SoM-RZx2L

User Manual

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EMAC, inc.
EQUIPMENT MONITOR AND CONTROL
2390 EMAC Way, Carbondale, Illinois 62902
Phone: (618) 529-4525 Fax: (618) 457-0110
http://www.emacinc.com

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1 Introduction

This document describes EMAC's SoM-RZx2L System-on-Module (SoM), which includes both the SoM-RZG2L and SoM-RZV2L variants. The SoM-RZx2L is an ARM64 Embedded System on Module (SoM) based on the Renesas RZ/G2L and RZ/V2L ARM Cortex-A55 Dual-Core processors. Designed and manufactured in the USA, this industrial temperature Dual-Core 1.20 GHz SoM utilizes 16MB of Serial Data Flash, 8GB of eMMC Flash (up to 64GB optional), and up to 4 GB of DDR4 RAM. Additional Flash storage can be had using the module's SDIO interface allowing the use of external SD flash cards.

1.1 Features

- **200 pin SODIMM form factor (2.66" x 2.375")**
- **Renesas RZ/G2L 1.2GHz ARM64 Dual Core Cortex A55 with 200 MHz Cortex M33 Processor or the RZ/V2L with the addition of DRP-AI AI accelerator & AI-MAC**
- **8GB Flash eMMC (16GB optional)**
- **2GB or 4GB of DDR4 RAM**
- **4x Serial ports (1x with full handshake, 3x with RTS/CTS handshake)**
- **2x USB 2.0 High-Speed Host Port**
- **1x USB 2.0 High-Speed OTG host/ device port**
- **24-bit Parallel RGB LCD Controller**
- **4-wire Resistive Touch Controller**
- **1x external SDIO port**
- **2x SPI Ports (4x SPI CS)**
- **2x I2C Ports**
- **2x CAN Ports**
- **4 Lane MIPI CSI**
- **4 Lane MIPI DSI**
- **1x Synchronous Serial I/O (I2S) Audio Port**
- **4 channels of 12-bit A/D (0 to 2.5V)**
- **16x GPIO Lines (3.3V)**
- **4x PWM Channels & 1x for LCD Backlight**
- **2x Timer/Counters**
- **2x Programmable Clock outputs**
- **External Address/Data Bus for CSI/DSI Lines**
- **1x 10/100/1000 BaseT Ethernet Port with Real Time PHY**
- **1x 10/100/1000 BaseT Ethernet MAC (requires external PHY on Carrier)**

2 Hardware

2.1 Specifications

- **CPU:** Renesas RZ/G2L 1.2GHz ARM64 Dual Core Cortex A55 with 200 MHz Cortex M33 Processor or the RZ/V2L with the addition of DRP-AI AI accelerator & AI-MAC
- **Flash:** 16MB Serial Data Flash, up to 16GB eMMC (MLC/SLC)
- **RAM:** 2GB or 4GB of DDR4
- **Flash Disk:** SD/MMC Flash Interface
- **System Reset:** External Reset Button
- **Timer/Counters:** 2x Timer/Counters/PWM
- **PWM:** 4x PWM Channels
- **Digital I/O:** 16x GPIO (3.3v lines)
- **Analog I/O:** 4x channels at 12-bit resolution
- **Power:** Power Management Controller allows selective shutdown capability on processor I/O functionality
- **JTAG:** JTAG for debugging, including real-time trace
- **Clocks:** 2x programmable clock outputs

Serial Interfaces

- **UARTS:** 4x Serial ports (1x with full handshake, 3x with RTS/CTS handshake)
- **SPI:** 2x SPI Ports (4x SPI CS)
- **Audio:** I2S Synchronous Serial Controller with analog interface support
- **USB:** 2x USB 2.0 High-Speed Host ports & 1x USB 2.0 High-Speed Host/Device port (OTG)
- **I2C:** 2x I2C Ports
- **CAN:** 2x CAN Ports

Ethernet Interface

- **MAC:**
  - 1x 10/100/1000 BaseT Ethernet MAC with Real Time PHY
  - 1x 10/100/1000 BaseT Ethernet MAC which requires an external PHY on the Carrier
- **PHY:** Texas Instruments DP83867 Gigabit PHY
- **Interface:** IEEE 802.3u 10/100/1000 BaseT Fast Ethernet

