User's Manual

RA6M2 Group

Evaluation Kit for RA6M2 Microcontroller Group
EK-RA6M2 v1
User's Manual

Renesas RA Family
RA6 Series

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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 Microcontrollers

EK-RA6M2 v1 – User's Manual

Contents

1. Kit Overview

The EK-RA6M2 v1 enables developers to get started with initial firmware development.

- Renesas RA6M2 Microcontroller Group
  - R7FA6M2AF3CFB
  - 144-pin LQFP package
  - 120 MHz Arm® Cortex®-M4 core with Floating Point Unit (FPU)
  - 384 KB SRAM
  - 1 MB code flash memory
  - 32 KB data flash memory
- Connectivity
  - A Device USB connector for the Main MCU
  - SEGGER J-Link® On-Board (OB) interface for debugging and programming of the RA6M2 MCU. A 10-pin JTAG/SWD interface is also provided for connecting optional external debuggers and programmers.
  - Two PMOD connectors, allowing use of appropriate PMOD compliant peripheral plug-in modules for rapid prototyping
  - Pin headers for access to power and signals for the Main MCU
- Multiple clock sources
  - Main MCU oscillator crystals, providing precision 12.000 MHz and 32,768 Hz external reference clocks
  - Additional low-precision clocks are available internal to the Main MCU
- MCU reset push-button switch
- MCU boot configuration jumper
- General purpose I/O ports
  - One jumper to allow measuring of Main MCU current
  - Copper jumpers on PCB bottom side for configuration and access to selected MCU signals
- Operating voltage
  - External 5 V input through the Debug USB connector supplies the on-board power regulator to power logic and interfaces on the board. Alternatively, 5 V or 3.3 V may be supplied through alternate locations on the board.
- A two-color board status LED indicating availability of regulated power and connection status of the J-Link interface
- A red User LED, controlled by the Main MCU firmware
- A User Push-Button switch, User Capacitive Touch Sensor (button), and an optional User Potentiometer, all are controlled by the Main MCU firmware

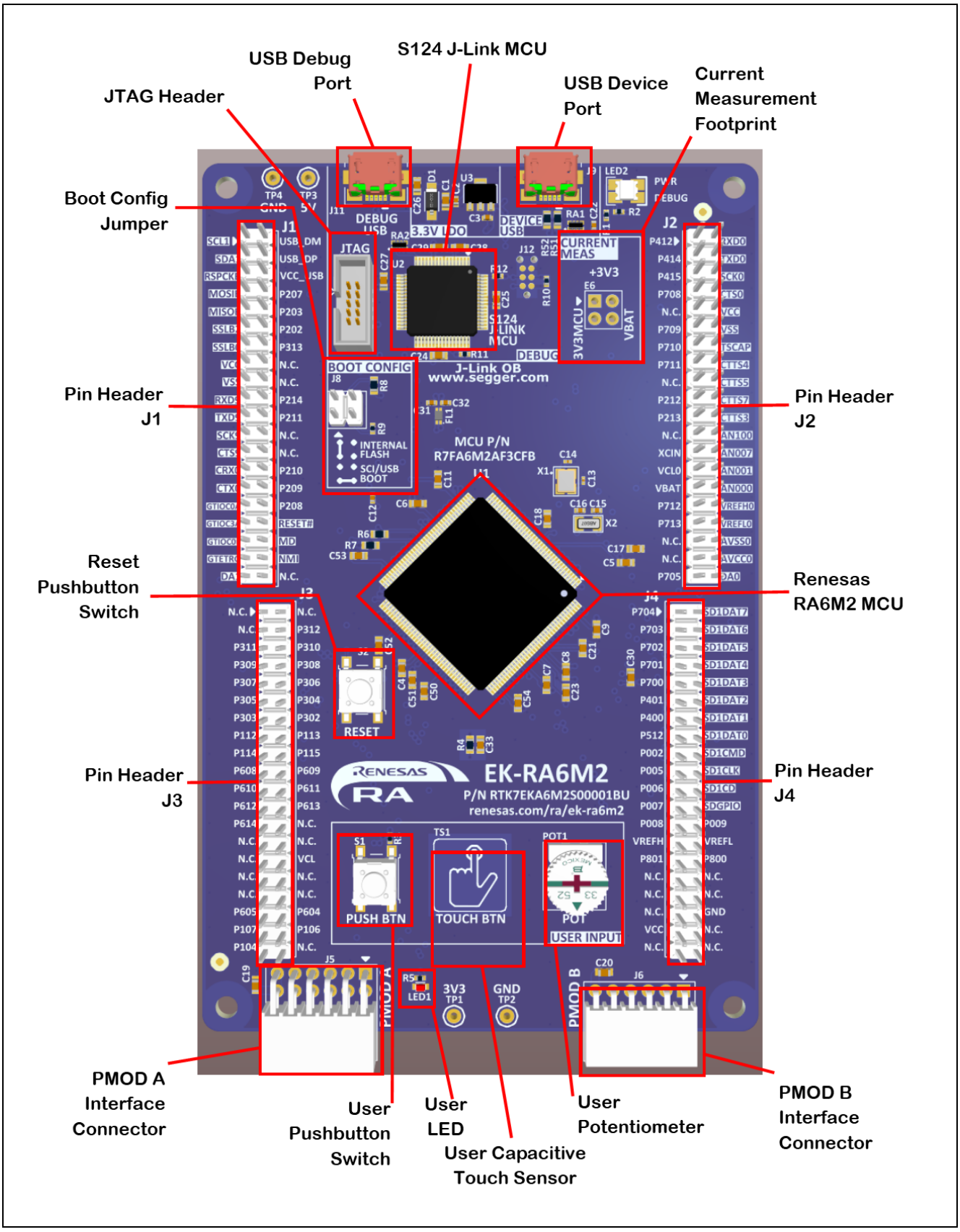


Figure 1. EK-RA6M2 v1 Top Side

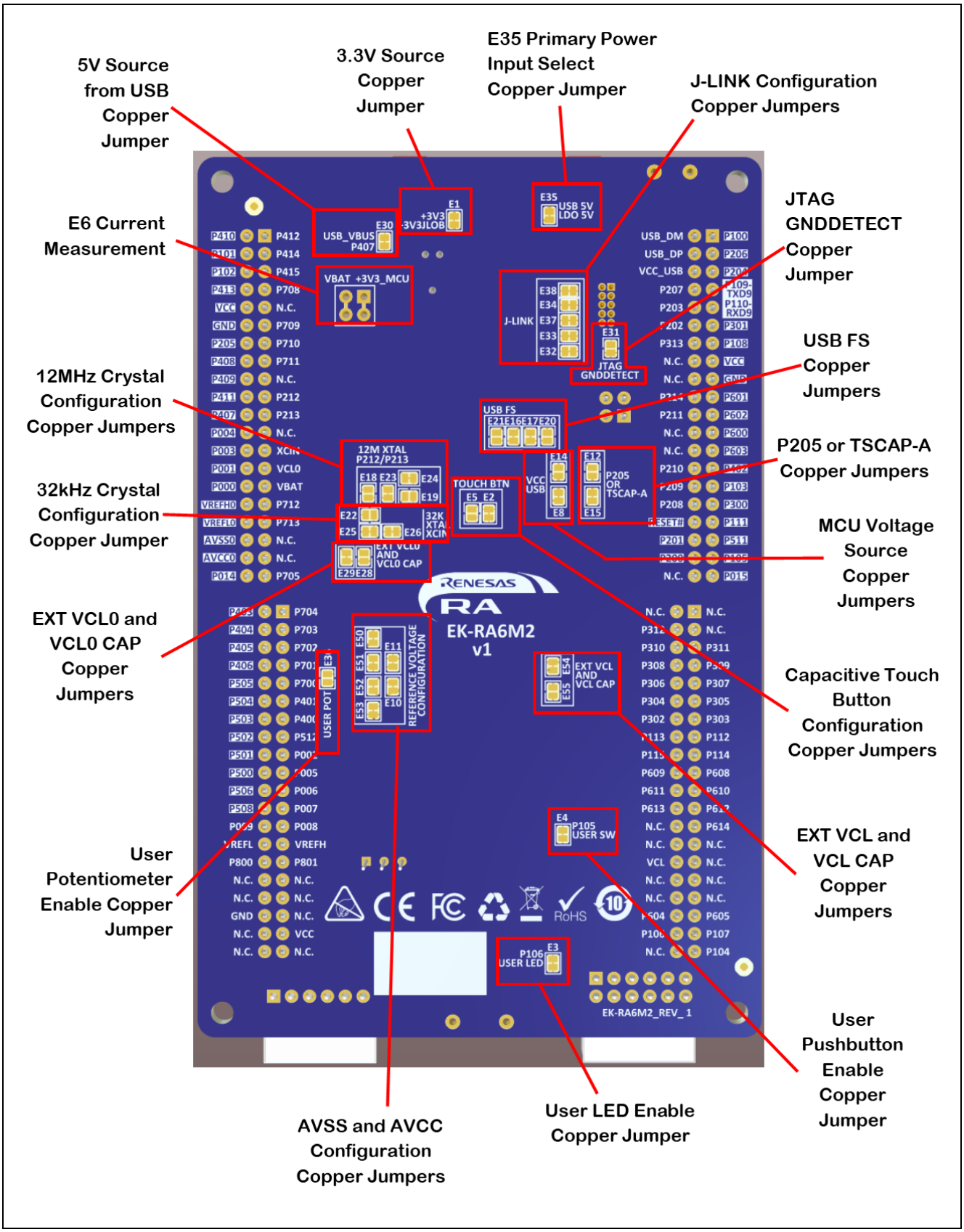


Figure 2. EK-RA6M2 v1 Bottom Side

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 refer to the *EK-RA6M2 - Quick Start Guide* to become acquainted with the kit and the Quick Start example the EK-RA6M2 comes preprogrammed with.
3. Flexible Software Package (FSP) and Integrated Development Environment (IDE) such as e^2 studio are required to develop embedded applications on EK-RA6M2. Instructions to download and install software are provided in the Quick Start Guide.
4. Additionally, the instructions to import example projects, build them and program the EK-RA6M2 are also provided in the Quick Start Guide.

