User's Manual

RA8M2 Group

Evaluation Kit for RA8M2 Microcontroller Group
EK-RA8M2 v1
User's Manual

Renesas RA Family
RA8 Series

Renesas Electronics
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1. Precaution against Electrostatic Discharge (ESD)

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

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

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

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

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

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

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

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

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Precautions

This Evaluation Kit is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area, or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:

• Ensure attached cables do not lie across the equipment.

• Reorient the receiving antenna.

• Increase the distance between the equipment and the receiver.

• Connect the equipment into an outlet on a circuit different from that which the receiver is connected.

• Power down the equipment when not in use.

• Consult the dealer or an experienced radio/TV technician for help.

Note: It is recommended that wherever possible shielded interface cables are used.

The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken:

• The user is advised that mobile phones should not be used within 10 m of the product when in use.

• The user is advised to take ESD precautions when handling the equipment.

The Evaluation Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

Renesas RA Family

EK-RA8M2 v1

Contents

Figures

Tables

1. Kit Overview

The EK-RA8M2, an Evaluation Kit for RA8M2 MCU Group, enables users to seamlessly evaluate the features of the RA8M2 MCU group and develop embedded systems applications using Flexible Software Package (FSP) and e^2 studio IDE. The users can use rich on-board features along with their choice of popular ecosystems add-ons to bring their big ideas to life.

The key features of the EK-RA8M2 board are categorized in three groups as follows:

MCU Native Pin Access

- R7KA8M2JFLCAC MCU (referred to as RA MCU)
- 1 GHz, Arm® Cortex®-M85 core
- 250 MHz, Arm® Cortex®-M33 core
- 1 MB MRAM, 2 MB SRAM with ECC
- 289 pins, BGA package
- Native pin access through 5 x 20-pin, and 3 x 40-pin headers (not populated)
- MCU current measurement points for precision current consumption measurement
- Multiple clock sources – RA MCU oscillator and sub-clock oscillator crystals, providing precision 24.000 MHz and 32,768 Hz reference clocks. Additional low-precision clocks are available internal to the RA MCU
- RTC Backup battery connector J36 (not populated)

System Control and Ecosystem Access

- USB Full Speed Host and Device (USB-C connector)
- Four 5 V input sources
  - USB (Debug, Full Speed, High Speed)
  - External power supply (using surface mount clamp test points and power input vias)
- Three Debug modes
  - Debug on-board (SWD and JTAG)
  - Debug in (ETM, SWD, SWO, and JTAG)
  - Debug out (SWD, SWO, and JTAG)
- User LEDs, Status LEDs and Switches
  - Three User LEDs (red, blue, green)
  - Power LED (white) indicating availability of regulated power
  - Debug LED (yellow) indicating the debug connection
  - Two User Switches
  - One Reset Switch
- Five most popular ecosystems expansions
  - Two Seeed Grove® system (I^{2}C/I3C/Analog) connectors (not populated)
  - SparkFun® Qwiic® connector (not populated)
  - Two Digilent Pmod™ (SPI, UART, and I^{2}C) connectors
  - Arduino™ (UNO R3) connector
  - MikroElektronika™ mikroBUS connector (not populated)
- MCU boot configuration jumper

Special Feature Access

- Ethernet (RJ45 RGMII interface)
- USB High Speed Host and Device (USB-C connector)
- 64 MB (512 Mb) External Octo-SPI Flash (present in the MCU Native Pin Access area of the EK-RA8M2 board)
- RS485 / MODBUS (3.5mm pitch 4-pin terminal block)
- CAN FD (3-pin header)
- Configuration Switches

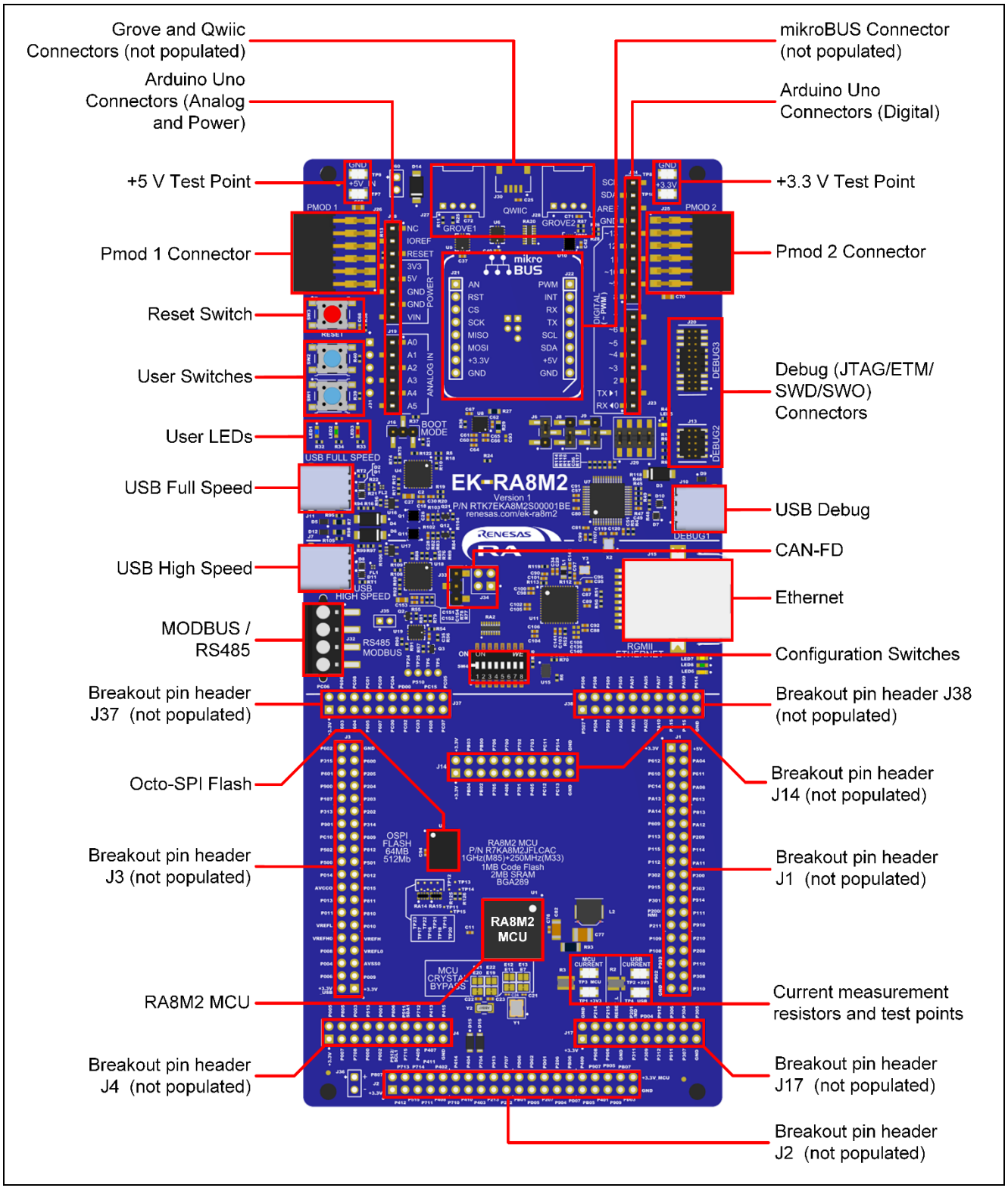

Figure 1. EK-RA8M2 Board Top Side

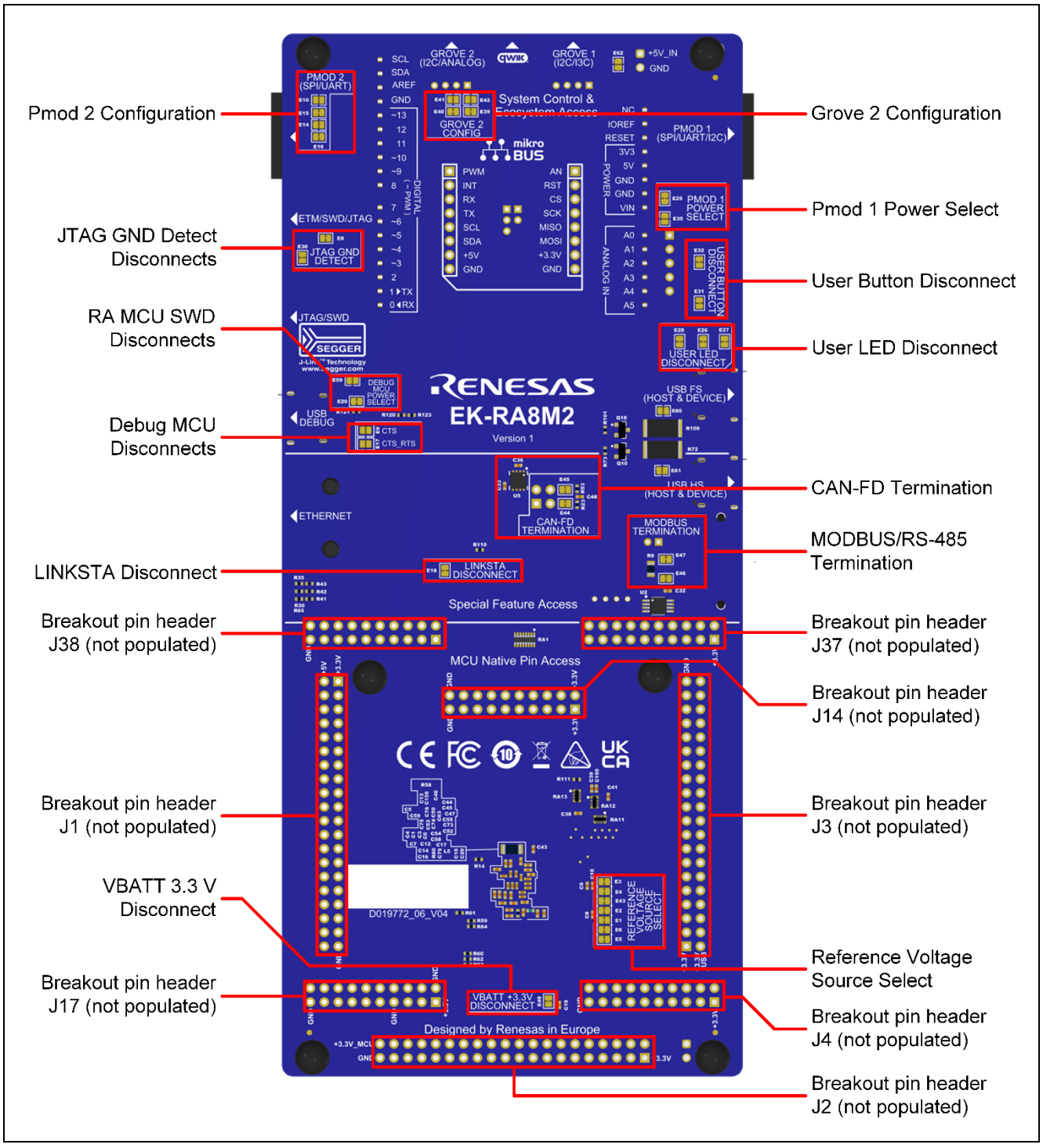

Figure 2. EK-RA8M2 Board Bottom Side

1.1 Assumptions and Advisory Notes

1. It is assumed that the user has a basic understanding of microcontrollers and embedded systems hardware.
2. It is recommended that the user refers to the *EK-RA8M2 Quick Start Guide* to get acquainted with the kit and the Quick Start example project that EK-RA8M2 board comes pre-programmed with.
3. Flexible Software Package (FSP) and Integrated Development Environment (IDE) such as e^2 studio are required to develop embedded applications on EK-RA8M2 kit.
4. Instructions to download and install software, import example projects, build them and program the EK-RA8M2 board are provided in the quick start guide.
5. The MCU fitted to the EK board may not contain the latest version of the on-chip boot firmware.

2. Kit Contents

The following component is included in the kit:

- EK-RA8M2 v1 board

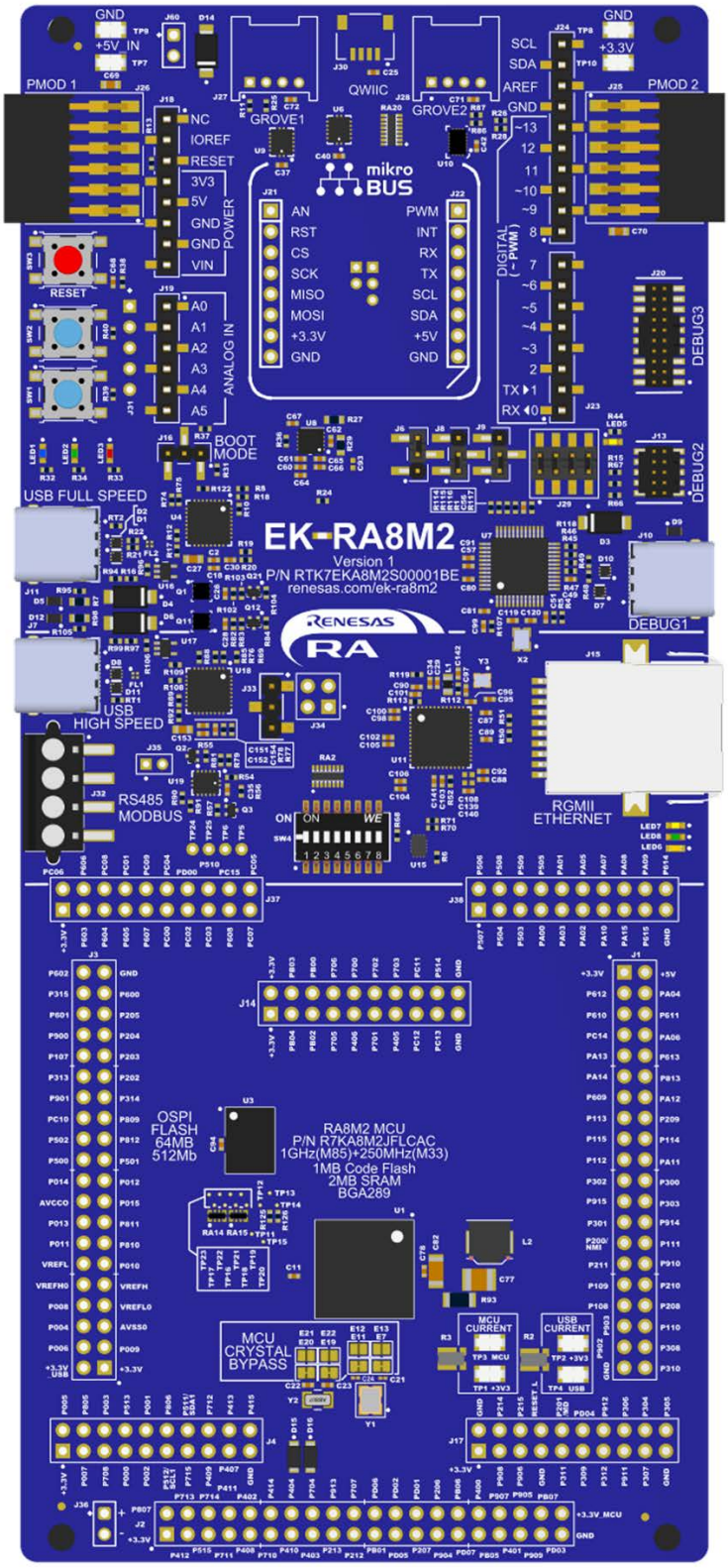

Figure 3. EK-RA8M2 Kit Contents

3. Ordering Information

- EK-RA8M2 v1 kit orderable part number: RTK7EKA8M2S00001BE

  Note: The underlined character in the orderable part number represents the kit version.

