

RA4L1 Group

Evaluation Kit for RA4L1 Microcontroller Group
EK-RA4L1 v1
User's Manual

Renesas RA Family
RA4 Series

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1. Precaution against Electrostatic Discharge (ESD)

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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.).

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8. Differences between products

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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-RA4L1 v1

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1. Kit Overview

The EK-RA4L1, an Evaluation Kit for RA4L1 MCU Group, enables users to seamlessly evaluate the features of the RA4L1 MCU group and develop embedded systems applications using Flexible Software Package (FSP) and e² 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-RA4L1 board are categorized in three groups (consistent with the architecture of the kit) as follows:

MCU Native Pin Access

- R7FA4L1BD4CFP MCU (referred to as RA MCU)
- 80 MHz, Arm® Cortex®-M33 core
- 512 KB Code Flash, 64 KB SRAM
- 100 pins, LQFP package
- Native pin access through 3 x 26-pin headers (not populated)
- Low Power Mode voltage input and operation
- Segment LCD Board Interface
- MCU current measurement points for precision current consumption measurement
- Multiple clock sources – RA MCU oscillator and sub-clock oscillator crystals, providing precision 8.000 MHz and 32,768 Hz reference clocks. Additional low-precision clocks are available internal to the RA MCU

System Control and Ecosystem Access

- USB Full Speed Host and Device (USB-C connector)
- Three 5 V input sources
 - USB (Debug, Full Speed)
 - External power supply (using surface mount clamp test points and power input vias)
- Three Debug modes
 - Debug on-board (SWD)
 - Debug in (SWD)
 - Debug out (SWD, SWO and JTAG)
- User LEDs and buttons
 - Three User LEDs (red, blue, green)
 - Power LED (white) indicating availability of regulated power
 - Debug LED (yellow) indicating the debug connection
 - Two User buttons
 - One Reset button
- Five most popular ecosystems expansions
 - Two Seeed Grove® system (I²C/I³C/Analog) connectors (not populated)
 - SparkFun Qwiic® connector (not populated)
 - Two Digilent Pmod™ (SPI, UART and I²C) connectors
 - Arduino® (UNO R3) connector
 - MikroElektronika mikroBUS™ connector (not populated)
- MCU boot configuration jumper

Special Feature Access

- 32 MB (256 Mb) External Quad-SPI Flash
- CAN-FD (3-pin header)
- Configuration switches

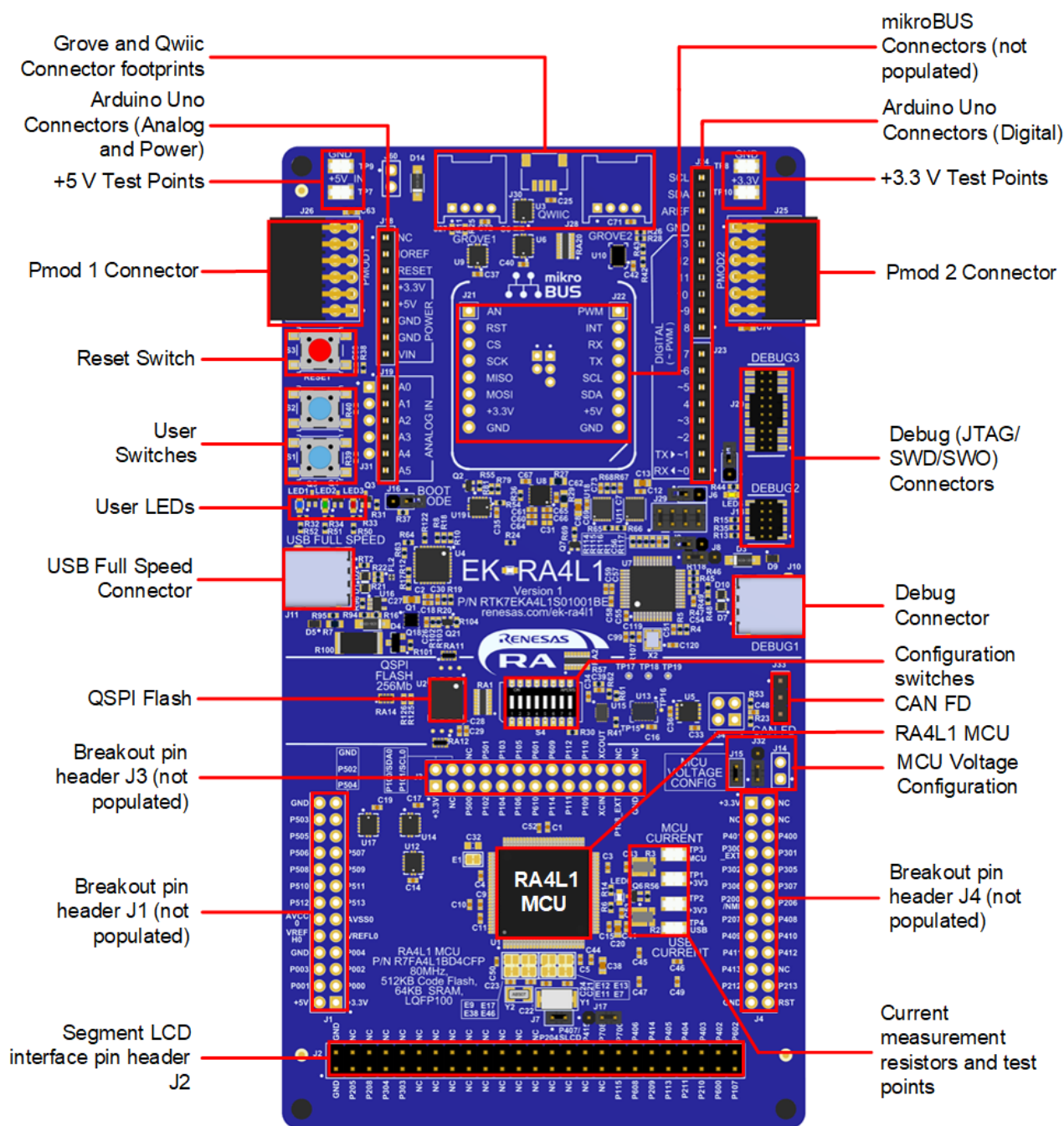


Figure 1. EK-RA4L1 Board Top Side

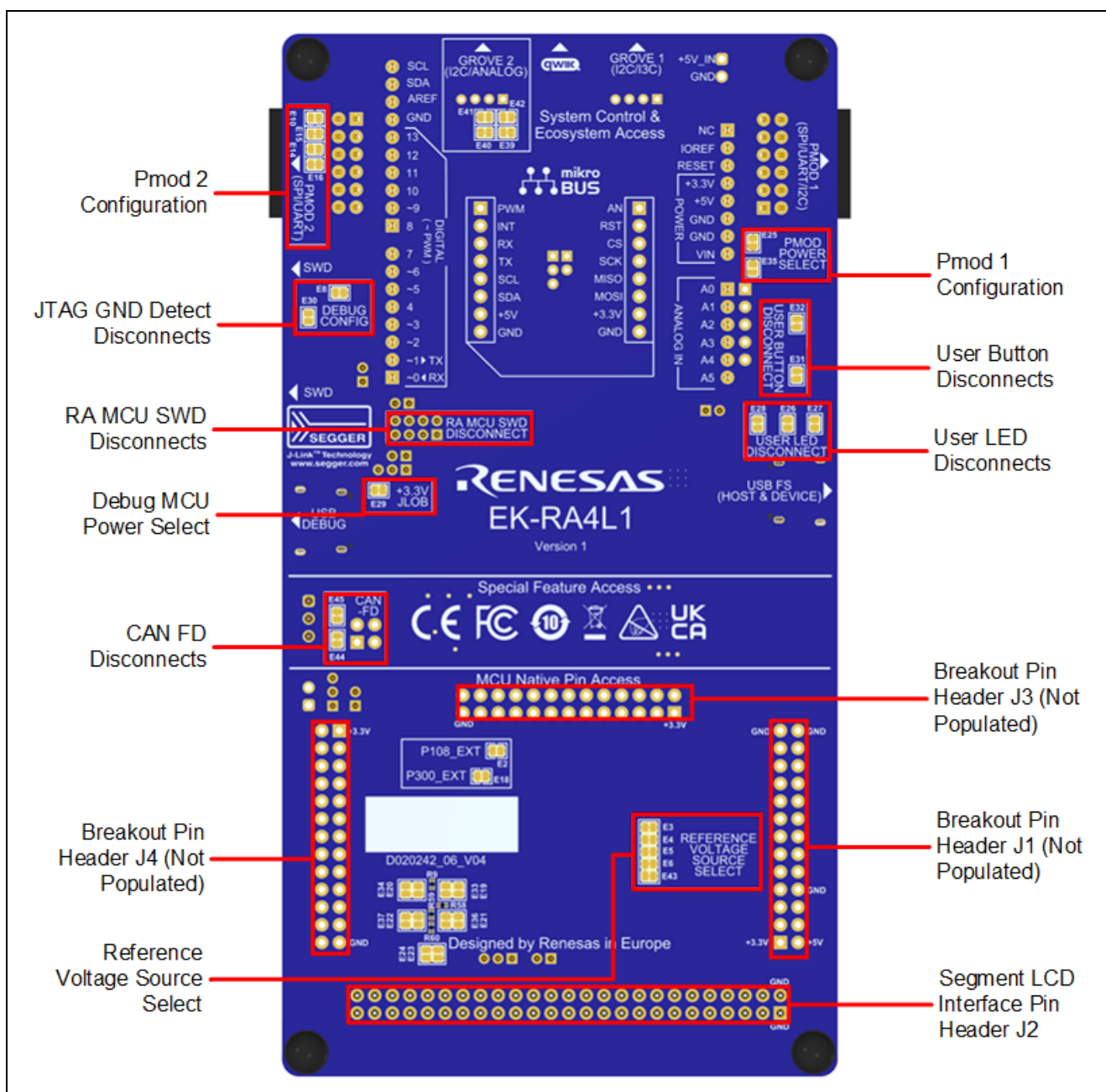


Figure 2. EK-RA4L1 Board Bottom Side

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-RA4L1 Quick Start Guide* to get acquainted with the kit and the Quick Start example project that EK-RA4L1 board comes pre-programmed with.
3. Flexible Software Package (FSP) and Integrated Development Environment (IDE) such as e² studio are required to develop embedded applications on EK-RA4L1 kit.
4. Instructions to download and install software, import example projects, build them and program the EK-RA4L1 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 components are included in the kit:

1. EK-RA4L1 v1 board
2. USB-C to USB-C cable
3. USB-A to USB-C cable
4. USB-C to USB-A female host cable
5. Display mounting hardware (spacers and fixing screws)
6. Segment LCD Board

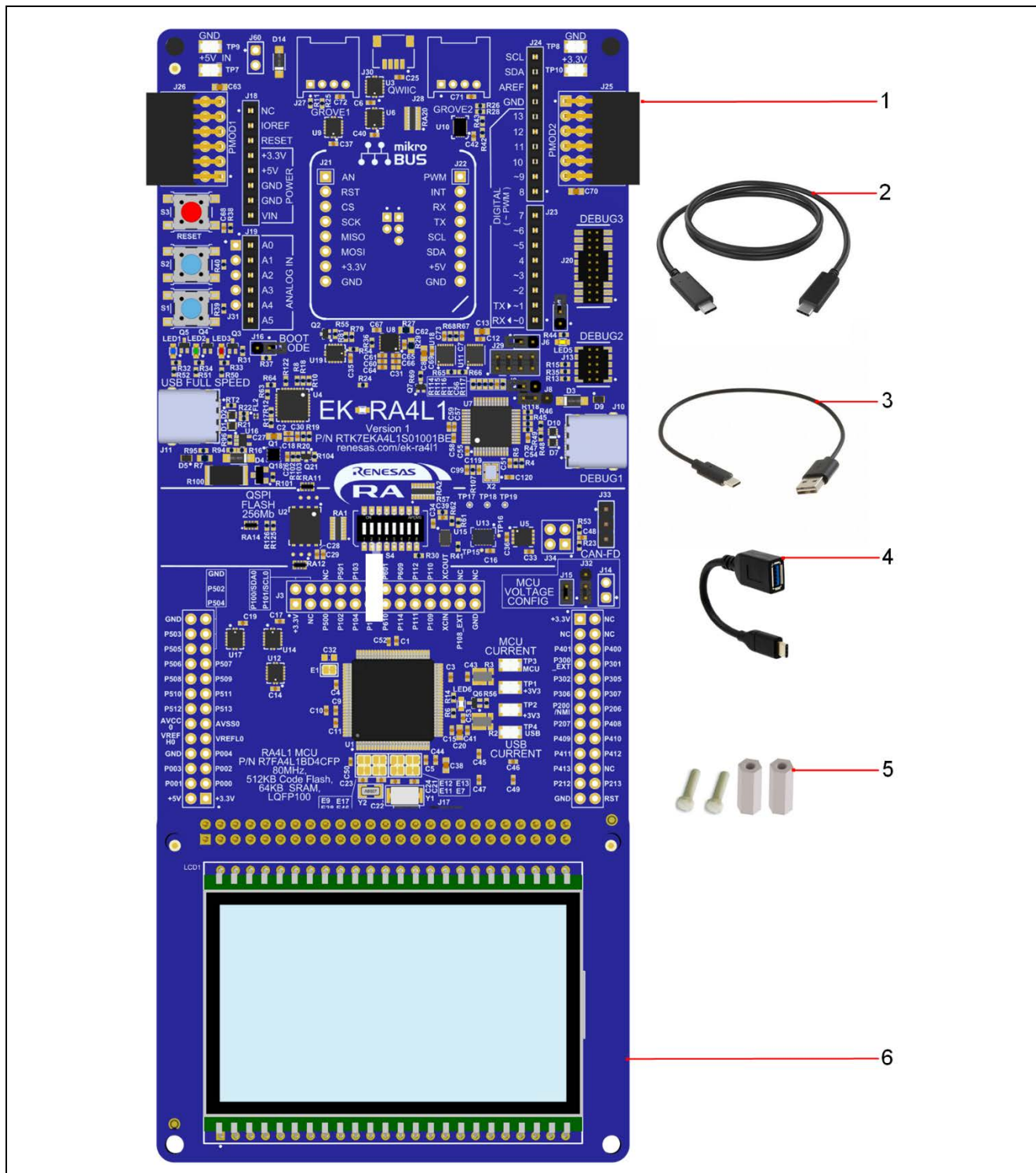


Figure 3. EK-RA4L1 Kit Contents

3. Ordering Information

- EK-RA4L1 v1 kit orderable part number: RTK7EKA4L1S01001BE

Notes:

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

- EK-RA4L1 board dimensions: 80 mm (width) x 145 mm (length)
- Segment LCD Board dimensions: 80 mm (width) x 60 mm (length)

4. Hardware Architecture and Default Configuration

4.1 Kit Architecture

The EK-RA4L1 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 and power, current measurement, low power input and Segment LCD Board Connector	Yes	MCU dependent
Special Feature Access Area	Configuration Switches MCU special features: Quad-SPI Flash, CAN FD	No	MCU dependent
System Control and Ecosystem Access Area	Power, Debug MCU, User LED and buttons, reset, ecosystem connectors, USB Full Speed Host and Device, and Boot configuration	Yes	Same or similar across similar kits