2. Kit Contents

The following components are included in the kit:

1. One EK-RA6M2 board
2. One USB Type-A to Micro-B cable

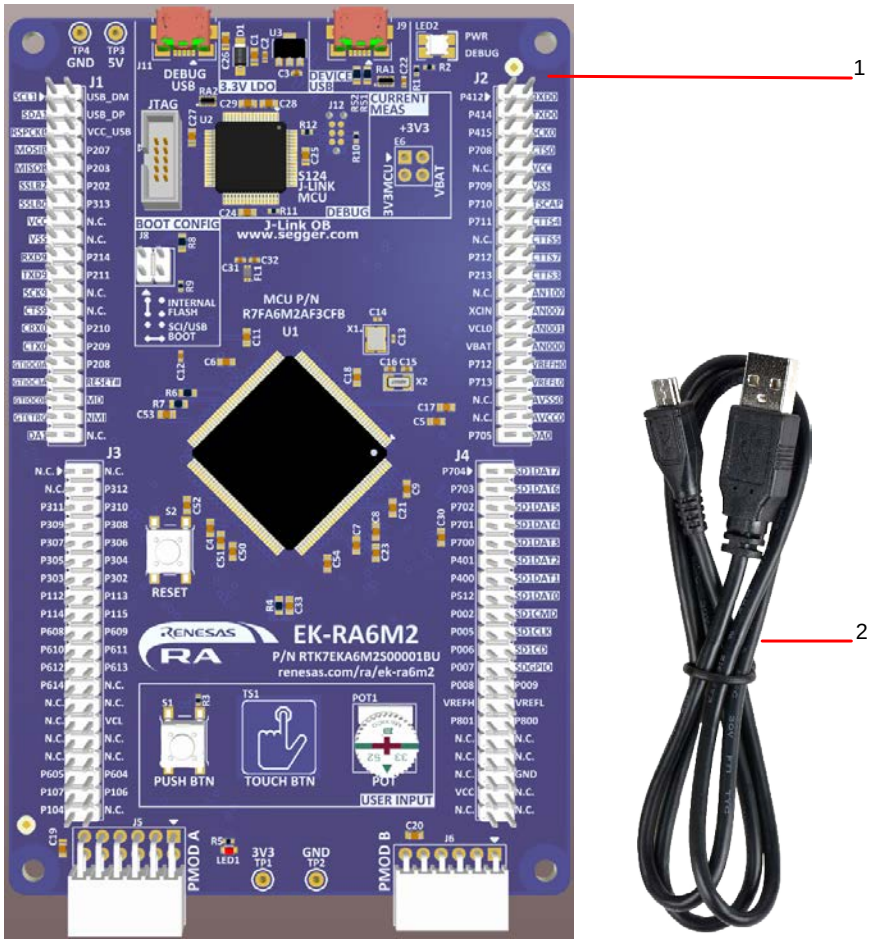


Figure 3. EK-RA6M2 v1 Kit Contents

3. Ordering Information

EK-RA6M2 Orderable Part Number: RTK7EKA6M2S00001BU

4. Hardware Details

4.1 Jumpers Settings

4.1.1 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.

The silk screen overlay printing around a solder-bridge jumper is a box with a gap in the lines adjacent to the isolation region between the pads.

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).

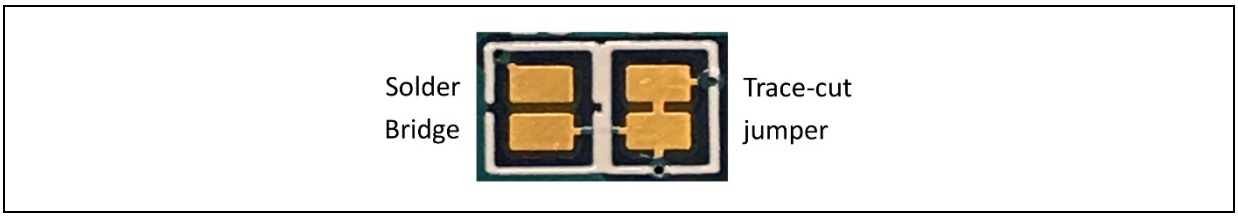


Figure 4. Copper Jumpers

4.1.2 Default Board Configuration

The following table describes the default settings for each jumper on the EK-RA6M2. This includes traditional pin jumpers (J*x* designation) and copper jumpers (E*x* designation).

The Circuit Group for each jumper is the designation found in the board schematic. See section 7, Design and Manufacturing Information. Functional details for many of the listed jumpers may be found in section 5.4, Connectivity and Settings and section 5.6, Additional Features.

Table 1. Default Jumper Settings

Location	Circuit Group	Default Open/Closed	Function
J8	MCU Mode Config	Jumper on pins 1-2	Sets the MCU Mode to boot from Internal Flash
E18	12M XTAL	Open	Connects signal P213 to MCU
E19		Open	Connects signal P212 to MCU
E23		Closed	Connects 12.000 MHz Crystal to MCU
E24		Closed	Connects 12.000 MHz Crystal to MCU
E1	3.3 V Linear Regulator	Closed	Alternate 3.3V source (+3V3JLOB)
E22	32K XTAL	Open	Connects signal P215 to MCU
E25		Closed	Connects 32.768 kHz Crystal to MCU
E26		Closed	Connects 32.768 kHz Crystal to MCU
E2	Capacitive Touch-Button	Closed	Enable/Disable Capacitive Touch-Button
E5		Open	Connects signal P207J to Capacitive Touch-Button

Location	Circuit Group	Default Open/Closed	Function
E54	EXT VCL and VCL CAP	Closed	Connects MCU VCL to a capacitor
E55		Open	Connects MCU VCL to the VCL signal
E28	EXT VCL0 and VCL0 CAP	Open	Connects VCL to MCU
E29		Closed	Connects MCU pin 15 (VCL) to capacitor
E32	J-Link	Closed	Connects the S124 MCU to the J-Link signal JLED
E33		Closed	Connects the S124 MCU to the J-Link signal RESET#
E34		Closed	Connects the S124 MCU to the J-Link signal TDO(/SWO) P109
E37		Closed	Connects the S124 MCU to the J-Link signal P108/SWDIO
E38		Closed	Connects the S124 MCU to the J-Link signal P300/SWCLK
E35	J-Link® OB USB	Closed	Connects the J-Link OB USB 5V input to the primary 5V->3.3V voltage regulator
E31	JTAG Connector	Open	JTAG Ground Detect. Connects the JTAG connector pin 9 to Ground.
E10	MCU VREF	Closed	Connects AVCC0 to +3V3MCU
E11		Closed	Connects AVSS0 to Ground
E50		Closed	Connects VREFH0 to +3V3MCU
E51		Closed	Connects VREFL0 to Ground
E52		Closed	Connects VREFH to +3V3MCU
E53		Closed	Connects VREFL to Ground
E12	P205 or TSCAP-A	Open	Connects MCU pin 43 to signal P205
E15		Closed	Connects MCU pin 43 to capacitor
E30	USB Device Interface	Closed	Connects the Device USB 5V input to the MCU
E16	USB FS	Closed	Connects MCU pin 38 to signal USB_N
E17		Closed	Connects MCU pin 39 to signal USB_P
E20		Open	Connects MCU pin 39 to signal USBPH_P
E21		Open	Connects MCU pin 38 to signal USBPH_N
E3	User LED	Closed	Enable/Disable User LED
E36	User Potentiometer	Open	Enable/Disable User Potentiometer
E4	User Push-Button	Closed	Enable/Disable User Push-Button switch
E6	VBAT +3V3_MCU	Closed	Dual Jumper. Pins 1-3 connect +3V3 to +3V3MCU. Pins 2-4 connect +3V3 to VBAT.
E14	VCC USB	Open	Connects VCC_USB to MCU pin 40
E8		Closed	Connects +3V3MCU to MCU pin 40