- EK-RA8M2 board dimensions: 84 mm (width) x 190 mm (length)

4. Hardware Architecture and Default Configuration

4.1 Kit Architecture

The EK-RA8M2 board is designed with three sections or areas to help shorten the learning curve of the users and maximize the design and knowledge reuse among similar kits. The contents of these three areas are conceptually standardized among similar kits.

Table 1. Kit Architecture

Kit area	Area features	Area present on all similar kits	Functionality is:
MCU Native Pin Access Area	RA MCU, Breakout Pin Headers for all MCU I/O power, Current Measurement, and Octo-SPI Flash	Yes	MCU dependent
Special Feature Access Area	Configuration Switches MCU Special Features: Gigabit Ethernet, USB High Speed, CAN FD, and MODBUS / RS-485	No	MCU dependent
System Control and Ecosystem Access Area	Power, Debug MCU, User LED and Switches, Reset, Ecosystem Connectors, USB Full Speed, and Boot Configuration	Yes	Same or similar across similar kits

Note: The Octo-SPI Flash is among the Special Feature Access Area features. Normally, it would be in Special Feature Access Area, however, to optimize the layout, routing, and performance, it is placed in the MCU Native Pin Access area.

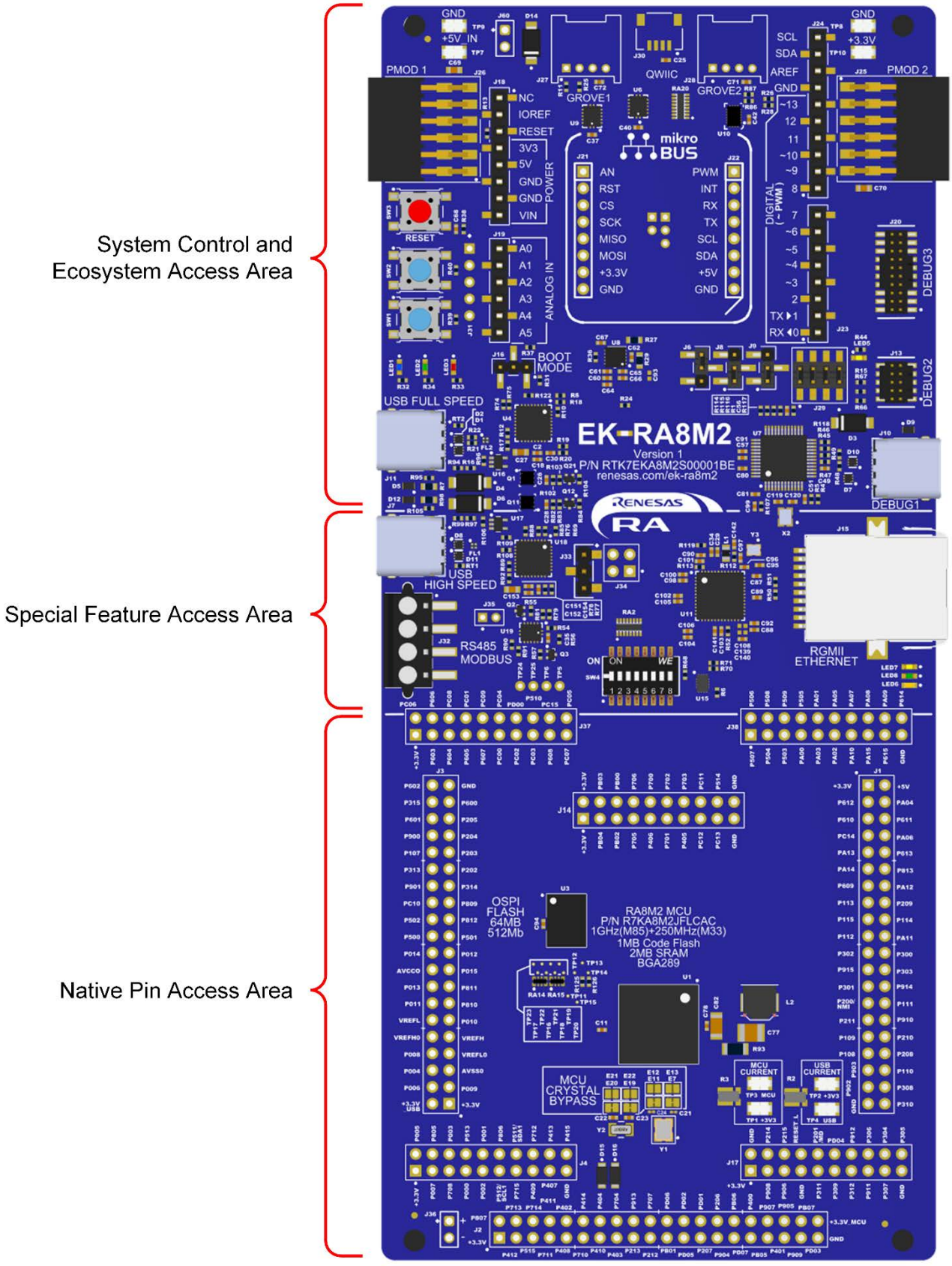

Figure 4. EK-RA8M2 Board Functional Area Definitions

4.2 System Block Diagram

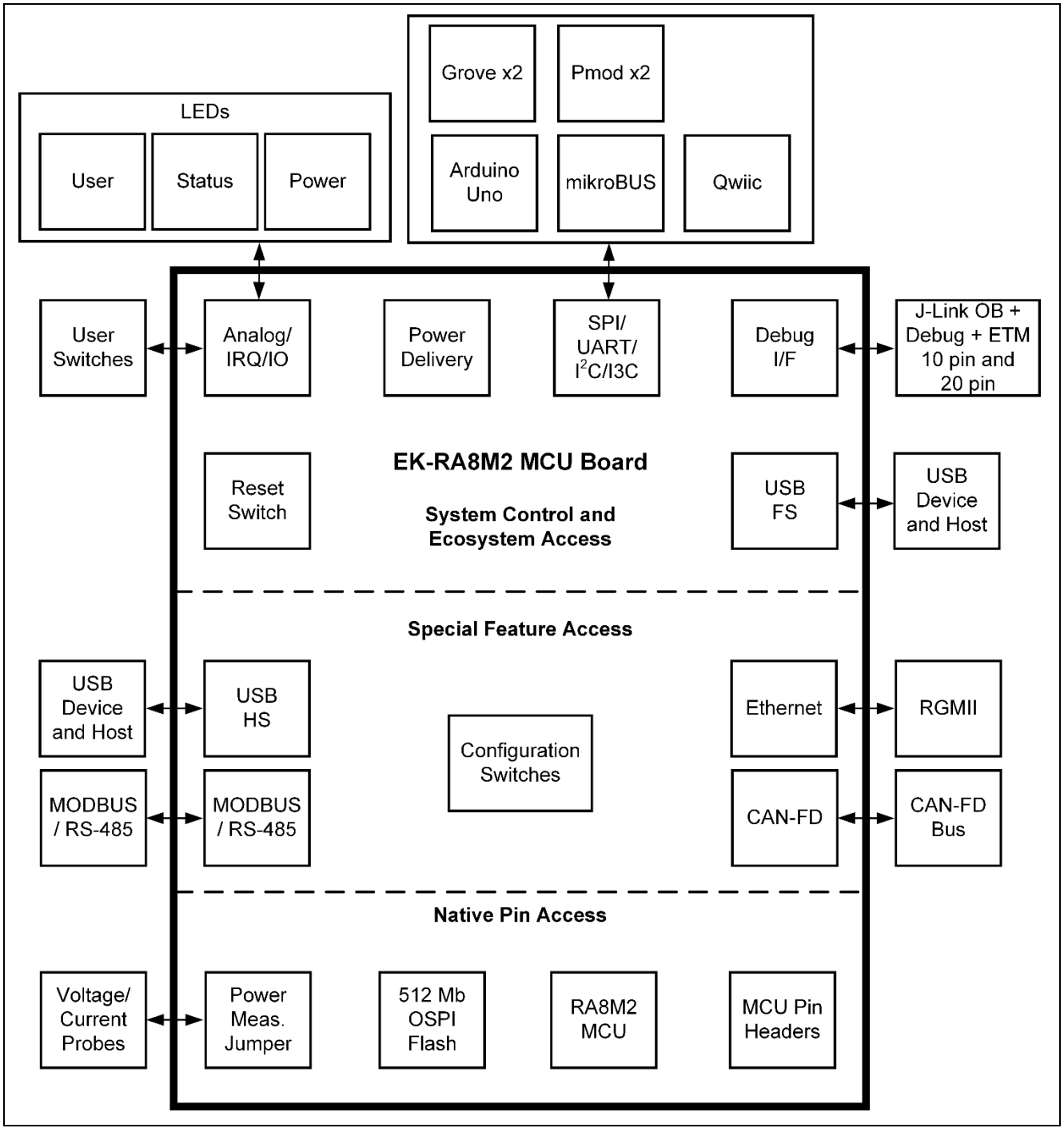

Figure 5. EK-RA8M2 Board Block Diagram

4.3 Jumper Configuration

Two types of jumpers are provided on the EK-RA8M2 board.

1. Copper jumpers (trace-cut type and solder bridge type)
2. Traditional pin header jumpers

The following sections describe each type and their default configuration.

4.3.1 Copper Jumpers

Copper jumpers are of two types, designated **trace-cut** and **solder-bridge**.

A **trace-cut jumper** is provided with a narrow copper trace connecting its pads. The silk screen overlay printing around a trace-cut jumper is a solid box. To isolate the pads, cut the trace between pads adjacent to each pad, then remove the connecting copper foil either mechanically or with the assistance of heat. Once the etched copper trace is removed, the trace-cut jumper is turned into a solder-bridge jumper for any later changes.

A **solder-bridge** jumper is provided with two isolated pads that may be joined together by one of three methods:

- Solder may be applied to both pads to develop a bulge on each and the bulges joined by touching a soldering iron across the two pads.
- A small wire may be placed across the two pads and soldered in place.
- A SMT resistor, size 0805, 0603, or 0402, may be placed across the two pads and soldered in place. A zero-ohm resistor shorts the pads together.

For any copper jumper, the connection is considered **closed** if there is an electrical connection between the pads (default for trace-cut jumpers.) The connection is considered **open** if there is no electrical connection between the pads (default for the solder-bridge jumpers.)

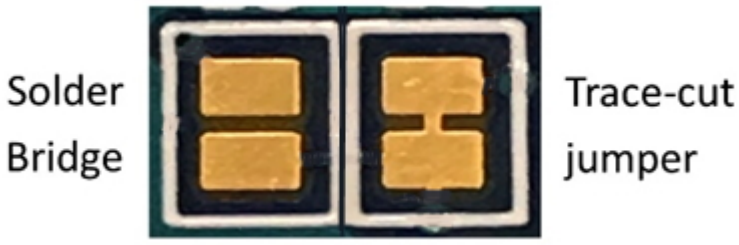

Figure 6. Copper Jumpers

4.3.2 Traditional Pin Header Jumpers

These jumpers are traditional small pitch jumpers that require an external shunt to open/close them. The traditional pin jumpers on the EK-RA8M2 board are 2 mm pitch headers and require compatible 2 mm shunt jumpers.

4.3.3 Default Jumper Configuration

The following table describes the default configuration for each jumper on the EK-RA8M2 board. This includes copper jumpers (Ex designation) and traditional pin jumpers (Jx designation).

The Circuit Group for each jumper is the designation found in the board schematic (available in the Design Package). Functional details for many of the listed jumpers may be found in sections associated with each functional area of the kits.