Mechanical and Environmental

- **Dimensions:** SODIMM form factor with the length dimension extended (2.66" x 2.375")
- **Power Supply Voltage:** 3.3 Volts DC +/- 5%
- **Operating Temperature:** -40 ~ 85° C (-40 ~ 185 ° F), fanless operation.
- **Operating Humidity:** 0% ~ 90% relative humidity, non-condensing

2.2 Real Time Clock

The SoM-RZx2L features an integrated real-time clock (RTC). Battery backup is supplied from the carrier board through the VSTBY pin, allowing the module to retain its time registers during power cycles or resets. In addition to basic timekeeping, the RTC supports programmable alarms capable of generating interrupts to the processor. This enables use cases such as placing the processor in a low-power sleep mode and later waking it on an RTC alarm event.

2.3 Watchdog Timer

The Renesas RZ/G2L dual-core processor features a three-channel watchdog timer (WDT). Channel 0 checks the operation of the Cortex-A55 CPU Core 0, channel 1 checks the operation of the Cortex-A55 CPU Core 1, and channel 2 checks the operation of the Cortex-M33 CPU.

2.4 External Connections

The SoM-RZx2L connects to a carrier board containing its connectors, power supply, and any expansion IO, through a standard ENIG-plated (Electroless Nickel Immersion Gold) SODIMM 200-pin connection shown below.

The SoM model will fit in any standard 200-pin SODIMM socket. These connections are designed to be compatible with all EMAC 200-pin SoM products. Note the SOM-RZx2L uses the new enhanced 200 pin specification. In order to get full functionality, you need to utilize a Next Gen 200 pin Carrier such as the SOM-255GS. See EMAC SoM 200-pin SODIMM Pinout Specification for how other 200-pin SoM pinouts align with the SoM-RZx2L's pinout. The use of the DDR SODIMM form factor for EMAC's SoM is a sound choice that has been proven rugged and reliable in the laptop and embedded SBC markets. The remainder of this section describes the pinout as it applies specifically to the SoM-RZx2L's processor.

2.5 JTAG

JTAG (Joint Test Action Group) is a standard for verifying and testing electronic circuits, enabling functionalities like debugging and boundary scans. The listed pins (e.g., JTAG_TCK for clock, JTAG_TDI for data input, and JTAG_TDO for data output) facilitate these operations, ensuring effective communication with the processor.

Table 1: Processor JTAG

SODIMM Pin#	SoM Pin Name	Processor Pin Name(s)	Description
139	JTAG_TCK	TCLK / SWDCLK / Y4	JTAG Clock
140	JTAG_TDI	TDI/AD1	JTAG Serial In
141	JTAG_TDO	TDO/AB2	JTAG Serial Out
142	JTAG_TMS	TMS / SWDIO / AB1	JTAG Operation Mode
143	JTAG_TRST	TRST# / AC1	Test Reset Signal
144	JTAG_RTCK	NC	Dynamic Clock Sync

2.6 I2C

I2C (Inter-Integrated Circuit) is a widely used communication protocol for connecting low-speed peripherals to processors. The listed pins, such as I2C_A_CLK and I2C_A_DATA for Channel 0 and I2C_B_CLK and I2C_B_DATA for Channel 1, handle clock signals and data transfers for their respective I2C channels enabling efficient and synchronized communication between devices.

Table 2: I2C Port

SODIMM Pin#	SoM Pin Name	Processor Pin Name(s)	Description
29	I2C_A_CLK	RIIC0_SCL / C20	I2C Channel 0 Clock
30	I2C_A_DATA	RIIC0_SDA / B20	I2C Channel 0 Data
146	I2C_B_CLK	RIIC1_SCL / A19	I2C Channel 1 Clock
148	I2C_B_DATA	RIIC1_SDA / B19	I2C Channel 1 Data

2.7 CSI

CSI is a high-speed serial interface used to connect camera modules to processors for image and video data transfer. The SoM-RZx2L provides a 4-lane MIPI CSI interface. The listed pins include CSI_CLK+ and CSI_CLK- for clock synchronization, as well as differential data channels (e.g., CSI_D0+/CSI_D0-, CSI_D1+/CSI_D1-) for transmitting positive and negative signals across multiple data lanes. This interface can be used as 8x 2-Lane or 4x 4-Lane.