5. Hardware Layout

5.1 System Block Diagram

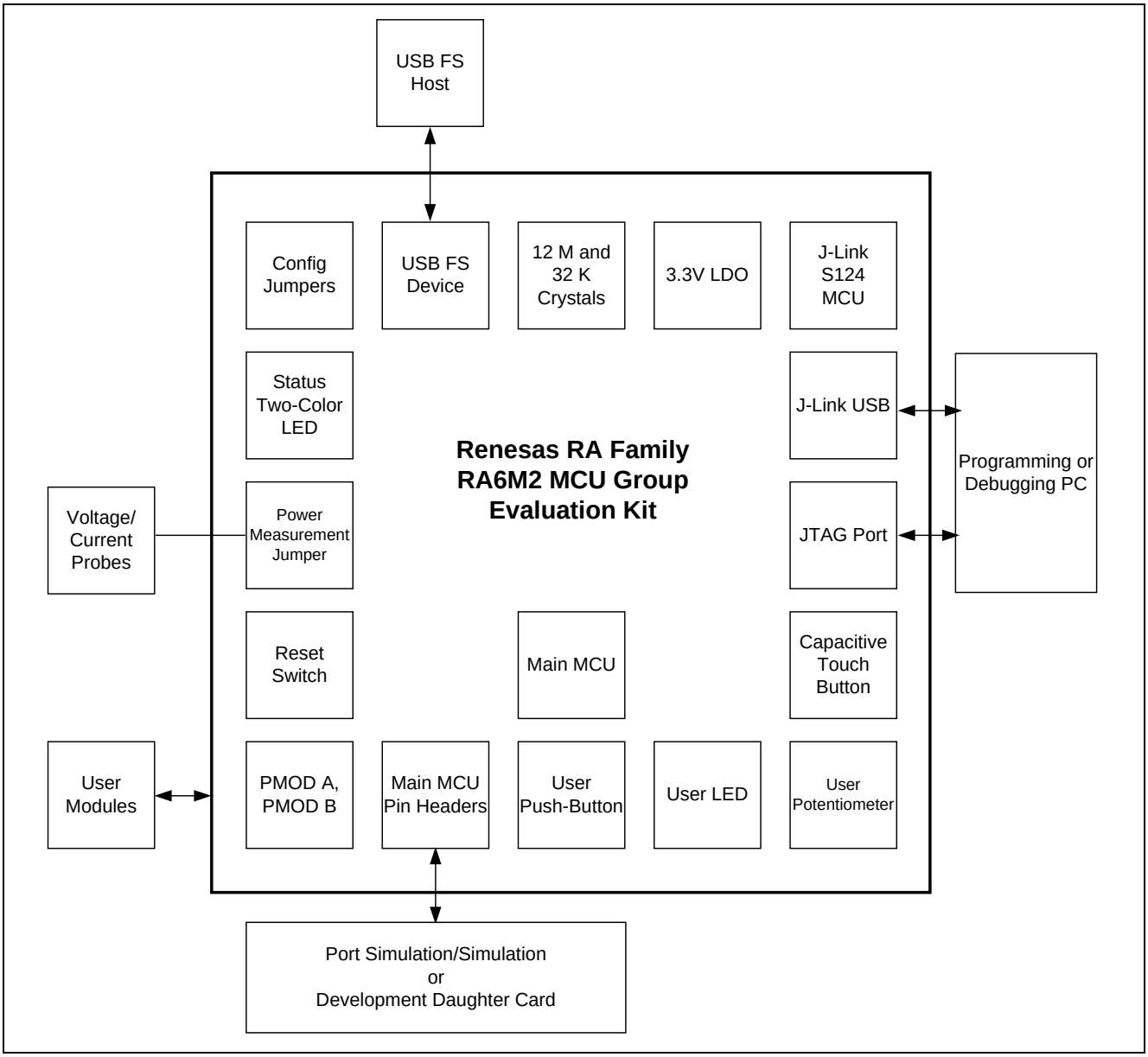


Figure 5. EK-RA6M2 Block Diagram

5.2 Power Requirements

EK-RA6M2 is designed for 3.3 V operation. This also means that 5 V PMOD devices cannot be used together with the EK-RA6M2 unless they are powered separately.

The total current available from the LDO regulator for all connected circuits is 600 mA or less, depending on the 5 V power source used.

5.2.1 Power Supply Options

EK-RA6M2 board can be powered in several different ways as described in this section.

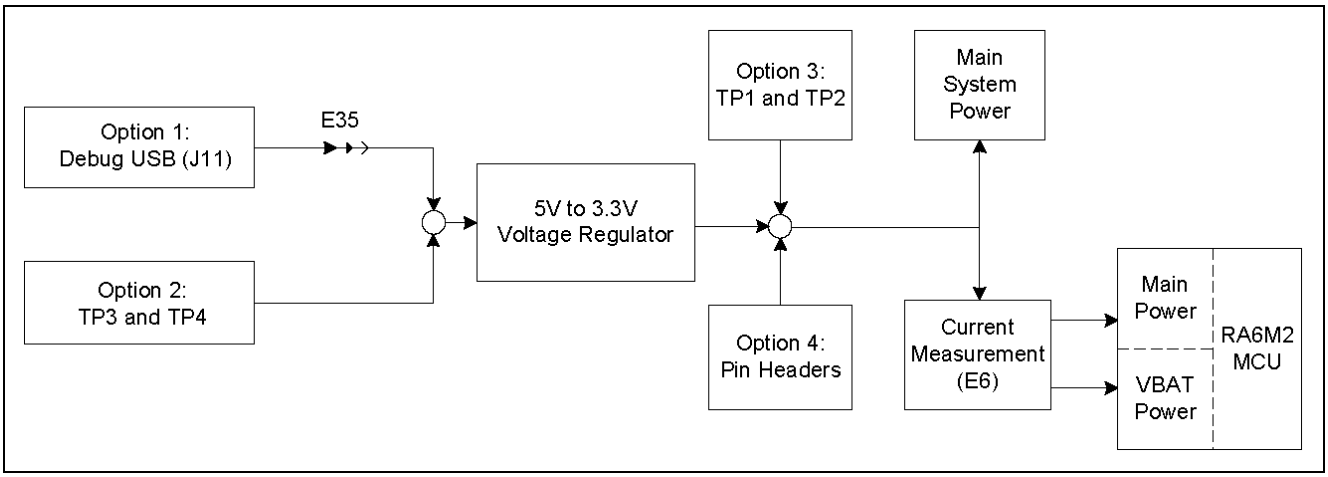
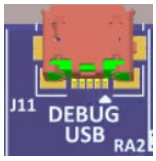


Figure 6. Power Supply Options

5.2.1.1 Option 1: Debug USB (default)



The default power source is 5 V, supplied from an external USB host to the USB Debug connector labelled **DEBUG USB** on the top surface of the board. A low drop-out regulator (LDO) is used to convert the 5 V signal to 3.3 V, which then is used to power the MCU and any connected devices.

Copper jumper E35 selects the source for the primary power input to the LDO regulator. By default, this jumper is configured to provide power through the Debug USB connector. Copper jumper E35 is closed for this configuration.

5.2.1.2 Option 2: Test Points TP3 and TP4

The EK-RA6M2 board can also be powered by installing a 5 V power source across TP3 (positive input) and TP4 (negative input). Copper jumper E35 must be opened to enable powering the board using these test points.

The on-board Low Dropout Regulator (see section 5.3, Main Components) has an input voltage range of +3.3 V to +5.5 V, and a built-in current limit of 600 mA. Make sure that any external power source connected to TP3 and TP4 meets these requirements.

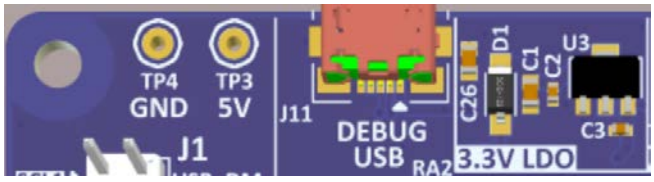


Figure 7. USB Debug Connector (J11), TP3, and TP4 on the Evaluation Kit Board

5.2.1.3 Option 3: Test Points TP1 and TP2

The EK-RA6M2 board can also be powered by installing a 3.3 V source across TP1 (positive input) and TP2 (negative input). Copper jumper E35 must be open to enable powering the board using these test points.

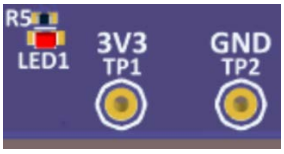


Figure 8. TP1, TP2, and LED1 on the Evaluation Kit Board

These test points supply voltage directly to the RA6M2 MCU, the S124 J-Link MCU, and other on-board circuitry. Use caution to ensure that any voltage connected in this manner meets the power requirements for the active features. Power sources that are

outside of the published operating range for the active devices may cause degraded performance or damage the board.

5.2.1.4 Option 4: Pin Headers

EK-RA6M2 board can also be powered through the following pin-headers.

- J1 (pin J1-15 for +3.3 V, pin J1-17 for Return)
- J2 (pin J2-10 for +3.3 V, pin J2-12 for Return)
- J4 (pin J4-37 for +3.3 V, pin J4-36 for Return)

Copper jumper E35 must be open for any of these configurations.

The pin headers supply voltage directly to the RA6M2 MCU, the S124 J-Link MCU, and other on-board circuitry. Use caution to ensure that any voltage connected in this manner meets the power requirements for the active features. Power sources that are outside of the published operating range for the active devices may cause degraded performance or damage the board.

See section 5.5, Pin Headers for more information on the Pin Headers.