Table 2. Default Jumper Configuration

Location	Circuit Group	Default Open/Closed	Function
J6	J-Link OB	Jumper on pins 2-3	Configures J-Link OB connection to MCU mode
J8	J-Link OB	Jumper on pins 1-2	Configures the MCU for normal operation
J9	J-Link OB	Jumper on pins 2-3	Configures JLOB_RESET_L for on-board debugger mode
J29	J-Link OB	Jumper on pins 1-2 Jumper on pins 3-4 Jumper on pins 5-6 Jumper on pins 7-8	Connects the J-Link OB debugger to the RA MCU
J16	MCU Boot Mode	Jumper on pins 2-3	Configures the MCU for Single-Chip mode
E1	MCU Power	Closed	Connects VREFL to GND
E2	MCU Power	Closed	Connects VREFH to +3.3 V
E3	MCU Power	Closed	Connects AVCC0 to +3.3 V
E4	MCU Power	Closed	Connects AVSS0 to GND
E5	MCU Power	Closed	Connects VREFL0 to GND
E6	MCU Power	Closed	Connects VREFH0 to +3.3 V
E43	MCU Power	Closed	Connects VREFH to ARDUINO_AREF
E49	MCU Power	Closed	Connects VBATT to +3.3 V
E7	MCU Clock	Closed	Connects P212/EXTAL to 24 MHz crystal
E11	MCU Clock	Closed	Connects P213/XTAL to 24 MHz crystal
E12	MCU Clock	Open	Connects P213/XTAL to J2 pin 17
E13	MCU Clock	Open	Connects P212/EXTALto J2 pin 19
E19	MCU Clock	Closed	Connects P215/XCIN to 32 KHz crystal
E20	MCU Clock	Closed	Connects P214/XCOUT to 32 KHz crystal
E21	MCU Clock	Open	Connects P214/XCOUT to J17 pin 4
E22	MCU Clock	Open	Connects P215/XCIN to J17 pin 6
E8	Debug	Closed	Connects debugger P104 to P306 (JTAG_TDATA1) and 20-pin JTAG connector
E9	Debug	Open	Connects PD05 (CTS) to Debug MCU port P408
E17	Debug	Open	Connects PD04 (RTS) to Debug MCU port P409
E30	JTAG	Closed	Connects the JTAG GND Detect pin on J20 and J13 to GND
E29	Debug MCU Power	Closed	Connects the Debug MCU power to +3.3 V
E26	User LED	Closed	Connects P303 to User LED2
E27	User LED	Closed	Connects P600 to User LED1
E28	User LED	Closed	Connects PA07 to User LED3
E31	User Button	Closed	Connects P009 to User Button SW1
E32	User Button	Closed	Connects P008 to User Button SW2
E18	Ethernet	Closed	Connects P402 to ENET_LED2
E25	Pmod 1	Closed	Connects +3.3 V to Pmod 1 pins 6 and 12
E35	Pmod 1	Open	Connects +5.0 V to Pmod 1 pins 6 and 12
E10	Pmod 2	Open	Connects P605 (CTS0) to Pmod 2 pin 1
E14	Pmod 2	Open	Connects P604 (RTS0) to Pmod 2 pin 4

Location	Circuit Group	Default Open/Closed	Function
E15	Pmod 2	Closed	Connects P604 (SS0) to Pmod 2 pin 1
E16	Pmod 2	Closed	Connects P601 (SCK0) to Pmod 2 pin 4
E39	Grove 2	Closed	Connects P512 (SCL1) to Grove 2
E40	Grove 2	Closed	Connects P511 (SDA1) to Grove 2
E41	Grove 2	Open	Connects P005 (AN005) to Grove 2
E42	Grove 2	Open	Connects P002 (AN002) to Grove 2
E44	CAN FD	Closed	Connect CANL to terminating network
E45	CAN FD	Closed	Connect CANH to terminating network
E46	MODBUS/RS-485	Closed	Connect A/Y to termination resistor
E47	MODBUS/RS-485	Closed	Connect B/Z to termination resistor
E59	USB Debug	Open	Eliminates diode D3 voltage drop
E60	USBFS VBUS	Open	Eliminates diode D4 voltage drop
E61	USBHS VBUS	Open	Eliminates diode D6 voltage drop
E62	+5 V External	Open	Eliminates diode D14 voltage drop

4.3.4 Default Switch Configuration

The EK-RA8M2 features an I²C I/O Port Expander (PI4IOE5V6408) at U15 and has the I²C address 0x43 on I²C channel 1. The port expander is connected to the configuration switches SW4.

The following table describes the function and default configuration for each switch that selects the operational peripheral pins on the EK-RA8M2 board.

The Circuit Group for each switch is the designation found in the board schematic (available in the Design Package). Functional details for many of the listed switches may be found in sections associated with each functional area of the kits.

Table 3. Default Switch Configuration (SW4)

Switch	Switch Definition	Position (Default shown in Bold)	Function	Conflict
SW4-1	Pmod 1 Mode Select 1	**OFF**	Please see Table 17	-
		ON		
SW4-2	Pmod 1 Mode Select 2	**OFF**		
		ON		
SW4-3	User Test Point	**OFF**	Connected TP5 to +3.3V	-
		ON	Connected to TP5 to GND	-
SW4-4	User Test Point	**OFF**	Connected to TP6 to +3.3V	-
		ON	Connected to TP6 to GND	-
SW4-5	User Test Point	**OFF**	Connected to TP25 to +3.3V	-
		ON	Connected to TP25 to GND	-
SW4-6	User Test Point	**OFF**	Connected to TP24 to +3.3V	-
		ON	Connected to TP24 to GND	-
SW4-7	USBFS Role Toggle	**OFF**	Toggles USBFS between Host and Device mode	-
		ON		-
SW4-8	USBHS Role Toggle	**OFF**	Toggles USBHS between Host and Device mode	-
		ON		-

Note: There are no conflicting settings for SW4.

5. System Control and Ecosystem Access Area

The following figure shows the System Control and Ecosystem Access area on the EK-RA8M2 board. Subsequent sections detail the features and functionality provided in the area.

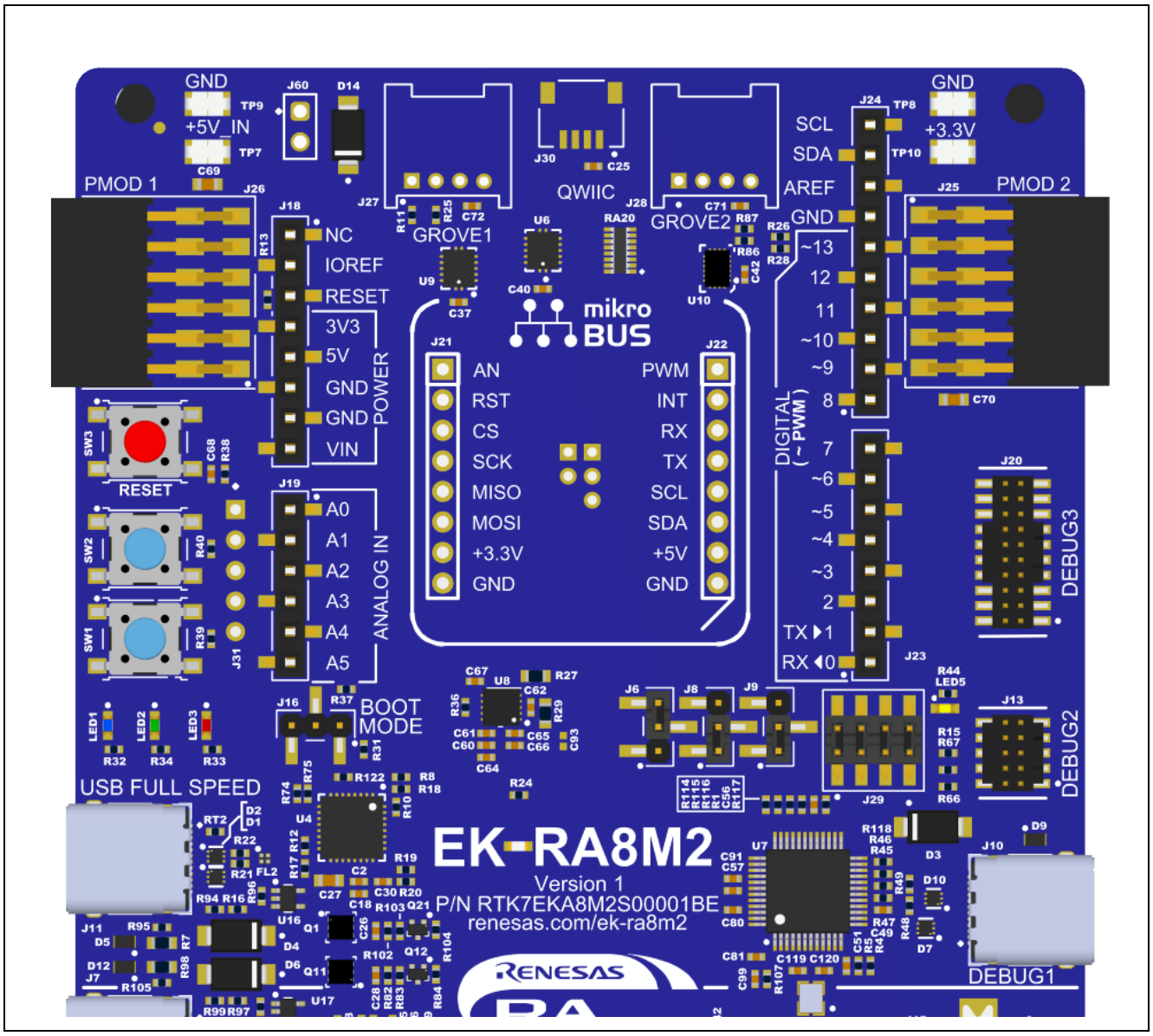

Figure 7. System Control and Ecosystem Access Area

5.1 Power

The EK-RA8M2 kit is designed for +5 V operation. An on-board Low Dropout Regulator (ISL80103IRAJZ) is used to convert the 5 V supply to a 3.3 V supply. The 3.3 V supply is used to power the RA MCU and other peripheral features.

5.1.1 Power Supply Options

This section describes the different ways in which EK-RA8M2 kit can be powered.

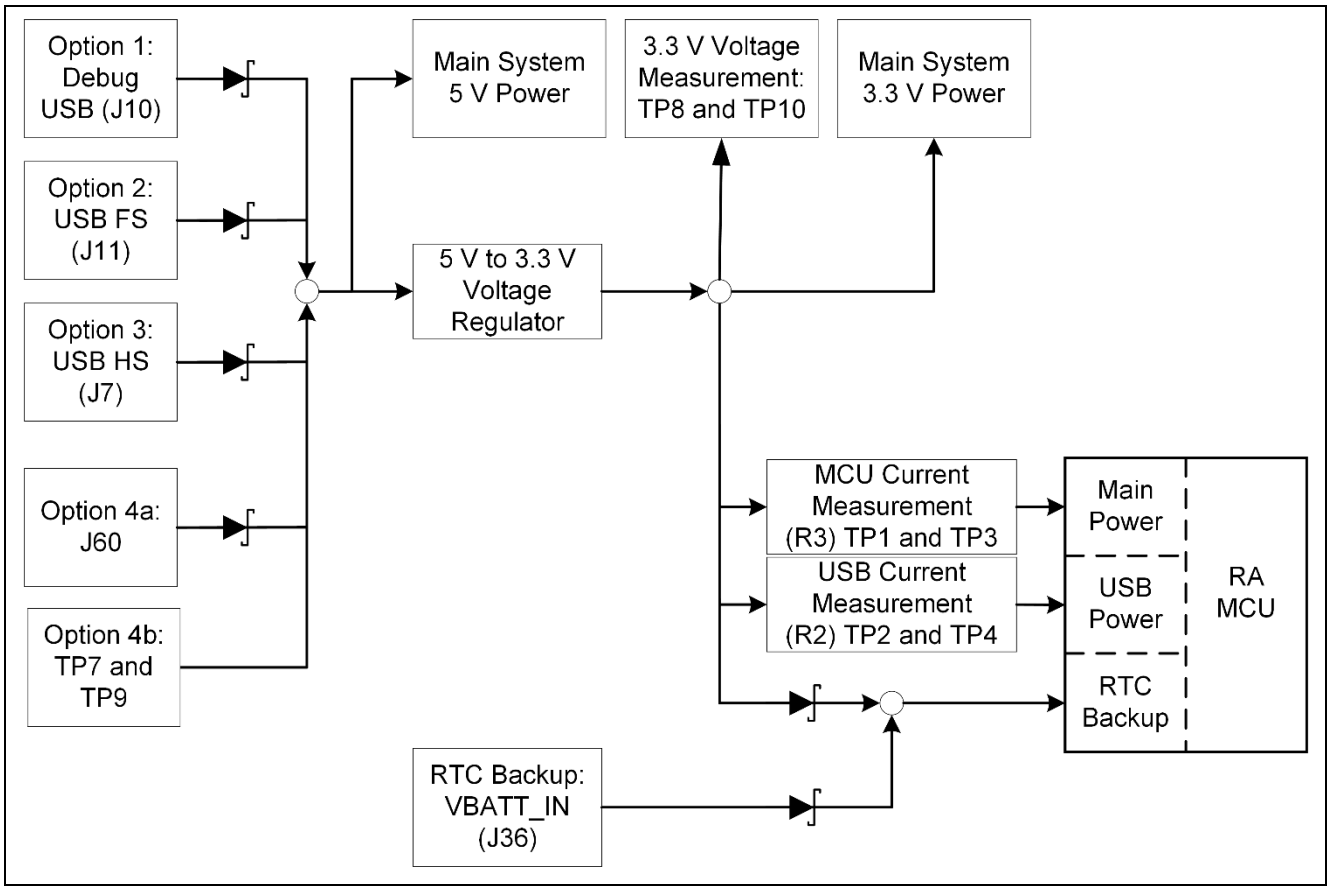

Figure 8. Power Supply Options

5.1.1.1 Option 1: Debug USB

5 V may be supplied from an external USB host to the USB Debug connector (J10) labelled DEBUG1 on the board. Power from this source is connected to the Main System 5 V Power. Reverse current protection is provided between this connector and the Main System 5 V Power by D3.

5.1.1.2 Option 2: USB Full Speed

5 V may be supplied from an external USB host to the USB Full Speed connector (J11) labelled USB FULL SPEED on the board. Power from this source is connected to the Main System 5 V Power. Reverse current protection is provided between this connector and the Main System 5 V Power by D4.

5.1.1.3 Option 3: USB High Speed

5 V may be supplied from an external USB host to the USB High Speed connector (J7) labelled USB HIGH SPEED on the board. Power from this source is connected to the Main System 5 V Power. Reverse current protection is provided between this connector and the Main System 5 V Power by D6.