Table 3: CSI

SODIMM Pin#	SoM Pin Name	Processor Pin Name(s)	Description
184	CSI_CLK+	AC10	CSI Clock Positive
186	CSI_CLK-	AC9	CSI Clock Negative
187	CSI_D0+	AE10	CSI Data Channel 0 Positive
189	CSI_D0-	AD10	CSI Data Channel 0 Negative
188	CSI_D1+	AE9	CSI Data Channel 1 Positive
190	CSI_D1-	AD9	CSI Data Channel 1 Negative
191	CSI_D2+	AE11	CSI Data Channel 2 Positive
193	CSI_D2-	AD11	CSI Data Channel 2 Negative
192	CSI_D3+	AE8	CSI Data Channel 3 Positive
194	CSI_D3-	AD8	CSI Data Channel 3 Negative

2.8 DSI

DSI is a high-speed serial interface used to connect display modules to processors for video and image data transmission. The SoM-RZx2L provides a 4-lane MIPI DSI interface. The listed pins include DSI_CLK+ and DSI_CLK- for clock synchronization, as well as differential data channels (e.g., DSI_D0+/DSI_D0-, DSI_D1+/DSI_D1-) for transmitting positive and negative signals across multiple data lanes, ensuring high-speed and reliable communication for display applications.

Table 4: DSI

SODIMM Pin#	SoM Pin Name	Processor Pin Name(s)	Description
175	DSI_CLK+	AC14	DSI Positive Clock
177	DSI_CLK-	AC13	DSI Negative Clock
176	DSI_D0+	AD13	DSI Data Channel 0 Positive
178	DSI_D0-	AE13	DSI Data Channel 0 Negative
179	DSI_D1+	AD14	DSI Data Channel 1 Positive
181	DSI_D1-	AE14	DSI Data Channel 1 Negative
180	DSI_D2+	AD12	DSI Data Channel 2 Positive
182	DSI_D2-	AE12	DSI Data Channel 2 Negative
183	DSI_D3+	AD15	DSI Data Channel 3 Positive
185	DSI_D3-	AE15	DSI Data Channel 3 Negative

2.9 Ethernet

The SOM-RZx2L provides a Texas Instruments DP83867 10/100/1000 Ethernet PHY IC on board. Carrier designers need only run these lines through the appropriate magnetics to have a functional Ethernet connection. Remember the RX and TX lines are differential pairs and need to be routed as such. Ethernet interfaces support high-speed data communication and networking applications. The Gigabit Ethernet pins include differential pairs, such as GIG D-/GIG D+ and GIG C-/GIG C+, as well as signal pairs for receiving (RX) and transmitting (TX) data, including Ethernet_RX-/Ethernet_RX+. These components work together to ensure reliable data transmission and reception. The RMII/RGMII Ethernet interface consists of transmit and receive data lanes, specifically TXD0-TXD3 for transmission and RXD0-RXD3 for reception. It also includes clock signals (TX_CLK and RX_CLK) and management pins (MDC and MDIO) for controlling and monitoring Ethernet operations. The RMII/RGMII interface requires a PHY on the Carrier board.

Table 5: Ethernet

SODIMM Pin#	SoM Pin Name	{PHY} Pin Name	Description
12	GIG D-	TD_M_D	GIG Ethernet D- pin
14	GIG D+	TD_P_D	GIG Ethernet D+ pin
13	GIG C-	TD_M_C	GIG Ethernet C- pin
15	GIG C+	TD_P_C	GIG Ethernet C+ pin
16	Ethernet_Rx-/GIG B-	TD_M_B	GIG Ethernet B- pin
18	Ethernet_Rx+/GIG B+	TD_P_B	GIG Ethernet B+ pin
17	Ethernet_Tx-/GIG A-	TD_M_A	GIG Ethernet A- pin
19	Ethernet_Tx+/GIG A+	TD_P_A	GIG Ethernet A+ pin
38	LED_LINK/CFG_2	LED_0/ LED_1	Ethernet Link/ Configuration
39	LED_ACT/CFG_3	LED_2	Ethernet Link/ Configuration