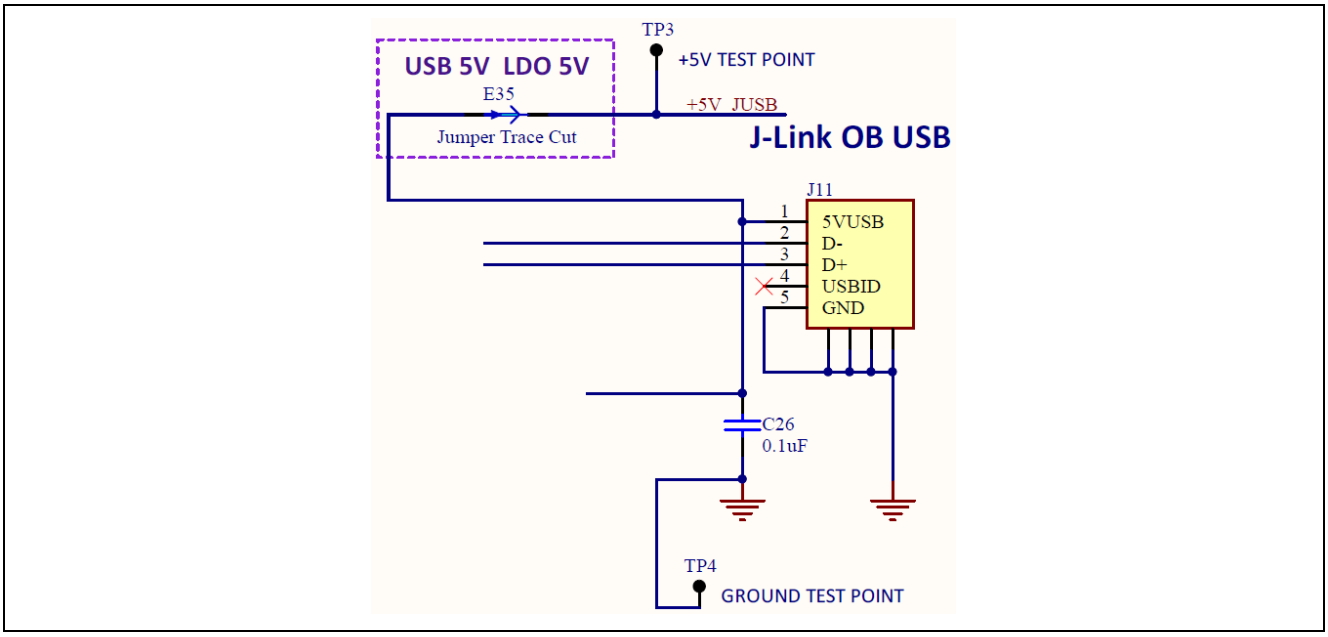


Figure 9. 5 V Power Input Circuit

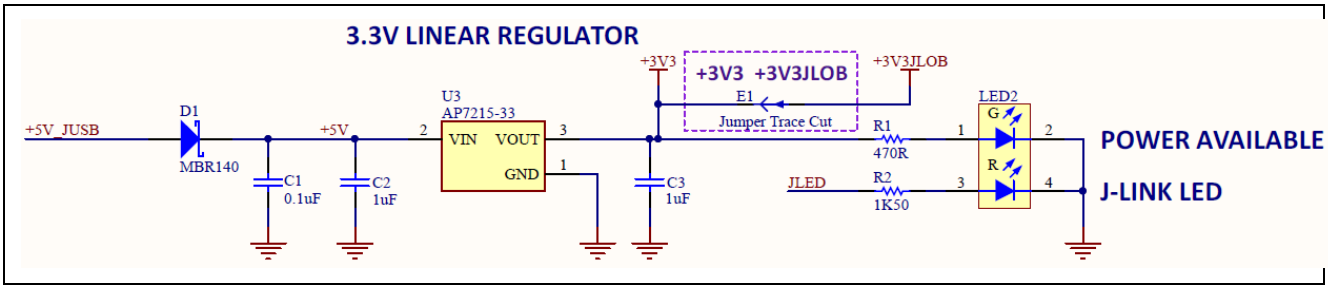


Figure 10. 3.3 V Power Regulator Circuit

5.2.2 Powering up the Board

When powered, the green LED to the right of the DEVICE USB connector (LED2) lights up.

The red LED in the same LED package functions as a status indicator for the J-Link® On-Board (OB) debug interface on the board. If both LEDs in the LED2 package are lit, LED2 appears orange.

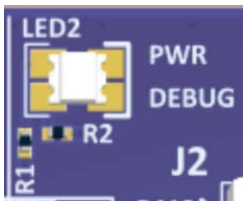


Figure 11. LED2 on the Evaluation Kit Board (Top Side)

5.2.3 Battery Supply Configuration

An external battery may be connected according to the methods outlined in section 5.2.1, Power Supply Options, providing that it meets the minimum voltage and current requirements.

Additionally, an external battery source may be connected to VBAT at Pin Header location J2-29 (J2-12 ground return) to maintain the MCU Realtime Clock (RTC) when other main power sources are disconnected from the EK-RA6M2 board.

5.2.4 Measuring Current Consumption

Pads 1 and 3 of the copper jumper E6, which is a dual trace-cut jumper, allow measurement of +3V3 MCU supply current. Pads 2 and 4 of E6 allow measurement of VBAT supply current. Both traces are connected by default. These traces should be cut to enable power measurement. Care must be taken when cutting the trace to not cause damage to PCB layers below the trace.

The actual current consumed by the RA6M2 MCU is dependent on many factors, including ambient temperature, internal clock speed, input voltage level, and device activity. The actual current consumed by the MCU can vary from less than 1 mA to nearly 40 mA. For more information on the electrical characteristics of the MCU, see the *RA6M2 Microcontroller Group User's Manual*.

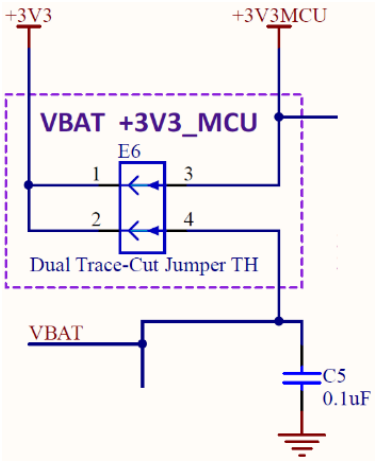


Figure 12. MCU Current Measurement Circuit

Figure 13. E6 on the Evaluation Kit Board (Top side)

Figure 14. E6 on the Evaluation Kit Board (Bottom side)

Once the shorting traces have been removed, there are several options to measure current:

- Pins can be installed that allow connection of a precision multi-meter or bench meter, or leaded current shunt to allow oscilloscope or data logger connection. When not measuring the current, this allows easily installed and removed shunts to be used to short the jumper terminals.
- Another option is to install current sense resistors between pads 1 and 3 for +3V3 MCU, and between pads 2 and 4 for VBAT. Precision non-inductive film or foil resistors are recommended for use in this application, and the value of each resistor should be carefully considered.

  For example, if the expected current requirement for the +3V3 MCU supply voltage is 10 mA, and the user would expect to measure a 10 mV drop across the current measurement resistor, then a 1.0-ohm resistor should be selected and installed.

  The actual value selected should be based on the operating conditions of the MCU for the specific user application, and the sensitivity of the measurement equipment used.

5.3 Main Components

- Main MCU
  - Renesas RA6M2 MCU device, part number R7FA6M2AF3CFB (U1)
- J-Link MCU
  - Renesas Synergy™ S124 MCU device, part number R7FS124773A01CFM#AA0 (U2)
- USB Connectors
  - FCI, part number 10118192-0001LF (J9, J11)
    - Micro USB 2.0 Female connector
    - Primary communication with Main MCU and J-Link MCU
- Push-Buttons
  - C&K, part number PTS645SM43SMTR92 LFS (S1, S2)
    - Momentary push-button switch
    - Used for system reset and user defined functions
- LDO Regulator
  - Diodes Inc., part number AP7215-33YG-13 (U3)
    - Low-drop out linear regulator
    - Generates system 3.3 V from J-Link USB 5 V input
- PMOD A Connector
  - Samtec, part number SSW-106-02-F-D-RA (J5)
    - 12-pin right angle connector for PMOD A
- PMOD B Connector
  - Samtec, part number SSW-106-02-FM-S-RA (J6)
    - 6-pin right angle connector for PMOD B
- Pin Headers
  - Sullins, part number PRPC020DAAN-RC (J1, J2, J3, J4)
    - 40 position pin header, 0.1” pitch
    - Provides signal breakout and access for Main MCU signals
- System LED
  - Dialight, part number 598-8610-207F (LED2)
    - Dual color red/green LED
    - System status indicator for power and J-Link status

- User LED
  - Lite-On, part number LTST-C191KRKT (LED1)
    - User defined
    - Single color red LED as needed for user environment
- User Potentiometer
  - Bourns, part number 3352T-1-1-3LF (POT1)
    - User defined
    - Provides variable resistance as needed for user environment
    - Not populated by default

5.4 Connectivity and Settings

Throughout this section, feature configuration using copper jumpers is described. See section 4.1.1, Copper Jumpers for information on using copper jumpers.

5.4.1 Device USB

The DEVICE USB Micro-B connection jack connects the Main MCU to an external USB Host, FS capable, allowing communications for testing and use of the Main MCU firmware. Power for the Evaluation Kit cannot be received from this connector. The DEVICE USB interface can detect the presence of power from the USB Host PC. USB Host power received at the DEVICE USB interface is not connected to the 5 V power bus.

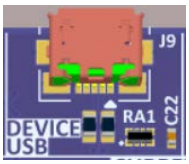


Table 2. DEVICE USB Connector (J9)

USB Device Connector		**EK-RA6M2**
Pin	**Description**	**Signal/Bus**
1	+5VDC, connected to a sense voltage 2/3 divider to allow Main MCU sensing of Host presence	+5VUSB P407/USB_VBUS = 2/3(5VUSB)
2	Data-	P915/USB_DM
3	Data+	P914/USB_DP
4	USB ID, jack internal switch, cable inserted	N.C.
5	Ground	GND

USB FS copper jumpers E16, E17, E20, and E21 configure the connection between the Device USB jack and the Main MCU. To allow use of the Device USB jack, copper jumper E16 and E17 must be closed, and copper jumpers E20 and E21 must be open.

USB_VBUS copper jumper E30 configures P407 as a VBUS power detector. E30 is closed by default to enable Device USB detection. To use P407 for any other purpose, E30 should be open.