5.1.1.4 Option 4: 5 V Test Points

5 V may be supplied from an external power supply to test points on the board. TP7 (5 V) and TP9 (GND) are loop-style test points, and J60 provides large via style test points that can accommodate a 0.1” pin header or connector. Reverse current protection is provided at J60-1 by D14 whereas TP7 directly connects to the 5V input pin of the voltage regulator U8 and to the Main System 5V Power. Care must be taken before

applying an external supply to this test point to ensure that that the polarity is correct. Failure to do so could result in damage to components on the PCB.

These test points can be found at the top left of the board above Pmod 1.

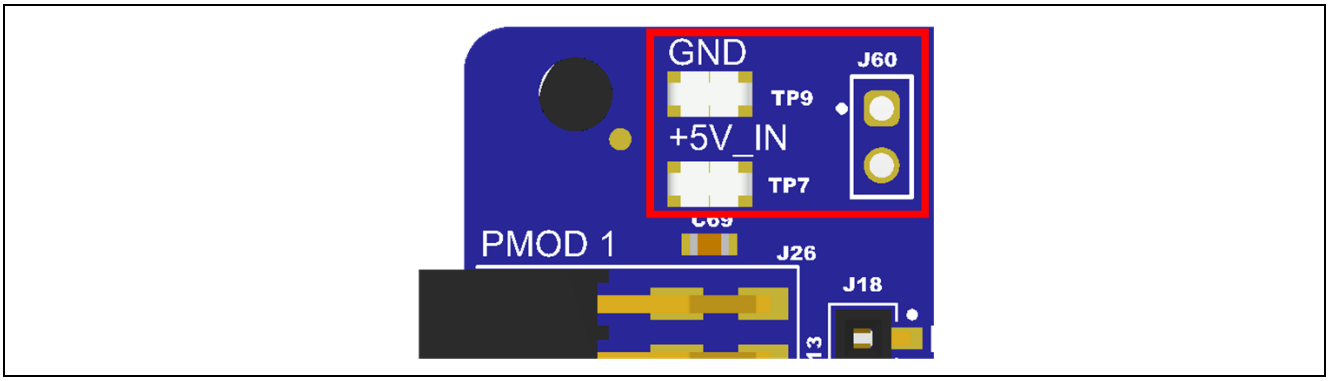

Figure 9. Test Point Location

5.1.1.5 RTC Backup: VBATT Supply

The MCU provides a battery backup function that maintains power to certain MCU peripherals in the event of a power loss (for example the Real Time Clock). A battery (lithium coin cell etc.) can be connected to J36 (not fitted) to provide this power. Reverse current protection is provided at J36-1 by D15 For further details see the MCU hardware manual and Schematic.

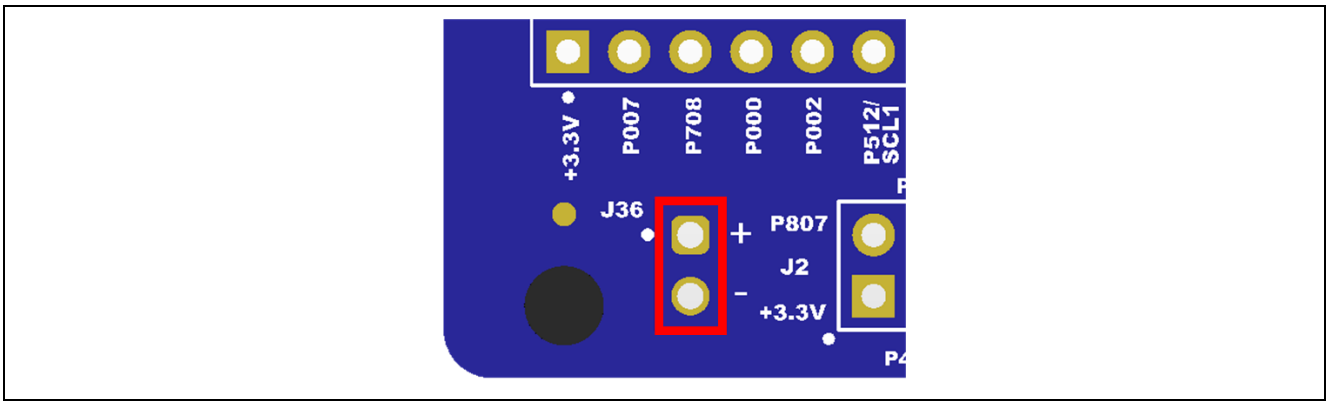

Figure 10. VBATT supply (J36) Location

5.1.2 Power Supply Considerations

The on-board LDO regulator which supplies +3.3 V has a built-in current limit of 3.0 A. Make sure the total current required by the RA MCU, any active on-board features, and any connected peripheral devices does not exceed this limit.

Note: The total current available depends on the configuration of the host USB port, for example an enumerated USB-A port may have a maximum output current capability of 500 mA. In these cases, multiple power sources may be required.

5.1.3 Power-up Behavior

When powered, the white LED near the center of the board (the “dash” in the EK-RA8M2 name) will light up. For more details on initial power up behavior, see the *EK-RA8M2 Quick Start Guide*.

5.2 Debug and Trace

The EK-RA8M2 board supports the following three debug modes.

Table 4. Debug Modes

Debug Modes	Debugger MCU (the device that connects to the IDE on PC)	Target MCU (the device that is being debugged)	Debugging Interface/Protocol	Connector Used
Debug on-board	RA4M2 (on-board)	RA8M2 (on-board)	SWD, JTAG	USB-C (J10)
Debug in	External debugging tools	RA8M2 (on-board)	SWD, SWO, ETM, JTAG	20-pin connector (J20) or 10-pin connector (J13)
Debug out	RA4M2 (on-board)	Any external RA MCU	SWD, SWO, JTAG	USB-C (J10) plus either 20-pin connector (J20) or 10-pin connector (J13)

Notes:

- See Table 6 for the Debug USB connector pin definition.
- See Table 9 for the 20-pin JTAG connector pin definition.
- See Table 10 for the 10-pin JTAG connector pin definition.

The following table summarizes the jumper configuration for each of the debug modes.

Table 5. Jumper Connection Summary for Different Debug Modes

Debug Modes	J6	J8	J9	J29
Debug on-board	Jumper on pins 2-3	Jumper on pins 1-2	Jumper on pins 2-3	Jumpers on pins 1-2, 3-4, 5-6, 7-8
Debug in	Jumper on pins 2-3	Jumper on pins 1-2	Jumper on pins 1-2	Jumpers on pins 1-2, 3-4, 5-6, 7-8
Debug out	Jumper on pins 2-3	Jumper on pins 2-3	Jumper on pins 2-3	All pins open

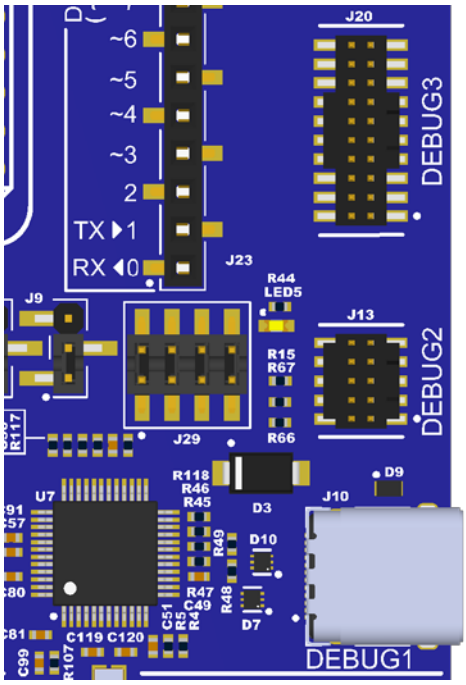

Figure 11. EK-RA8M2 Debug Interface

5.2.1 Debug On-Board

The on-board debug functionality is provided using Renesas RA4M2 Debug MCU and SEGGER J-Link® firmware. Debug USB-C connector (J10) connects the RA4M2 Debug MCU to an external USB Full Speed Host, allowing reprogramming and debugging of the target RA MCU firmware. This connection is the default debug mode for the EK-RA8M2 board.

The RA4M2 Debug MCU connects to the target RA MCU using the SWD interface.

Table 6. Debug USB Port Assignments

Debug USB Connector		**EK-RA8M2**
Pin	**Description**	**Signal/Bus**
J10-A1	GND	GND
J10-A2	TX1+	N.C.
J10-A3	TX1-	N.C.
J10-A4	VBUS	+5V_USB_DBG
J10-A5	CC1	USB_JLOB_CC1
J10-A6	DA+	USB_JLOB_P
J10-A7	DA-	USB_JLOB_N
J10-A8	SBU1	N.C.
J10-A9	VBUS	+5V_USB_DBG
J10-A10	RX2-	N.C.
J10-A11	RX2+	N.C.
J10-A12	GND	GND
J10-B1	GND	GND
J10-B2	TX2+	N.C.
J10-B3	TX2-	N.C.
J10-B4	VBUS	+5V_USB_DBG
J10-B5	CC2	USB_JLOB_CC2
J10-B6	DB+	USB_JLOB_P
J10-B7	DB-	USB_JLOB_N
J10-B8	SBU2	N.C.
J10-B9	VBUS	+5V_USB_DBG
J10-B10	RX1-	N.C.
J10-B11	RX1+	N.C.
J10-B12	GND	GND
J10-S1	SHIELD	GND
J10-S2	SHIELD	GND
J10-S3	SHIELD	GND
J10-S4	SHIELD	GND

A yellow indicator, LED5, shows the visual status of the debug interface. When the EK-RA8M2 board is powered on, and LED5 is blinking, it indicates that the RA4M2 Debug MCU is not connected to a programming host. When LED5 is solid on, it indicates that the RA4M2 Debug MCU is connected to a programming interface.

To configure the EK-RA8M2 board to use the Debug On-Board mode, configure the jumpers using the following table.

Table 7. Debug On-Board Jumper Configuration

Location	Default Open/Closed	Function
J6	Jumper on pins 2-3	Configures J-Link OB connection to MCU mode
J8	Jumper on pins 1-2	Target RA MCU RESET_L connected to debug RESET_L
J9	Jumper on pins 2-3	RA4M2 Debug MCU in normal operation mode
J29	Jumpers on pins 1-2, 3-4, 5-6, 7-8	Target RA MCU debug signals connected to the Debug Interface

5.2.2 Debug In

One 20-pin Cortex® Debug Connector at J20 supports JTAG, SWD, SWO, and ETM (TRACE) debug. One 10-pin Cortex® Debug Connector at J13 supports JTAG, SWO, and SWD. Either of these connectors may be used for external debug of the target RA MCU.

To configure the EK-RA8M2 board to use the Debug In mode, configure the jumpers using the following table.

Table 8. Debug In Mode Jumper Configuration

Location	Default Open/Closed	Function
J6	Jumper on pins 2-3	Configures J-Link OB connection to MCU mode
J8	Jumper on pins 1-2	Target RA MCU RESET_L connected to debug RESET_L
J9	Jumper on pins 1-2	RA4M2 Debug MCU is held in RESET
J29	Jumpers on pins 1-2, 3-4, 5-6, 7-8	Target RA MCU debug signals connected to the Debug Interface

Table 9. JTAG/SWD/SWO/ETM Port Assignments

JTAG 20-pin Connector				EK-RA8M2
Pin	**JTAG Pin Name**	**SWD Pin Name**	**ETM Pin Name**	**Signal/Bus**
J20-1	Vtref	Vtref	Vtref	+3V3
J20-2	TMS	SWDIO	TMS / SWDIO	P210/SWDIO/TMS
J20-3	GND	GND	GND	GND
J20-4	TCK	SWCLK	TCK / SWCLK	P211/SWCLK/TCK
J20-5	GND	GND	GND	GND
J20-6	TDO	SWO	TDO / SWO	P209/SWO/TDO
J20-7	Key	Key	Key	N.C.
J20-8	TDI	N/A	TDI / N/A	P208/TDI
J20-9	GNDDetect	GNDDetect	GNDDetect	GND*1
J20-10	nSRST	nSRST	nSRST	RESET_L
J20-11	GND	GND	GND	GND
J20-12	N/A	N/A	TCLK	P308/TCLK
J20-13	GND	GND	GND	GND
J20-14	N/A	N/A	TDATA0	P307/TDATA0
J20-15	GND	GND	GND	GND
J20-16	N/A	N/A	TDATA1	P306/TDATA1*2
J20-17	GND	GND	GND	GND
J20-18	N/A	N/A	TDATA2	P305/TDATA2
J20-19	GND	GND	GND	GND
J20-20	N/A	N/A	TDATA3	P304/TDATA3

*1 Option to isolate from GND with E30
*2 Option to isolate from Debugger with E8

Table 10. JTAG/SWD/SWO Port Assignments

JTAG 10-pin Connector			EK-RA8M2
Pin	**JTAG Pin Name**	**SWD Pin Name**	**Signal/Bus**
J13-1	Vtref	Vtref	+3V3
J13-2	TMS	SWDIO	P210/SWDIO/TMS
J13-3	GND	GND	GND
J13-4	TCK	SWCLK	P211/SWCLK/TCK
J13-5	GND	GND	GND
J13-6	TDO	SWO	P209/SWO/TDO
J13-7	Key	Key	N.C.
J13-8	TDI	N/A	P208/TDI
J13-9	GNDDetect	GNDDetect	GND (cut E30 to open)
J13-10	nSRST	nSRST	RESET_L

Note: The Cortex® Debug Connector is fully described in the Arm® CoreSight™ Architecture Specification.

5.2.3 Debug Out

The EK-RA8M2 board can be configured to use the RA4M2 Debug MCU to debug target RA MCU on an external board.

A yellow indicator, LED5, shows the visual status of the debug interface. When the EK-RA8M2 board is powered on, and LED5 is blinking, this indicates that the RA4M2 Debug MCU is not connected to a programming host. When LED5 is solid on, this indicates that the RA4M2 Debug MCU is connected to a programming interface. When the debug interface is actively in use, the LED will flicker randomly.

To configure the EK-RA8M2 board to use the Debug Out mode, configure the jumpers according to the following table.