Table 6: RMII/RGMII Ethernet Interface

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
159	TXD0	W1	P30_0	Transmit Data 0
161	TXD1	V2	P30_1	Transmit Data 1
163	TXD2	U4	P31_0	Transmit Data 2
165	TXD3	V3	P31_1	Transmit Data 3
167	TX_CTL	U2	P29_1	Transmit Control
169	TX_CLK	Y1	P29_0	Transmit Clock
160	RXD0	AA1	P34_1	Receive Data 0
162	RXD1	W2	P35_0	Receive Data 1
164	RXD2	W3	P35_1	Receive Data 2
166	RXD3	AA2	P36_0	Receive Data 3
168	RX_CTL	Y3	P34_0	Receive Control
170	RX_CLK	Y2	P33_1	Receive Reference Clock
171	MDC	U3	P37_0	Management Data Clock
173	MDIO	U1	P37_1	Management Data I/O
172	RX_ERR	T2	P36_1	Receive Error

2.10 USB

The SoM-RZx2L provides two USB 2.0 High Speed Host ports and one USB 2.0 High Speed Host/Device port (OTG). The USB host ports are connected to a USB hub controller for handling multiple connections. USB OTG pins such as USB_OTG_D+/D- are for data transmission, USB_OTG_VBUS for VBUS power, and USB_OTG_ID for identifying OTG roles. The VBUS_EN pin is used to enable the USB power supply.

Table 7: USB

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
5	USB_A+	*	*	Host USB Port A+
7	USB_A-	*	*	Host USB Port A-
6	USB_B+	*	*	Host USB Port B+
8	USB_B-	*	*	Host USB Port B-
9	USB_OTG_D-	AD7	USB0_DM	USB OTG Port D-
11	USB_OTG_D+	AE7	USB0_DP	USB OTG Port D+
10	USB_OTG_VBUS	AA9	USB0_VBUSIN	OTG VBUS
40	USB_OTG_ID	AC5	P5_1	OTG ID
174	VBUS_EN	AE4	P4_0	VBUS Enable

* USB ports A & B are connected to a USB Hub controller.

2.11 SPI

The SoM-RZx2L provides two SPI Ports which are labeled as SPI0 and SPI1. The SPI0_MISO and SPI0_MOSI lines are for data input and output, SPI0_SCK for clock signals, and multiple chip select lines (e.g., SPI0_CS0#, SPI0_CS1#) to enable communication with various peripherals. Additionally, SPI1 pins are detailed for supporting an additional SPI channel, ensuring flexibility and scalability in peripheral connections.

Table 8: Serial Peripheral Interface (SPI)

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name	Description
22	SPI0_MISO	A15	P43_2	SPI0 Serial Data In
23	SPI0_MOSI	B15	P43_1	SPI0 Serial Data Out
24	SPI0_SCK	D14	P43_0	SPI0 Serial Clock Out
25	SPI0_CS0#	C15	P43_3	SPI0 Chip Select Line 0
26	SPI0_CS1#	L2	P22_1	SPI0 Chip Select Line 1
27	SPI0_CS2#	M2	P23_0	SPI0 Chip Select Line 2
28	SPI0_CS3#	K2	P23_1	SPI0 Chip Select Line 3
126	SPI1_SCK	D15	P44_0	SPI1 Serial Clock Out
127	SPI1_MOSI	B16	P44_1	SPI1 Serial Data In
128	SPI1_MISO	A16	P44_2	SPI1 Serial Data Out
134	SPI1_CS0#	C16	P44_3	SPI1 Chip Select

2.12 SDIO Multimedia Card

The SoM-RZx2L provides one MMC/SD card interface. This interface facilitates communication with external memory devices such as MMC or SD cards. Key pins include SCLK for the clock signal, CMD for sending commands, and DAT0 through DAT3 for transferring data. Additional pins like Card_Detect and SD_WP provide functionality for detecting card presence and managing write protection, ensuring reliable and efficient data storage and access. The SDIO port can also be used to interface to WiFi modules should wireless communication be needed.

Table 9: MMC/SD Card Interface

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name	Description
31	SCLK	H3	SD1_CLK	MCI Clock
32	CMD	H1	SD1_CMD	MCI Command
33	DAT0	H2	SD1_DATA0	MCI Data 0
34	DAT1	J1	SD1_DATA1	MCI Data 1
35	DAT2	J2	SD1_DATA2	MCI Data 2
36	DAT3	J3	SD1_DATA3	MCI Data 3
37	Card_Detect	C2	P19_0	Card Detect
196	SD_WP	D3	P19_1	SD Write Protect

2.13 Serial Ports

The SoM-RZx2L provides 4 Serial Ports. One Serial port offers full handshaking while the other three offer RTS/CTS handshaking. The table below highlight pins for multiple communication channels (COMA, COMB, COMC, and COMD) with functionalities like transmit (TXD), receive (RXD), and flow control (CTS, RTS). Additional signals such as DSR, DTR, and RI are also included on COMA, offering robust and versatile serial communication for various peripherals.