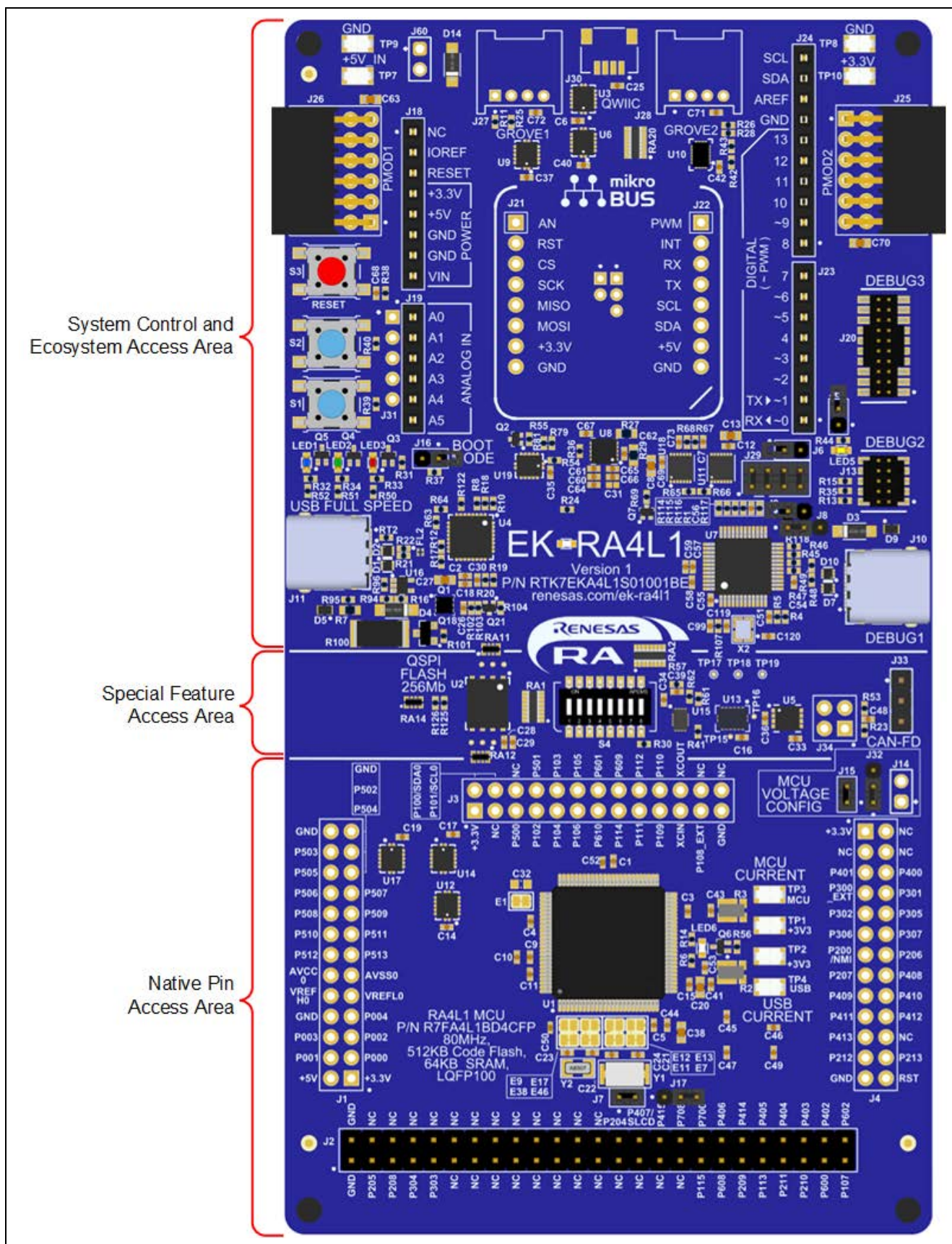


Figure 4. EK-RA4L1 Board Functional Area Definitions

4.2 System Block Diagram

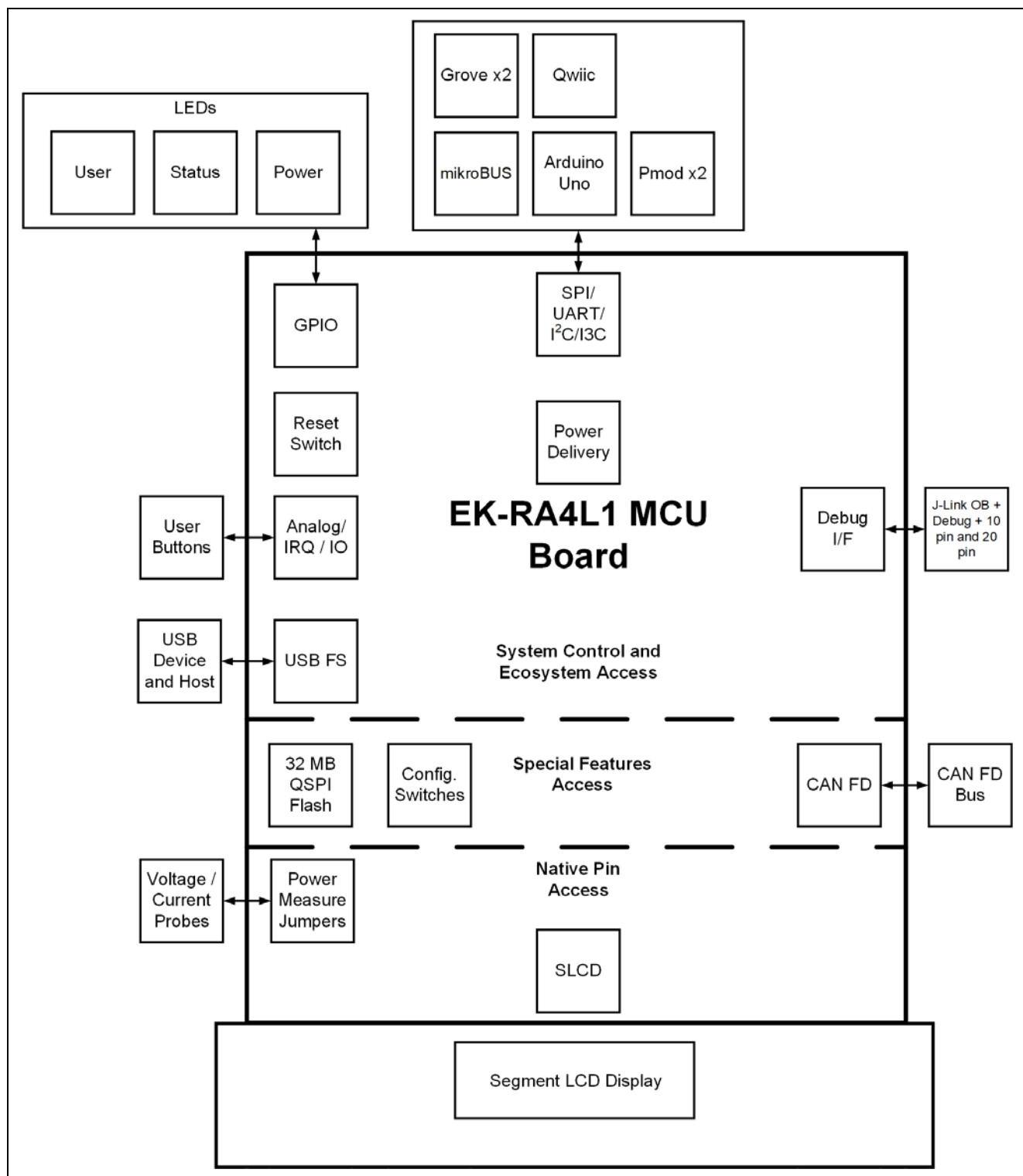


Figure 5. EK-RA4L1 Board Block Diagram

4.3 Jumper Configuration

Two types of jumpers are provided on the EK-RA4L1 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-RA4L1 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-RA4L1 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	Open	Configures J-Link OB connection to MCU mode in normal operation
J6-A	J-Link OB	Open	Configures J-Link OB connection to MCU mode in low power mode operation
J8	J-Link OB	Jumper on pins 1-2	Configures the MCU for normal operation

Location	Circuit Group	Default Open/Closed	Function
J9	J-Link OB	Open	Configures JLOB_RESET# 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	Open	Configures the MCU for normal boot mode
J7	USB FS	Open	Connects P407 to USB FS VBUS
J17	SLCD	Jumper on pins 1-2	Connects P407 to SLCD
J15	MCU Low Power Mode	Closed	Connects EXT_V_N to GND
J32	MCU Low Power Mode	Jumper on pins 1-2	Configures MCU operation mode
E1	QSPI	Closed	Connects P500 to QSPI_CLK
E3	MCU Power	Closed	Connects AVCC0 to VCC_MCU
E4	MCU Power	Closed	Connects AVSS0 to GND
E5	MCU Power	Closed	Connects VREFL0 to GND
E6	MCU Power	Closed	Connects VREFH0 to VCC_MCU
E7	MCU Clock	Closed	Connects P212/EXTAL to 8 MHz crystal
E11	MCU Clock	Closed	Connects P213/XTAL to 8 MHz crystal
E12	MCU Clock	Open	Connects P213/XTAL pin to J4 pin 24
E13	MCU Clock	Open	Connects P212/EXTAL pin to J4 pin 23
E9	MCU Clock	Open	Connects XCIN to J3 pin 21
E17	MCU Clock	Open	Connects XCOUT to J3 pin 22
E38	MCU Clock	Closed	Connects XCIN pin to 32 KHz crystal
E46	MCU Clock	Closed	Connects XCOUT pin to 32 KHz crystal
E8	Debug Out	Closed	Connects debugger JLOB_TRST# to J20 pin 16
E30	Debug Out	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
E2	Debug EXT	Open	Connects P108 to J3 pin 23
E18	Debug EXT	Open	Connects P300 to J4 pin 7
E26	User LED	Closed	Connects P610 to User LED2
E27	User LED	Closed	Connects P609 to User LED1
E28	User LED	Closed	Connects P601 to User LED3
E31	User Switch	Closed	Connects P000 to User Switch S1
E32	User Switch	Closed	Connects P001 to User Switch S2
E43	Arduino	Closed	Connects ARDUINO_AREF to VREFH0
E25	Pmod 1	Closed	Connects +3.3 V to Pmod 1 pin 6 and pin 12
E35	Pmod 1	Open	Connects +5.0 V to Pmod 1 pin 6 and pin 12
E10	Pmod 2	Open	Connects P412 (CTS3) to Pmod 2 pin 1
E14	Pmod 2	Open	Connects P411 (RTS3) to Pmod 2 pin 4
E15	Pmod 2	Closed	Connects P411 (SS3/CTS_RTS3) to Pmod 2 pin 1
E16	Pmod 2	Closed	Connects P410 (SCK3) to Pmod 2 pin 4
E33	Pmod 2	Closed	Connects P408 (MISO3/RXD3) to Pmod 2 pin 3
E34	Pmod 2	Closed	Connects P409 (MOSI3/TXD3) to Pmod 2 pin 2
E36	Pmod 2	Closed	Connects P410 (SCK3) to Pmod 2 pin 4
E37	Pmod 2	Closed	Connects P411 (SS3/CTS_RTS3) to Pmod 2 pin 1
E39	Grove 2	Closed	Connects P101 (I ² C SCL) to Grove 2 pin 1
E40	Grove 2	Closed	Connects P100 (I ² C SDA) to Grove 2 pin 2

Location	Circuit Group	Default Open/Closed	Function
E41	Grove 2	Open	Connects P003 (AN001) to Grove 2 pin 2
E42	Grove 2	Open	Connects P004 (AN002) to Grove 2 pin 1
E44	CAN FD	Closed	Connects CANL to J34 pin 1
E45	CAN FD	Closed	Connects CANH to J34 pin 3
E19	SLCD	Closed	Connects P408/VL3 to external capacitor
E20	SLCD	Closed	Connects P409/VL4 to external capacitor
E21	SLCD	Closed	Connects P410/VL2 to external capacitor
E22	SLCD	Closed	Connects P411/VL1 to external capacitor
E23	SLCD	Open	Connects +5 V pull up circuit to VL1-4
E24	SLCD	Open	Connects +3.3 V pull up circuit to VL1-4

4.3.4 Default Switch Configuration

The EK-RA4L1 features an I²C I/O Port Expander (PI4IOE5V6408) at U15 and has the I²C address 0x43. The port expander is connected to the configuration switches S4.

The following table describes the function and default configuration for each switch that selects the operational peripheral pins on the EK-RA4L1 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 (S4)

Location	Circuit Group	Default ON/Off	Function / Restrictions
S4-1	Pmod 1	Off	Pmod 1 connectivity switch between I ² C/UART/SPI Please see Table 19 for details
S4-2	Pmod 1	Off	Pmod 1 connectivity switch between I2C/UART/SPI Please see Table 19 for details
S4-3	USBFS ROLE SW	Off	Switch USB FS between Host mode and Device mode
S4-4	USBFS VBUS SEL	Off	Configures the polarity of voltage – power out/power in
S4-5	TP17	Off	Test point
S4-6	BOOT_SERIAL	Off	Configures for boot mode serial debug
S4-7	Arduino	Off	Arduino reset
S4-8	EXT_V_N	Off	Allows READING of the power mode configured on the board. (See caution below)

Pmod 1 will not be functional unless a valid selection is made via I²C port expander or the manual switches.

Table 4. Permitted Switch Configuration (S4)

IMPORTANT: Ensure that invalid switch configuration is not made to avoid potential failures

SWITCH S4	S4-1 Pmod1	S4-2 Pmod1	S4-3 USBFS ROLE SW	S4-4 USBFS VBUS SEL	S4-5 TP17	S4-6 BOOT_SERIAL	S4-7 Arduino	S4-8 EXT_V_N
S4-1 Pmod1	-	OK	OK	OK	OK	NO	OK	OK *
S4-2 Pmod1	OK	-	OK	OK	OK	NO	OK	OK *
S4-3 USBFS ROLE SW	OK	OK	-	OK	OK	OK	OK	OK *
S4-4 USBFS VBUS SEL	OK	OK	OK	-	OK	OK	OK	OK *
S4-5 TP17	OK	OK	OK	OK	-	OK	OK	OK *
S4-6 BOOT_SERIAL	NO	NO	OK	OK	OK	-	OK	OK *
S4-7 Arduino	OK	OK	OK	OK	OK	OK	-	OK *
S4-8 EXT_V_N	OK *	OK *	OK *	OK *	OK *	OK *	OK *	-

Caution: The connection to S4-8 is only provided to READ the state of the EXT V N in normal mode.

Please note that the port expander cannot be interrogated in low power mode.

*** This pin must not be pulled or driven high or low via the port expander.**

5. System Control and Ecosystem Access Area

The following figure shows the System Control and Ecosystem Access area on the EK-RA4L1 board. Subsequent sections detail the features and functionality provided in the area.

