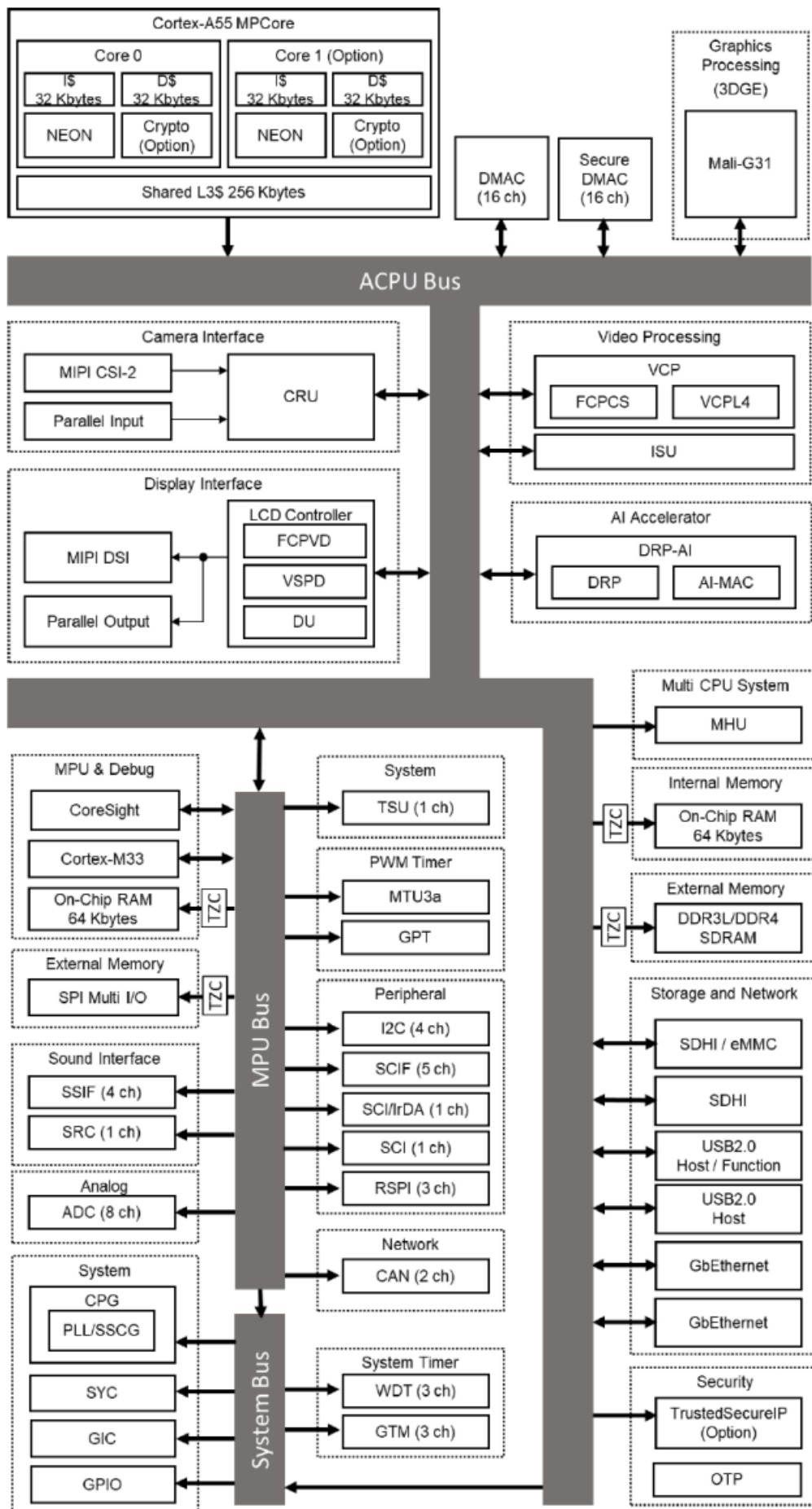
6.3 DRP-AI Accelerator Core

Dynamically Reconfigurable Processor (DRP) is a programmable, highly flexible accelerator core, optimised for use in AI accelerated vision applications

DRP-AI Resource	Relevant Specs.	AI Operations Best Suited For
DRP	192 ALU/DMU @ 266 MHz	Pooling, Softmax, + other processing
AI-MAC	576 MAC @ 400 MHz	Convolution
Data type	FP16	higher precision than INT8 (used by competitors)



6.4 RZ/V2L Architecture (ACPU bus, MCPU bus, System bus)



6.5 RZBoard V2L Block Diagram

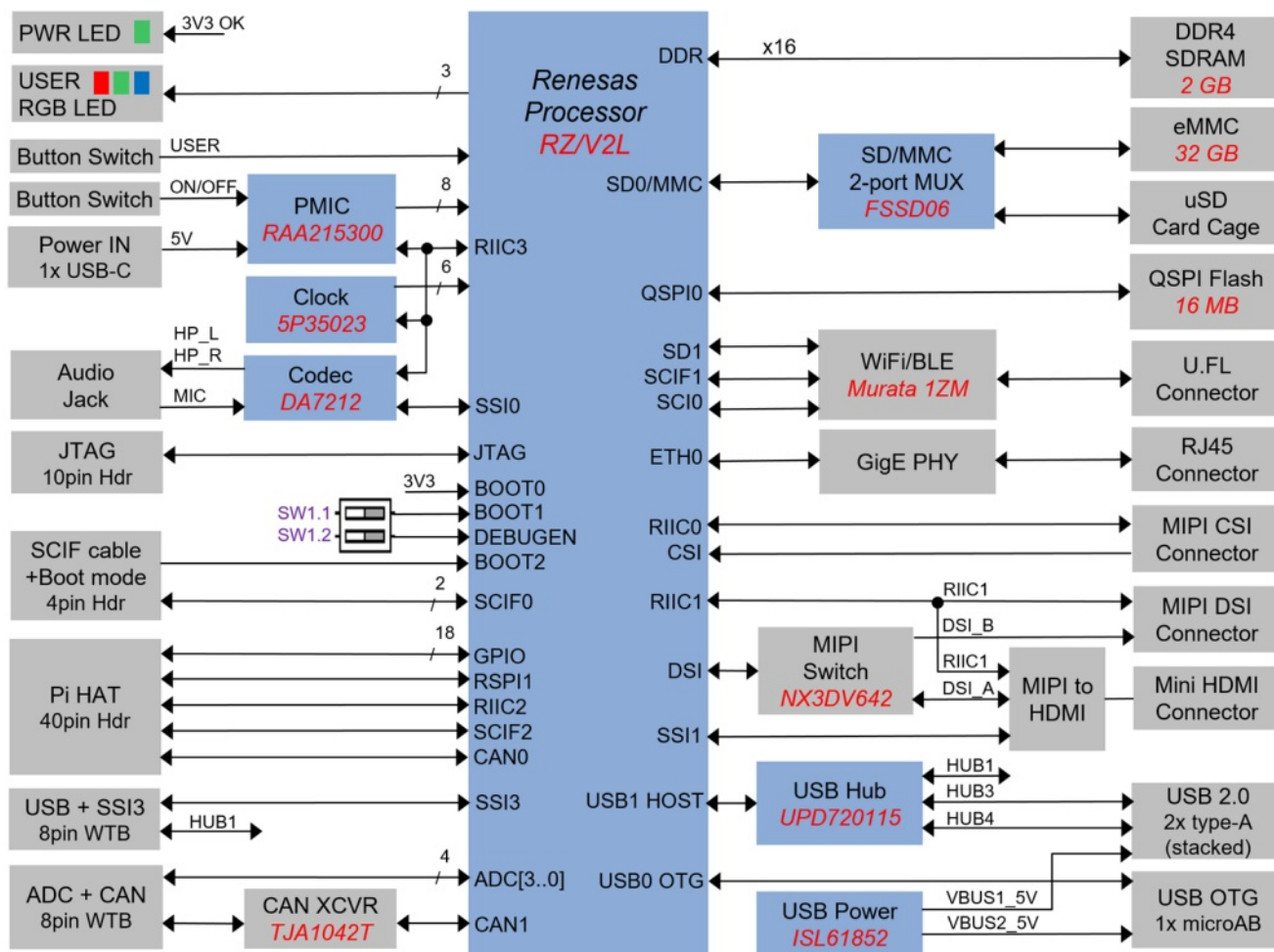
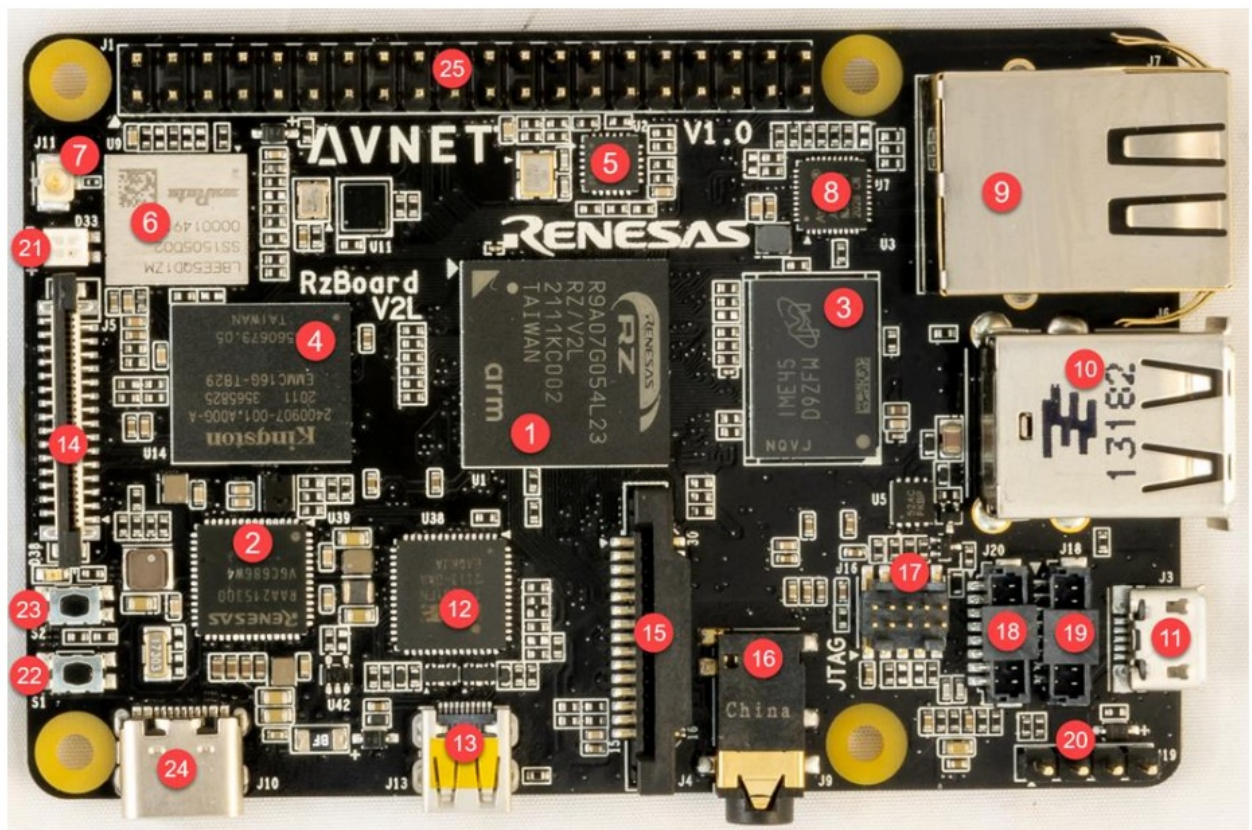


Figure 2 – RZBoard V2L Block Diagram (Rev 1.2 PCB)

Renesas parts on RZBoard (8 devices)

- RZ/V2L Processor
- RAA215300 PMIC
- 5P35023B Clock
- DA7212 Audio Codec
- UPD720115 USB Hub
- ISL61852 USB Power
- AT25QL128A QSPI NOR
- SLG7RN45292 Configurable Analog