Table 10: UART

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
95	COMA_TXD	C12	P38_0	COMA transmit/GPIO
96	COMA_RXD	A10	P38_1	COMA receive/GPIO
97	COMA_CTS	A12	P39_1	COMA CTS/GPIO
98	COMA_RTS	C13	P39_2	COMA RTS/GPIO
99	COMA_DTR	B12	P39_0	COMA DTR/GPIO
100	COMA_DSR	A14	P40_2	COMA DSR /GPIO
101	COMA_RI	A8	P46_3	COMA RING/GPIO
102	COMB_TXD	B13	P40_0	COMB transmit/GPIO
103	COMB_RXD	A13	P40_1	COMB receive/GPIO
104	COMB_CTS	C14	P41_0	COMB CTS/GPIO
105	COMB_RTS	B14	P41_1	COMB RTS/GPIO

106	COMC_TXD	D17	P48_0	COMC transmit/GPIO
107	COMC_RXD	B18	P48_1	COMC receive/GPIO
108	COMC_CTS	C18	P48_3	COMC CTS/GPIO
109	COMC_RTS	D18	P48_4	COMC RTS/GPIO
110	COMD_TXD	A9	P0_0	COMD transmit/GPIO
111	COMD_RXD	B10	P0_1	COMD receive/GPIO
112	COMD_CTS	B9	P46_2	COMD CTS/GPIO
113	COMD_RTS	A18	P48_2	COMD RTS/GPIO

2.14 I2S

The SoM-RZx2L provides one I2S audio port. Note that there is no CODEC on the SoM and therefore must be provided on the Carrier. In addition, the CODEC will require either SPI or I2C for control.

Table 11: I2S

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
86	AudioA_SCLK	B7	P45_0	I2S Clock
87	AudioA_LRCLK/Frame	C8	P45_1	I2S Left/Right Clock
88	AudioA_MCLK	*	*	I2S Master Clock
89	AudioA_DIN	B8	P45_3	I2S Data Input
90	AudioA_DOUT	D8	P45_2	I2S Data Output

* The I2S Master Clock is provided by an onboard 12.288MHz crystal

2.15 CAN

The SoM-RZx2L has two CAN (Control Area Network) ports. These ports are available at the card edge as listed in the table below.

Table 12: CAN

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
93	CAN_A_TX	AC4	P42_1	CAN A Transmit
94	CAN_A_RX	AD3	P42_2	CAN A Receive
145	CAN_B_TX	D9	P46_0	CAN B Transmit
147	CAN_B_RX	C9	P46_1	CAN B Receive

2.16 IRQs

The SoM-RZx2L provides 3 dedicated Interrupt requests (IRQs) lines. However, any GPIOs on the RZ/X2L processor may be programmed for interrupts.

Table 13: IRQs

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
129	IRQA	B17	P47_2	Interrupt Request 2
130	GPIO12 / IRQ6	B11	P3_0	Interrupt Request 6
131	GPIO13 / IRQ7	A11	P3_1	Interrupt Request 7

2.17 Oscillators

The SoM-RZx2L features GPIO oscillator outputs that provide precise clock signals for various peripheral devices and system operations. These outputs can be configured to generate specific frequencies, making them suitable for driving external components such as audio codecs, sensors, and communication interfaces.

Table 14: Oscillators

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
132	GPIO14 / OSC0	AE5	P4_1	Oscillator 0
133	GPIO15 / OSC1	AD5	P5_0	Oscillator 1

2.18 ADC

The SoM-RZx2L allows for 8 channels of 12 bit Analog-to-Digital Converters (ADCs). Four of these channels can be utilized as ADC inputs while the other four are utilized as the Touchscreen control. In this system, ADC channels 0, 1, 2, and 3 are designated specifically for Resistive Touchscreen control.