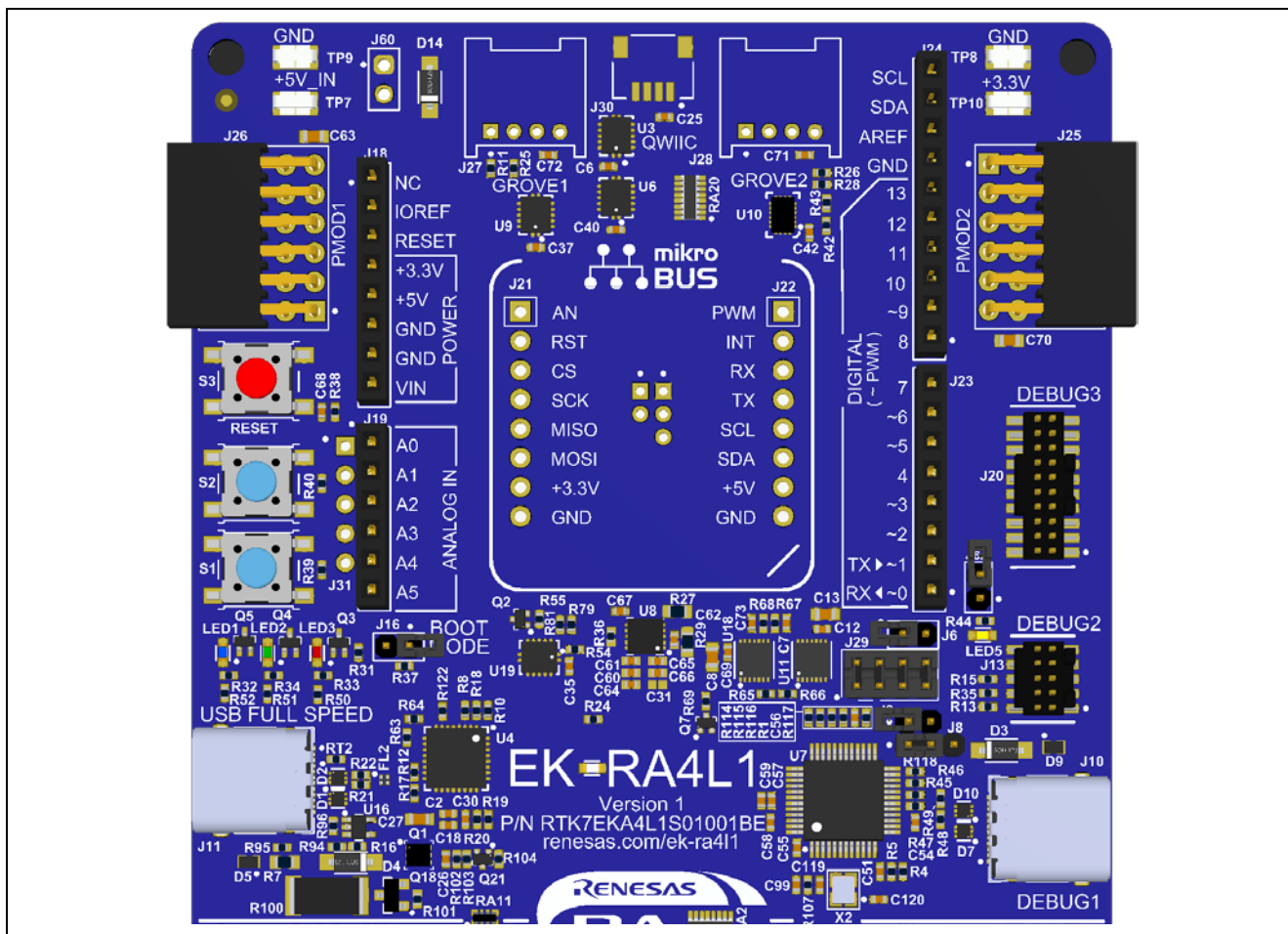


Figure 7. System Control and Ecosystem Access Area

5.1 Power

The EK-RA4L1 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. The kit can also be operated at a low voltage of +1.6 V.

5.1.1 Power Supply Options

This section describes the different ways in which EK-RA4L1 kit can be powered.

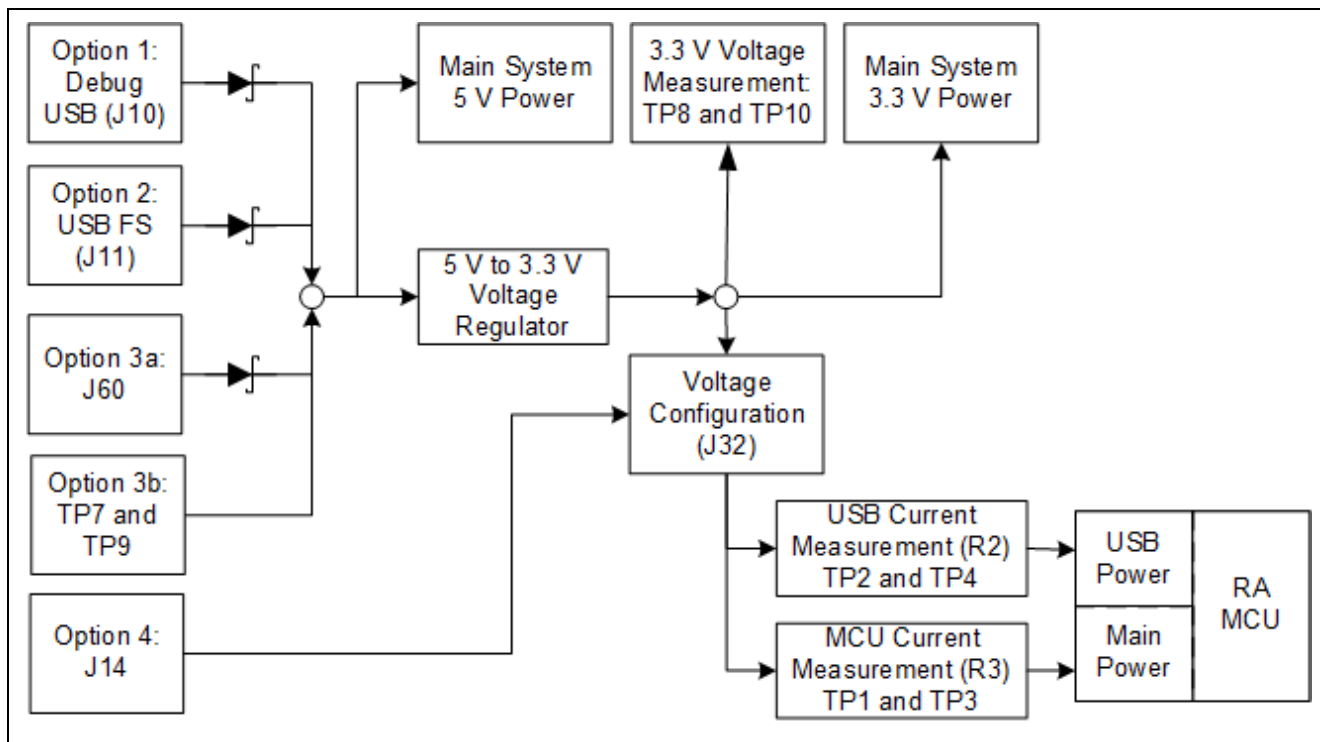


Figure 8. Power Supply Options

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.

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.

5.1.1.3 Option 3: 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 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 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 Pmod1.

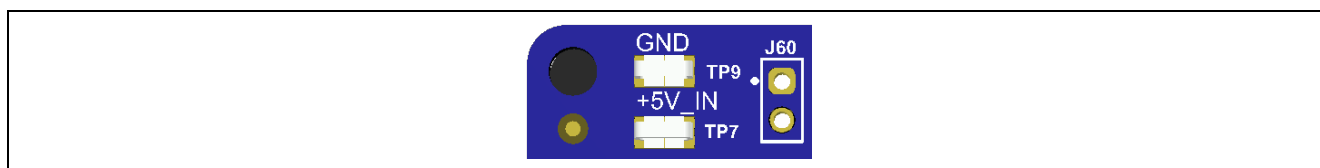


Figure 9. 5 V Test Point Location

5.1.1.4 Option 4: Low Power Input

EK-RA4L1 supports operation at a low power mode. A regulated voltage of +1.6 V can be supplied through J14. Refer Section 8 for the jumper configurations.

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-RA4L1 name) will light up. For more details on initial power up behavior, see the *EK-RA4L1 Quick Start Guide*.

5.2 Debug

The EK-RA4L1 board supports the following three debug modes.

Table 5. 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)	RA4L1 (on-board)	SWD	USB-C (J10)
Debug in	External debugging tools	RA4L1 (on-board)	SWD	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 8 for the Debug USB connector pin definition
- See Table 11 for the 20-pin JTAG connector pin definition
- See Table 12 for the 10-pin JTAG connector pin definition

EK-RA4L1 supports debug in both normal operation and low power mode operation. The following tables summarize the jumper configuration for each of the debug modes in both operation modes.

Table 6. Jumper Connection Summary for Different Debug Modes (Normal Operation)

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

Table 7. Jumper Connection Summary for Different Debug Modes (Low Power Mode Operation)

Debug Modes	J6	J6-A	J8	J9	J29
Debug on-board	x	Open	Open	Open	All pins open
Debug in	x	Open	Open	Jumper on pins 1-2	All pins open
Debug out	x	Open	Jumper on pins 2-3	Open	All pins open

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 re-programming and debugging of the target RA MCU firmware. This connection is the default debug mode for the EK-RA4L1 board.

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

Table 8. Debug USB Port Assignments

Debug USB Port Assignments		EK-RA4L1
Pin	Description	Signal/Bus
J10-A1	GND	GND
J10-A2	TX1+	NC
J10-A3	TX1-	NC
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	NC
J10-A9	VBUS	+5V_USB_DBG
J10-A10	RX2-	NC
J10-A11	RX2+	NC
J10-A12	GND	GND
J10-B1	GND	GND
J10-B2	TX2+	NC
J10-B3	TX2-	NC
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	NC
J10-B9	VBUS	+5V_USB_DBG
J10-B10	RX1-	NC
J10-B11	RX1+	NC
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-RA4L1 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 on solid, it indicates that the RA4M2 Debug MCU is connected to a programming interface.

To configure the EK-RA4L1 board to use the Debug On-Board mode, configure the jumpers using the following table.