Table 11. Debug Out Jumper Configuration

Location	Default Open/Closed	Function
J6	Jumper on pins 2-3	Configures J-Link OB connection to MCU mode
J8	Jumper on pins 2-3	On-board RA MCU is held in RESET
J9	Jumper on pins 2-3	RA4M2 Debug MCU in normal operation mode
J29	All jumpers removed	Disconnects the on-board RA MCU debug signals from the Debug Interface

5.2.4 Debug Serial

The debug port can act as a virtual COM port that supports serial communication.

Table 12. Debug Serial Port Assignments

Debug Serial Port Assignments	EK-RA8M2 Port
U7-P301 (RXD2)	PD02
U7-P302 (TXD2)	PD03
U7-P409 (CTS)	PD05 *1
U7-P408 (RTS)	PD04 *1

*1 Jumpers E9 and E17 are open by default.

5.3 Ecosystem

The System Control and Ecosystem area provides users the option to simultaneously connect several third-party add-on modules compatible with five most popular ecosystems using the following connectors:

1. Two Seeed Grove® system (I²C/I3C/Analog) connectors (not populated)
2. SparkFun® Qwiic® connector (not populated)
3. Two Digilent Pmod™ (SPI, UART, and I²C) connectors
4. Arduino™ (Uno R3) connector
5. MikroElektronika™ mikroBUS connector (not populated)

5.3.1 Seeed Grove® Connectors

5.3.1.1 Grove 1

A Seeed Grove® I3C connector (not populated) is provided at J27 (not populated). The RA MCU acts as a two-wire serial master, and a connected module acts as a two-wire serial slave.

Table 13. Grove 1 Port Assignments

Grove 1 Connector		EK-RA8M2
Pin	**Description**	**Signal/Bus**
J27-1	I3C_SCL	P400 (SCL0) *1
J27-2	I3C_SDA	P401 (SDA0) *1
J27-3	VCC	+3.3 V
J27-4	GND	GND

*1 Pullup resistors need to be enabled in software to use I²C (see section 5.4.2).

5.3.1.2 Grove 2

A Seeed Grove® I²C connector (not populated) is provided at J28 (not populated). The RA MCU acts as a two-wire serial master, and a connected module acts as a two-wire serial slave.

Option links E39, E40, E41, and E42 provide the capability to convert this connector to an analog Seeed Grove® implementation.

Table 14. Grove 2 Port Assignments

Grove 2 Connector		EK-RA8M2	
Pin	**Description**	**Signal/Bus**	
J28-1	SCL	P512 (SCL1) *1	P002 (AN002) *2
J28-2	SDA	P511 (SDA1) *1	P005 (AN005) *2
J28-3	VCC	+3.3 V	
J28-4	GND	GND	

*1 Jumpers E39 and E40 are closed, E41 and E42 are open
*2 Jumpers E39 and E40 are open, E41 and E42 are closed

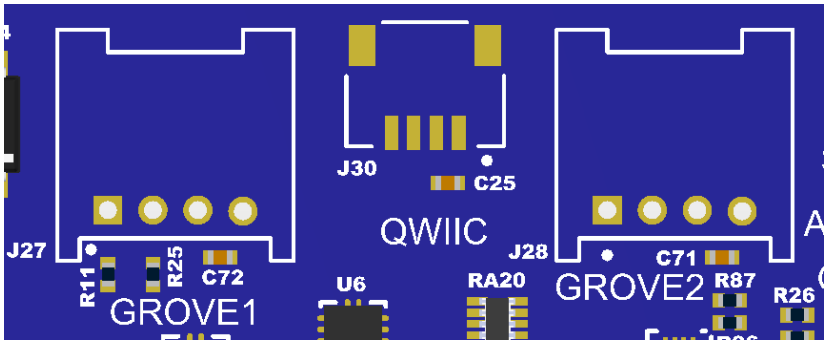

Figure 12. Seeed Grove® and SparkFun® Qwiic® Connectors (not populated)

5.3.2 SparkFun® Qwiic® Connector

A SparkFun® Qwiic® connector (not populated) is provided at J30 (not populated). The Main MCU acts as a two-wire serial master, and a connected module acts as a two-wire serial slave (data lines shared with Grove 1).

Table 15. Qwiic® Port Assignments

Qwiic® Connector		EK-RA8M2
Pin	**Description**	**Signal/Bus**
J30-1	GND	GND
J30-2	VCC	+3.3 V
J30-3	SDA	P401 (SDA0) *1
J30-4	SCL	P400 (SCL0) *1

*1 Pullup resistors need to be enabled in software to use I²C (see section 5.4.2).

5.3.3 Digilent Pmod™ Connectors

Two 12-pin connectors are provided to support Pmod modules where the RA MCU acts as the master, and the connected module acts as a slave device.

These interfaces may be configured in firmware to support several Pmod types such as Type-2A (expanded SPI), Type-3A (expanded UART), and Pmod Type-6A (I²C).

The default 12-pin Pmod interface supports +3.3 V devices. Please ensure that any Pmod device installed is compatible with a +3.3 V supply.

Note that both Pmods use the SCI peripheral in “Simple SPI” mode and so do not offer the full functionality of the SPI peripheral. Please see the hardware manual for full details of the SCI “Simple SPI” mode.

5.3.3.1 Pmod 1

A 12-pin Pmod connector is provided at J26, Pmod 1.

This Pmod connector is controlled by switch options (SW4-1) and (SW4-2).

Table 16. Pmod 1 Port Assignments

Pmod 1 Connector				EK-RA8M2	Pmod 1 Configuration	
Pin	**Option Type-2A (SPI)*1**	**Option Type-3A (UART)*1**	**Option Type-6A (I²C)*1**	**Signal/Bus**	**Short**	**Open**
J26-1	SS			PA05 (SSL)		
		CTS		PA06 (CTS2)		
J26-2	MOSI	TXD		PA03 (MOSI2/TXD2)		
J26-3	MISO	RXD		PA02 (MISO2/RXD2)		
			SCL	P512 (SCL1)		
J26-4	SCK			PA04 (SCK2)		
		RTS		PA05 (RTS2)		
			SDA	P511 (SDA1)		
J26-5	GND			GND		
J26-6	VCC			+3.3 V	E25	E35
				+5.0 V	E35	E25
J26-7	IRQ			P006 (IRQ11-DS)		
J26-8	RESET (master to slave)			P403		
J26-9	GPIO			P412		
J26-10	GPIO			P413		
J26-11	GND			GND		
J26-12	VCC			+3.3 V	E25	E35
				+5.0 V	E35	E25

*1 Option is selected by setting switches SW4-1 and SW4-2 as follows:

Table 17. Pmod 1 Function Selection

SW4-1	SW4-2	Selected function	Conflict
Off	Off	SPI (Default)	-
On	Off	UART	-
Off	On	I^2C	-
On	On	Invalid	Invalid

Caution: 5 V optional supply is provided (J26-6 and J26-12), however the interface must only be driven with 3.3 V signals from the Pmod 1. The EK-RA8M2 will only provide 3.3 V signal levels to Pmod 1.

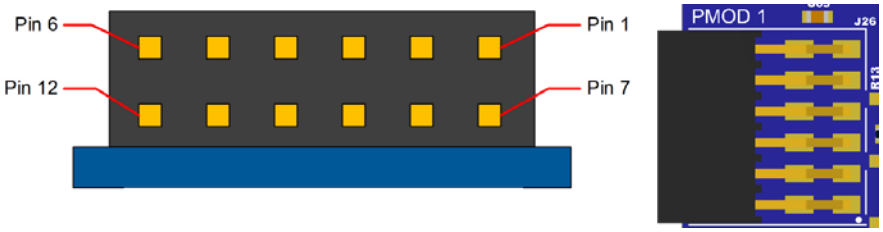

Figure 13. Pmod 1 Connector

5.3.3.2 Pmod 2

A 12-pin Pmod connector is provided at J25, Pmod 2.

Table 18. Pmod 2 Port Assignments

Pmod 2 Connector			EK-RA8M2	Pmod 2 Configuration	
Pin	Option Type-2A (SPI)	Option Type-3A (UART)	Signal/Bus	Short	Open
J25-1	SS		P604 (SS0)	E15	E10
J25-1		CTS	P605 (CTS0)	E10	E15
J25-2	MOSI	TXD	P603 (MOSI0/TXD0)		
J25-3	MISO	RXD	P602 (MISO0/RXD0)		
J25-4	SCK		P601 (SCK0)	E16	E14
J25-4		RTS	P604 (RTS0)	E14	E16
J25-5	GND		GND		
J25-6	VCC		+3.3 V		
J25-7	IRQ		P012 (IRQ15)		
J25-8	RESET (master to slave)		P410		
J25-9	GPIO		P409		
J25-10	GPIO		P704		
J25-11	GND		GND		
J25-12	VCC		+3.3 V		

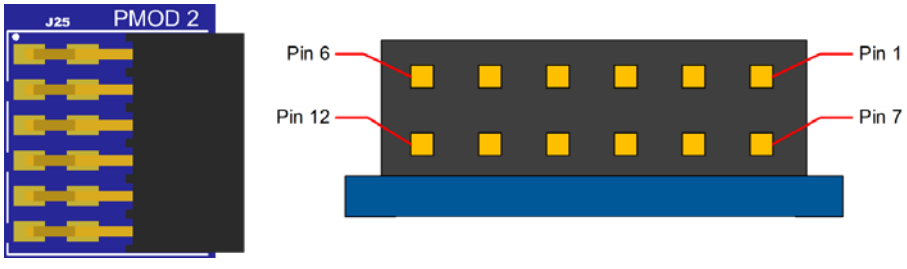

Figure 14. Pmod 2 Connector

5.3.4 Arduino™ Connector

Near the center of the System Control and Ecosystem Access area is an Arduino™ Uno R3 compatible connector interface.

Table 19. Arduino Uno Port Assignments

Arduino Compatible Connectors				**EK-RA8M2**
Pin	**Description**			**Signal/Bus**
J18-1	N.C.			N.C.
J18-2	IOREF			+3.3 V
J18-3	RESET			P710
J18-4	3.3 V			+3.3 V
J18-5	5 V			+5 V
J18-6	GND			GND
J18-7	GND			GND
J18-8	VIN			N.C.
J19-1	A0			P001 (AN001)
J19-2	A1			P007 (AN007)
J19-3	A2			P003 (AN003)
J19-4	A3			P004 (AN004)
J19-5	A4			P014 (AN014/DA0)
J19-6	A5			P015 (AN015/DA1)
J23-1	D0	RXD		PC04 (RXD7)
J23-2	D1	TXD		PC03 (TXD7)
J23-3	D2	INT0		P011 (IRQ16)
J23-4	D3	INT1	PWM	P811 (IRQ22/GTIOC10B)
J23-5	D4			P810 (IRQ21/GTIOC10A)
J23-6	D5		PWM	P510 (IRQ3/GTIOC1B)
J23-7	D6		PWM	P509 (IRQ2/GTIOC1A)
J23-8	D7			P312 (IRQ22-DS)
J24-1	D8			PD01 (IRQ22)
J24-2	D9		PWM	P110 (IRQ20/GTIOC9B)
J24-3	D10	SPI_SS	PWM	P414 (SSLB0/GTIOC0B)
J24-4	D11	SPI_MOSI		P708 (MOSIB)
J24-5	D12	SPI_MISO		P709 (MISOB)
J24-6	D13	SPI_SCK		P415 (RSPCKB/SCK9/GTIOC0A)
J24-7	GND			GND
J24-8	ARDUINO_AREF			+3.3 V
J24-9	I3C_SDA			P401 (SDA0) [*1]
J24-10	I3C_SCL			P400 (SCL0) [*1]

[*1] Pullup resistors need to be enabled in software to use I^2C (see section 5.4.2).

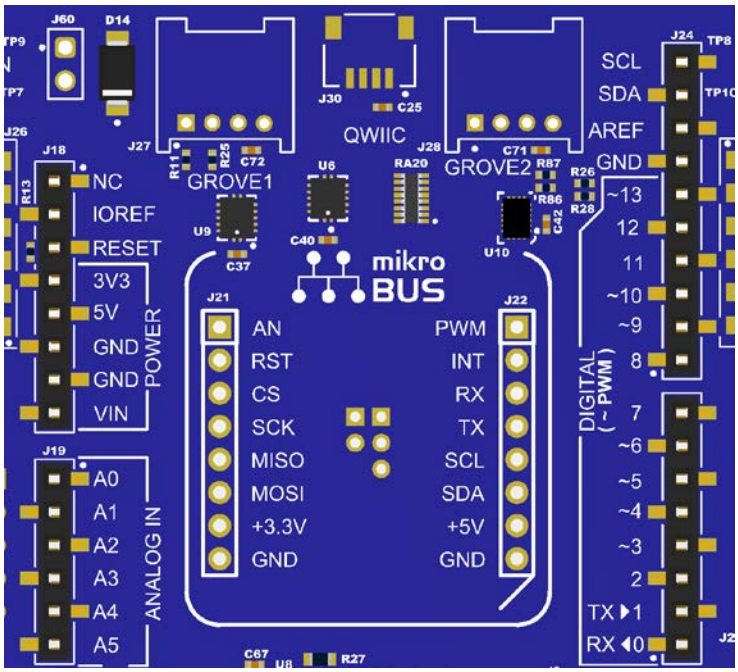

Figure 15. Arduino Uno Connectors

5.3.5 MikroElektronika™ mikroBUS Connector

In the center of the System Control and Ecosystem Access area is a mikroBUS compatible connector interface (not populated). This interface is compliant with mikroBUS Standard Specifications revision 2.00.

Table 20. mikroBUS Assignments

mikroBUS Connectors		**EK-RA8M2**
Pin	**Description**	**Signal/Bus**
J21-1	AN (Analog)	P004 (AN004)
J21-2	RST (Reset)	P111 (MIKROBUS RESET_L)
J21-3	CS (SPI Chip Select)	P414 (SSLB0)
J21-4	SCK (SPI Clock)	P415 (RSPCKB)
J21-5	MISO	P709 (MISOB)
J21-6	MOSI	P708 (MOSIB)
J21-7	+3.3 V	+3.3 V
J21-8	GND	GND
J22-1	PWM	P810 (GTIOC10A)
J22-2	INT (Hardware Interrupt)	P010 (IRQ14)
J22-3	RX (UART Receive)	PC04 (RXD7)
J22-4	TX (UART Transmit)	PC03 (TXD7)
J22-5	SCL (I3C Clock)	P400 (SCL1) [*1]
J22-6	SDA (I3C Data)	P401 (SDA1) [*1]
J22-7	+5 V	+5 V
J22-8	GND	GND

[*1] Pullup resistors need to be enabled in software to use I^2C (see section 5.4.2).