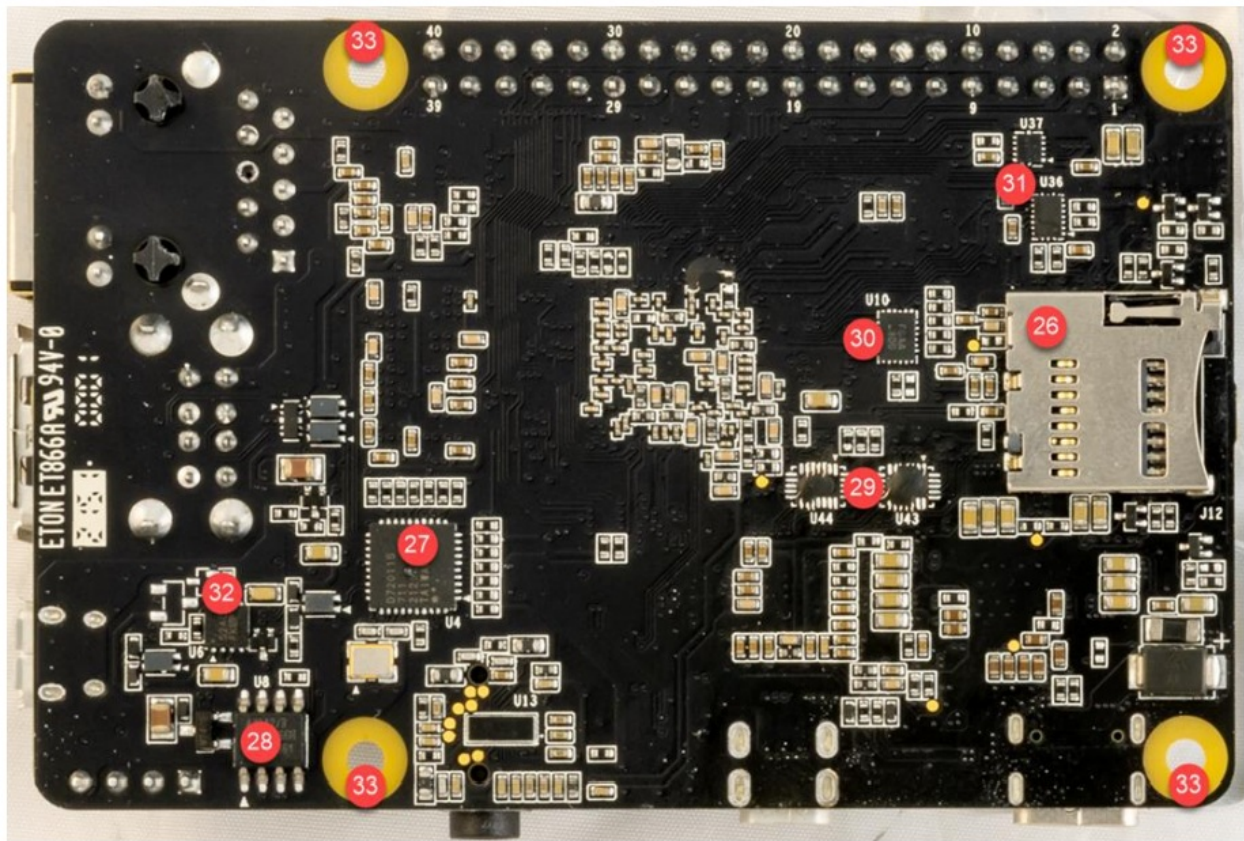
6.6 RZBoard V2L Component Locations (Top)



#	Ref	Component Description	#	Ref	Component Description
1	U1	Renesas RZ/V2L processor	14	J5	MIPI DSI display connector
2	U39	Renesas RAA215300 PMIC	15	J4	MIPI CSI camera connector
3	U3	LPDDR4 SDRAM memory	16	J9	Stereo audio jack
4	U14	eMMC memory (32G)	17	J16	10-pin header (JTAG/SWD)
5	U11	QSPI NOR flash memory (16 MB)	18	J20	8-pin WTB connector (UART, USB)
6	U9	Murata Wi-Fi/BT module	19	J18	8-pin WTB connector (ADC, CAN1)
7	J11	U.FL antenna connector	20	J19	4-pin header (debug uart)
8	U7	GMII Gigabit Ethernet PHY	21	D33	User RGB LED
9	J7	Gig Ethernet RJ45 connector	22	S1	S1 button switch (ON/OFF)
10	J6	Stacked USB host connectors	23	S2	S2 button switch (USER)
11	J3	OTG USB 2.0 connector	24	J10	USB-C 5V power input
12	U38	MIPI to HDMI display convertor	25	J1	40-pin Pi-HAT expansion header
13	J13	Micro HDMI display connector			

Table 3 – Key Components on RZBoard V2L (Top)

6.7 RZBoard V2L BaseBoard Component Locations (Bottom)



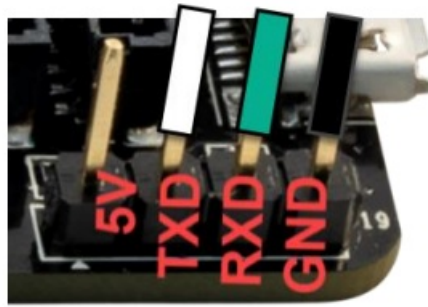
#	Ref	Component Description	#	Ref	Component Description
26	J12	MicroSD cage (removable storage)	30	U10	eMMC / microSD QSPI bus switch
27	U4	USB 4-port HUB	31	U36 U37	3V3 / 1V8 Greenpak level-shifter 3V3 / 1V8 level-shifter
28	U8	CAN transceiver	32	U6	USB OTG 5V switch
29	U43 U44	MIPI / HDMI display switch	33	MH	Mounting Holes (standoffs or Pi-Hat)

Table 4 – Key Components on RZBoard V2L (Bottom)

6.8 Debug Header, Switches and LEDs

6.8.1 Debug UART 4-pin Header (J19)

A USB-Serial debug cable needs to be attached to the J1 header for console debug output and Linux command-line access.



**J19 USB-Serial cable
to SCIF0 connections**

J19 Pin	RZBoard V2L Signals	Serial Interface Signal Direction
1	BOOT2	n/a
2	TXD	TX to RZBoard
3	RXD	RX from RZBoard
4	GND	GND

6.8.2 DIP Switches (SW1) and Boot-Mode Selection

SW1 #	Function	
SW1.1	BOOT1	
SW1.2	DEBUGEN	

RZ/V2L boot-mode is determined by the state of BOOT[2:0] at end of Reset:

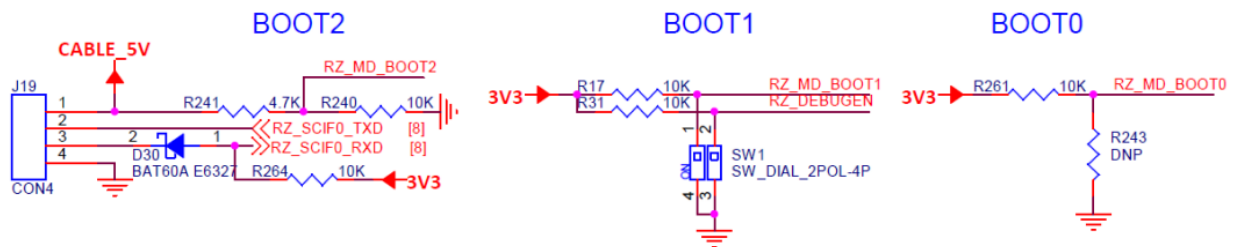
- BOOT2 (Debug header J19 pin 1)
- BOOT1 (DIP switch SW1.1)
- BOOT0 (SD card inserted/or not)

RZBoard supports 4 different boot sources (default eMMC boot mode is highlighted):

BOOT2	BOOT1	BOOT0	BOOT MODE
0	0	0	Boot from 3V3 SD card
0	0	1	Boot from 1V8 eMMC (default)
0	1	1	Boot from 1V8 QSPI flash
1	0	1	Boot from SCIF serial download

To use “SCIF serial download” boot mode:

- Remove SD card from SD card cage (this sets BOOT0=1)
- Strap a fly-lead from pin1 of this J19 debug header to J1-pin2 on 40pin header (ie. To 5V pin, this sets BOOT2=1)



o BOOT2 is set by use of a flywire from J19-pin1 of Debug UART 4pin header.

BOOT2	Strapping to change boot mode
0	Default. No flywire strapping required
1	Strap J19-pin1 to 5V (J1-pin2 on HAT 40pin header)



Figure 3 – J1 Header pin-numbering

o BOOT1 is set by DIP switch SW1.1

BOOT1	Strapping to change boot mode
0	Controlled by DIP switch: SW1.1 = ON
1	Controlled by DIP switch: SW1.1 = OFF

o BOOT0 is driven by the SD card-detect signal (from uSD card cage)

BOOT1	Strapping to change boot mode
0	SD card is inserted
1	SD card not inserted

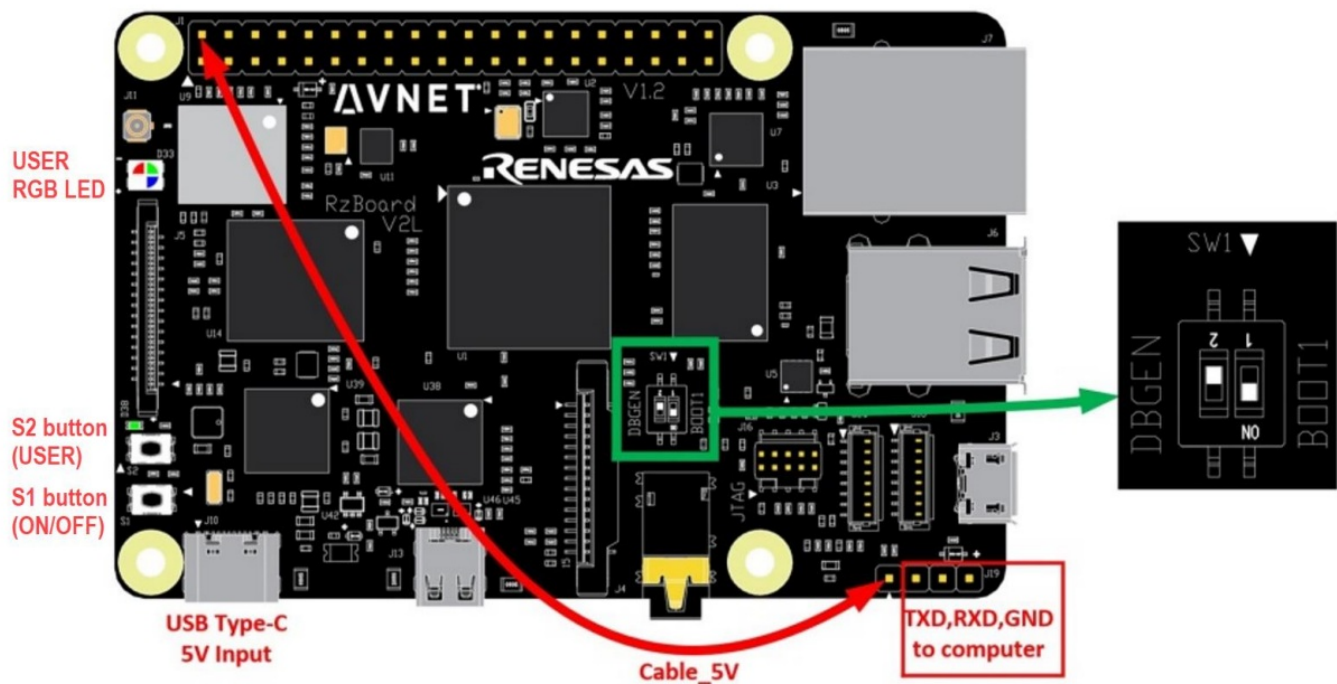


Figure 4 – Selecting the Boot Mode

6.8.3 Push-Button Switches

Two pushbuttons are located near the board edge, in the bottom-left corner

Ref. Des	Switch Name	Button Switch Function	RZ/V2L GPIO Pin	PMIC Pin
S1	ONOFF	Board ON/OFF control	n/a	PMIC PWRON input
S2	USER	USER function (unassigned)	RZ_P39_0	n/a

6.8.4 Status LEDs

Ref. Des.	LED Status Function	LED Color	RZ/V2L GPIO Pin	Linux sysfs Definitions	RZ/V2L Board Function
D38	PWR	Green	n/a	n/a	3V3 status
D33	USER-RED	Red	RZ_P8_1	/sys/class/leds/ledred	GPIO / PWM
D33	USER-GREEN	Green	RZ_P17_2	/sys/class/leds/ledbgreen	GPIO / PWM
D33	USER-BLUE	Blue	RZ_P19_1	/sys/class/leds/ledblue	GPIO / PWM

The User RGB LED can easily be exercised from Linux command-line using sysfs commands: eg.

```
echo default-on > /sys/class/leds/ledblue/trigger
echo 0 > /sys/class/leds/ledblue/brightness
echo 1 > /sys/class/leds/ledgreen/brightness
echo 0 > /sys/class/leds/ledgreen/brightness
echo 1 > /sys/class/leds/ledred/brightness
echo 0 > /sys/class/leds/ledred/brightness
echo heartbeat > /sys/class/leds/ledblue/trigger
```

6.9 Memory Resources

RZBoard includes the following onboard memory resources:

Memory Type	RZ/V2L Interface	Memory Size	Performance Considerations	Part Number
DDR4 SDRAM	DDR	2 GB	800 MHz, x16 bus	Micron MT40A1G16KD-062E
eMMC flash	SD0	32 GB	200 MHz, x8 bus	Micron MTFC32GAZAQHD-IT
microSD slot	SD0	removable media	??? MHz, x4 bus	<i>determined by User</i>
QSPI flash	QSPI0	16 MB	104 MHz, x4 bus	Adesto AT25QL128A-UIUE-T