Table 9. Debug On-Board Jumper Configuration

Location	Default Open/Closed	Function
J6	Open	No connection to RA MCU
J6-A	Open	No connection to RA MCU
J8	Jumper on pins 1-2	Target RA MCU RESET# connected to debug RESET#
J9	Open	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
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To use this debug mode in low power mode operation, configure the jumpers following Table 7.

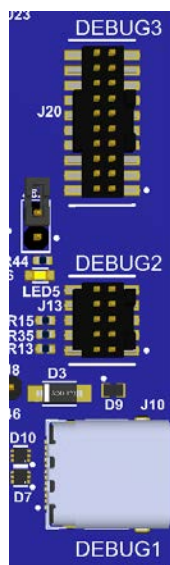


Figure 10. EK-RA4L1 Debug Interface

5.2.2 Debug In

One 20-pin Cortex® Debug Connector at J20 supports SWD debug. One 10-pin Cortex® Debug Connector at J13 supports SWD. Either of these connectors may be used for external debug of the target RA MCU.

To configure the EK-RA4L1 board to use the Debug In mode, configure the jumpers using the following table.

Table 10. Debug In Mode Jumper Configuration

Location	Default Open/Closed	Function
J6	Open	No connection to RA MCU
J6-A	Open	No connection to RA MCU
J8	Jumper on pins 1-2	Target RA MCU RESET# connected to debug RESET#
J9	Closed	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

To use this debug mode in low power mode operation, configure the jumpers following Table 7.

Table 11. JTAG/SWO/SWD Port Assignments (J20)

JTAG Port Assignments			EK-RA4L1
Pin	JTAG Pin Name ^{*1}	SWD/SWO Pin Name	Signal/Bus
J20-1	Vtref	Vtref	+3V3
J20-2	TMS	SWDIO	P108/SWDIO/TMS
J20-3	GND	GND	GND
J20-4	TCK	SWCLK	P300/SWCLK/TCK
J20-5	GND	GND	GND
J20-6	TDO	SWO	P109/SWO/TDO/BOOT_SERIAL
J20-7	Key	Key	NC
J20-8	TDI	N/A	P110/TDI/BOOT_SERIAL
J20-9	GNDDetect	GNDDetect	GND (cut E30 to open)
J20-10	nSRST	nSRST	RESET# (via J8)
J20-11	GND	GND	GND

JTAG Port Assignments			EK-RA4L1
Pin	JTAG Pin Name ^{*1}	SWD/SWO Pin Name	Signal/Bus
J20-12	NC	NC	NC
J20-13	GND	GND	GND
J20-14	NC	NC	NC
J20-15	GND	GND	GND
J20-16	RESET	RESET	TRST
J20-17	GND	GND	GND
J20-18	NC	NC	NC
J20-19	GND	GND	GND
J20-20	NC	NC	NC

^{*1} Only for debug out

Table 12. JTAG/SWD/SWO Port Assignments (J13)

JTAG Port Assignments			EK-RA4L1
Pin	JTAG Pin Name ^{*1}	SWD/SWO Pin Name	Signal/Bus
J13-1	Vtref	Vtref	+3V3
J13-2	TMS	SWDIO	P108/SWDIO/TMS
J13-3	GND	GND	GND
J13-4	TCK	SWCLK	P300/SWCLK/TCK
J13-5	GND	GND	GND
J13-6	TDO	SWO	P109/SWO/TDO/BOOT_SERIAL
J13-7	Key	Key	NC
J13-8	TDI	N/A	P110/TDI/BOOT_SERIAL
J13-9	GNDDetect	GNDDetect	GND (cut E30 to open)
J13-10	nSRST	nSRST	RESET# (via J8)

^{*1} Only for debug out

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

5.2.3 Debug Out

The EK-RA4L1 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-RA4L1 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 on solid, 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-RA4L1 board to use the Debug Out mode, configure the jumpers according to the following table.

Table 13. Debug Out Jumper Configuration

Location	Default Open/Closed	Function
J6	Open	No connection to RA MCU
J6-A	Open	No connection to RA MCU
J8	Jumper on pins 2-3	On-board RA MCU is held in RESET
J9	Open	RA4M2 Debug MCU in normal operation mode
J29	All jumpers removed	Disconnects the on-board RA MCU debug signals from the Debug Interface

To use this debug mode in low power mode operation, configure the jumpers following Table 7.

5.2.4 Debug Serial

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

Table 14. Debug Serial Port Assignments

Debug Serial Port Assignments	EK-RA4L1 Port
U7-P301 (RXD2)	P506
U7-P302 (TXD2)	P507
U7-P409 (CTS)	TP19
U7-P408 (RTS)	TP18

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

5.3.1 Seeed Grove® Connections

5.3.1.1 Grove 1

A Seeed Grove I³C connector footprint is provided at J27. The RA MCU acts as a two-wire serial master in I³C mode or I²C mode, and a connected module acts as a two-wire serial slave.

Table 15. Grove 1 Port Assignments

Grove 1 Port Assignments		EK-RA4L1
Pin	Description	Signal/Bus
J27-1	I ³ C_SCL/I ² C_SCL ^{*1}	P400 (SCL0)
J27-2	I ³ C_SDA/I ² C_SDA ^{*1}	P401 (SDA0)
J27-3	VCC	+3.3 V
J27-4	GND	GND

^{*1} See section 5.3.6.

5.3.1.2 Grove 2

A Seeed Grove I²C connector footprint is provided at J28. 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 16. Grove 2 Port Assignments

Grove 2 Port Assignments		EK-RA4L1	
Pin	Description	Signal/Bus	
J28-1	SCL	P101 (SCL0)	P004(AN002) ^{*1}
J28-2	SDA	P100 (SDA0)	P003(AN001) ^{*1}
J28-3	VCC	+3.3 V	
J28-4	GND	GND	

^{*1} Jumpers E39 and E40 are open, E41 and E42 are closed

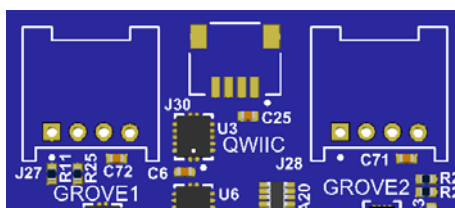


Figure 11. Seeed Grove and SparkFun Qwiic® Connector Footprints

5.3.2 SparkFun Qwiic® Connections

A SparkFun Qwiic® connector footprint is provided at J30. 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 17. Qwiic Port Assignments

Qwiic Port Assignments		EK-RA4L1	
Pin	Description	Signal/Bus	
J30-1	GND	GND	
J30-2	VCC	+3.3 V	
J30-3	SDA	P401 (SDA0)*	
J30-4	SCL	P400 (SCL0)*	

* See section 5.3.6.

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) and Type-3A (expanded UART).

The EK-RA4L1 board also provides quick switches so the 12-pin connector may alternatively be used for 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 a switch options (S4-1) and (S4-2).

Table 18. Pmod 1 Port Assignments

Pmod 1 Port Assignments				EK-RA4L1	Pmod 1 Configuration	
Pin	Option Type-2A (SPI) ^{*1}	Option Type-3A (UART) ^{*1}	Option Type-6A (I ² C) ^{*1*3}	Signal/Bus	Short	Open
J26-1	SS			P112 (SSLA0)		
		CTS		P114 (CTS9)		
			INT	P110 (IRQ3)		
J26-2	MOSI	TXD		P109 (MOSI9/TXD9)		
			NC	NC		
J26-3	MISO	RXD		P110 (MISO9/RXD9)		
			SCL	P101 (SCL0)		
J26-4	SCK			P111 (SCK9)		
		RTS		P112 (RTS9)		
			SDA	P100 (SDA0)		
J26-5	GND			GND		
J26-6	VCC ^{*2}			+3.3 V	E25	E35
				+5.0 V	E35	E25
J26-7	IRQ			P105 (IRQ0)		
J26-8	RESET (master to slave)			P306		
J26-9	GPIO			P307		
J26-10	GPIO			P413		
J26-11	GND			GND		
J26-12	VCC ^{*2}			+3.3 V	E25	E35
				+5.0 V	E35	E25

^{*1} Option is selected by setting switches S4-1 and S4-2 as follows:

Table 19. Pmod 1 Function Selection

S4-1	S4-2	Selected function
Off	Off	SPI (Default)
On	Off	UART
Off	On	I ² C
On	On	None

^{*2} Caution: 5 V optional supply is provided (J26-6 and J26-12), however the interface must only be driven with 3 V signals from the Pmod 1. The EK-RA4L1 will only provide 3.3 V signal levels to the Pmod 1.

^{*3} Refer to section 5.3.6

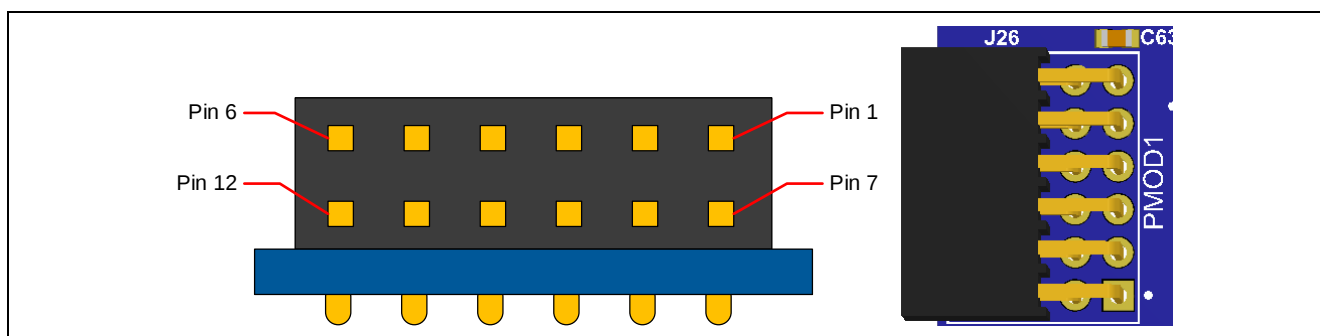


Figure 12. Pmod 1 Connector

5.3.3.2 Pmod 2

A 12-pin Pmod connector is provided at J25, Pmod 2. Please note that by default Pmod 2 pins 1-4 cannot be used as these pins are used for Segment LCD power supply pins.