VCC USB copper jumpers E8 and E14 configure the source for the VCC USB power. To provide VCC_USB from +3V3MCU, E8 must be closed. To isolate VCC_USB from +3V3MCU, E8 must be open. To source +3V3MCU power from J1, or to monitor VCC_USB voltage from J1, E14 pads must be closed, otherwise, E14 should be left open.

The VCC_USB pin on the MCU (pin 40) is used to detect the presence of a USB connection.

Table 3. USB Source Copper Jumper Settings

Copper Jumper	USB Signal Source		
	Device USB Micro-B Connector	MCU Pin Header	Function
E16	Closed	Open	USB N signal to MCU
E17	Closed	Open	USB P signal to MCU
E8	Closed	Open	+3V3MCU to MCU VCC_USB
E30	Closed	Open	Connect USB 5V to MCU P407
E20	Open	Closed	USB P signal to MCU
E14	Open	Closed	USB Micro-B 3.3V to MCU VCC_USB
E21	Open	Closed	USB N signal to MCU

P407 is also used by the Capacitive Touch interface.

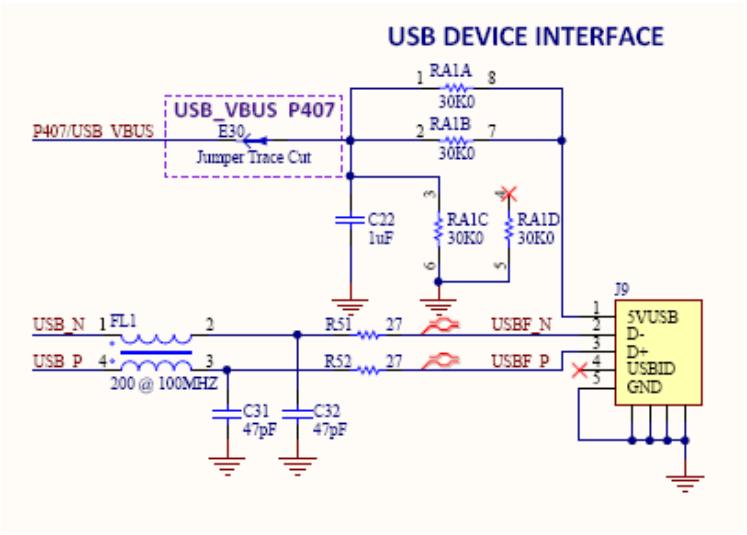
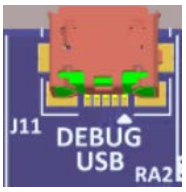


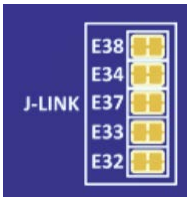
Figure 15. USB Device Interface Circuit

5.4.2 Debug USB



The DEBUG USB Micro-B connection jack connects the S124 J-Link MCU to an external USB Host, FS capable, allowing re-programming and debugging of the Main MCU firmware. Power for the Evaluation Kit may be received from this connector.

The J-Link® OB interface is multiplexed with the JTAG interface, and can collectively be referred to as the Programming Interface. While the J-Link OB interface and the JTAG interface do not conflict, the J-Link OB signals may be isolated from the programming interface by changing the associated copper jumpers.



J-Link Disconnect Copper Jumpers E32, E33, E34, E37, and E38, connect the J-Link signals to the MCU programming interface. To isolate the J-Link signals from the JTAG interface, the copper jumpers must be open. To allow use of the J-Link interface, each copper jumper must be closed.

J-Link MCU Power Copper Jumper, E1, connects the main +3.3 V power to the J-Link +3.3 V power. The default condition for E1 is closed, which connects the J-Link MCU power to the main +3.3 V power. If J-Link signals are disconnected, the power to the J-Link MCU should also be removed by changing E1 to open.

Table 4. DEBUG USB Connector (J11)

DEBUG USB Connector		EK-RA6M2
Pin	**Description**	**Signal/Bus**
1	+5VDC	+5V_JUSB
2	Data-	U2 USB_DM (U2-18)
3	Data+	U2 USB_DP (U2-19)
4	USB ID, jack internal switch, cable inserted	N.C.
5	Ground	GND

Three of the J-Link ports (P108, P109, and P300) are multiplexed with the SPI Fixed Pin Function on pin header J1. To use these signals for the SPI function, the J-Link debug function must be disabled. Details of the multiplexed signals are shown in the following table.

Table 5. J-Link Interface Conflicts

Programming Interface		Conflicting Interface	
Port	**Use**	**Interface**	**Use**
P108	SWDIO/JTAG TMS	SPI	SSLB0 fixed function, J1-13
P109	SWO/JTAG TDO	SPI	MOSIB fixed function, J1-7
P300	SWCLK/JTAG TCK	GPT	GTIOC0A fixed function, J1-31

5.4.3 JTAG/SWD

A 10-pin Cortex® Debug Connector is provided at J10.

Table 6. JTAG Connector (J10)

JTAG Connector			EK-RA6M2
Pin	**JTAG pin name**	**SWD pin name**	**Signal/Bus**
1	VTref	VTref	+3V3
2	TMS	SWDIO	U1 P108/SWDIO (U1-51)
3	GND	GND	GND
4	TCK	SWCLK	U1 P300/SWCLK (U1-50)
5	GND	GND	GND
6	TDO	SWO	U1 P109 (U1-52)
7	Key	Key	N.C.
8	TDI	NC/EXTb	U1 P110 (U1-53)
9	GNDDetect	GNDDetect	N.C. (short E31 to connect to GND)
10	nSRST	nSRST	U1 RESET# (U1-38)

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

The J-Link MCU Power Copper Jumper and J-Link Disconnects Copper Jumpers may be open for proper operation of the JTAG interface to prevent interactions with the J-Link MCU. See section 5.4.2, Debug USB for details.

If a JTAG adapter that properly interprets the Arm® Cortex 10-pin Debug Connector assignment of pin 9 to GND is in use, the JTAG GNDDetect copper jumper E31 should be closed. If the JTAG adapter used is one of several that may be confused or damaged by the presence of GND at pin 9, E31 should be open (as shipped).

The J-Link® OB interface is multiplexed with the JTAG interface, and can collectively be referred to as the Programming Interface. While the J-Link® OB interface and the JTAG interface do not conflict, the J-Link® OB signals may be isolated from the programming interface by changing the copper jumpers as described in section 5.4.2, Debug USB.

Four of the JTAG ports (P108, P109, P110, and P300) are multiplexed with the SPI Fixed Pin function on pin header J1. To use these signals for the SPI function, the J-Link debug function must be disabled. Details of the multiplexed signals are shown in the following table.

Table 7. JTAG Interface Conflicts

Programming Interface		Conflicting Interface	
Port	**Use**	**Interface**	**Use**
P108	TMS/J-Link SWDIO	SPI	SSLB0_B fixed function, J1-13
P109	TDO/J-Link SWO	SPI	MOSIB_B fixed function, J1-7
P110	TDI	SPI	MISOB_B fixed function, J1-9
P300	SWCLK	GPT	GTIOC0A_A fixed function, J1-31

5.4.4 LEDs

Two LEDs are provided on the EK-RA6M2 board. U1 is the Main MCU, and directly controls LED1. See Figure 8 for LED1 location, Figure 11 for LED2 location, and Figure 10 for LED2 circuit. U2 is the J-Link MCU, and it controls the red LED in LED2.

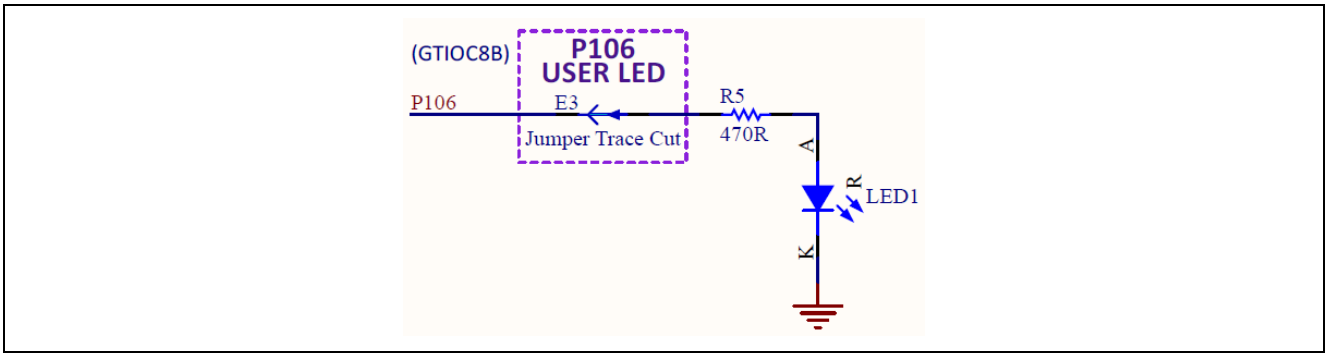


Figure 16. LED1 Control Circuit

The behavior of the LEDs is described in the following table.

Table 8. LED Functions on the Evaluation Kit

Designator	Color	Function	MCU Control Port	MCU Pin
LED1	Red	User LED	U1 P106	U1-102
LED2	Red	J-Link Indicator	JLED (U2 P103)	U2-45
LED2	Green	3.3 V Power Available	+3V3	N.A.

To disconnect the User LED from the MCU signal P106, the copper jumper E3 must be open.

5.4.5 Switches

Two miniature, momentary, mechanical push-button type SMT switches are mounted on the EK-RA6M2 board. Pressing the RESET Switch generates a reset signal to restart the Main MCU.