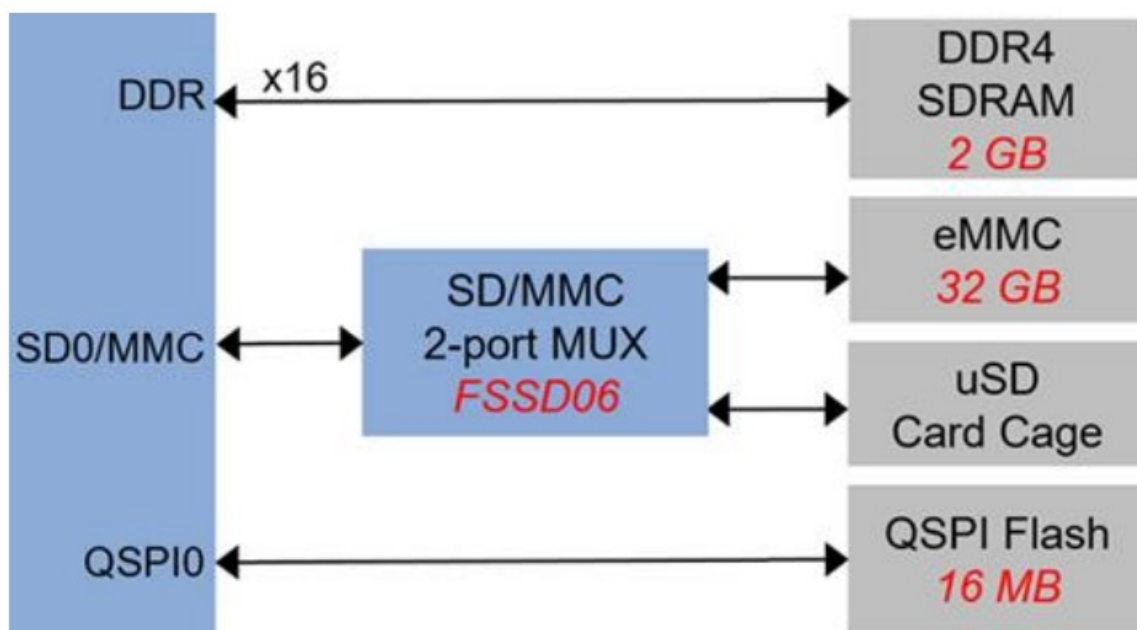


Figure 5 – RZBoard V2L Memory Resources

6.9.1 eMMC Memory (Partition size and Programming)

- For convenience, the procedures for changing partition size and programming new images into eMMC flash memory are included in the Appendix area of this User Guide document
- Configuring and programming the microSD card and QSPI memory use a similar scripted approach, but this is detailed in the software documentation

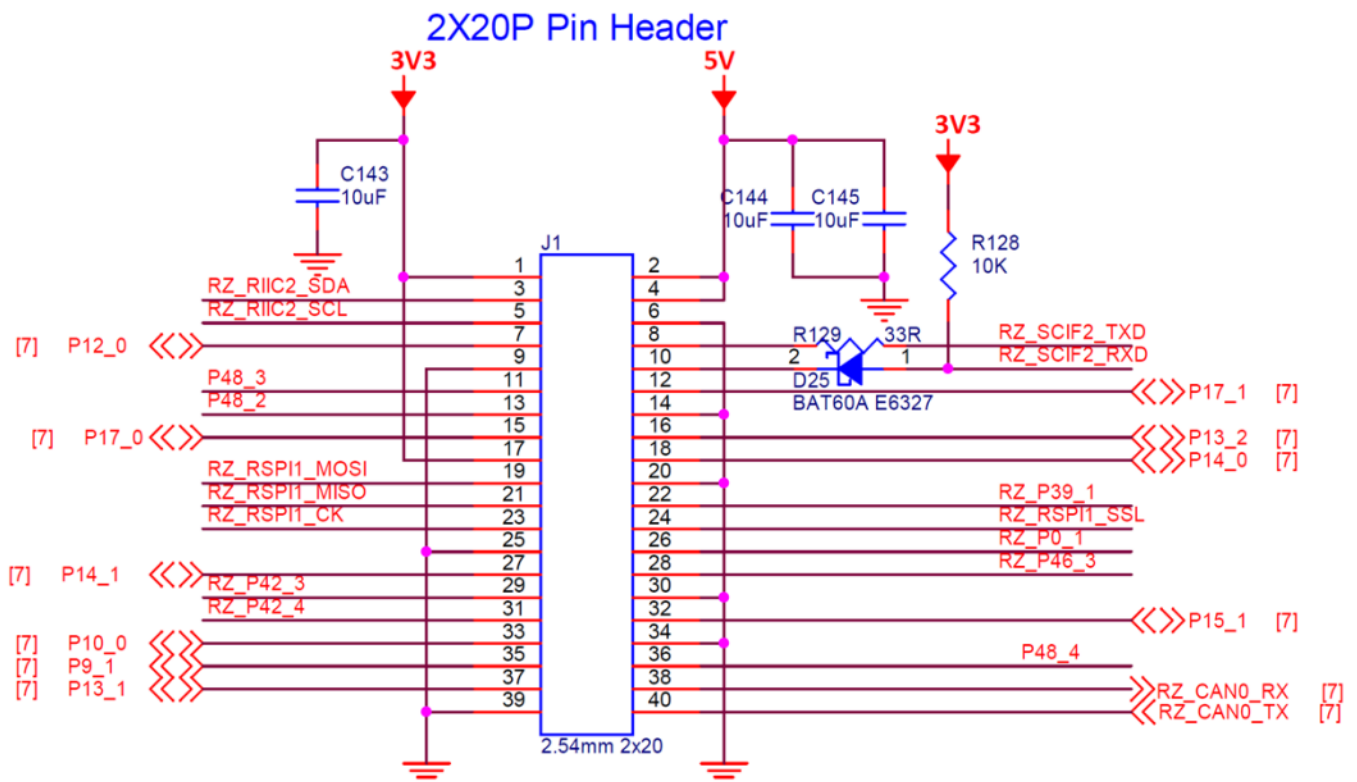
6.10 Peripheral Devices and Interfaces

6.10.1 J1: Pi-HAT compatible 40-pin header

Pin #	Possible HAT Pin Function	J1 RZBoard V2L Signal Name	Pin #	Possible HAT Pin Function	J1 RZBoard V2L Signal Name
1	3V3	VDD_3V3	2	5V	5V_SYS
3	I2C_SDA	RZ_RIIC2_SDA	4	5V	5V_SYS
5	I2C_SCL	RZ_RIIC2_SCL	6	GND	GND
7	GPIO / GPCLK0	P12_0	8	UART_TX	RZ_SCIF2_TXD
9	GND	GND	10	UART_RX	RZ_SCIF2_RXD
11	GPIO / RTS	P48_3	12	PCM_CLK	P17_1
13	GPIO	P48_2	14	GND	GND
15	GPIO	P17_0	16	GPIO	P13_2
17	3V3	VDD_3V3	18	GPIO	P14_0
19	SPI_MOSI	RZ_RSPI1_MOSI	20	GND	GND
21	SPI_MISO	RZ_RSPI1_MISO	22	GPIO	RZ_P39_1
23	SPI_SCLK	RZ_RSPI1_CK	24	SPI_CS0	RZ_RSPI1_SSL
25	GND	GND	26	SPI_CS1	RZ_P0_1
27	EEPROM_SDA	P14_1	28	EEPROM_SCL	RZ_P46_3
29	GPIO / GPCLK1	RZ_P42_3	30	GND	GND
31	GPIO / GPCLK2	RZ_P42_4	32	GPIO / PWM0	P15_1

33	GPIO / PWM1	P10_0	34	GND	GND
35	GPIO / PCM_FS	P9_1	36	GPIO / CTS	P48_4
37	GPIO	P13_1	38	GPIO / PCM_DIN	RZ_CAN0_RX
39	GND	GND	40	GPIO / PCM_DOUT	RZ_CAN0_TX

Table 5 – Pi-HAT compatible 40-pin header (J1)



6.10.2 J1: Pinout Comparison with MikroE Pi-2-Click HAT Adapter

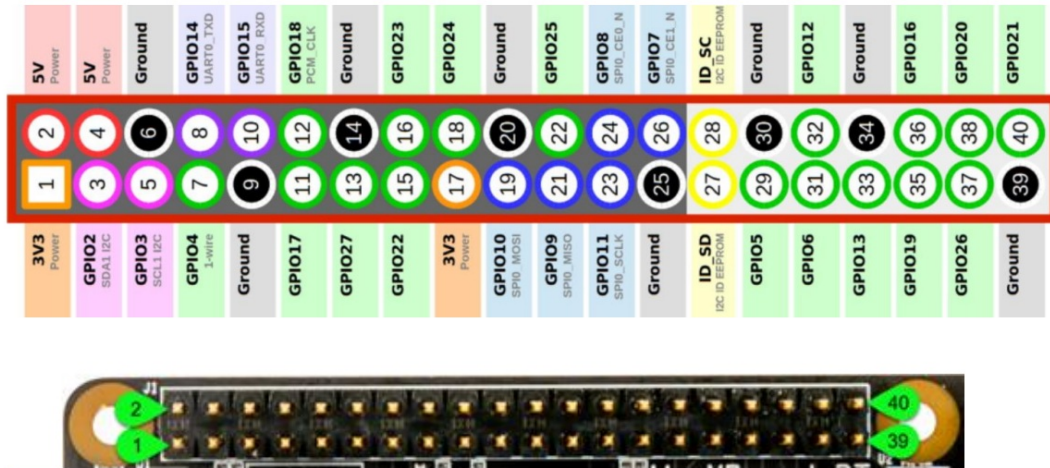
- Pinout for recommended HAT adapter (\$8.00) is shown below (this accommodates two Click boards)

Pin #	Pi-2-Click HAT Pin Function	J1 RZBoard V2L Signal Name	Pin #	Pi-2-Click HAT Pin Function	J1 RZBoard V2L Signal Name
1	3V3	VDD_3V3	2	5V	5V_SYS
3	GPIO2 SDA	RZ_RIIC2_SDA	4	5V	5V_SYS

5	GPIO3 SCL	RZ_RIIC2_SCL	6	GND	GND
7	GPIO4 AN1	P12_0	8	GPIO14 UART_TX	RZ_SCIF2_TXD
9	GND	GND	10	GPIO15 UART_RX	RZ_SCIF2_RXD
11	GPIO17 PWM2	P48_3	12	GPIO18 PWM1	P17_1
13	GPIO27 <i>nc</i>	P48_2	14	GND	GND
15	GPIO22 <i>nc</i>	P17_0	16	GPIO23 <i>nc</i>	P13_2
17	3V3	VDD_3V3	18	GPIO24 <i>nc</i>	P14_0
19	GPIO10 SPI_MOSI	RZ_RSPI1_MOSI	20	GND	GND
21	GPIO9 SPI_MISO	RZ_RSPI1_MISO	22	GPIO25 <i>nc</i>	RZ_P39_1
23	GPIO11 SPI_SCLK	RZ_RSPI1_CK	24	GPIO8 SPI_CS0	RZ_RSPI1_SSL
25	GND	GND	26	GPIO7 SPI_CS1	RZ_P0_1
27	ID_SDA <i>nc</i>	P14_1	28	ID_SCL <i>nc</i>	RZ_P46_3
29	GPIO5 RST1	RZ_P42_3	30	GND	GND
31	GPIO6 INT1	RZ_P42_4	32	GPIO12 <i>nc</i>	P15_1
33	GPIO13 AN2	P10_0	34	GND	GND
35	GPIO19 RST2	P9_1	36	GPIO16 <i>nc</i>	P48_4

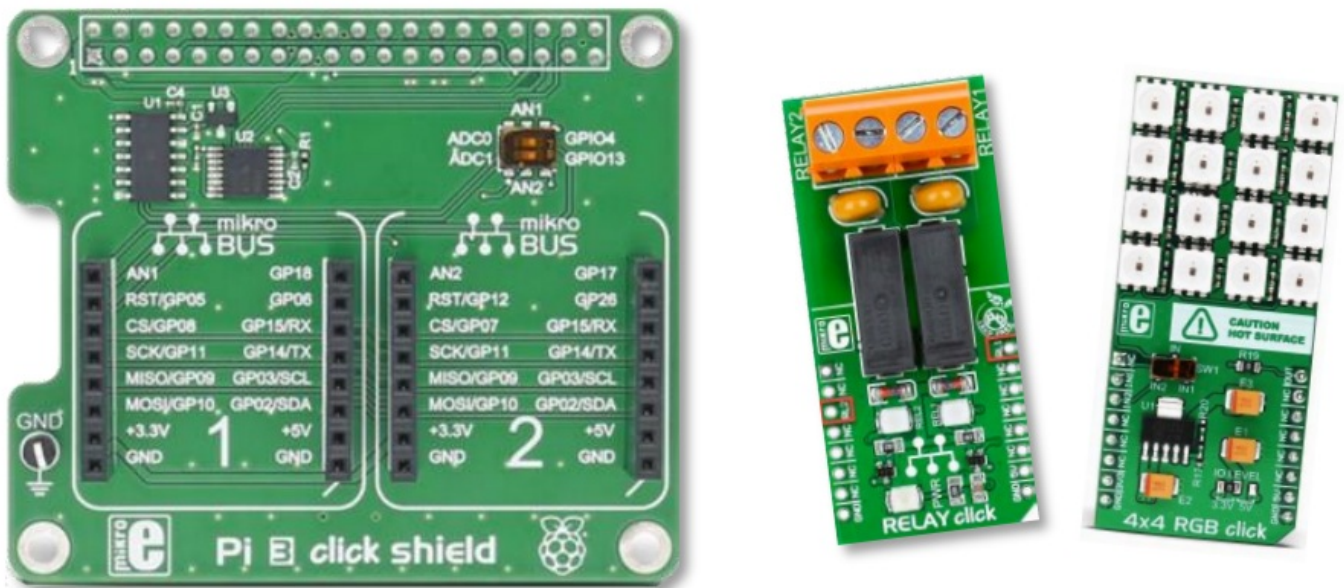
37	GPIO26 <i>INT2</i>	P13_1	38	GPIO20 <i>nc</i>	RZ_CAN0_RX
39	GND	GND	40	GPIO21 <i>nc</i>	RZ_CAN0_TX