Table 15: Analog to Digital Converters

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
45	X+/ADC0	D21	ADC_CH0	ADC Channel 0
46	X-/ADC1	C22	ADC_CH1	ADC Channel 1
47	Y+/ADC2	B22	ADC_CH2	ADC Channel 2
48	Y-/ADC3	A22	ADC_CH3	ADC Channel 3
49	SX+/ADC4	D20	ADC_CH4	ADC Channel 4
50	SX-/ADC5	C21	ADC_CH5	ADC Channel 5
51	SY+/ADC6	B21	ADC_CH6	ADC Channel 6
52	SY-/ADC7	A21	ADC_CH7	ADC Channel 7

2.19 GPIO

The GPIO section outlines the SoM's General-Purpose Input/Output capabilities, where pins can be configured as digital input/output ports or utilized for specific internal SoM-RZx2L functions. The GPIO expander extends flexibility for additional peripherals or custom applications with I2C control. These configurable pins offer versatility for controlling and monitoring various hardware components.

Table 16: General Purpose IO (Native)

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
122	GPIO8	A17	P47_1	General Purpose 8 Input/Output
123	GPIO9	D16	P47_0	General Purpose 9 Input/Output
124	GPIO10	C17	P47_3	General Purpose 10 Input/Output
125	GPIO11	W4	P32_1	General Purpose 11 Input/Output
130	GPIO12	B11	P3_0	General Purpose 12 Input/Output
131	GPIO13	A11	P3_1	General Purpose 13 Input/Output
132	GPIO14	AE5	P4_1	General Purpose 14 Input/Output
133	GPIO15	AD5	P5_0	General Purpose 15 Input/Output

Table 17: General Purpose IO (Expander)

SODIMM Pin#	SoM Pin Name	Expander Pin Name(s)	Description
114	GPIO0	P0	General Purpose 0 Input/Output
115	GPIO1	P1	General Purpose 1 Input/Output
116	GPIO2	P2	General Purpose 2 Input/Output
117	GPIO3	P3	General Purpose 3 Input/Output
118	GPIO4	P4	General Purpose 4 Input/Output
119	GPIO5	P5	General Purpose 5 Input/Output
120	GPIO6	P6	General Purpose 6 Input/Output
121	GPIO7	P7	General Purpose 7 Input/Output

2.20 LCD

The 200-pin System on Module (SoM) specification supports connections for up to 24-bit LCDs. Additionally, these pins can be utilized to enable analog VGA connectivity for a conventional monitor by incorporating a video DAC into the Carrier. There is also a Pulse Width Modulation (PWM) feature for brightness, providing software control over the LCD's brightness level.

Table 18: LCD

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
57	LCD_BLUE0	AB16	P7_2	LCD Blue 0
58	LCD_BLUE1	AE16	P8_0	LCD Blue 1
59	LCD_BLUE2	AD16	P8_1	LCD Blue 2
60	LCD_BLUE3	AC17	P8_2	LCD Blue 3
61	LCD_BLUE4	AC16	P9_0	LCD Blue 4
62	LCD_BLUE5	AD17	P9_1	LCD Blue 5
63	LCD_BLUE6	AE17	P10_0	LCD Blue 6
64	LCD_BLUE7	AC18	P10_1	LCD Blue 7
65	LCD_GREEN0	AB18	P11_0	LCD Green 0
66	LCD_GREEN1	AD18	P11_1	LCD Green 1
67	LCD_GREEN2	AB19	P 12_0	LCD Green 2
68	LCD_GREEN3	AB21	P12_1	LCD Green 3
69	LCD_GREEN4	AD22	P 13_0	LCD Green 4
70	LCD_GREEN5	AC19	P 13_1	LCD Green 5
71	LCD_GREEN6	AC22	P 13_2	LCD Green 6
72	LCD_GREEN7	AE24	P 14_0	LCD Green 7
73	LCD_RED0	AE18	P 14_1	LCD Red 0
74	LCD_RED1	AE19	P 15_0	LCD Red 1
75	LCD_RED2	AD19	P 15_1	LCD Red 2
76	LCD_RED3	AE20	P 16_0	LCD Red 3
77	LCD_RED4	AE21	P16_1	LCD Red 4
78	LCD_RED5	AD20	P 17_0	LCD Red 5
79	LCD_RED6	AC20	P 17_1	LCD Red 6
80	LCD_RED7	AE22	P17_2	LCD Red 7
81	LCD_HSYNC	AD21	P 6_1	LCD Vertical Sync
82	LCD_VSYNC	AE23	P 7_0	LCD Horizontal Sync
83	LCD_ENA	AD23	P 7_1	LCD Enable
84	LCD_CLK	AC21	P 6_0	LCD Clock
85	BCKLIGHT_PWM	N/A	N/A	Backlight Brightness