To disconnect the User Switch from the MCU signal P105/IRQ0, copper jumper E4 must be open.

Table 9. Switches on the Evaluation Kit

Designator	Function	MCU Control Port	MCU Pin
S1	User Switch	U1 P105/IRQ0	U1-103
S2	MCU Reset Switch	RESET#	U1-55

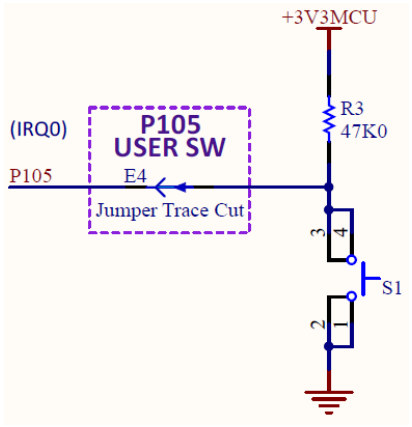


Figure 17. User Switch Circuit

Figure 18. User Switch (S1) on the Evaluation Kit

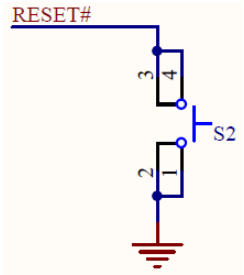


Figure 19. Reset Switch Circuit

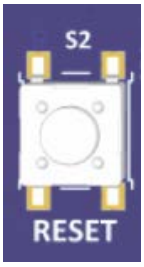
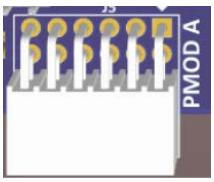


Figure 20. Reset Switch (S2) on the Evaluation Kit

5.4.6 PMOD A

A 12-pin PMOD type 2A connector is provided at PMOD A. The interface is powered for 3.3 V modules only. The Main MCU acts as the SPI master, and the connected module acts as an SPI slave device. This interface may additionally be re-configured in firmware as several other PMOD types.



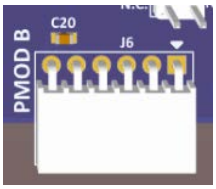
Signals on PMOD A are shared with Main MCU pin headers J1 and J2. Care must be taken to ensure that shared signals are not used concurrently.

Table 10. PMOD A Connector (J5)

PMOD A Connector		EK-RA6M2
Pin	**Description**	**Signal/Bus**
1	SS (low to select slave)	U1 P103, SSLA0_A (U1-105)
2	MOSI	U1 P101, MOSIA_A (U1-107)
3	MISO	U1 P100, MISOA_A (U1-108)
4	SCK	U1 P102, RSPCKA_A (U1-106)
5	GND	GND
6	VCC	+3V3
7	INT (slave to master)	U1 P104, IRQ1 (U1-104)
8	RESET (master to slave)	U1 P107, GPIO (U1-101)
9	Not Specified	U1 P111, GPIO (U1-76)
10	Not Specified	U1 P112, GPIO (U1-77)
11	GND	GND
12	VCC	+3V3

Limits of the 3.3 V regulator, and limits of the power source supplying that regulator (especially for USB Host devices), including the to-be-connected PMOD device, must be considered prior to connecting a module to a PMOD connector.

5.4.7 PMOD B



A 6-pin PMOD type 4 connector is provided at PMOD B. The interface is powered for 3.3 V modules only. The Main MCU acts as the UART DCE, and the connected module acts as the UART DTE. This interface may additionally be re-configured in firmware as some other PMOD type.

Signals on PMOD B are shared with Main MCU pin header J1 and J2. Care must be taken to ensure that shared signals are not used concurrently.

Table 11. PMOD B Connector (J6)

PMOD B Connector		EK-RA6M2
Pin	**Description**	**Signal/Bus**
1	CTS (from module)	U1 P403, CTS1 (U1-4)
2	TXD	U1 P401, TXD1 (U1-2)
3	RXD	U1 P402, RXD1 (U1-3)
4	RTS (from Main MCU)	U1 P400, GPIO (U1-1) (for RTS by Main MCU firmware)
5	GND	GND
6	VCC	+3V3

Limits of the 3.3 V regulator, and limits of the power source supplying that regulator (especially for USB Host devices), including the to-be-connected PMOD device, must be considered prior to connecting a module to a PMOD connector.

5.4.8 User Capacitive Touch Button

A capacitive sensor region for use as a Capacitive Touch button is provided in the board USER INPUT region.

To disconnect the Capacitive Touch Button from the MCU, the copper jumper E2 must be open.

To connect MCU signal P207 to pin header J3, the copper jumper E5 must be closed.

Note: Capacitor C33 is optional. This design does not include a dielectric overlay, so C33 is added to reduce the sensitivity of the Capacitive Touch Button. This capacitor is not required by the MCU specification.

Table 12. Evaluation Kit Capacitive Touch Button Sensor

Designator	Function	MCU Control Port	MCU Pin
TS1	Capacitive Touch Button	U1 P207	U1-41
TSCAP-A	TSCAP Support	U1 P205 (TSCAP-A)	U1-43

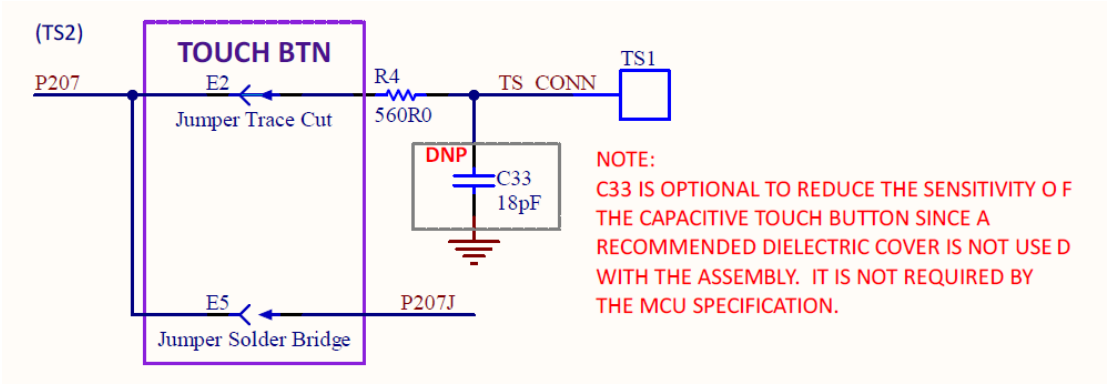


Figure 21. Capacitive Touch Button Circuit

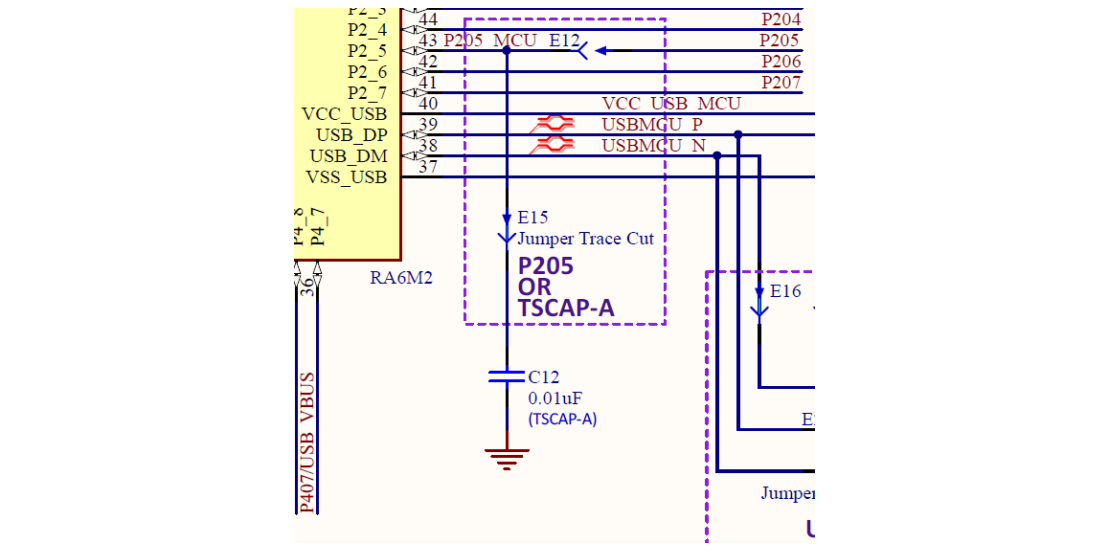


Figure 22. Capacitive Touch TSCAP Circuit

Figure 23. Capacitive Touch Button on the Evaluation Kit (Top side)

5.5 Pin Headers

The Pin Headers, J1, J2, J3, and J4, provide access to all Main MCU interface signals, and to voltages for all Main MCU power ports.

On the EK-RA6M2 board, 40 pins of the pin headers are set aside for **fixed function** assignment. These pins are odd-numbered pins of J1 and even-numbered pins of J2.

Pin Header Fixed Function pins are labeled on the board with dark text on a white background. Pins that are not Fixed Function pins are labeled with white text on a dark background. On the top side of the board is the functional label for the fixed location. On the bottom side of the board is the port information for the same pin.