Table 6 – MikroE Pi-2-Click HAT Adapter Mapping to J1 Header



6.10.3 MikroE Click Boards

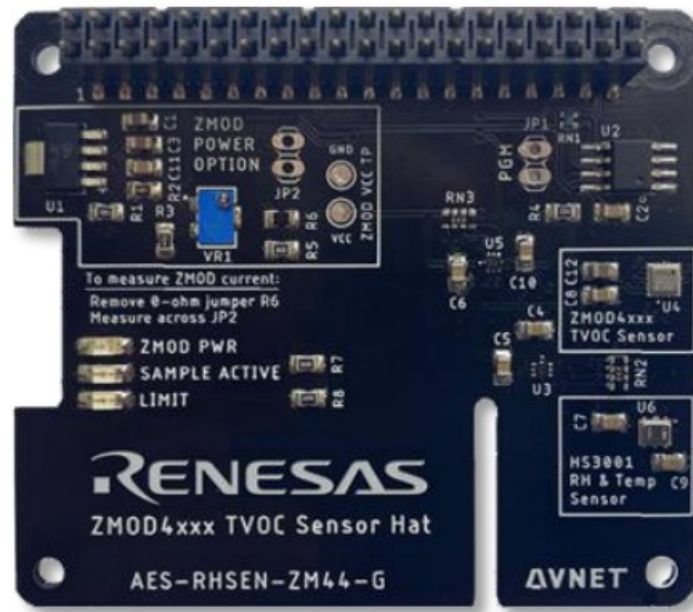
- Over 1200+ Click boards available. Orderable from Avnet <http://avnet.me/click>
- Parametric search tool on [MikroE website](http://www.mikroe.com)
- Open source library code available at <https://www.mikroe.com/click-boards>



6.10.4 Pi HAT Expansion Boards

- Ecosystem of Pi HAT boards support a wide range of functionality
- See listings at websites such as <https://pinout.xyz/boards>

- Height of stacked boards is minimized as RZ/V2L does not require heatsink



6.10.5 J16: SWD/JTAG debugger 10-pin mini-header

The 10-pin Mini-header by default supports the SWD interface tabled below

JTAG	SWD	Pin	Pin	SWD	JTAG
JTAG_TMS_18	SWD_IO	2	1	IF_VREF	1V8
JTAG_TCK_18	SWCLK	4	3	GND	GND
JTAG_TDO_18	SWO	6	5	GND	GND
JTAG_TDI_18	IF_TDI	8	7	IF_ISPEN	N/C
RZ_PRST#	IF_RST	10	9	IF_DETECT	JTAG_TRST#_18

Table 7 – SWD/JTAG debugger 10-pin mini-header (J16)

6.10.6 J3: USB 2.0 OTG Interface

RZ_USB0 controller connects with the J3 MicroUSB connector, that supports USB device or host operation. In host mode this interface's USB 5V output is rated for 600mA max.

6.10.7 J6, J20: USB 2.0 Host Interfaces

RZ_USB1 controller connects to an onboard USB Hub that supports 4 USB Host interfaces:

USB HUB	Label on RZBoard V2L
HUB_#1	J20 WTB connector USB (expansion interface)
HUB_#2	< Unused >
HUB_#3	J6 stacked USB type-A connectors (UPPER)
HUB_#4	J6 stacked USB type-A connectors (LOWER)

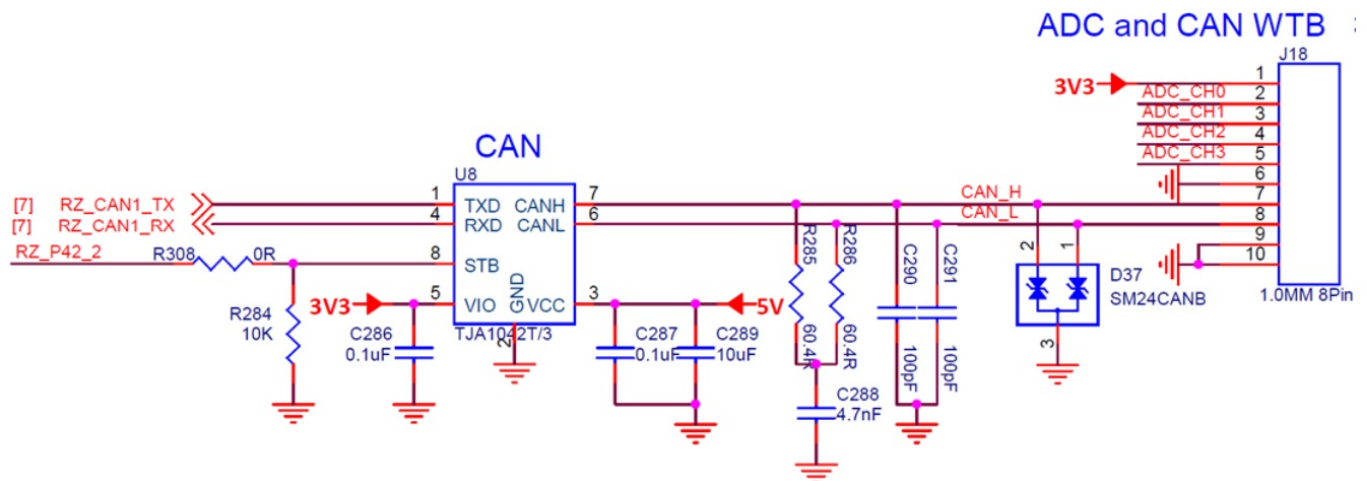
6.10.8 J1: CAN0 Interface

CAN0 TXD and RXD signals are accessible on the 40-pin Pi HAT connector, but the pinout deviates from the HAT standard (ie. This interface can only be supported via a custom HAT board on which a suitable CAN transceiver, termination and ESD protection is then provided)

Pin #	Possible HAT Pin Function	J1 RZBoard V2L Signal Name
38	GAO / PCM DIN	RZ_CAN0_RX
40	GPIO / PCM_DOUT	RZ_CAN0_TX

6.10.9 J18: CAN1 and ADC[3:0] interfaces (10-pin WTB header)

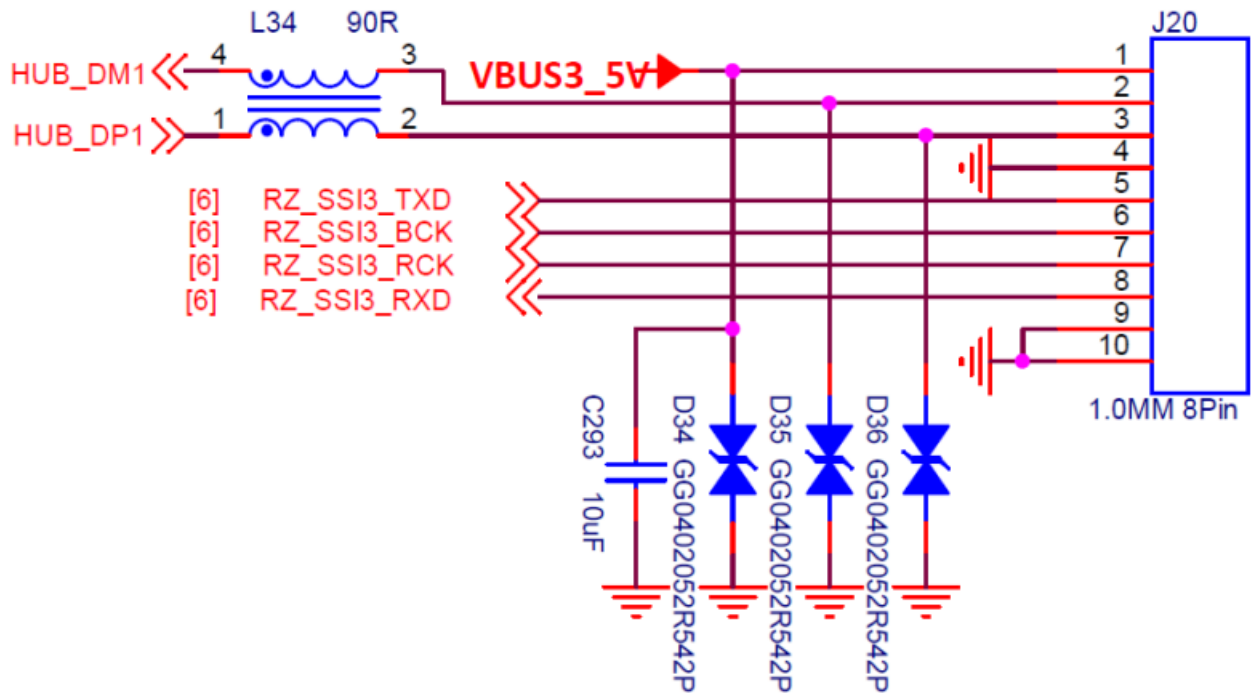
- CAN1 TXD and RXD signals are available on the J18 WTB 8-pin connector (This interface has onboard transceiver, termination and ESD protection)
- ADC_CH0..CH3 supports 4x 12bit ADC inputs. (0V~1.8V range, 1us per chan conversion-rate)



6.10.10 J20: USB1 and SSI3 (10-pin WTB header)

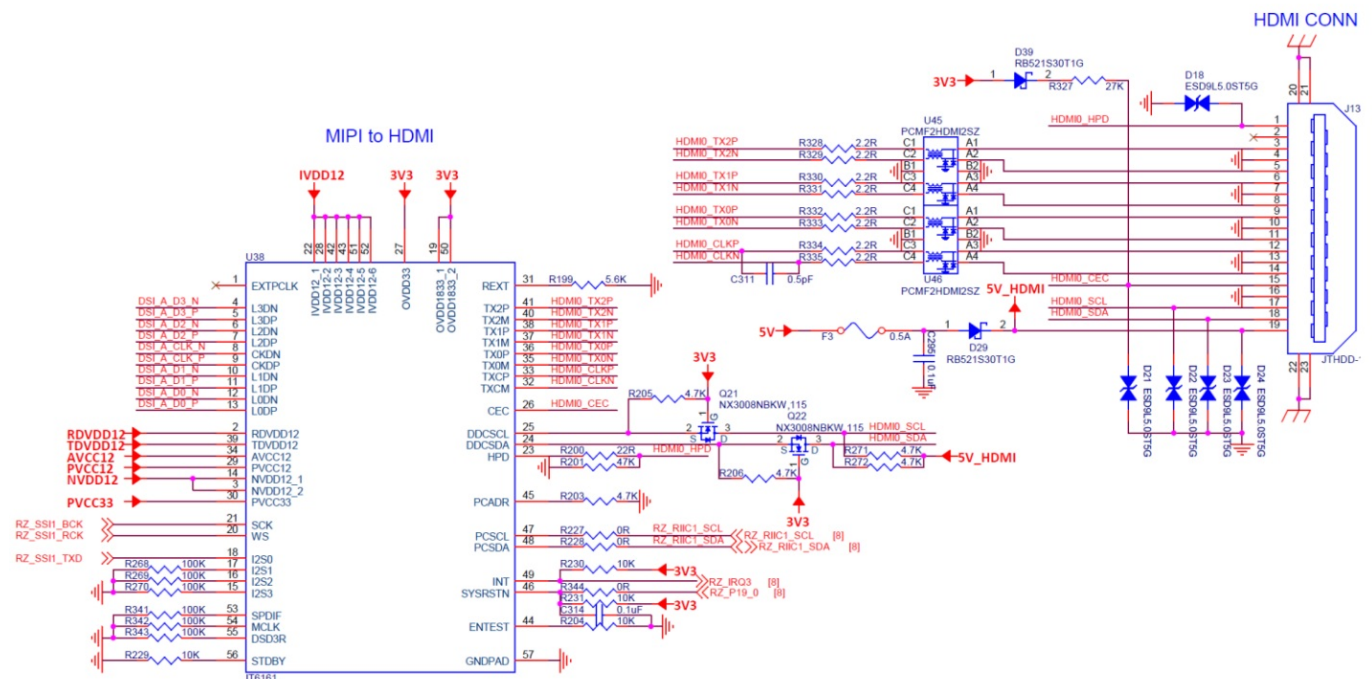
- An ESD-protected USB host interface from RZ_USB1 4-port hub is available on J20
- The 4-wire SSI3 (I2S) digital audio interface on J20 pins