To disable the Segment LCD power supply pins and enable Pmod 2 pins 1-4, cut jumpers E19, E20, E21 and E22.

Table 20. Pmod 2 Port Assignments

Pmod 2 Port Assignments			EK-RA4L1	Pmod 2 Configuration	
Pin	Option Type-2A (SPI)	Option Type-3A (UART)	Signal/Bus	Short	Open
J25-1	SS		P411 (SS3)	E15	E10 E22 (C49 disconnect)
J25-1		CTS	P412 (CTS3)	E10	E15 E21 (C47 disconnect)
J25-2	MOSI	TXD	P409 (MOSI3/TXD3)		E20 (C46 disconnect)
J25-3	MISO	RXD	P408 (MISO3/RXD3)		E19 (C45 disconnect)
J25-4	SCK		P410 (SCK3)	E16	E14
J25-4		RTS	P411 (RTS3)	E14	E16
J25-5	GND		GND		
J25-6	VCC		+3.3 V		
J25-7	IRQ		P104 (IRQ1)		
J25-8	RESET (master to slave)		P305		
J25-9	GPIO		P302		
J25-10	GPIO		P301		
J25-11	GND		GND		
J25-12	VCC		+3.3 V		

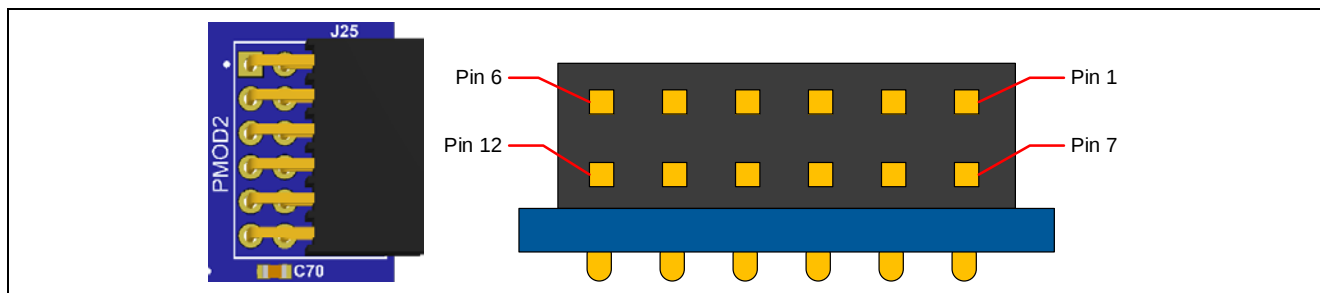


Figure 13. Pmod 2 Connector

5.3.4 Arduino® Connector

Near the center of the System Control and Ecosystem Access area is an Arduino® UNO R3 compatible connector interface. Please note the Arduino connector cannot be used when Segment LCD is in use, see Table 21.

Table 21. Arduino UNO Port Assignments

Arduino UNO Port Assignments		EK-RA4L1
Pin	Description	Signal/Bus
J18-1	NC	NC
J18-2	IOREF	+3.3 V
J18-3	RESET	S4-7*1
J18-4	3.3 V	+3.3 V
J18-5	5 V	+5 V
J18-6	GND	GND
J18-7	GND	GND

Arduino UNO Port Assignments				EK-RA4L1
Pin	Description			Signal/Bus
J18-8	VIN			NC
J19-1	A0			P510 (AN025)
J19-2	A1			P511 (AN024)
J19-3	A2			P512 (AN023)
J19-4	A3			P513 (AN022)
J19-5	A4			P003 (AN001)
J19-6	A5			P004 (AN002/DA0)
J23-1	D0	RXD	PWM	P608 (RXD1/GTIOC4B) ^{*3}
J23-2	D1	TXD		P115 (TXD1/GTIOC4A) ^{*3}
J23-3	D2	INT0		P415 (IRQ8/GTIOC0A) ^{*3}
J23-4	D3	INT1	PWM	P414 (IRQ9/GTIOC0B) ^{*3}
J23-5	D4			P404 (IRQ15) ^{*3}
J23-6	D5		PWM	P405 (GTIOC1A) ^{*3}
J23-7	D6		PWM	P406 (GTIOC1B) ^{*3}
J23-8	D7			P107 ^{*3}
J24-1	D8			P602 ^{*3}
J24-2	D9		PWM	P600 (GTIOC2B) ^{*3}
J24-3	D10	SPI_SS		P204 (SSLA0/CTS_RTS4) ^{*3}
J24-4	D11	SPI_MOSI		P211 (MOSIA) ^{*3}
J24-5	D12	SPI_MISO		P210 (MISOA) ^{*3}
J24-6	D13	SPI_SCK		P209 (RSPCKA) ^{*3}
J24-7	GND			GND
J24-8	ARDUINO_AREF			+3.3 V
J24-9	I3C_SDA			P401 (SDA0) ^{*2}
J24-10	I3C_SCL			P400 (SCL0) ^{*2}

^{*1} Refer to section 4.3.4

^{*2} Refer to section 5.3.6

^{*3} Pin cannot be used when using Segment LCD

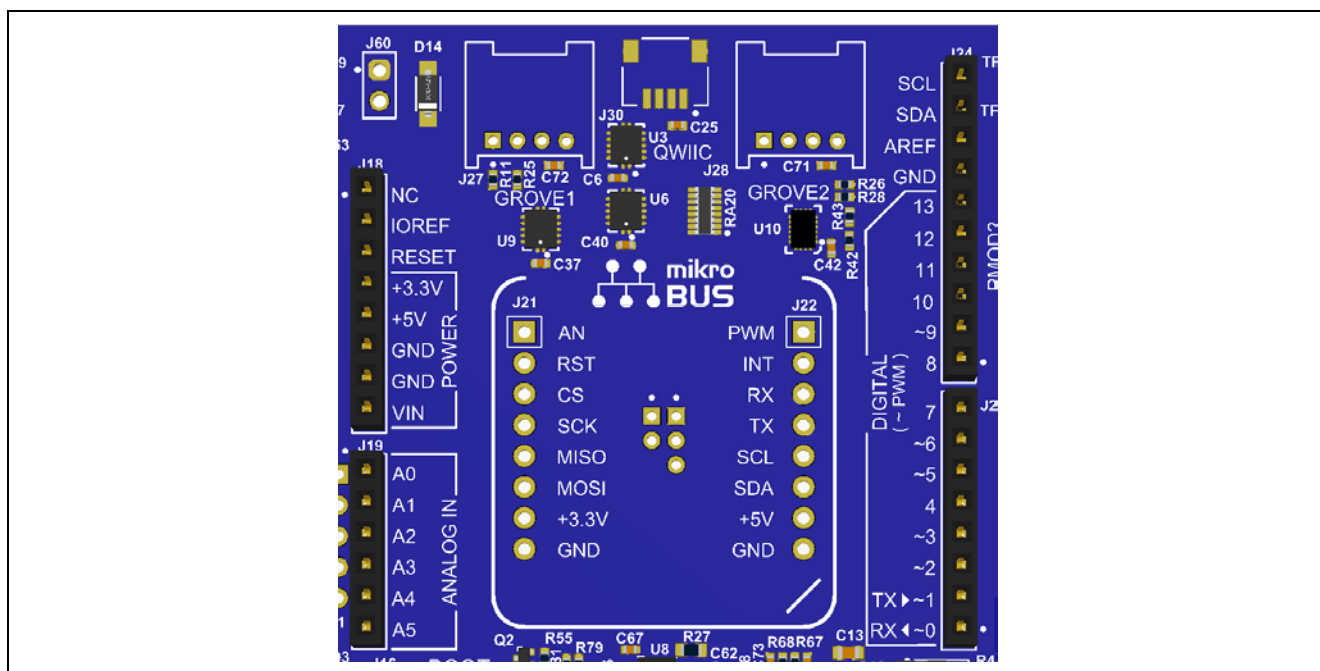


Figure 14. Arduino UNO Connectors

5.3.5 MikroElektronika mikroBUS™ Connector

In the center of the System Control and Ecosystem Access area is a mikroBUS compatible connector interface. This interface is compliant with mikroBUS Standard Specifications revision 2.00. Please note the mikroBUS connector cannot be used when Segment LCD is in use, see Table 22.

Table 22. mikroBUS Port Assignments

mikroBUS Port Assignments		EK-RA4L1
Pin	Description	Signal/Bus
J21-1	AN (Analog)	P510 (AN025)
J21-2	RST (Reset)	P113 (MIKROBUS RESET#) ^{*2}
J21-3	CS (SPI Chip Select)	P204 (SSLA0) ^{*2}
J21-4	SCK (SPI Clock)	P209 (RSPCKA) ^{*2}
J21-5	MISO	P210 (MISOA) ^{*2}
J21-6	MOSI	P211 (MOSIA) ^{*2}
J21-7	+3.3 V	+3.3 V
J21-8	GND	GND
J22-1	PWM	P405 (GTIOC1A) ^{*2}
J22-2	INT (Hardware Interrupt)	P403 (IRQ-14) ^{*2}
J22-3	RX (UART Receive)	P608 (RXD1) ^{*2}
J22-4	TX (UART Transmit)	P115 (TXD1) ^{*2}
J22-5	SCL (I3C Clock)	P400 (SCL0) ^{*1}
J22-6	SDA (I3C Data)	P401 (SDA0) ^{*1}
J22-7	+5 V	+5 V
J22-8	GND	GND

^{*1} Refer to section 5.3.6

^{*2} Pin cannot be used when using Segment LCD

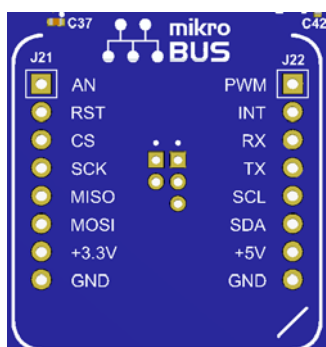


Figure 15. mikroBUS Connectors (not populated)

5.3.6 I3C

The Arduino, mikroBUS, Grove 1 and Qwiic connectors connect the RA MCU I3C interface to external I3C or I²C devices allowing communications between devices.

Please ensure that Port P508 and P509 are set signal high impedance when I3C is in use or set signal high for I²C.