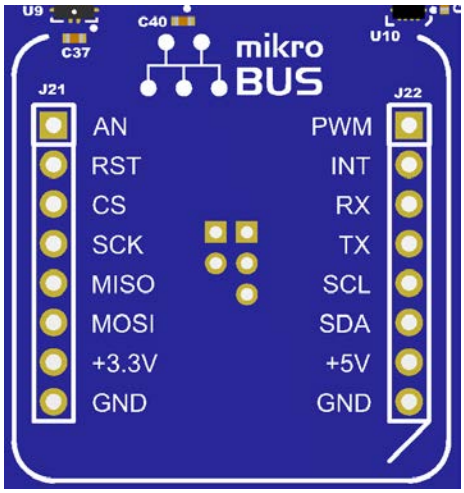

Figure 16. mikroBUS Connector

5.4 Connectivity

5.4.1 USB Full Speed

The USB-C connector (J11) connects the RA MCU USB Full Speed interface to an external USB interface, allowing communications for testing and use of the RA MCU firmware. This connection can be configured as either a USB device or a USB host interface.

For a USB Device configuration, set P500 to low and configure the RA MCU firmware to use the USB Full Speed ports in device mode. Power from an external USB Host on this connection can be used to provide power to the EK-RA8M2 board.

For a USB Host configuration, set P500 to high and configure the RA MCU firmware to use the USB Full Speed ports in host mode. In this configuration, power to J11 is supplied from U4. The total current available from U4 is 2 A. Note that the input power sources must be configured with enough power for both the EK-RA8M2 board and the USB Full Speed port in host mode. Connect a USB type-A female to USB-C male cable to J11. USB device cables or devices can be connected to the USB Full Speed port using this cable.

Table 21. USB Full Speed Port Assignments

USB Full Speed Connector		**EK-RA8M2**
Pin	**Description**	**Signal/Bus**
J11-A1	GND	GND
J11-A2	TX1+	N.C.
J11-A3	TX1-	N.C.
J11-A4	VBUS	USBFS_cVBUS_CON
J11-A5	CC1	USB_FS_CC1
J11-A6	DA+	USBFS_P
J11-A7	DA-	USBFS_N
J11-A8	SBU1	N.C.
J11-A9	VBUS	USBFS_cVBUS_CON
J11-A10	RX2-	N.C.
J11-A11	RX2+	N.C.
J11-A12	GND	GND
J11-B1	GND	GND
J11-B2	TX2+	N.C.
J11-B3	TX2-	N.C.
J11-B4	VBUS	USBFS_cVBUS_CON
J11-B5	CC2	USB_FS_CC2
J11-B6	DB+	USBFS_P
J11-B7	DB-	USBFS_N
J11-B8	SBU2	N.C.
J11-B9	VBUS	USBFS_cVBUS_CON

USB Full Speed Connector		EK-RA8M2
Pin	**Description**	**Signal/Bus**
J11-B10	RX1-	N.C.
J11-B11	RX1+	N.C.
J11-B12	GND	GND
J11-S1	SHIELD	GND
J11-S2	SHIELD	GND
J11-S3	SHIELD	GND
J11-S4	SHIELD	GND

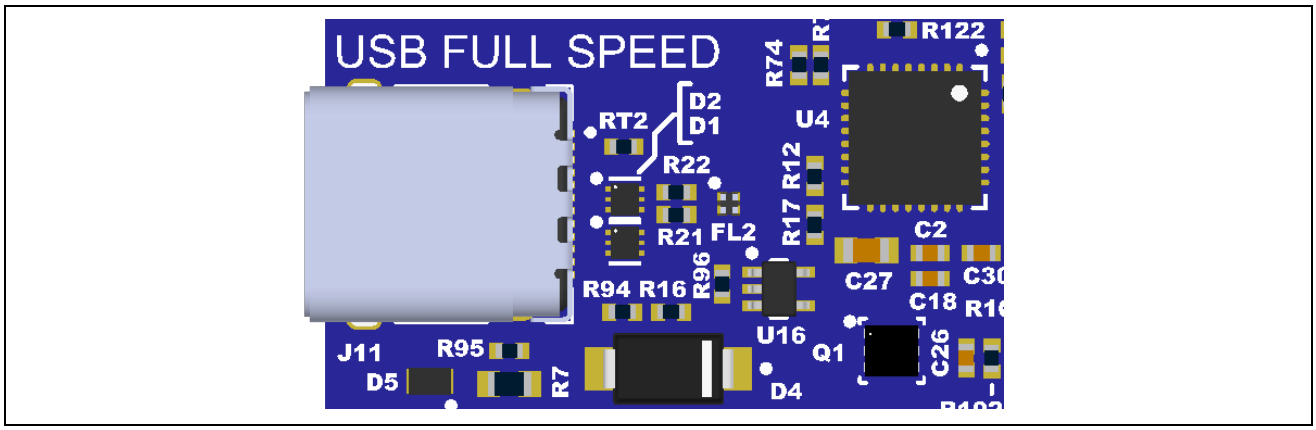

Figure 17. USB Full Speed Connector

5.4.2 I3C

The I3C port connects the Arduino, mikroBUS, Grove 1, and Qwiic connectors to the RA MCU I3C interface via P400 and P401. When P013 and P109 are set high, the RA MCU I3C peripheral can be used in I^2C mode.

All configurations are shown in Table 22.

Table 22. I^2C/I3C Pullup Configuration

I3C	I^2C	P013 & P109	Usable connectors
P400 (SCL0) & P401 (SDA0)	N/A	Inputs (high impedance) or outputs (driven high) *1	Arduino, mikroBUS, Grove 1, and Qwiic
N/A	P400 (SCL0) & P401 (SDA0)	Push-pull outputs driven high	

*1Please refer to the I3C specification for management and control of the I3C pull-ups

5.5 Miscellaneous

5.5.1 User and Status LEDs

Eight LEDs are provided on the EK-RA8M2 board.

Behavior of the LEDs on the EK-RA8M2 board is described in the following table.

Table 23. EK-RA8M2 Board LED Functions

Designator	Color	Function	MCU Control Port
LED1	Blue	User LED	P600
LED2	Green	User LED	P303
LED3	Red	User LED	PA07
LED4	White	Power on indicator	+3.3 V
LED5	Yellow	Debug LED	J-Link OB MCU
LED6	Orange	Ethernet LED	P402 / ENET_LED2
LED7	Yellow	Ethernet LED	ENET_LED0
LED8	Green	Ethernet LED	ENET_LED1

The user LEDs may be isolated from the main MCU, so the associated ports can be used for other purposes. To separate LED1 from P600, trace cut jumper E27 must be open. To separate LED2 from P303, trace cut jumper E26 must be open. To separate LED3 from PA07, trace cut jumper E28 must be open.

To separate the LINKSTA signal (P402) from Ethernet LED6, trace cut jumper E18 must be open.

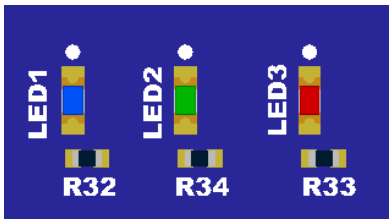

Figure 18. User LEDs

Figure 19. Power LED

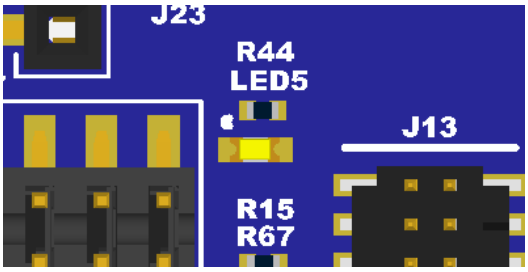

Figure 20. Debug LED

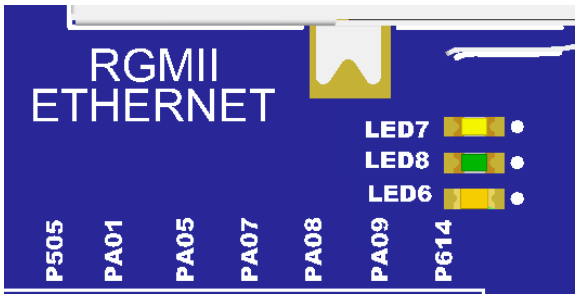

Figure 21. Ethernet LEDs

5.5.2 User and Reset Buttons

Three miniature, momentary, mechanical push-Switch type SMT switches are mounted on the EK-RA8M2 board. Pressing the reset switch (SW3) generates a reset signal to restart the RA MCU.

Table 24. EK-RA8M2 Board Switches

Designator	Function	MCU Control Port	Switch Color
SW3	MCU Reset Switch	RESET_L	Red
SW2	User Switch	P008 (IRQ12-DS)	Blue
SW1	User Switch	P009 (IRQ13-DS)	Blue

The user Switches SW1 and SW2 may be isolated from the main MCU, so the associated ports can be used for other purposes. To separate SW1 from P009, trace cut jumper E31 must be open. To separate SW2 from P008, trace cut jumper E32 must be open.

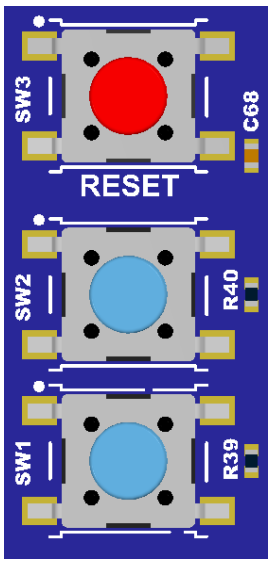

Figure 22. Reset and User Switches

5.5.3 MCU Boot Mode

A three-pin header (J16) is provided to select the boot mode (P201) of the RA MCU. For normal operation, or Single-Chip mode, connect J16 pins 2-3. To enter SCI Boot mode or USB boot mode, place a jumper on J16 pins 1-2.

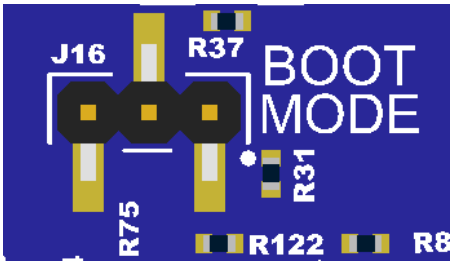

Figure 23. Boot Mode

6. Special Feature Access Area

The Special Feature Access area provides features specific to the RA8M2 MCU group such as Ethernet MAC controller and USB High Speed (Host and Device). The switches to control the peripheral interface selection are also provided.

Note: Normally the Octo-SPI device would be in this area, however, to optimize the layout for this high-speed device, this component has been placed in the MCU Native Pin Access area.

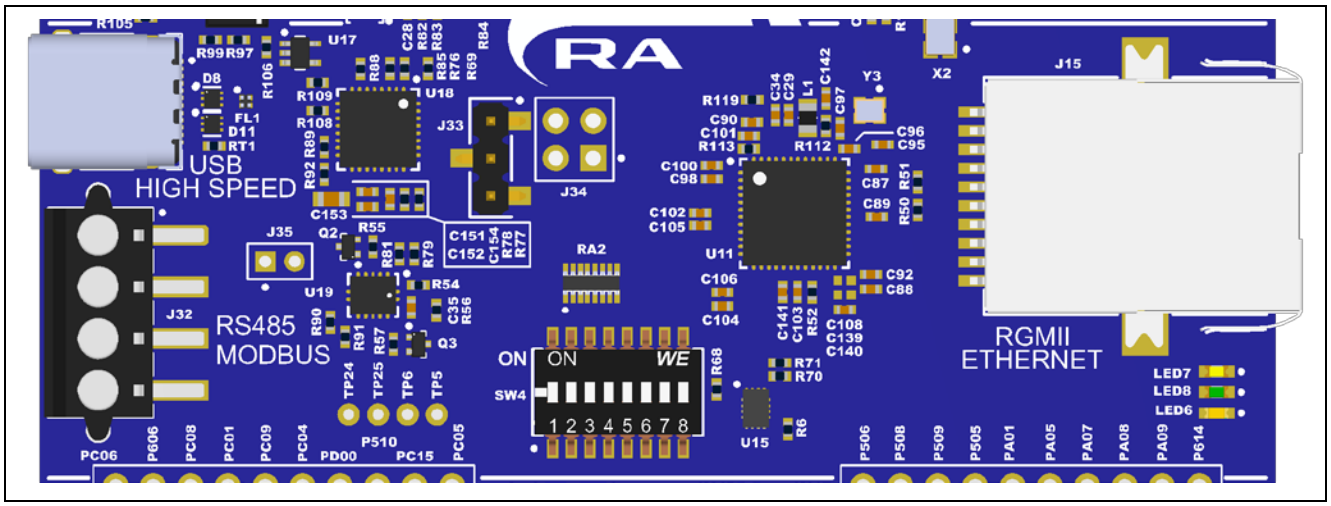

Figure 24. Special Feature Access Area

6.1 Ethernet

The Ethernet interface uses an RGMII Ethernet Physical Layer Transceiver (PHY) (U11), connected to an RJ45 standard Ethernet connector (J15) with integrated magnetics. The Ethernet clock is sourced from a precision 25 MHz clock oscillator (Y3) connected directly to the Ethernet PHY.