USB and SSI WTB CONN

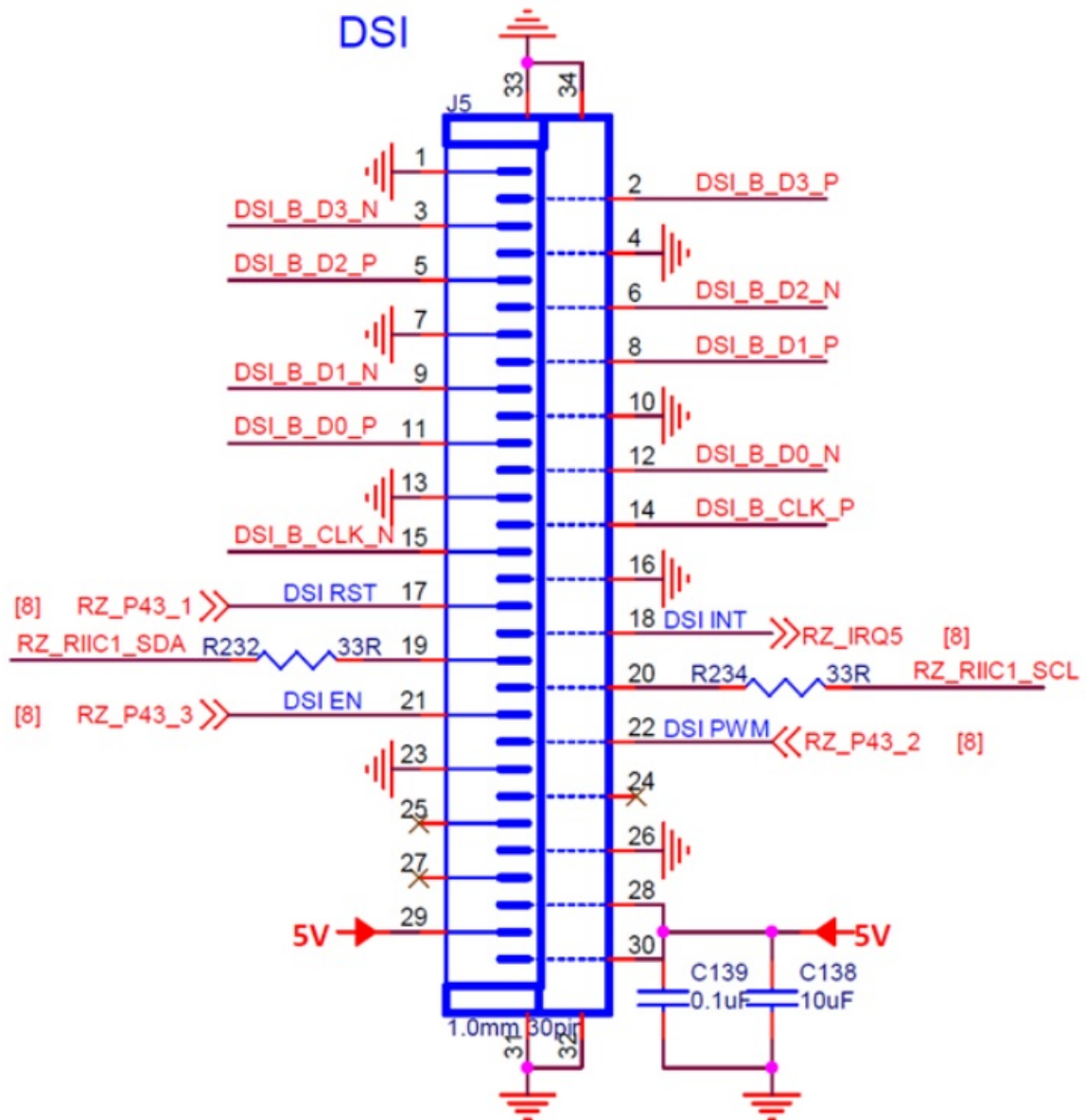


6.10.11 J13: HDMI Display Output

- The 4-lane MIPI-DSI output from the RZ/V2L processor is routed via NX3DV642 high-speed MIPI switch devices to drive either:
 - the J5 MIPI Interface, or
 - the J13 HDMI interface (via the U38 MIPI to HDMI convertor)
- MIPI to HDMI conversion is implemented using an IT6161 device



- This supports the 7-inch MaaXBoard 720 x 1280 display via the 30-pin J5 ribbon connector.

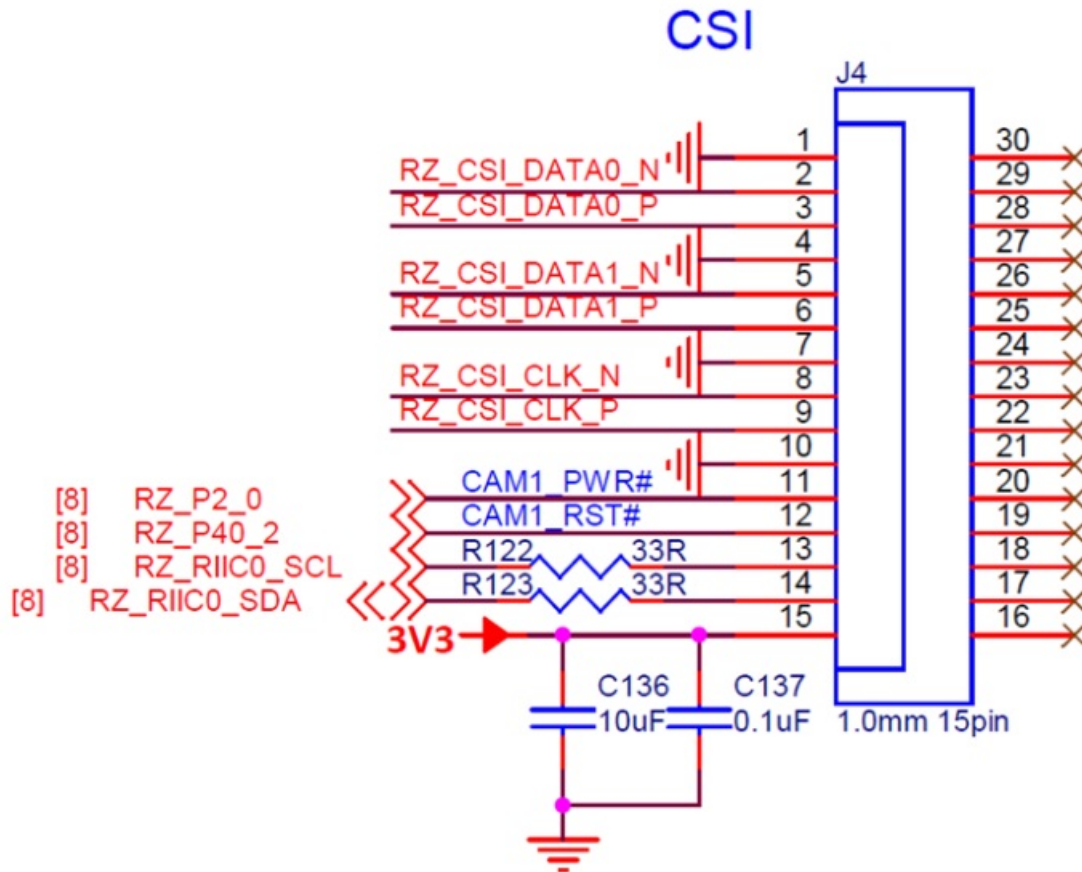


- This 30-pin connector has same form-factor as display connector on Raspberry Pi but the pinout is adapted to include an I2C touchscreen controller interface

DSI Connector Signal Name	RZ/V2L Processor I/O	MIPI DSI Panel Function
DSI_RST	RZ_P43_1	Display Controller and Touch Controller Reset
DSI_EN	RZ_P43_3	Display Enable
DSI_PWM	RZ_P43_2	Display Backlight PWM
DSI_INT	RZ_IRQ5	Touch Controller Interrupt
RZ_RIIC1_SCL	RZ_RIIC1_SCL	Touch Controller I2C Clock
RZ_RIIC1_SDA	RZ_RIIC1_SDA	Touch Controller I2C Data

6.10.13 J4: MIPI-CSI Camera Interface

The 2-lane, 15-pin MIPI connector pinout is the same as what is used on Raspberry-Pi board



Camera Control I/O	RZ/V2L Processor I/O
CAM1_PWR#	RZ_P2_0
CAM1_RST#	RZ_P40_2
RZ_RIIC0_SCL	RZ_RIIC0_SCL
RZ_RIIC0_SDA	RZ_RIIC0_SDA

6.10.14 J7: Gigabit Ethernet RJ45 Interface

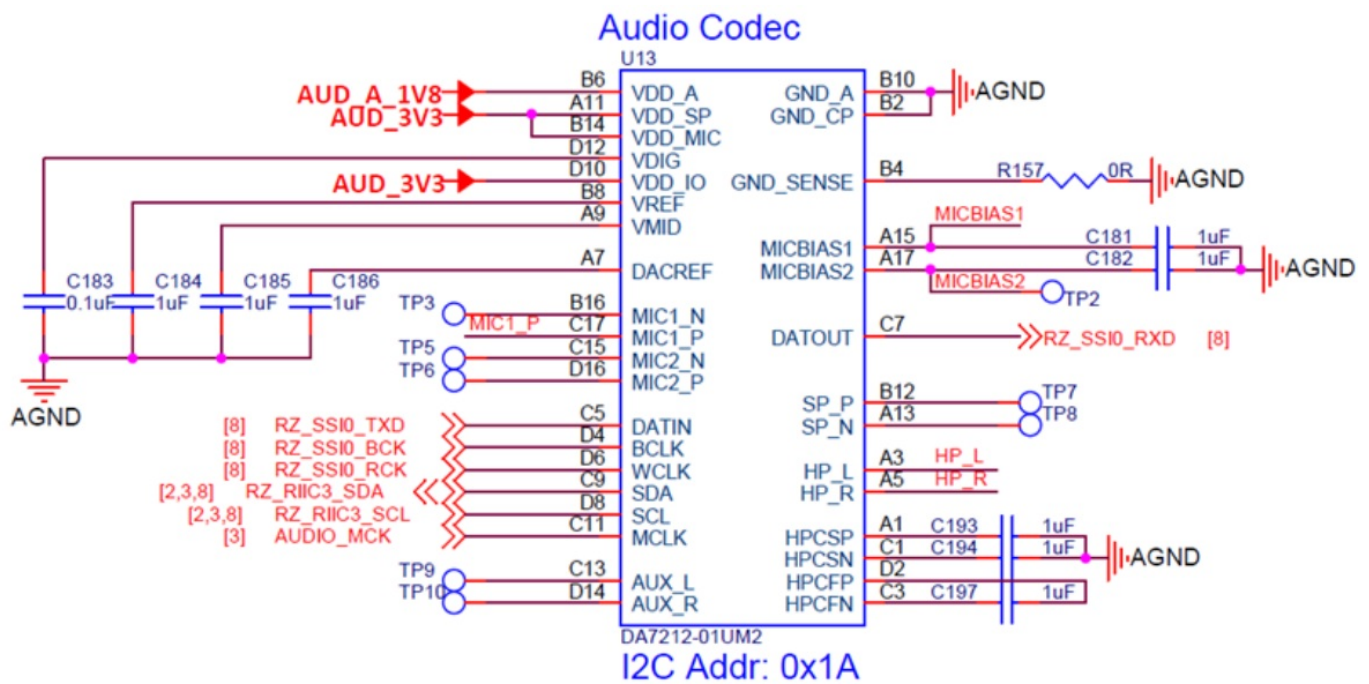
The 10/100 Ethernet subsystem is comprised of:

- AR8035-AL1B Ethernet transceiver (U24) with GRMII interface,
- RJ45 (J7) connector with integrated magnetics.

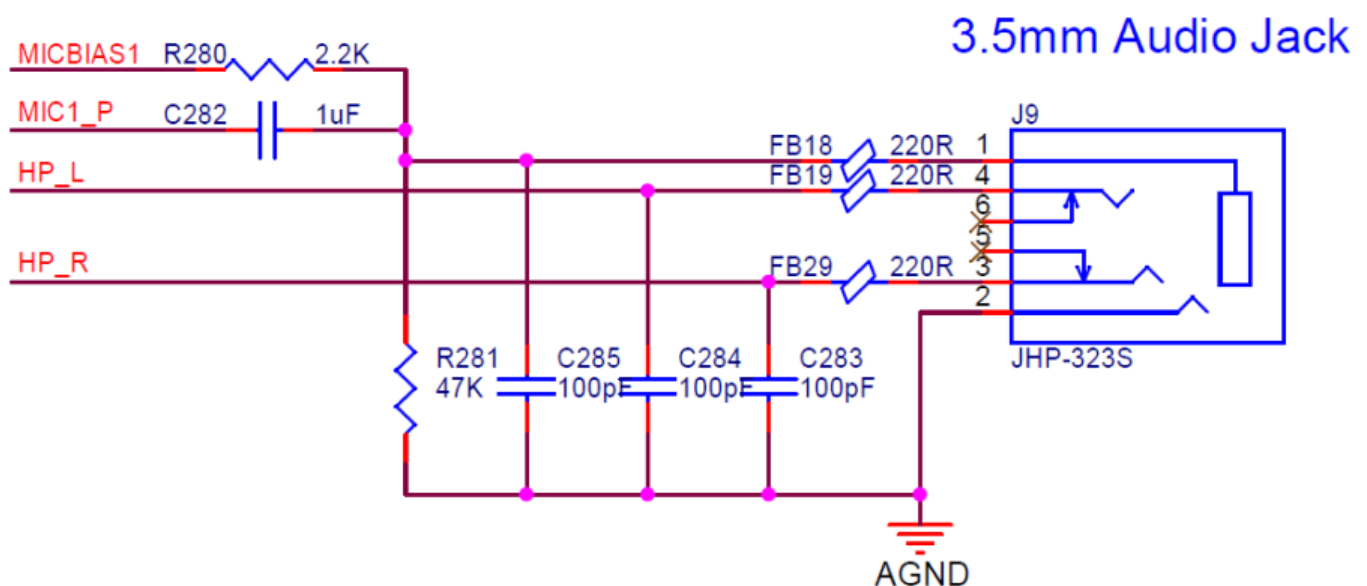
6.10.15 Audio Codec

RZ_SSI0 interface of RZ/V2L (Serial Audio Interface #0) connects to Dialog DA7212-01UM2 stereo audio Codec. PCM audio between Wi-Fi/BT module and the Codec, requires routing through the RZ/V2L processor.