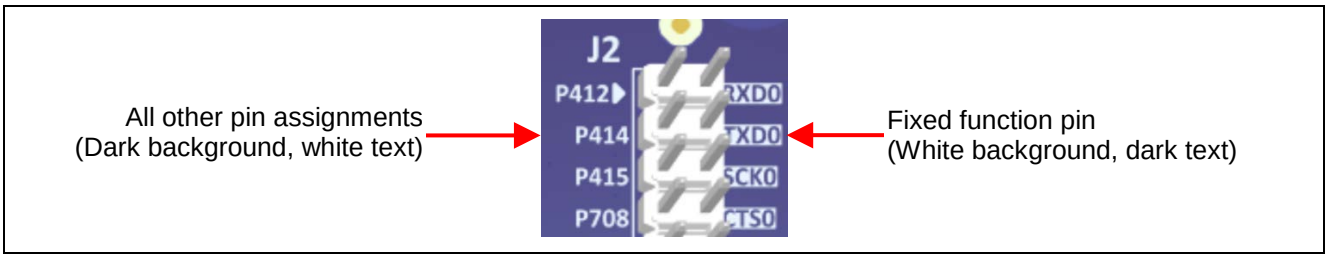


Figure 24. Fixed Function Pin Label Example

Primary Fixed Function Pins share the same functionality across EK-RA6M1, EK-RA6M2, EK-RA4M1, and EK-RA2A1 boards.

Secondary fixed function pins share common pin assignments with other Renesas RA Family Evaluation Kits that have Main MCUs with the same functionality. The Secondary Fixed Function Pins are also labeled with the top side having a functional label, and bottom side having a port label.

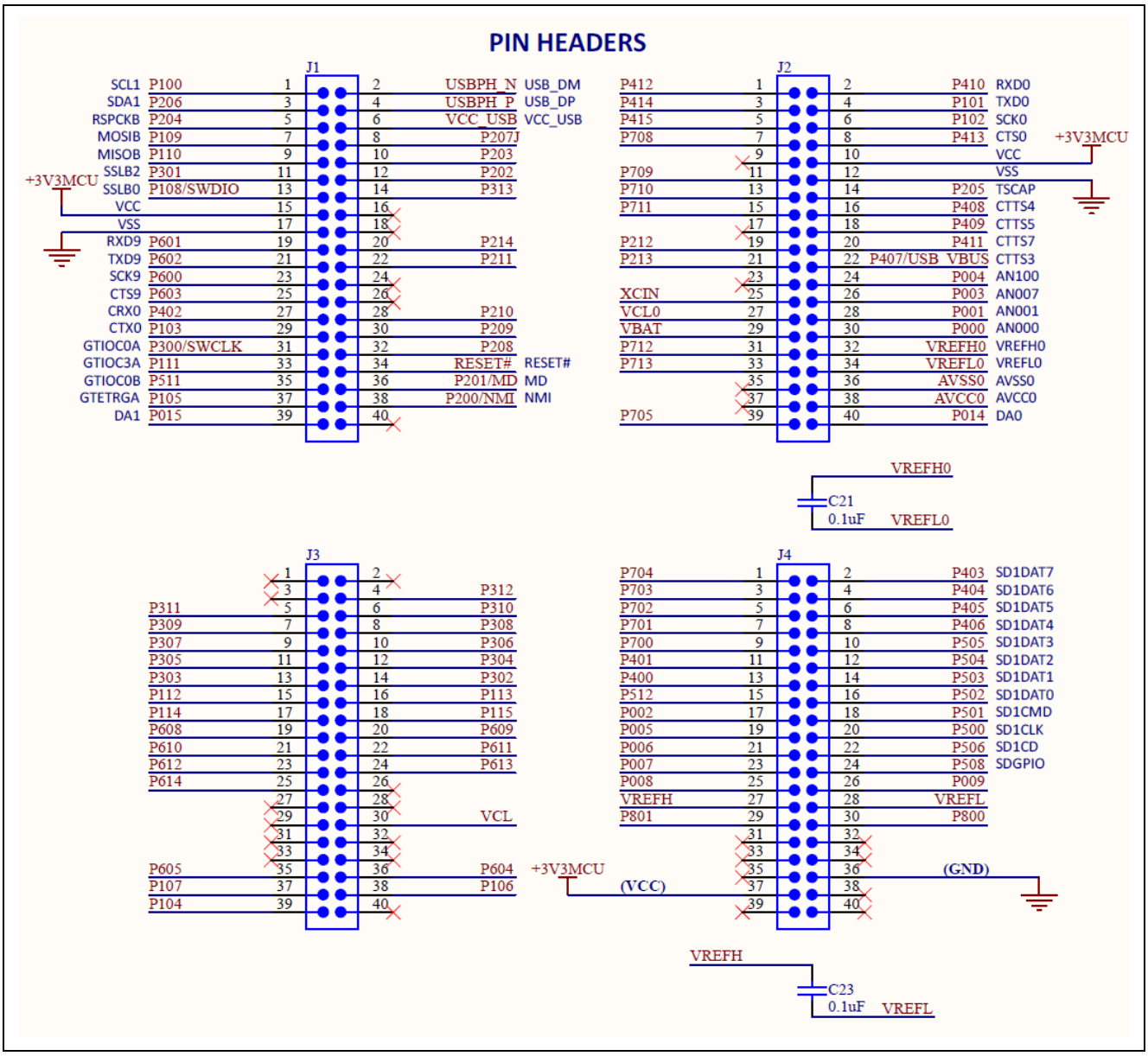


Figure 25. EK-RA6M2 Pin Headers Circuit

5.5.1 Pin Header J1

Pin header J1 is a 2-column by 20-row through-hole pin header on 2.54 mm centers.

Table 13. Pin Header J1 Pin Assignment

MCU Pin	Signal	Port	J1 Pins		Signal	MCU Pin
108	SCL	P100	1	2	USB_DM	28
42	SDA	P206	3	4	USB_DP	27
44	RSPICLK	P204	5	6	VCC_USB	29
74	MOSI	P109/TDO	7	8	P207	NC
75	MISO	P110/TDI	9	10	P203	NC
71	SSL	P301	11	12	P202	34
73	SSL	P108/TMS/SWDIO	13	14	P313	35
90	VCC	VCC	15	16	Not Connected	41
91	VSS	VSS	17	18	Not Connected	NC
97	RXD/SCL/MISO	P601	19	20	P214	43
96	TXD/SDA/MOSI	P602	21	22	P211	44
98	SCK	P600	23	24	Not Connected	45
95	CTS_RTS/SS	P603	25	26	Not Connected	46
3	CRX	P402	27	28	P210	47
105	CTX	P103	29	30	P209	NC
72	GTIOC	P300/TCK/SWCLK	31	32	P208	NC
76	GTIOC	P111	33	34	RESET#	38
144	GTIOC	P511	35	36	P201/MD	39
103	GTETRG	P105	37	38	P200	40
123	DA	P015	39	40	Not Connected	55

Color Key

Primary Fixed Function Pins
Secondary Fixed Function Pins

5.5.2 Pin Header J2

Pin header J2 is a 2-column by 20-row through-hole pin header on 2.54 mm centers.

Table 14. Pin Header J2 Pin Assignment

MCU Pin	Signal	J2 Pins		Port	Signal	MCU Pin
31	P412	1	2	P410	RXD/SCL/MISO	33
29	P414	3	4	P101	TXD	107
28	P415	5	6	P102	SCK	106
27	P708	7	8	P413	CTS	30
NC	Not Connected	9	10	VCC	VCC	21
26	P709	11	12	VSS	VSS	18
25	P710	13	14	P205	TSCAP	43
24	P711	15	16	P408	TS	35
NC	Not Connected	17	18	P409	TS	34
20	P212/EXTAL	19	20	P411	TS	32
19	P213/XTAL	21	22	P407	TS	36

MCU Pin	Signal	J2 Pins		Port	Signal	MCU Pin
NC	Not Connected	23	24	P004	AN	136
16	XCIN	25	26	P003	AN	137
15	VCL0	27	28	P001	AN	139
14	VBATT	29	30	P000	AN	140
23	P712	31	32	VREFH0	VREFH	130
22	P713	33	34	VREFL0	VREFL	129
NC	Not Connected	35	36	AVSS0	AVSS	128
NC	Not Connected	37	38	AVCC0	AVCC	127
13	P705	39	40	P014	DA	124

Color Key

Primary Fixed Function pins
Secondary Fixed Function pins

5.5.3 Pin Header J3

Pin header J3 is a 2-column by 20-row through-hole pin header on 2.54 mm centers.

Table 15. Pin Header J3 Pin Assignment

MCU Pin	Signal	Port	J3 Pins		Signal	MCU Pin
NC		Not Connected	1	2	Not Connected	NC
NC		Not Connected	3	4	P312	58
59		P311	5	6	P310	60
61		P309	7	8	P308	62
63		P307	9	10	P306	64
65		P305	11	12	P304	66
69		P303	13	14	P302	70
77		P112	15	16	P113	78
79		P114	17	18	P115	80
83		P608	19	20	P609	84
85		P610	21	22	P611	86
87		P612	23	24	P613	88
89		P614	25	26	Not Connected	NC
NC		Not Connected	27	28	Not Connected	NC
NC		Not Connected	29	30	VCL	92
NC		Not Connected	31	32	Not Connected	NC
NC		Not Connected	33	34	Not Connected	NC
93		P605	35	36	P604	94
101		P107	37	38	P106	102
104		P104	39	40	Not Connected	NC

Color Key

Secondary Fixed Function pins

5.5.4 Pin Header J4

Pin header J4 is a 2-column by 20-row through-hole pin header on 2.54 mm centers.