2.21 Power Connections

The SoM-RZx2L requires a 3.3V supply for the bus and I/O voltages. The 1.8V core voltage is regulated on the module from the 3.3V. Unlike some other modules, no supply voltage other than 3.3V is required.

Table 19: Power Connections

SODIMM Pin#	SoM Pin Name	Description
3,4,43,44,135, 136,197,198	3.3VCC	3.3 Volt SoM Supply Voltage
1,2,20,21,41,42, 91,92,137,138, 155,156,199,200, 201,202	GND	Digital Ground
53	Analog_GND	Analog Ground
56	VSTBY	Voltage standby
55	AV_REF	Analog power/reference

2.22 Boot Options

The 200-pin SoM specification provides two pins for boot-time configuration. On the SoM-3354M, they are used to select between four boot modes.

Table 20: Boot Options

SODIMM Pin#	SoM Pin Name	Processor Pin #	Processor Pin Name(s)	Description
157	BOOT_OPTION0	F4	MD_BOOT0	Boot0 Option Select
158	BOOT_OPTION1	E4	MD_BOOT2	Boot1 Option Select

3 Design Considerations

One of the goals of the SoM-RZx2L is to provide a modular, flexible, and inexpensive solution capable of delivering high-end microcontroller performance with low power requirements.

3.1 Off-the-Shelf Carriers

Many SoM-RZx2L applications can make use of EMAC's off-the-shelf carriers. These carriers provide power to the SoM as well as a wealth of connectors and interfaces to access peripheral I/O including audio and LCD.

3.1.1 SOM-255G2 Carrier

This is a 6.55" x 4.15" carrier designed as a basis for a 7" or 10" Panel PC.

- 2x 10/100/1000 BaseT Ethernet
- 3x serial RS232 ports and 1x RS232/422/485 port
- Resistive Touchscreen interface
- 800 x 480 (WVGA) or 1024 x 600 (WSVGA) Graphic LCD with Touchscreen
- 4x MIPI-CSI Lanes & MIPI-DSI
- Battery for nonvolatile RAM and Real Time Clock
- Micro SDHC/MMC Flash Card Socket
- 2x USB Host & 1x USB OTG ports
- 1x I2S Audio port with Line-In/Line-Out
- 1x Audio Beeper
- Timer/Counters and Pulse Width Modulation (PWM) ports
- Operating Voltage of 12 to 28 Vdc.

https://shop.emacinc.com/product/som-255g2

3.2 Semi-Custom Carriers

EMAC also offers a semi-custom engineering service. By modifying one of our existing designs, EMAC can offer quick-turn, low-cost engineering, for your specific application.

3.3 Designing Your Own Carrier

It is best to start with the SoM-255G2 Carrier as a reference. When designing a carrier, be sure to use a 200 pin DDR1 SODIMM socket instead of the more common DDR2 socket. The DDR2 socket is keyed in such a way as to prevent the SoM from being inserted into it. The part number for a compatible DDR1 socket made by TE Connectivity is 1473005-1. This socket will provide 3.0 mm of height from the top of carrier PCB to the bottom of the module PCB. The module specification allows for a 1.5 mm maximum height for bottom components. Therefore, this allows the user < 1.5 mm for placing components safely under the module. If more height is needed, TE Connectivity as well as other manufacturers make SODIMM sockets with additional height, although these are more expensive.

3.4 Power

The SoM-RZx2L requires a voltage of 3.3V. For a bare-bones population, users can get away with using only 3.3V, and simply provide this to all the voltage inputs listed in the Power Connections section.

3.4.1 Legacy

ALT_VCC is a legacy connection, required to support the SoM-400EM and may be used in future SoM modules. The SoM-RZx2L does not use this connection, so if general SoM compatibility is not an issue, then this can be tied to 3.3V in a carrier designed for this SoM.