RZ_SCI0 (Serial Communications Interface #1) connects the RZ/V2L processor with the Bluetooth PCM audio interface of the WiFi/BT module.



6.10.16 J9: Stereo Audio Jack



6.11 Wireless Connectivity

RZBoard V2L uses a Murata Type-1ZM Wi-Fi 5 and Bluetooth 5 combo module, which is based on the NXP 88W8987 device. Dual-band 2.4 GHz and 5 GHz Wi-Fi operation is supported. Interfaces between the 88W8987 based module and the RZ/V2L host processor include:

- Wi-Fi SDIO 3.0 (4-bit) interface (uses RZ_SD1)
- BT/BLE UART 4-wire interface (uses RZ_SCIF1)
- Bluetooth Audio PCM interface (uses RZ_SCI0)

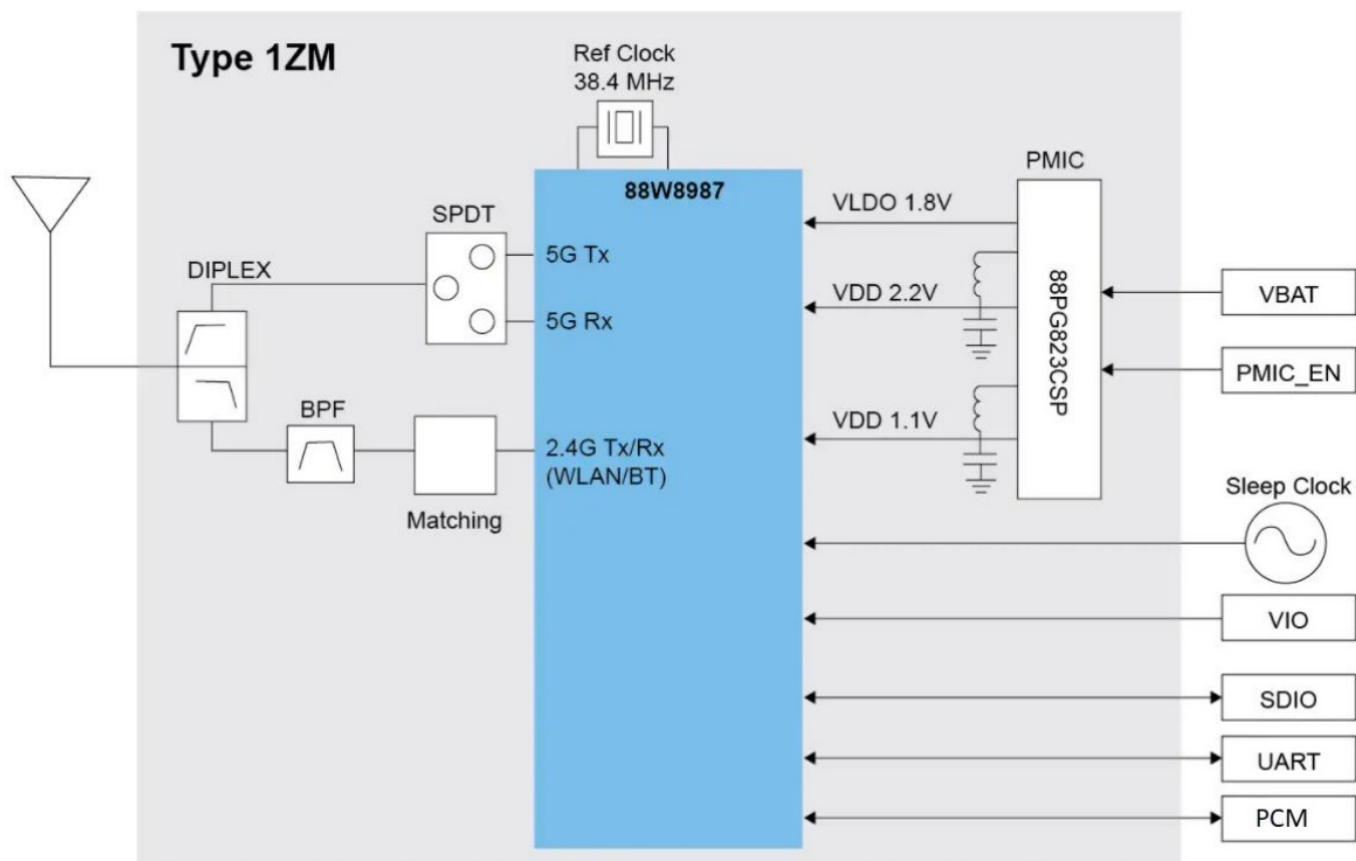


Figure 6 – Murata Type-1ZM Wi-Fi/BT Combo Module Block Diagram

6.11.1 Wi-Fi SDIO Interface

RZ_SD1 interface is configured for 1.8V operation and is clocked at 200 MHz (This is the same SDIO interface as used on the RZ/V2L-EVK)

RZ/V2L Signal Name	1ZM Module WLAN Pin Name
RZ_SD1_[D3:D0]	SD_DAT[3:0]
RZ_SD1_CMD	SD_CMD
RZ_SD1_CLK	SD_CLK
RZ_P7_1	WL_WAKE_HOST
RZ_P8_0	HOST_WAKE_WLAN
RZ_P39_2	PMIC_EN

Table 8 – Wi-Fi Interface

6.11.2 BT/BLE UART Interface

RZ_SCIF1 including hardware flow is routed from the RZ/V2L via a 3.3V to 1.8V level-shifter, to the 1ZM module's Bluetooth UART interface. (Note uses of LPUART10 interface is different from what used on the RZ/V2L-EVK, which uses LPUART2 for this interface)

RZ/V2L SCIF Signal Name	1ZM Module BT Pin Name
RZ_SCIF1_RXD	BT_UART_TXD
RZ_SCIF1_TXD	BT_UART_RXD
RZ_SCIF1_RTS	BT_UART_CTS
RZ_SCIF1_CTS	BT_UART_RTS
RZ_P7_2	HOST_WAKE_BT
RZ_P7_0	BT_WAKE_HOST

Table 9 – Bluetooth Data Interface

6.11.3 BT PCM Audio Interface

RZ_SCI0 is routed from the RZ/V2L via a 3.3V to 1.8V level-shifter, to the Murata 1ZM module's Bluetooth UART PCM audio interface.

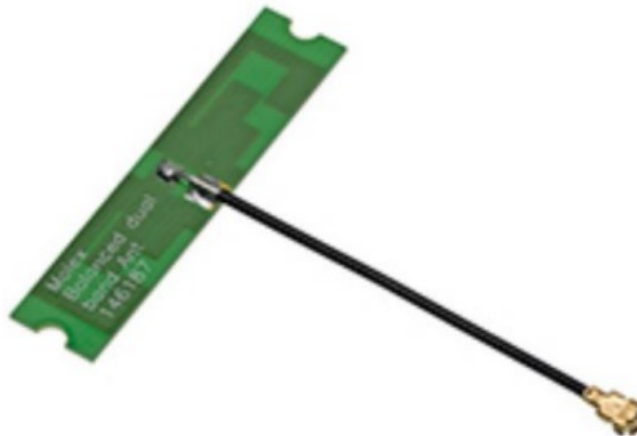
RZ/V2L SCI0 Signal Name	1ZM Module BT Audio Pin Name
RZ_SCI0_TXD	BT_PCM_DIN
RZ_SCI0_CTS	BT_PCM_SYNC
RZ_SCI0_SCK	BT_PCM_CLK
RZ_SCI0_RXD	BT_PCM_DOUT

Table 10 – Bluetooth Audio Interface

6.11.4 Wi-Fi / BT antenna

This board only supports an external antenna, attached via UFL / IPEX MHF connector.

The antenna shipped with RZBoard V2L (as used in regulatory certifications) is [Molex p/n: 1461870050](#)



6.12 Power Architecture

RZBoard is a power-efficient low-wattage board (typical 1.5W ~ 4.5W depending on use case)

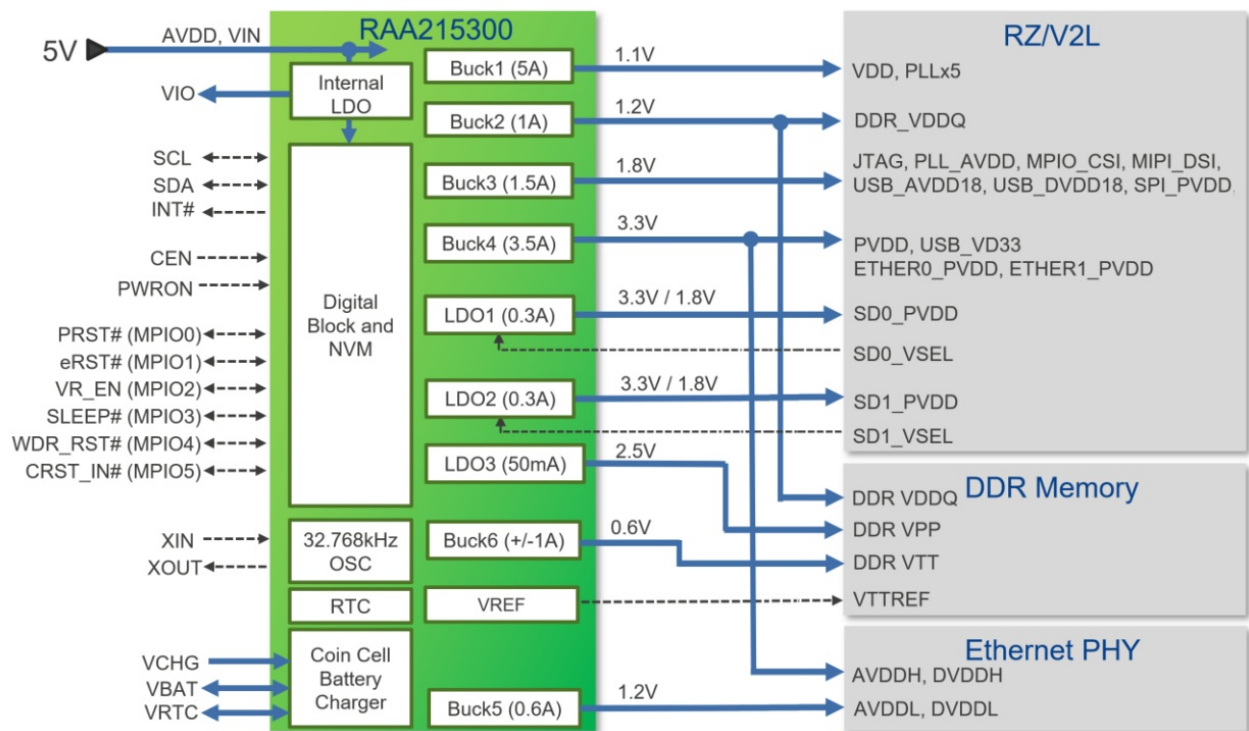
6.12.1 Power Input (+5V USB type-C Connector)

The USB type-C connector is used for 5V power input (It does not support a data interface)

6.12.2 Power Regulation (RAA215300 PMIC: 6 Buck Regulators, 3 LDOs)

The Renesas PMIC efficiently converts the 5V power input into multiple regulated supply rails Power architecture of RZBoard is based on the Renesas diagram below

(See table for detail on RZBoard's specific usage of the PMIC output rails)



PMIC Voltage Regulator	RZBoard Power Rail	Power Rail Connects To...
BUCK1	VDD_1V1	VDD, PLLx5
BUCK2	VDDQ_DDR_1V2	DDR_VDDQ
BUCK3	1V8	JTAG, PLL_AVDD, MPIO_CSI, MIPI_DSI, USB_AVDD18, USB_DVDD18, SPI_PVDD, ADC, eMMC, QSPI, Codec, WiFi/BT, Level-shifters
BUCK4	3V3	PVDD_1, PVDD_2, USB_VD33, Clock module, ETHER0_PVDD, ETHER1_PVDD, USB hub, CSI camera, IT6161, MIPI switches, CAN, Pi-HAT header, SD card, SD/eMMC switch, eMMC, Codec, Level-shifters
BUCK5	1V2	IT6161 (6x power rails)
BUCK6	VTT_DDR	(Unused)
LDO1	SD0_PVDD	SD0_PVDD
LDO2	TP23	(Unused)
LDO3	VPP_DDR_2V5	SD1_PVDD
VREFOUT	VREF_DDR_0V6	VREFCA (DDR4)
VIO	VIO_1V8	(Unused)

6.12.3 Power Consumption Measurements

An inexpensive current-measurement USB dongle is recommended during development, in-line with the USB power connection to monitor 5V input current draw. The USB dongle meter shown here accommodate type-C and type-A cable connections and is available online for around \$20 <https://www.amazon.com/Tester-Eversame-Voltmeter-Ammeter-Braided/dp/B07MGQZHGM>

Note: An invalid current measurement will be seen if RZBoard V2L is powered from a USB port of same PC as used by the debugger probe! To achieve a useful current measurement, power RZBoard from a separate power-adaptor, or disconnect the debugger probe.



Figure 7 – Current-measurement USB Dongle

6.13 ESD Protection

All USB interfaces and the HDMI interface have high-speed ESD protection discrete devices on their power rails and data lines. The CAN1 interface also includes ESD protection.