Table 25. Ethernet Port Assignments

Ethernet Signal Description	EK-RA8M2
	Signal/Bus
MDINT	PC13
MDC	PC11
MDIO	PC12
TXD0	PB00
TXD1	PB02
TXD2	PB03
TXD3	PB04
TX_CTL	P705
TX_CLK	P706
RXD0	P702
RXD1	P701
RXD2	P700
RXD3	P406
RX_CTL	P405
RX_CLK	P703
RSTN	P514

Table 26. Ethernet Components

Component	Manufacturer	Manufacturer Part Number
Ethernet PHY	Maxlinear	PEF7071VV16SLLHU
RJ45 Connector	Wurth Elektronik	7498111001A
25 MHz Oscillator	ECS Inc International	ECS-250-10-37B-CTN-TR

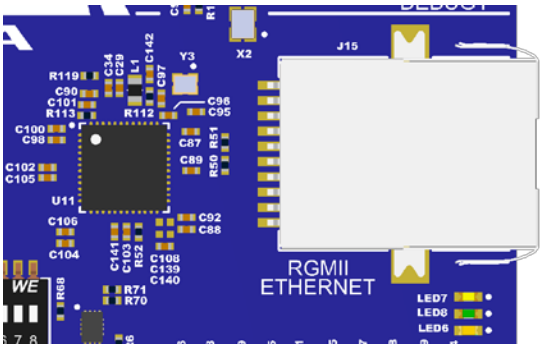

Figure 25. Ethernet Connector

6.2 USB High Speed

The USB-C connection jack (J7) connects the RA MCU USB High Speed interface to an external USB interface, allowing communications for testing and use of the RA MCU firmware. This connection can be configured as either a USB Device or a USB Host interface.

For a USB Device configuration, set PD07 to low and configure the RA MCU firmware to use the USB High Speed ports in device mode. Power from an external USB Host on this connection can be used to provide power to the EK-RA8M2 board.

For a USB Host configuration, set PD07 to high and configure the RA MCU firmware to use the USB High Speed ports in host mode. In this configuration, power to J7 is supplied from U18. The total current available from U18 is 500 mA. Note that the input power sources must be configured with enough power for both the EK-RA8M2 board and the USB Full Speed port in host mode. Connect a USB Type-A female to USB-C male cable to J7. USB device cables or devices can be connected to the USB High Speed port using this cable.

Table 27. USB High Speed Port Assignments

USB High Speed Connector		**EK-RA8M2**
Pin	**Description**	**Signal/Bus**
J7-A1	GND	GND
J7-A2	TX1+	N.C.
J7-A3	TX1-	N.C.
J7-A4	VBUS	USBHS_cVBUS_CON
J7-A5	CC1	USB_HS_CC1
J7-A6	DA+	USBHS_P
J7-A7	DA-	USBHS_N
J7-A8	SBU1	N.C.
J7-A9	VBUS	USBHS_cVBUS_CON
J7-A10	RX2-	N.C.
J7-A11	RX2+	N.C.
J7-A12	GND	GND
J7-B1	GND	GND
J7-B2	TX2+	N.C.
J7-B3	TX2-	N.C.
J7-B4	VBUS	USBHS_cVBUS_CON
J7-B5	CC2	USB_HS_CC2
J7-B6	DB+	USBHS_P
J7-B7	DB-	USBHS_N
J7-B8	SBU2	N.C.
J7-B9	VBUS	USBHS_cVBUS_CON
J7-B10	RX1-	N.C.
J7-B11	RX1+	N.C.
J7-B12	GND	GND
J7-S1	SHIELD	GND
J7-S2	SHIELD	GND

USB High Speed Connector		EK-RA8M2
Pin	**Description**	**Signal/Bus**
J7-S3	SHIELD	GND
J7-S4	SHIELD	GND

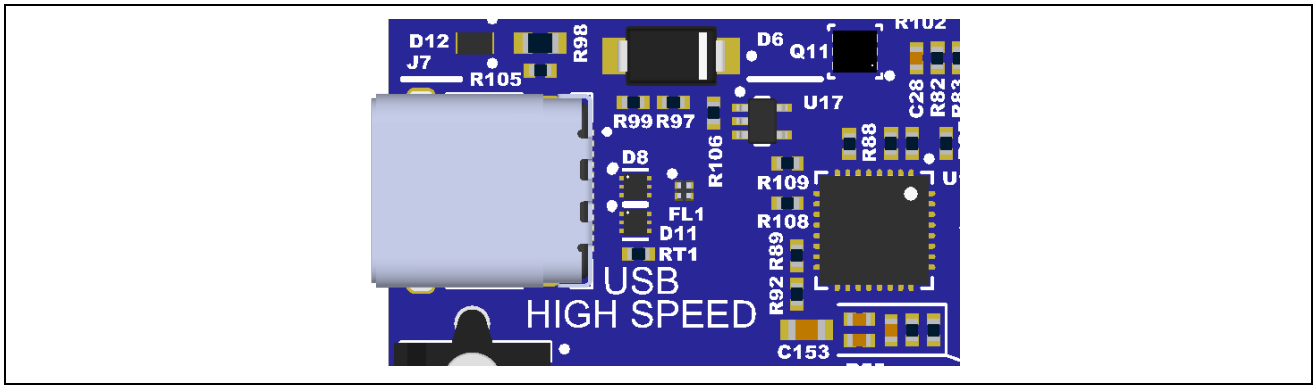

Figure 26. USB High Speed Connector

6.3 CAN FD Bus

The EK-RA8M2 board provides a CAN FD bus transceiver (MCP2562FD-E/MF) (U5) that is connected directly to the RA MCU. External connection to the CAN FD bus is made using the 0.1” pitch 3-pin male header J33.

Resistors R23 and R53 comprise the 60.4 Ohm termination resistors needed on a CAN network. To remove these resistors, remove links E44 and E45. To reconnect these resistors, link 1-2 and 3-4 on connector J34 (not populated).

Table 28. CAN FD Bus Connections Between U5 and RA8M2

CAN FD Signal Description	EK-RA8M2 Port
RXD	P908
TXD	P909
STBY	P907

Table 29. CAN FD Port Assignments

CAN FD Connector (J33)	Function
1	CANH
2	CANL
3	GND

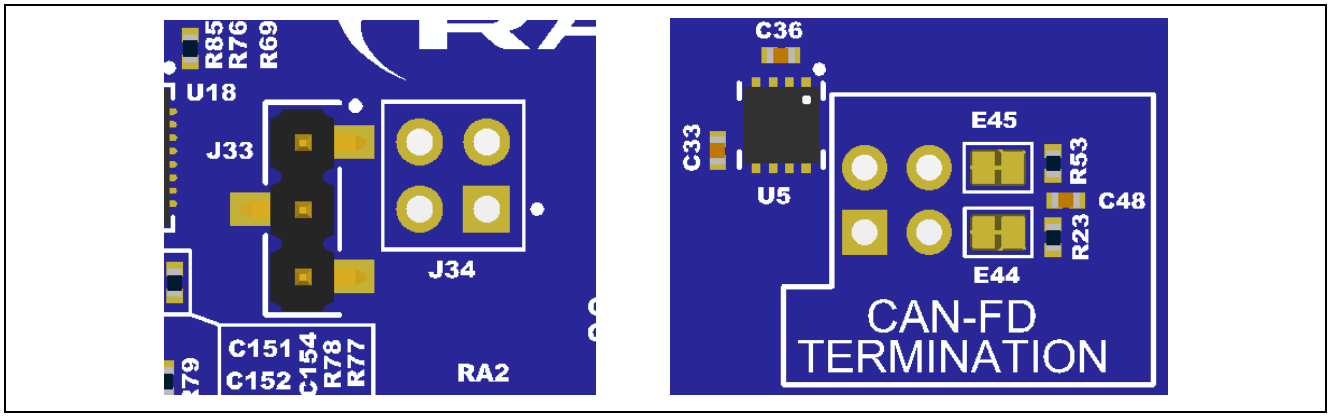

Figure 27. CAN FD Connector and Chip

6.4 MODBUS / RS-485

The EK-RA8M2 board provides a MODBUS / RS-485 bus transceiver (ISL3172EIUZ) (U2) that is connected directly to the RA MCU. External connection to the MODBUS / RS-485 bus is made using the 3.5 mm pitch 4-contact terminal block J32.

Table 30. MODBUS / RS-485 Bus Connections Between U2 and RA8M2

MODBUS / RS-485 Signal Description	EK-RA8M2 Port
RO	PA08 (RXD5)
RE_L	PA10 (DE5)
DE	PA10 (DE5)
DI	PA09 (TXD5)

Table 31. MODBUS / RS-485 Port Assignments

MODBUD / RS-485 Connector (J32)	Function
1	GND
2	B/Z
3	A/Y
4	GND

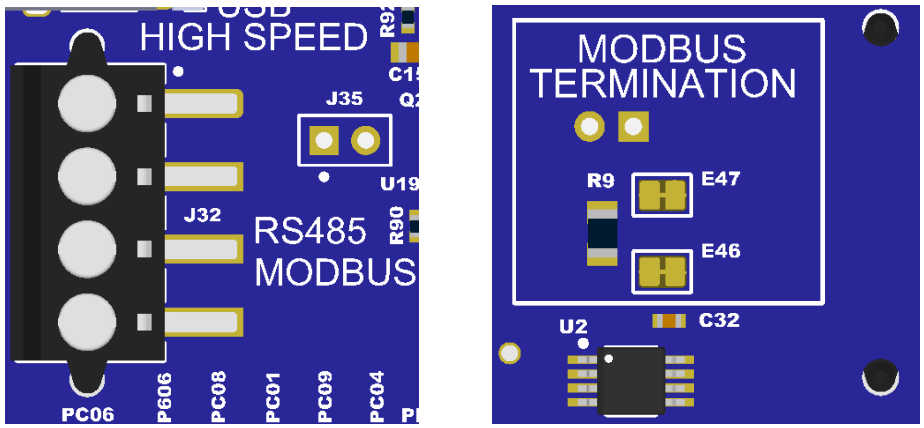

Figure 28. MODBUS / RS-485 Connector and Chip

6.5 Octo-SPI Flash

Included on the EK-RA8M2 board is a 512 Mb (64 MB) Octo-serial flash memory (MX25LW51245GXDI00). The Octo-SPI serial flash device (U3) connects to the Octo-SPI peripheral on the RA MCU and defaults to standard SPI mode initially. The flash memory is enabled for XIP (Execute-In-Place) mode directly after power-on.

Table 32. Octo-SPI Flash Assignments

Octo-SPI Signal Description	EK-RA8M2 Port	Test Point
OSPI_RESET_L	P106	TP11
OSPI_ECS_L	P105	TP12
OSPI_CLK	P808	TP13
OSPI_CS_L	P104	TP14
OSPI_DQS	P801	TP15
OSPI_SIO0	P100	TP16
OSPI_SIO1	P803	TP17
OSPI_SIO2	P103	TP18
OSPI_SIO3	P101	TP19
OSPI_SIO4	P102	TP20

Octo-SPI Signal Description	EK-RA8M2 Port	Test Point
OSPI_SIO5	P800	TP21
OSPI_SIO6	P802	TP22
OSPI_SIO7	P804	TP23

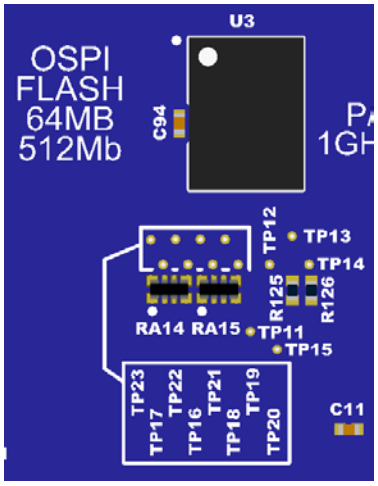

Figure 29. Octo-SPI Flash

6.5.1 OSPI Flash Read / Write Byte Order

The MX25LW51245GXDI00 flash device uses the byte order shown in Figure 30 below (taken from the Macronix MX25LW51245G data sheet) when writing or reading data in DOPI mode.

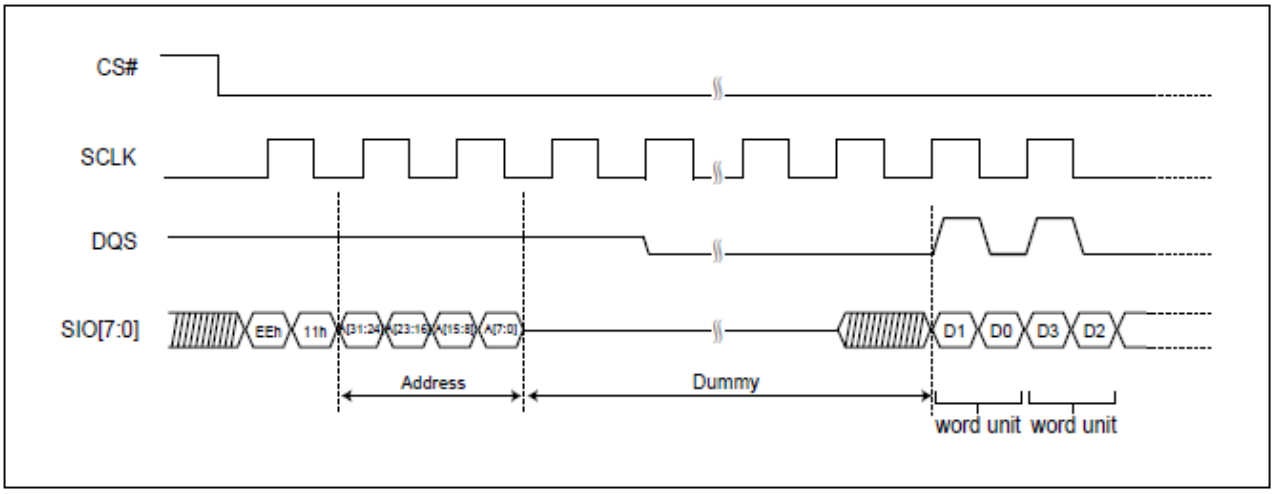

Figure 30. Octo-SPI Flash Read Write Byte Order in DOPI mode

This order (D1, D0, D3, D2 ...) differs from the order that is used when reading or writing data in SPI mode (D0, D1, D2, D3, …). The mode used for reading data must be the same as the mode used for writing data. This must be taken into consideration.