Table 23. I²C/I3C Pullup Configuration

I ² C/I3C	P508/P509
I3C (Ecosystems expansions)	Input (High impedance)
I ² C (Ecosystems expansions)	Push-pull outputs drive high

5.4 Connectivity

5.4.1 USB Full Speed

The USB-C connection jack (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 and Host configuration, toggle S4-3 and configure the RA MCU firmware to switch the USB Full Speed ports mode. Power from an external USB Host on this connection can be used to provide power to the EK-RA4L1 board. In USB host configuration, power to J11 is supplied from U4. The total current available is 2A. Note that the input power sources must be configured with enough power for both the EK-RA4L1 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. Please note that the USB FS cannot be used when Segment LCD is in use.

Table 24. USB Full Speed Port Assignments

USB Full Speed Port Assignments		EK-RA4L1
Pin	Description	Signal/Bus
J11-A1	GND	GND
J11-A2	TX1+	NC
J11-A3	TX1-	NC
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	NC
J11-A9	VBUS	USBFS_cVBUS_CON
J11-A10	RX2-	NC
J11-A11	RX2+	NC
J11-A12	GND	GND
J11-B1	GND	GND
J11-B2	TX2+	NC
J11-B3	TX2-	NC
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	NC
J11-B9	VBUS	USBFS_cVBUS_CON
J11-B10	RX1-	NC
J11-B11	RX1+	NC
J11-B12	GND	GND
J11-S1	SHIELD	GND
J11-S2	SHIELD	GND
J11-S3	SHIELD	GND
J11-S4	SHIELD	GND

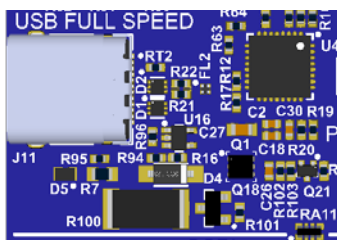


Figure 16. USB Full Speed Connector

5.5 Miscellaneous

5.5.1 User and Power LEDs

Six LEDs are provided on the EK-RA4L1 board.

Behavior of the LEDs on the EK-RA4L1 board is described in the following table.

Table 25. EK-RA4L1 Board LED Functions

Designator	Color	Function	MCU Control Port
LED1	Blue	User LED	P609
LED2	Green	User LED	P610
LED3	Red	User LED	P601
LED4	White	Power on indicator	+3.3 V
LED5	Yellow	Debug LED	J-Link OB MCU
LED6	White	MCU Power Available	MCU Power

The User LEDs may be isolated from the main MCU, so the associated ports can be used for other purposes. To separate LED1 from P609, trace cut jumper E27 must be open. To separate LED2 from P610, trace cut jumper E26 must be open. To separate LED3 from P601, trace cut jumper E28 must be open.

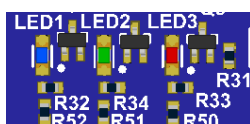


Figure 17. User LEDs



Figure 18. Power LED

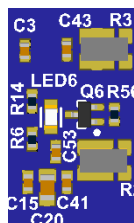


Figure 19. MCU Power LED

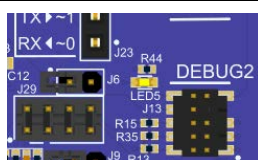


Figure 20. Debug LED

5.5.2 User and Reset Switches

Three miniature, momentary, mechanical push-button type SMT switches are mounted on the EK-RA4L1 board.

Pressing the reset switch (S3) generates a reset signal to restart the RA MCU.

Table 26. EK-RA4L1 Board Switches

Designator	Function	MCU Control Port	Button Color
S3	MCU Reset Switch	RESET#	Red
S2	User Switch	P001 (IRQ7)	Blue
S1	User Switch	P000 (IRQ6)	Blue

The user switches S1 and S2 may be isolated from the main MCU, so the associated ports can be used for other purposes. To separate S1 from P000, trace cut jumper E31 must be open. To separate S2 from P001, trace cut jumper E32 must be open.

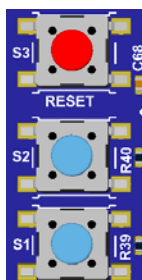


Figure 21. Reset and User Switches

5.5.3 MCU Boot Mode

A two-pin header (J16) is provided to select the boot mode (P201) of the RA MCU. For normal operation, or Single-Chip mode, leave J16 open. To enter SCI Boot mode or USB boot mode, place a jumper on J16.

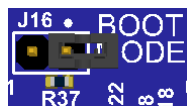


Figure 22. Boot Mode

6. Special Feature Access Area

The Special Feature Access area provides features specific to the RA4L1 MCU group such as Quad-SPI Flash and CAN FD.

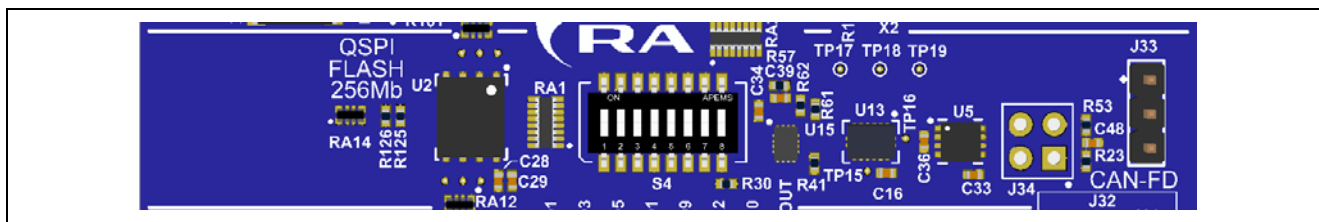


Figure 23. Special Feature Access Area

6.1 CAN FD Bus

The EK-RA4L1 board provides a CAN FD bus transceiver (MCP2562FD-E/MF) 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. Please note, during low power mode there will be no connection between CAN FD(U11) and RA MCU.

Table 27. CAN FD Bus Connections Between U5 and RA4L1

CAN FD Signal Description	EK-RA4L1 Port
RXD	P103
TXD	P102
STB	P106

Table 28. CAN FD Port Assignments

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

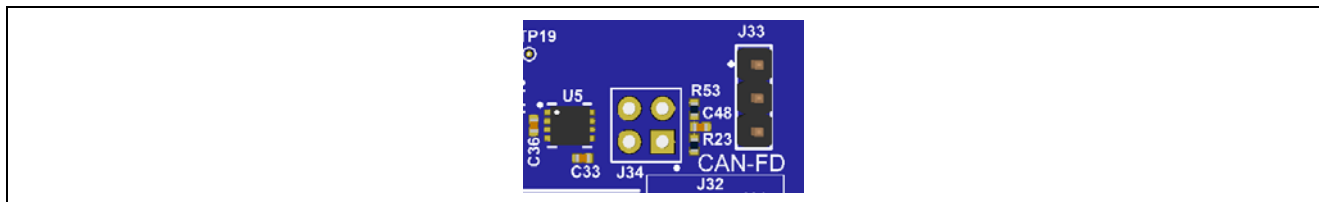


Figure 24. CAN FD Connector and Chip

6.2 Quad-SPI Flash

Included on the EK-RA4L1 board is a 256 Mb (32 MB) Quad-SPI serial flash memory (MX25L25645GZNI-08G). The Quad-SPI serial flash device (U2) connects to the Quad-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 29. Quad-SPI Flash Assignments

Quad-SPI Flash	EK-RA4L1
Description	Signal/Bus
QSPI_CS#	P501
QSPI_SCLK	P500
QSPI_SIO0/SI	P502
QSPI_SIO1/SO	P503
QSPI_SIO2/WP#	P504

Quad-SPI Flash	EK-RA4L1
Description	Signal/Bus
QSPI_SIO3/RESET#	P505
QSPI_VSS	GND
QSPI_VCC	+3.3 V

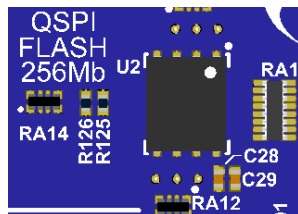


Figure 25. Quad-SPI Flash

6.3 Segment LCD Board Interface

The RA MCU supports interface to a Segment LCD Board at port J2. Table 30 shows the port assignments of the segment LCD board and its corresponding signals to the RA MCU.

Some ports used for the segment LCD board interface are also used by USB-FS interface. To use P407 for SLCD, leave J7 open and set pins 1-2 of J17. Improper connections may damage the SLCD display, use caution. Please note that when SLCD is in use, Arduino, Pmod 2 and mikroBus cannot be used.

Table 30. Segment LCD Board Interface Assignments

Segment LCD Board Port Assignments		EK-RA4L1
Pin	Description	Signal/Bus
J2-1	GND	GND
J2-2	GND	GND
J2-3	COM1	P205
J2-4	SEG44	NC
J2-5	COM2	P208
J2-6	SEG43	NC
J2-7	COM3	P304
J2-8	SEG42	NC
J2-9	COM4	P303
J2-10	SEG41	NC
J2-11	SEG1	NC
J2-12	SEG40	NC
J2-13	SEG2	NC
J2-14	SEG39	NC
J2-15	SEG3	NC
J2-16	SEG38	NC
J2-17	SEG4	NC
J2-18	SEG37	NC
J2-19	SEG5	NC
J2-20	SEG36	NC
J2-21	SEG6	NC
J2-22	SEG35	NC
J2-23	SEG7	NC
J2-24	SEG34	NC
J2-25	SEG8	NC
J2-26	SEG33	NC

Segment LCD Board Port Assignments		EK-RA4L1
Pin	Description	Signal/Bus
J2-27	SEG9	NC
J2-28	SEG32	P204
J2-29	SEG10	NC
J2-30	SEG31	P407
J2-31	SEG11	NC
J2-32	SEG30	P415
J2-33	SEG12	NC
J2-34	SEG29	P708
J2-35	SEG13	P115
J2-36	SEG28	P700
J2-37	SEG14	P608
J2-38	SEG27	P406
J2-39	SEG15	P209
J2-40	SEG26	P414
J2-41	SEG16	P113
J2-42	SEG25	P405
J2-43	SEG17	P211
J2-44	SEG24	P404
J2-45	SEG18	P210
J2-46	SEG23	P403
J2-47	SEG19	P600
J2-48	SEG22	P402
J2-49	SEG20	P107
J2-50	SEG21	P602