Technical Support

7.1 Renesas-hosted Technical Support Resources

Renesas Support Portal

Technical support of RZ/V2L software enablement plus the broader RZ family is available via the Renesas Portal for knowledge base, FAQs and Support Forums, eg.

<https://en-support.renesas.com>

<https://en-support.renesas.com/knowledgeBase/category/31243> (requires Renesas login)

Renesas RZ/V2L and RZ/G2L SMARC Wiki Pages

https://renesas.info/wiki/RZ-V/RZ-V2L_SMARC

https://renesas.info/wiki/RZ-G/RZ-G2L_SMARC

Renesas Github Repos

Renesas maintains various github repositories in context of RZ/V2L, eg.

https://github.com/renesas-rz/rz_linux-cip

<https://github.com/mkosinski05/meta-renesas-ai>

7.2 Avnet-hosted Technical Support Resources

For general RZBoard V2L questions, visit the product page at <http://avnet.me/RZBoard-V2L> where you will find technical documentation, videos and tutorials, reference designs and other support.

Detailed questions regarding RZBoard V2L hardware design, software application development, training and use of related tools, can be posted on the RZBoard Support Forum at <http://avnet.me/RZBoard-forum> (This forum is monitored by technical resources in Avnet's Advanced Applications Group)

If interested in customization of RZBoard V2L with customer-specific options, send an email inquiry with detail of desired changes (and use-case) to customize@avnet.com

Sales Contact Info

For further info on Avnet-designed Development Boards, contact your local Avnet representative at:

Region	Organization	Contact Webpage	Address & Phone
North America	Avnet Americas	www.avnet.com/contact	2211 South 47th Street Phoenix, AZ 85034, USA Phone: + 1-800-585-1602
EMEA	Avnet Silica	avnet-silica.com/contact	Gruber Str. 60c 85586 Poing, Germany Phone: +49-8121-77702
EMEA	EBV	ebv.com/contact	Im Technologypark 2-8 85586 Poing, Germany Phone: +49-8121-774 – 0

Cautionary Notes

ESD – Handling precautions for ESD-vulnerable electronic equipment are strongly recommended. It is advised to touch the metal housing of Ethernet or USB connectors, prior to touching any other part of the PCB.

Connectors – Use care when inserting/unplugging cables, especially with USB-C and audio jack connectors. Finger-support is advised to brace surface mount connectors against excessive lateral force.

MIPI Connectors – The locking mechanism of MIPI-DSI and MIPI-CSI ribbon cable connectors are relatively fragile and should be handled with care. Make sure of alignment and use minimal force when locking.

OTP eFuses – For security reasons, the on-chip OTP fuses in the RZ/V2L are one-time programmable. During application development, there should never be a need to program these fuses. Two boot modes are supported via selection jumper (J19). Programming of OTP eFuses will only be necessary when deploying this board in an end-product. It is the user's responsibility to be absolutely certain of their requirements before OTP programming and to not program the fuses by accident.

Note that Avnet accepts no liability and will not replace boards that have been:

- Damaged by ESD or mishandling.
- Compromised through OTP eFuse programming

Safety Warnings

1. It is recommended that this product only be powered via the onboard USB type-C connector, from one of the following +5V power sources:
 - a) Connected to the development computer (depends on use-case)
 - b) Connected to a 5V power-bank battery of suitable rating
 - c) Connected to an external +5V, 1A DC power adaptor (a higher rating may be needed if an expansion Pi_HAT or custom board is fitted). The external power supply shall comply with relevant regulations and standards applicable in the country of intended use.
2. Only compatible plug-in modules shall be connected to RzBoard V2L. Connection of incompatible devices may affect compliance or result in damage to the unit and void the warranty.
3. This product must be operated in a well-ventilated environment.
If an enclosure is used, this must provide adequate ventilation.
4. Do not insert or remove any expansion board or cable, without first unplugging the relevant +5V DC power source
5. Ambient operating temperature range when using RzBoard V2L shall not exceed: -30C to +85C

Disclaimer

RZBoard V2L is engineered for use as a development board (to facilitate product evaluation and systemlevel prototyping) as well as for potential use as a sub-assembly in custom OEM end-products. Avnet assumes no liability for modifications that a user chooses to make to RZBoard V2L.

Software: eMMC Memory and Device Tree Overlays

12.1 Procedure to Reflash the Bootloader Firmware (eMMC)

Typically not necessary to update the bootloader (the Linux System Image is what usually gets updated!) Bootloader programming is however detailed below.

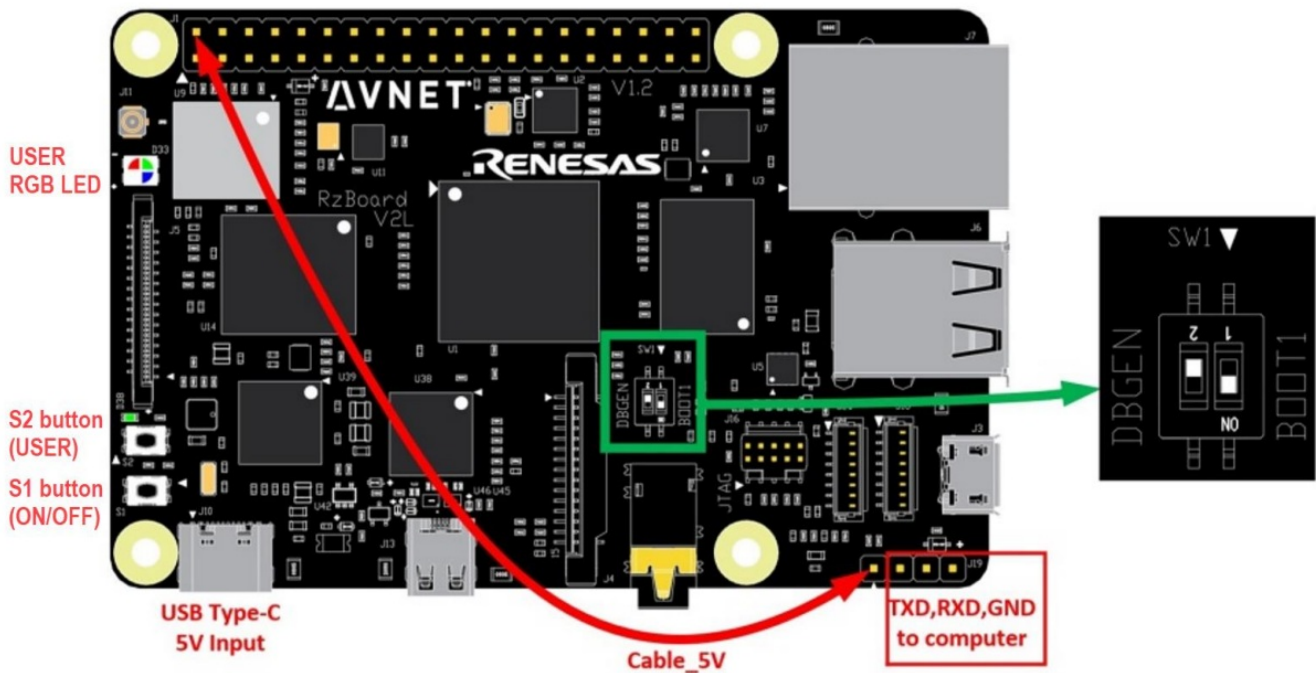
.BAT File Name	File Size	File Names	Boot Mode Board Settings
flash_bootloader.bat Download Type: SCIF 0 @115.2 kb/s	268 KB 115 KB 2.02 MB	• flashwriter_RZBoard.mot • bl2_bp-RZBoard.srec • fip-RZBoard.srec	BOOT2=1: Fit fly-wire from J1 pin2 to J19 pin1 BOOT1=0: Set SW1.1 = ON BOOT0=1: Remove SD card

RZBoard supports an easy scripted procedure to program the following bootloader image files via SCIF serial download from the development computer into RZBoard's eMMC flash memory.

- **flashwriter_RZBoard.mot** FlashWriter image tool
Once downloaded, this is used to program the following two bootloader images into eMMC
- **bl2_bp-RZBoard.srec** bootloader image in Motorola S-Record format, ARM TFA (Trusted Firmware-A) BL2 image
- **fip-RZBoard.srec** which is a combination of bootloader image, ARM TFA (Trusted Firmware-A) BL31 and u-boot combined image

Note: Complete steps 1-6 below, prior to running the provided flash_bootloader.bat file:

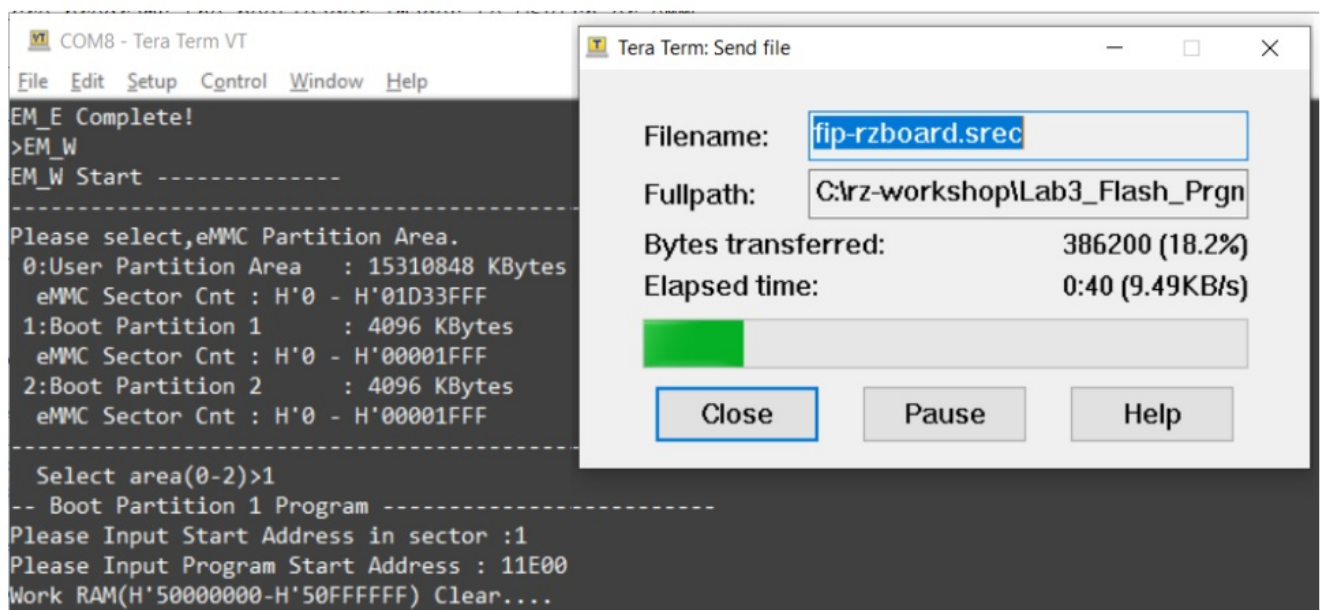
1. Download the latest image files, .bat and macro files from https://avnet.me/RZBoard_emmc and extract the zipped files to a staging folder on the development computer
2. Edit Windows Ethernet network adapter settings for the development computer: Set it's IPv4 properties to static IP Address 192.168.1.88
3. Edit the config.ini file (update the COM port#, check for matching names of BootLoader image files)
4. Power-off RZBoard
5. Place RZBoard into "SCIF download boot-mode" by setting BOOT[2:0] to b101 (as tabled above), ie.
 - a) Set BOOT2=1 by strapping J19-pin1 to +5V (ie. connect it to J1-pin2 on the 40pin header)
 - b) Set BOOT1=0 by strapping SW1.1 = ON
 - c) Set BOOT0=1 by removing SD card from MicroSD slot
6. On RZBoard's J19 Debug UART 4-pin header, connect the fly-leads from the USB-Serial cable connected to the development computer.
- 7.



Run flash_bootloader.bat (this launches a Tera Term macro using the edited config.ini settings)



- Press and hold S1 for 2 seconds to power-on RZBoard, the macro will now proceed. Wait for this to complete (<5 min)



12.2 Procedure to Reflash the Linux System Image (eMMC)

.BAT File Name	File Size	File Names	Boot Mode Settings
flash_system_image.bat <u>Download Type:</u> Ethernet Fastboot @1 Gb/s	2.53 GB *typical	core-image-RZBoard- 20220920085823.rootfs.wic	BOOT2=0: Remove fly-wire from J1 pin2 to J19 pin1 BOOT1=0: Set SW1.1 = ON BOOT0=1: Remove SD card

RZBoard supports an automated procedure to program the large Linux System Image file, into RZBoard's eMMC flash memory, via Gigabit Ethernet from the development computer.