7. MCU Native Pin Access Area

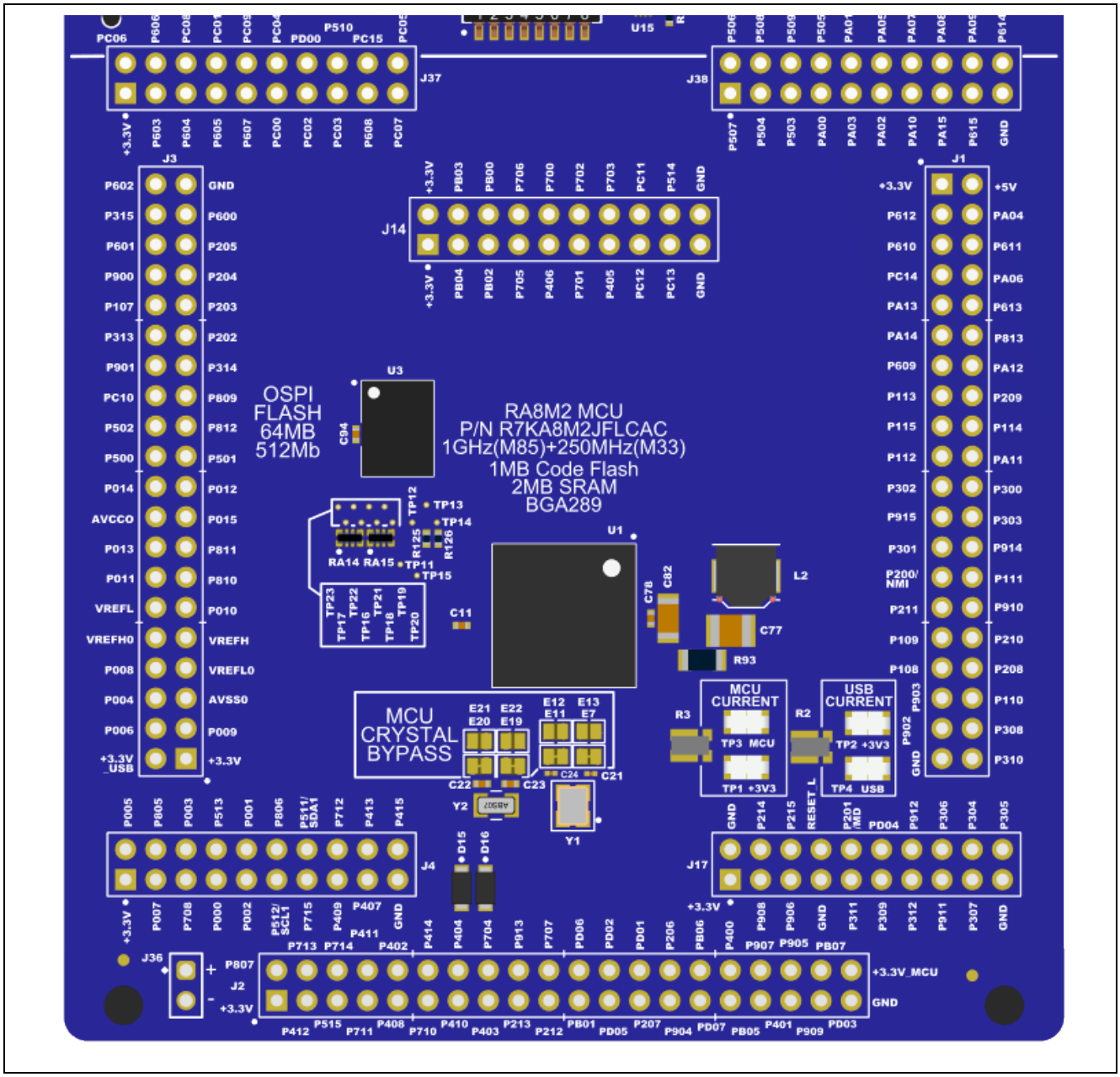

Figure 31. Native Pin Access Area

7.1 Breakout Pin Headers (not populated)

The EK-RA8M2 board pin headers (not populated), J1, J2, J3, J4, J14, J17, J37, and J38 provide access to nearly all RA MCU interface signals, and to voltages for all RA MCU power ports. Each pin location is labelled with the voltage or port connected to it. Refer to the RA8M2 MCU Group User's Manual for details of each port function, and the EK-RA8M2 board schematic for pin header port assignments.

7.2 MCU and USB Current Measurement

Included in the Native Pin Access area are current measurement resistors and test points to measure the MCU USB controller current and the MCU core power current.

The EK-RA8M2 board provides precision 5 mΩ resistors (Yageo, part number PS0612FKE070R005L) for current measurement of the main 3.3 V MCU power and the 3.3 V USB MCU power. Measure the voltage drop across these resistors and use Ohm's Law to calculate the current. For convenience, TP1 and TP3 are provided to measure the main 3.3 V MCU power, and TP2 and TP4 are provided to measure the 3.3 V USB MCU power. See Figure 34 for the location of TP1, TP2, TP3, and TP4.

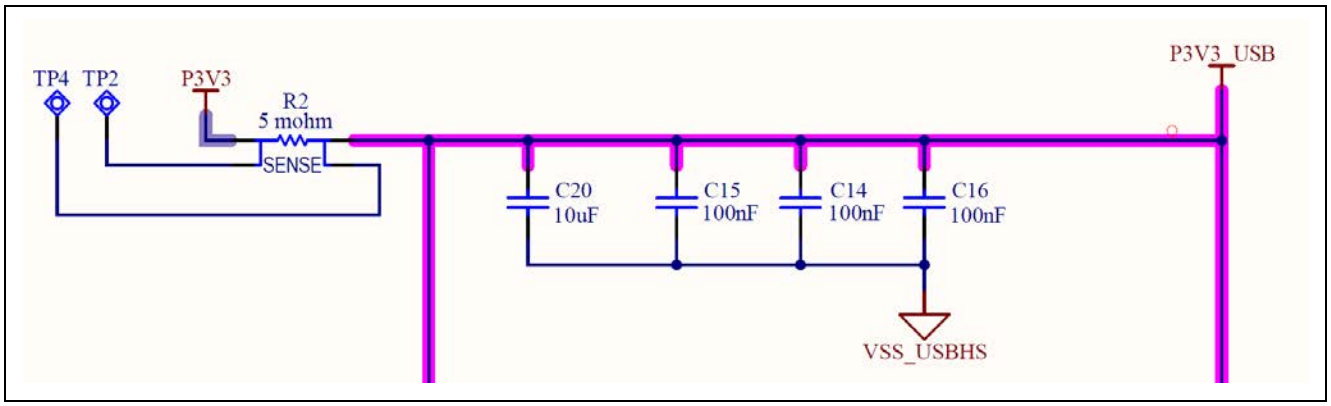

Figure 32. RA USB Current Measurement Circuit

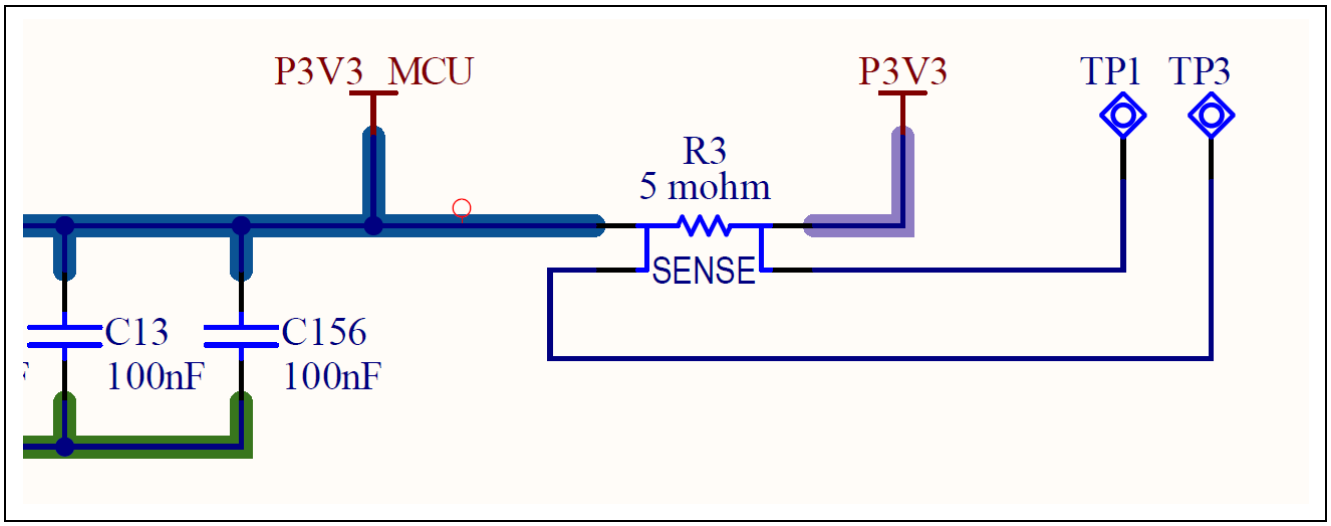

Figure 33. RA +3.3 V Current Measurement Circuit

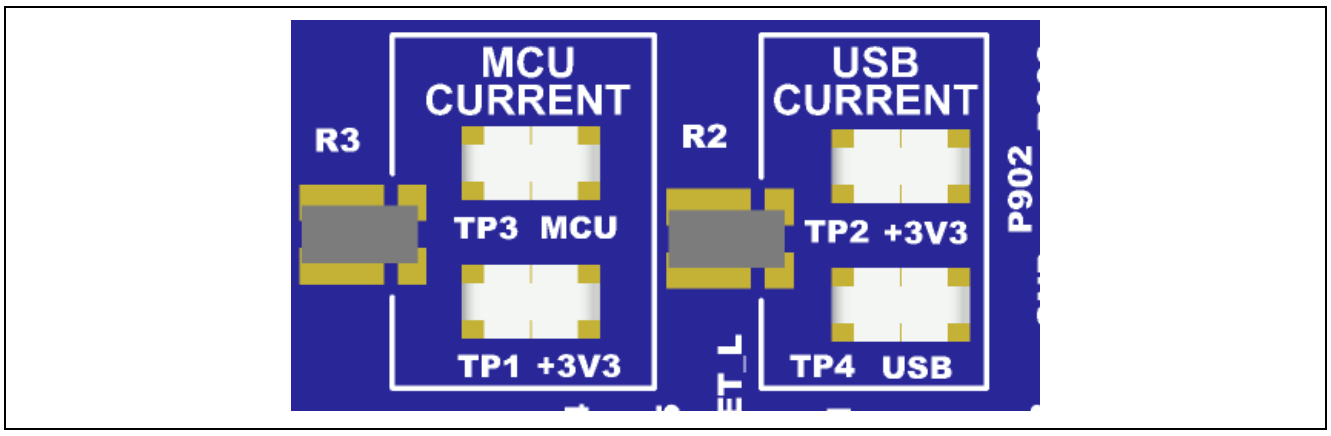

Figure 34. RA MCU and USB Current Measurement

8. Recommended Parts

Table 33 lists recommended part numbers for optional components that can be fitted as required.

Table 33. Part Numbers

Designator(s)	Description	Manufacturer	Part Number
J1, J2, J3	40-way male header	Samtec	TSW-120-07-F-D
J4, J14, J17, J37, J38	20-way male header	Würth Elektronik	613 020 211 21
J27, J28	Seeed Grove® system connector	Seeed Studio	110990037
J30	SparkFun® Qwiic® connector	JST	SM04B-SRSS-TB-LFSN
J21, J22	mikroBUS connector	Samtec	CES-108-01-T-S

9. Certifications

The EK-RA8M2 v1 kit meets the following certifications/standards. See page 3 of this user's manual for the disclaimer and precautions.

9.1 EMC/EMI Standards

- FCC Notice (Class A)

  This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

  NOTE- This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
  - Reorient or relocate the receiving antenna.
  - Increase the separation between the equipment and receiver.
  - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
  - Consult the dealer or an experienced radio/television technician for help.
- Innovation, Science and Economic Development Canada ICES-003 Compliance:

  CAN ICES-3 (A)/NMB-3(A)
- CE Class A (EMC)

  This product is herewith confirmed to comply with the requirements set out in the Council Directives on the Approximation of the laws of the Member States relating to Electromagnetic Compatibility Directive 2014/30/EU.

  Warning – This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be requried to take adequate measures to correct this interference.
- UKCA Class A (EMC)

  This product is in conformity with the following relevant UK Statutory Instrument(s) (and its amendments): 2016 No. 1091 Electromagnetic Compatibility Regulations 2016.

  Warning – This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be requried to take adequate measures to correct this interference.
- Taiwan: Chinese National Standard 13438, C6357 compliance, Class A limits
- Australia/New Zealand AS/NZS CISPR 32:2015, Class A

9.2 Material Selection, Waste, Recycling and Disposal Standards

- EU RoHS
- WEEE
- China SJ/T 113642014, 10-year environmental protection use period.

9.3 Safety Standards

- UL 94V-0

10. Design and Manufacturing Information

The design and manufacturing information for the EK-RA8M2 v1 kit is available in the "EK-RA8M2 v1 Design Package" available on renesas.com/ek-ra8m2.

- Design package name: ek-ra8m2-v1-designpackage.zip

Table 34. EK-RA8M2 Board Design Package Contents

File Type	Content	File/Folder Name
File (PDF)	Schematics	ek-ra8m2-v1-schematics
File (PDF)	Mechanical Drawing	ek-ra8m2-v1-mechdwg
File (PDF)	3D Drawing	ek-ra8m2-v1-3d
File (PDF)	BOM	ek-ra8m2-v1-bom
Folder	Manufacturing Files	Manufacturing Files
Folder	Design Files	Design Files-Altium

11. Website and Support

Visit the following URLs to learn about the kit and the RA family of microcontrollers, download tools and documentation, and get support.

EK-RA8M2 Resources	renesas.com/ek-ra8m2
RA Kit Information	renesas.com/ra/kits
RA Product Information	renesas.com/ra
RA Product Support Forum	renesas.com/ra/forum
RA Videos	renesas.com/ra/videos
Renesas Support	renesas.com/support
RA Flexible Software Package (FSP)	renesas.com/fsp

Revision History

Rev.	Date	Description	
		Page	Summary
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