3.4.2 Sleep Logic Pins

The SOM-RZx2L can be put into sleep mode by asserting (active low) processor GPIO pin P42_0. The SOM WKUP pin, SOM pin #54, has a Maximum input voltage of 3.3V.

3.4.3 Analog Reference

No external Analog Reference voltage (AV_REF pin #55) is required for the SoM-RZx2L so this pin is normally a No Connect on the Module. A processor 1.8V reference is provided to the processor on the ADC_AVDD18 pin. The analog input range is therefore 0 to 1.8V.

3.4.4 Analog Considerations

When designing power for the Analog subsystem there are 2 main considerations: range and accuracy.

- **Range**

  The AV_VCC pins normally will affect the range, however, on the SoM-RZx2L this pin is a no-connect since the processor's Analog VCC is directly connected to filtered 1.8V. This voltage reference defines the voltage range of the A/D convertor. See Analog Reference section 3.4.3.

- **Accuracy**

  The accuracy of the A/D converters is determined by the voltage reference that is provided to the analog subsystem. Since the stability of the voltage between this reference and ground will affect the accuracy of the subsystem's measurements, this has been built into the SoM in this design.

4 Software

The SoM-RZx2L offers a wide variety of software support from both open-source and proprietary sources. The hardware core utilizes the Renesas ARM64 Cortex-A55 RZG2L or RZV2l, which are supported by Linux.

For more information on software support, please visit the EMAC Wiki Software Section at:

http://wiki.emacinc.com/wiki/product_wiki

4.1 Das U-Boot

EMAC utilizes Das U-Boot for its ARM-based products. U-Boot is an open-source/cross-architecture platform independent bootloader. It supports reading and writing to the flash, auto-booting, environmental variables, and TFTP. Das U-boot can be used to upload and run and/or reflash the OS or to run stand-alone programs without an OS. Products are shipped with a valid MAC address installed in flash in the protected U-boot environmental variable “ethaddr”. At boot time U-Boot automatically stores this address in a register within the MAC, which effectively provides it to any OS loaded after that point.

4.2 Embedded Linux

EMAC Open Embedded Linux is an open-source Linux distribution for use in embedded systems. The EMAC OE Linux Build is based on the Open Embedded (www.openembedded.org) and Yocto (www.yoctoproject.org) Linux build system. Open Embedded is a superior Linux distribution for embedded systems. Custom Linux builds are also available on request.

The distribution contains everything a user could expect from a standard Linux kernel: powerful networking features, advanced file system support, security, debugging utilities, and countless other features.

The basic root file system includes:

- Busybox
- Hotplugging support
- APM utilities for power management
- Openssh SSH server
- lighttpd HTTP server
- EXT4 file system with utilities

4.2.1 Linux with PREEMPT RT

PREEMPT RT provides pseudo real time to the kernel and can be used to schedule tasks with hard deadlines and minimal latencies. The PREEMPT RT build is an option to the standard Linux build and is available for a one-time inexpensive support/installation fee.

4.2.2 Linux Packages

EMAC provides support for many Linux Packages such as: PHP, SQLite, Perl, SNMP, DHCP Server, etc. As with the Xenomai Package, other Packages can be added to the standard Linux file system and are available for a one-time inexpensive support/installation fee.

4.2.3 Linux Patches

EMAC provides support for many Linux Packages such as: PHP, SQLite, Perl, SNMP, DHCP Server, etc. As with the PREEMPT RT Option, other Packages can be added to the standard Linux file system and are available for a one-time inexpensive support/installation fee.

4.3 Qt Creator

Qt Creator is a cross-platform IDE (Integrated Development Environment) tailored to the needs of Qt developers but works well for Headless applications as well. EMAC provides sample code as projects that can be imported into Qt Creator. Qt Creator supports remote deployment and source debugging.

http://wiki.qt.io/Main

4.4 ARM EABI Cross Compiler

The popular open source gcc compiler has a stable build for the ARM family. EMAC uses the 4.9.1 version of the ARM EABI compiler. The Embedded Linux kernel and EMAC Qt Creator projects use this compiler for building ARM stand alone, and OS specific binaries. The EMAC Qt Creator provides source level debugging over Ethernet or serial using gdbserver. The Linux binaries for the ARM EABI cross compiler are available online along with the SDK. See the EMAC wiki for further information.