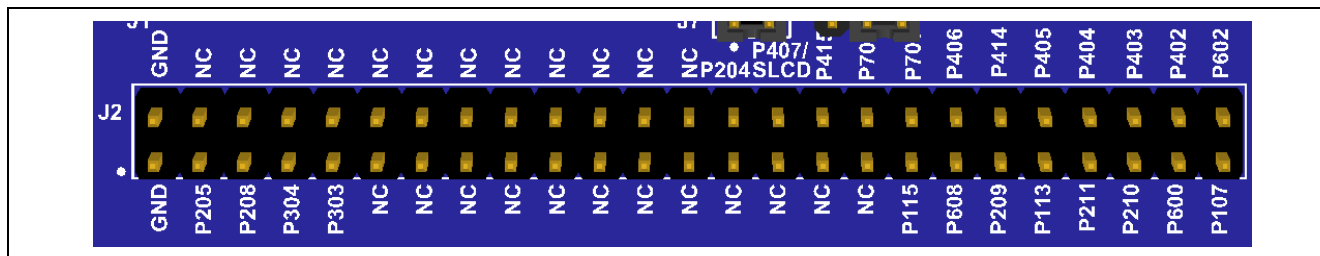


Figure 26. Segment LCD Board Port Connector

7. MCU Native Pin Access Area

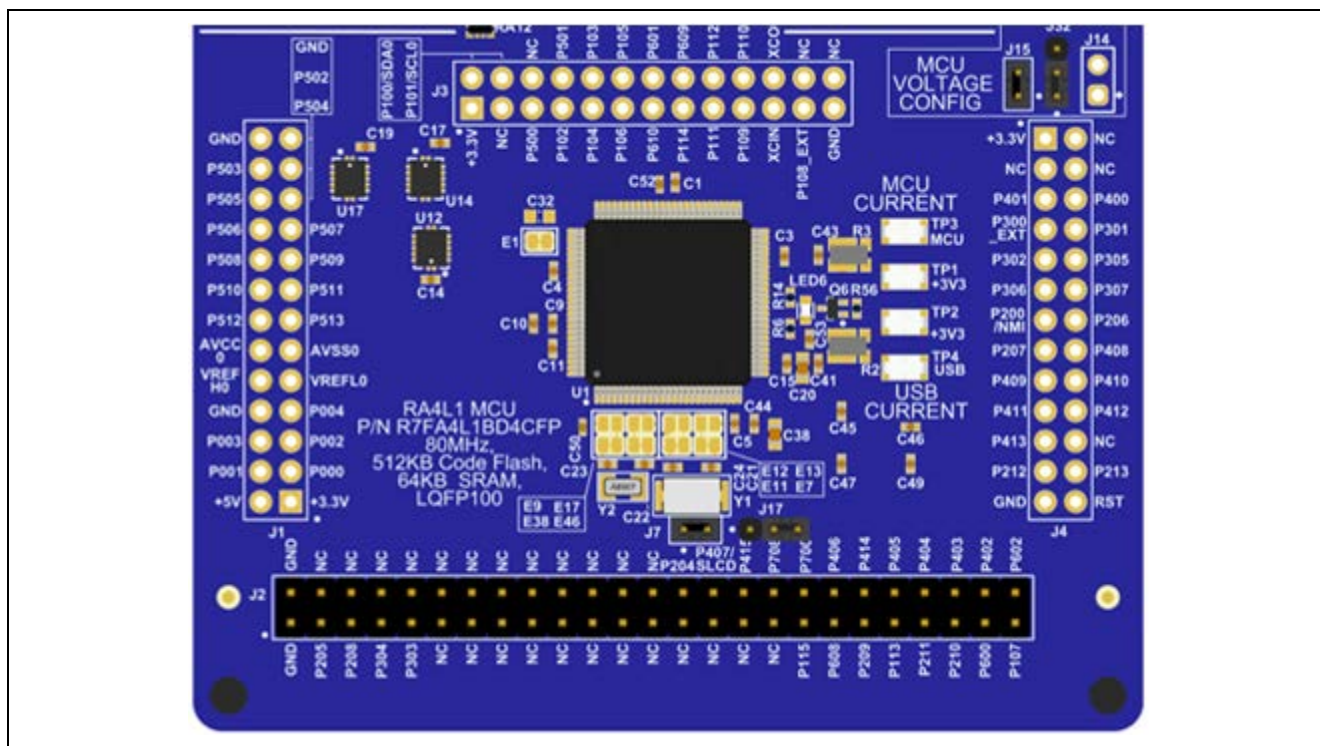


Figure 27. Native Pin Access Area

7.1 Breakout Pin Headers (not populated)

The EK-RA4L1 board pin header footprints, J1, J3, and J4 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 RA4L1 MCU Group User's Manual for details of each port function, and the EK-RA4L1 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-RA4L1 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 30 for the location of TP1, TP2, TP3 and TP4.

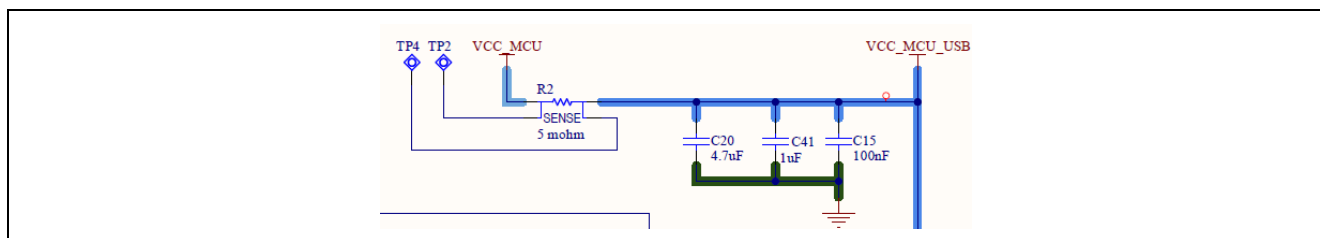


Figure 28. RA USB Current Measurement Circuit

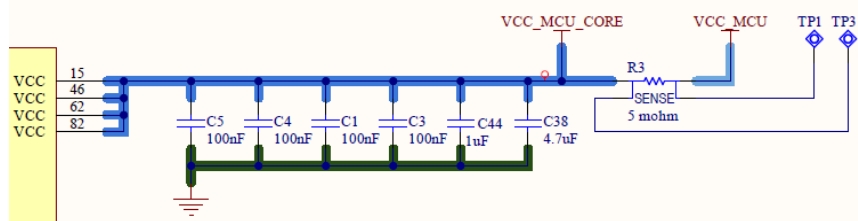


Figure 29. RA +3.3 V Current Measurement Circuit

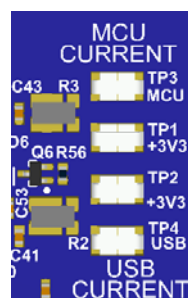


Figure 30. RA MCU and USB Current Measurement

8. Low Power Mode Operation

EK-RA4L1 supports operation in a low power mode by reducing the MCU voltage. A regulated voltage of at least +1.6 V can be supplied through J14 subject to the cautionary notes below.

CAUTION: Improper connections may damage the board and are not covered by manufacturer's warranty.

No over-voltage protection is provided on the VCC_EXT rail when providing an external supply.

The input voltage shall not exceed the minimum or absolute maximum ratings of the MCU.

The external supply shall be applied before or simultaneously with other external sources.

USB sources including debug USB shall not be connected unless the MCU is powered when in low power mode.

The following table summarizes the configuration to operate EK-RA4L1 in low voltage mode and normal mode.

Table 31. Configuration for Low Power Mode and Normal Operation

Jumper/Switch	Low Power Mode Operation	Normal Operation
J6-A	Open	Closed
J15	Open	Closed
J29	All pins open	Debug mode dependent (refer to Section 5.2)
J32	Jumper on pins 2-3	Jumper on pins 1-2

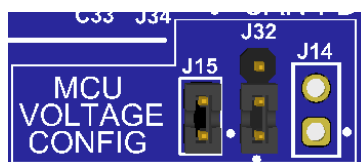


Figure 31. Low Power Input Location

9. Recommended Parts

Table 32 lists recommended part numbers for optional components that can be fitted as required.

Table 32. Part Numbers

Designator(s)	Description	Manufacturer	Part Number
J1, J3, J4	26-way male header	Sullins	PRPC013DAAN-RC
J21, J22	MikroElektronika mikroBUS™ connector	TE Connectivity AMP Connectors	5-535541-6
J27, J28	Seeed Grove® system connector	Seeed Studio	110990037
J30	SparkFun Qwiic® connector	JST	SM04B-SRSS-TB-LFSN

10. Certifications

The EK-RA4L1 v1 kit meets the following certifications/standards. See page 3 of this user's manual for the disclaimer and precautions.

10.1 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 required 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 required 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

10.2 Material Selection, Waste, Recycling and Disposal Standards

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

10.3 Safety Standards

- UL 94V-0

11. Design and Manufacturing Information

The design and manufacturing information for the EK-RA4L1 v1 kit is available in the “EK-RA4L1 v1 Design Package” available on renesas.com/ek-ra4l1.

- Design package file name: ek-ra4l1kit-v1-designpackage.zip
- Design package contents:
 1. EK-RA4L1 Board design package: ek-ra4l1-v1-designpackage.zip
 2. Segment LCD Board design package: slcd-v1-designpackage.zip

Table 33. EK-RA4L1 Board Design Package Contents

File Type	Content	File/Folder Name
File (PDF)	Schematics	ek-ra4l1-v1-schematics
File (PDF)	Mechanical Drawing	ek-ra4l1-v1-mechdwg
File (PDF)	3D Drawing	ek-ra4l1-v1-3d
File (PDF)	BOM	ek-ra4l1-v1-bom
Folder	Manufacturing Files	Manufacturing Files
Folder	Design Files	Design Files-Altium

Table 34. Segment LCD Board Design Package Contents

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

12. 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-RA4L1 Resources	renesas.com/ek-ra4l1
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

Revision History

Rev.	Date	Description	
		Page	Summary
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1.01	Jan.27.25	6,7,9,11,34	Updated figures

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