Note: Complete steps 1-6 below, prior to running the provided flash_system_image.bat file:

1. Download the image files, .bat and macro files from https://avnet.me/RZBoard_emmc and extract the zipped files to a staging folder on the development computer
2. Edit Windows Ethernet network adapter settings for the development computer: Set it's IPv4 properties to static IP Address 192.168.1.88
3. Edit the config.ini file (update the COM port#, the IP address and name of the System image file)
4. Power-off RZBoard
5. Place RZBoard into "eMMC (1V8) boot-mode" by setting BOOT[2:0] to b001 (as tabled above), ie.
 - d) Set BOOT2=0 by removing fly-wire from J19-pin1 to J1-pin2 (40pin header)
 - e) Set BOOT1=0 by strapping SW1.1 = ON
 - f) Set BOOT0=1 by removing SD card from MicroSD slot
6. Run flash_system_image.bat (launches applicable Tera Term macro using saved config.ini settings)
7. Power-on RZBoard. Ethernet connection will be established and a blue window shall open in <30 sec. Wait for the macro to complete (typically 15 blocks of data are sent and this completes in <5 min)

```

COM10 - Tera Term VT
File Edit Setup Control Window Help

.....
downloading of 117436536 bytes finished
Flashing Sparse Image
..... wrote 117448704 bytes to 'rawimg'
Starting download of 117436480 bytes
.....
downloading of 117436480 bytes finished
Flashing Sparse Image
..... wrote 117436416 bytes to 'rawimg'
Starting download of 22831228 bytes
.....
downloading of 22831228 bytes finished
Flashing Sparse Image
..... wrote 873431040 bytes to 'rawimg'
.....

Writing 'rawimg' (bootloader) writing
OKAY [ 4.250s]
Sending sparse 'rawimg' 6/15 (114684 KB) OKAY [ 15.067s]
Writing 'rawimg' OKAY [ 4.217s]
Sending sparse 'rawimg' 7/15 (114684 KB) OKAY [ 15.029s]
Writing 'rawimg' (bootloader) writing
OKAY [ 4.248s]
Sending sparse 'rawimg' 8/15 (114684 KB) OKAY [ 15.000s]
Writing 'rawimg' OKAY [ 4.187s]
Sending sparse 'rawimg' 9/15 (114684 KB) OKAY [ 15.006s]
Writing 'rawimg' (bootloader) writing
OKAY [ 6.640s]
Sending sparse 'rawimg' 10/15 (104012 KB) OKAY [ 13.640s]
Writing 'rawimg' OKAY [ 3.858s]
Sending sparse 'rawimg' 11/15 (114684 KB) OKAY [ 15.061s]
Writing 'rawimg' (bootloader) writing
OKAY [ 4.215s]
Sending sparse 'rawimg' 12/15 (114684 KB) OKAY [ 15.147s]
Writing 'rawimg' OKAY [ 4.263s]
Sending sparse 'rawimg' 13/15 (114684 KB) OKAY [ 15.275s]
Writing 'rawimg' (bootloader) writing
OKAY [ 4.079s]
Sending sparse 'rawimg' 14/15 (114684 KB) OKAY [ 15.270s]
Writing 'rawimg' OKAY [ 4.249s]
Sending sparse 'rawimg' 15/15 (22296 KB) OKAY [ 2.898s]
Writing 'rawimg' (bootloader) writing
OKAY [ 30.747s]
Finished. Total time: 311.853s
Press any key to continue . . .
  
```

12.3 Procedure to Increase the eMMC Partition Size

Caution: A miss-step in this procedure can delete all files on your board!

As configured during manufacture, only a section of the 32GB eMMC is accessible.

Use the following steps to expand the rootfs partition in eMMC flash memory:

- Open a serial port connection to RZBoard's debug connector
- Boot Linux and login to the board with user: root and password: avnet
- Execute the command `fdisk /dev/mmcblk0`
- Make note of the `mmcblk0p2` start address displayed on the screen
- Execute the following sequence of commands: `p -> d -> 2 -> n -> p -> 2 -> <mmcblk0p2 start address> -> enter (to accept default) -> N -> w`
- Now resize the partition using the entered settings: `resize2fs /dev/mmcblk0p2`

```
root@rzboard:~# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        2.4G  1.6G  655M   71% /
devtmpfs         430M   4.0K  430M    1% /dev
tmpfs            654M    0  654M    0% /dev/shm
tmpfs            654M   18M  636M    3% /run
tmpfs            654M    0  654M    0% /sys/fs/cgroup
tmpfs            654M    0  654M    0% /tmp
tmpfs            654M  120K  654M    1% /var/volatile
/dev/mmcblk0p1   100M   18M   83M   18% /boot
tmpfs            131M    0  131M    0% /run/user/0

root@rzboard:~#
root@rzboard:~# fdisk /dev/mmcblk0

Welcome to fdisk (util-linux 2.35.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Command (m for help): p
Disk /dev/mmcblk0: 14.62 GiB, 15678308352 bytes, 30621696 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0xf0397cab

Device      Boot  Start      End  Sectors  Size Id Type
/dev/mmcblk0p1 *      32    204831    204800    100M  c W95 FAT32 (LBA)
/dev/mmcblk0p2      204832 5324831 5120000    2.5G 83 Linux

Command (m for help): d
Partition number (1,2, default 2): 2

Partition 2 has been deleted.
```

```

Command <m for help>: n
Partition type
  p primary (1 primary, 0 extended, 3 free)
  e extended (container for logical partitions)
Select (default p): p
Partition number (2-4, default 2): 2
First sector (204832-30621695, default 206848): 204832
Last sector, +/-sectors or +/-size(K,M,G,T,P) (204832-30621695, default 30621695):

Created a new partition 2 of type 'Linux' and of size 14.5 GiB.
Partition #2 contains a ext4 signature.

Do you want to remove the signature? [Y]es/[N]o: N

Command <m for help>: w

The partition table has been altered.
Syncing disks.

root@rzboard:~# resize2fs /dev/nmcblk0p2
resize2fs 1.45.4 (23-Sep-2019)
Filesystem at /dev/nmcblk0p2 is mounted on /; on-line resizing required
old_desc_blocks = 1, new_desc_blocks = 2
The filesystem on /dev/nmcblk0p2 is now 3802108 (4k) blocks long.

root@rzboard:~# df -h

```

Filesystem	Size	Used	Avail	Use%	Mounted on
/dev/root	14G	1.6G	12G	12%	/
devtmpfs	430M	4.0K	430M	1%	/dev
tmpfs	654M	0	654M	0%	/dev/shm

12.4 Linux Device Tree Description of RZBoard Hardware

At startup, u-boot loads the RZBoard.dtb device tree blob, plus whatever device tree overlays have been specified by the user in the uEnv.txt (u-boot environment) file.

To configure Linux to use the MIPI DSI display (rather than default HDMI output) or to support peripherals such as I2C, SPI, CAN, ADC, Audio Codec, etc, requires that specific device tree overlay files be enabled. The available device tree overlay files are located in the file-system /boot/overlays/ folder

Config to enable	Value if set	File that this loads
enable_overlay_disp	'hdmi' 'mipi'	RZBoard-hdmi.dtbo RZBoard-mipi.dtbo
enable_overlay_camera	'ov5640' sas02601	RZBoard-ov5640.dtbo RZBoard-as0260.dtbo
enable_overlay_adc	'1' or 'yes'	RZBoard-adc.dtbo
enable_overlay_can	'1' or 'yes'	RZBoard-can.dtbo
enable_overlay_cm33	'1' or 'yes'	RZBoard-cm33.dtbo
enable_overlay_audio	'1' or 'yes'	RZBoard-lite-audio.dtbo
enable_overlay_i2c	'1' or 'yes'	RZBoard-ext-i2c.dtbo
enable_overlay_spi	'1' or 'yes'	RZBoard-ext-spi.dtbo
enable_overlay_uart2	'1' or 'yes'	RZBoard-ext-uart2.dtbo
fdtfile : is base dtb file, should be set to RZBoard.dtb		
fdt_extra_overlays : other dtbo files to load eg. RZBoard-f1.dtbo RZBoard-f2.dtbo		
uboot env : Use env set to add u-boot environment variables, eg. 'console=' 'bootargs='		

Default uEnv.txt setting:

fdtfile=RZBoard.dtb

enable_overlay_disp=hdmi

#fdt_extra_overlays=1.dtbo 2.dtbo 3.dtbo

#ethaddr=aa:bb:cc:aa:bb:cc

Refer to RZBoard V2L Linux Yocto User Manual for further detail of the Linux BSP software support provided for the RZBoard V2L hardware.

Accessories: RZBoard V2L Add-On Options

13.1 MIPI DSI 7-inch Capacitive Touch LCD Display (Optional)

- Supports up to 1280 x 720 resolution
- Compatible with all MaaXBoard SBC platforms.
- Connects to host via 2-lane MIPI-DSI interface
- Capacitive multi-touch display overlay
- Custom displays available via Avnet Embedded

Part# (and link): AES-ACC-MAAX-DISP2 (MSRP = \$95.00)



13.2 MIPI CSI 5 MP Camera (Optional)

- High quality 5 MP image sensor
- Compatible with all MaaXBoard SBCs and Raspberry Pi
- Attaches to host via 2-lane MIPI CSI ribbon cable
- Supports 1080p30, 720p60 and 640x480p90 video
- Small dimensions (24mm x 25mm x 9mm)

Part# (and link): AES-ACC-MAAX-CAM1 (MSRP = \$31.95)

	
MIPI 7" Display	MIPI 5MP Camera
p/n: AES-ACC-MAAX-DISP1 Available: In stock! Price: \$95.00 USD	p/n: AES-ACC-MAAX-CAM1 Available: In stock! Price: \$31.95 USD
avnet.me/maax-disp1-buy	avnet.me/maax-cam1-buy

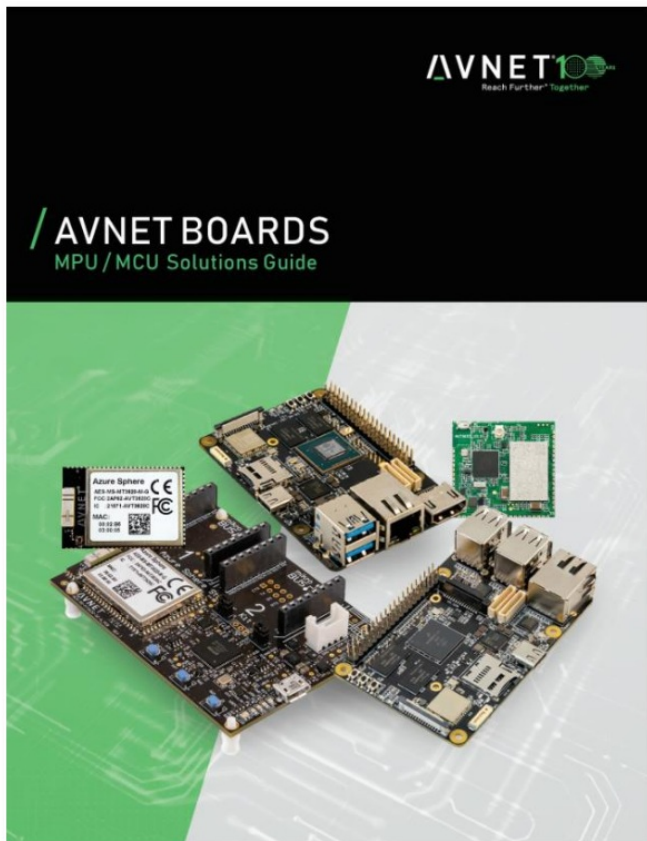
13.3 Other SBCs, SOMs and Accessories from “Avnet Boards”

The engineering team in Avnet’s Advanced Application Group, work in close partnership with key suppliers to develop a range of enablement solutions:

- Kits / Boards / SOMs / Modules
- Reference Designs
- Trainings / Tutorials / Blogs



For more information, visit avnet.me/avnetboards
Solutions Guides are also available for download:



avnet.me/mpu-mcu-solutions-guide-2022
avnet.me/xlx-solutions-guide-2022



Documents / Resources

 RZBOARD V2L AI Accelerated RZV2L Development Board  RZBoard V2L Hardware User Guide © 2022 Renesas Electronics Corporation	AVNET RZBoard V2L AI Accelerated Development Board [pdf] User Guide RZBoard V2L AI Accelerated Development Board, RZBoard V2L, AI Accelerated Development Board, Accelerated Development Board, Development Board, Board
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References

-  [Locations and Contacts | Avnet Silica](#)
-  [Avnet Boards](#)
-  [Click Boards - MIKROE](#)
-  [RZBoard - Avnet Boards Forums - element14 Community](#)
-  [RZBoard V2L | Avnet Boards](#)
-  [avnet.me/xlx-solutions-guide-2022](#)
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-  [RZBoard V2L | Avnet Boards](#)
-  [en-support.renesas.com](#)
-  [en-support.renesas.com/](#)
-  [en-support.renesas.com/knowledgeBase/category/31243](#)
-  [GitHub - mkosinski05/meta-renesas-ai: Renesas RZ/G AI BSP](#)
-  [GitHub - renesas-rz/rz_linux-cip](#)
-  [Raspberry Pi GPIO Pinout](#)
-  [RZ/G2L, RZ/G2LC, RZ/G2UL SMARC Board by Renesas - Renesas.info](#)
-  [RZ/V2L SMARC Board by Renesas - Renesas.info](#)
-  [USB C Power Meter Tester, Eversame USB Voltmeter Ammeter Load Tester,USB Voltage and Current Monitor with Braided USB C to USB C Cable\(1.5Ft/50cm\)-Test USB Cable Speed - PD 2.0/3.0 QC 2.0/3.0/4.0: Amazon.com: Industrial & Scientific](#)
-  [AES-ACC-MAAX-DISP2 by Avnet Engineering Services LCD Displays | Avnet](#)
-  [MaaXBoard RT | Avnet Boards](#)
-  [Click Boards - MIKROE](#)
-  [Molex Connector Part Number - 146187-0050 | Molex](#)
-  [renesas.com/document/mah/rzv2l-group-users-manual-hardware?language=en&r=1496691](#)
-  [eÂ² studio | Renesas](#)