Table 16. Pin Header J4 Pin Assignment

MCU Pin	Signal	J4 Pins		Port	Signal	Function	MCU Pin
12	P704	1	2	P403	SD	DAT7	4
11	P703	3	4	P404	SD	DAT6	5
10	P702	5	6	P405	SD	DAT5	6
9	P701	7	8	P406	SD	DAT4	7
8	P700	9	10	P505	SD	DAT3	118
2	P401	11	12	P504	SD	DAT2	117
1	P400	13	14	P503	SD	DAT1	116
143	P512	15	16	P502	SD	DAT0	115
138	P002	17	18	P501	SD	CMD	114
135	P005	19	20	P500	SD	CLK	113
134	P006	21	22	P506	SD	CD	119
133	P007	23	24	P508	SD	GPIO (WP) *	120
132	P008	25	26	P009			131
126	VREFH	27	28	VREFL			125
110	P801	29	30	P800			109
NC	Not Connected	31	32	Not Connected			NC
NC	Not Connected	33	34	Not Connected			NC
NC	Not Connected	35	36	VSS			122
121	VCC	37	38	Not Connected			NC
NC	Not Connected	39	40	Not Connected			NC

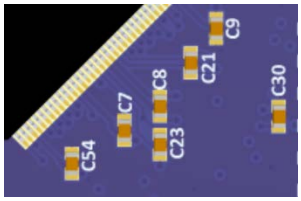
Color Key

Secondary Fixed Function pins

*Note: The RA6M2 MCU does not support the SDHI WP signal, so J4-24 has been assigned a GPIO signal.

5.6 Additional Features

5.6.1 Analog Reference Voltages



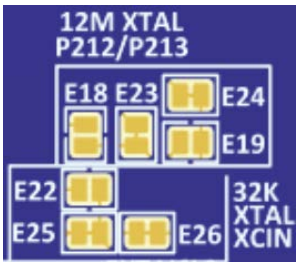
Footprints for installation of capacitors C21 and C23 are provided on the board. These two capacitors provide noise-bypass capability for ports P010/P011 and for ports P012/P013. See Figure 24 for the circuit design.

Port pair P010/P011 may be assigned as GPIO, where bypass capacitor C21 would damage signal quality. When P010/P011 are to be assigned as VREFH0/VREFL0, installation of the capacitor C21 can reduce reference voltage noise and improve ADC measurement and DAC output quality. The Evaluation Kit Board was designed for Samsung P/N CL10B104KB8NNNC, or similar, noise-bypass capacitors.

Port pair P012/P013 may be assigned as GPIO, where bypass capacitor C23 would damage signal quality. When P012/P013 are to be assigned as VREFH/VREFL, installation of capacitor C23 may reduce reference voltage noise and improve ADC measurement and DAC output quality. The EK-RA6M2 was designed for Samsung P/N CL10B104KB8NNNC, or similar, noise-bypass capacitors.

5.6.2 On-Board Clock Crystals

The EK-RA6M2 board includes two precision crystal clock sources. A precision 12.000 MHz crystal is installed at location X1, and a precision 32.768 kHz crystal is installed at location X2. These crystal clock sources are connected to the Main MCU by default.



The MCU pins for the 12 MHz clock crystal may be connected to P212 and P213. To disconnect the 12 MHz crystal, open copper jumpers E23 and E24, and close copper jumpers E18 and E19.

The MCU pins for the 32.768 kHz clock crystal may be connected to P214 and P215. To disconnect the 32.768 kHz crystal, open copper jumpers E25 and E26, and close copper jumpers E22 and E27.

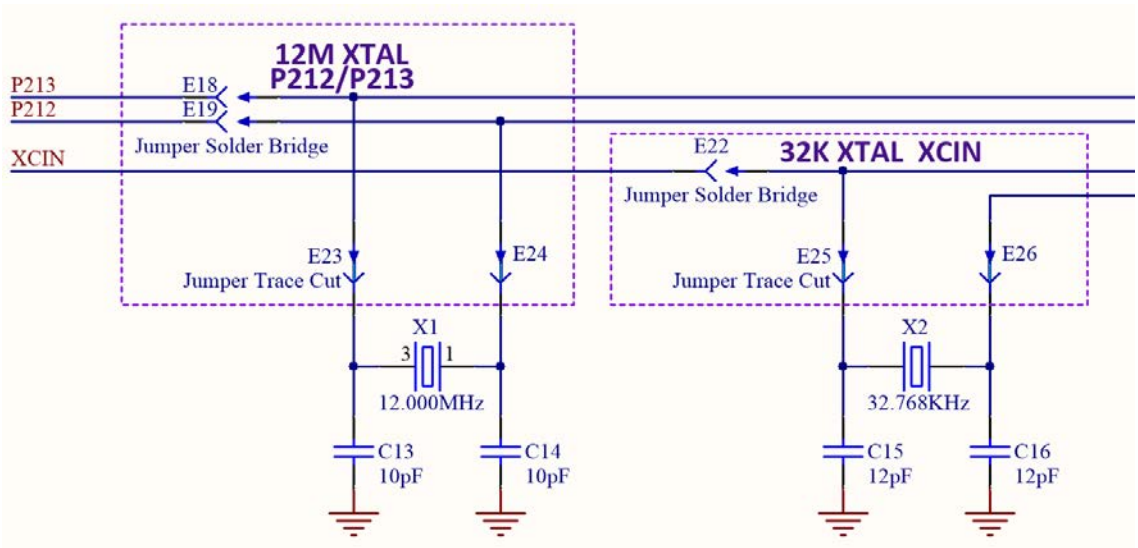


Figure 26. Crystal Clock Sources

5.6.3 User Potentiometer

A footprint for installation of a potentiometer and a recommended noise-bypass capacitor are provided on the board. The footprint was designed for installation of a Bourns P/N 3352T-1-103LF, or equivalent, as the potentiometer, and a Samsung P/N CL10B104KB8NNNC, or similar, as the noise-bypass capacitor.

When the User Potentiometer is installed, copper jumper E36 must be closed to connect the User Potentiometer to the MCU.

Table 17. Evaluation Kit Board User Potentiometer

Designator	Function	MCU Control Port	MCU Pin
POT1	User Potentiometer	U1 P004 (AN004)	U1-136

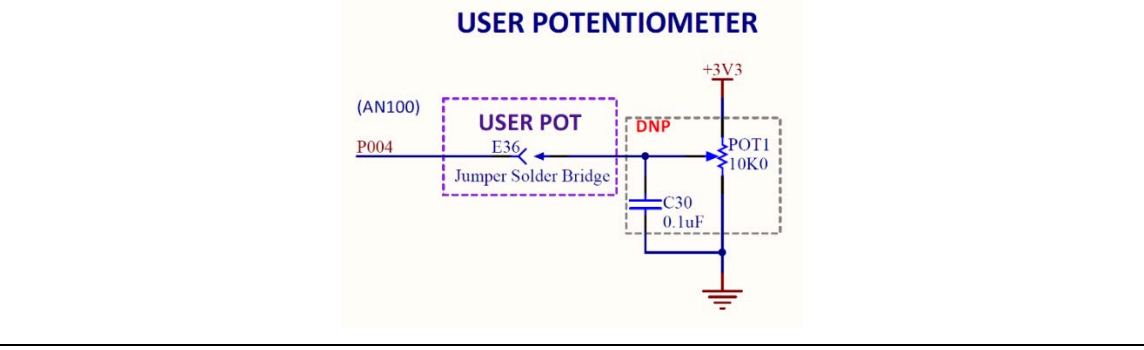


Figure 27. User Potentiometer Circuit

Figure 28. User Potentiometer on the Evaluation Kit Board (top)

5.6.4 Boot Configuration

The BOOT CONFIG jumper, J8 is used to configure the operating mode of the RA6M2 MCU at boot.

Table 18. Boot Configuration

Boot Configuration	J8 Shunt Location
Normal Boot (default)	Pins 1 and 2
SCI / USB Boot	Pins 1 and 3

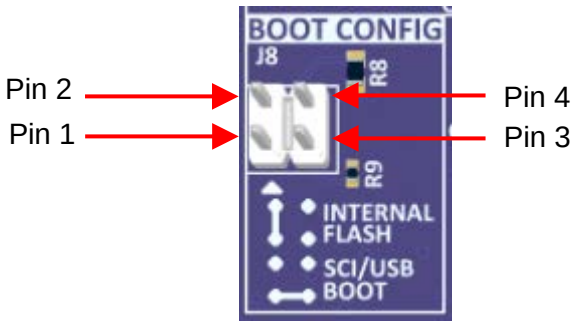


Figure 29. Boot Configuration Header

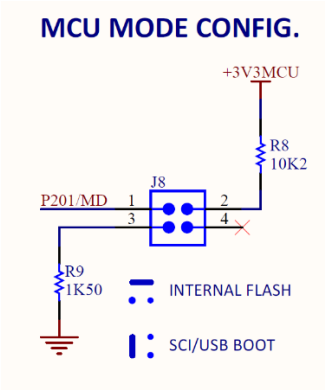


Figure 30. Boot Mode Configuration Circuit

5.6.5 Miscellaneous Signals

5.6.5.1 Analog Voltage AVCC0/AVSS0

By default, AVCC0 is connected to +3V3 MCU and AVSS0 is connected to the system ground. To disconnect these references from the AVCC0 and AVSS0 lines, copper jumpers E10 and E11 must be open.

By default, VREFH is connected to +3V3MCU, and VREFL is connected to the system ground. To disconnect these references from the VREFH and VREFL lines, copper jumpers E52 and E53 must be open.

By default, VREFH0 is connected to +3V3MCU, and VREFL0 is connected to the system ground. To disconnect these references from the VREFH0 and VREFL0 lines, copper jumpers E50 and E51 must be open.

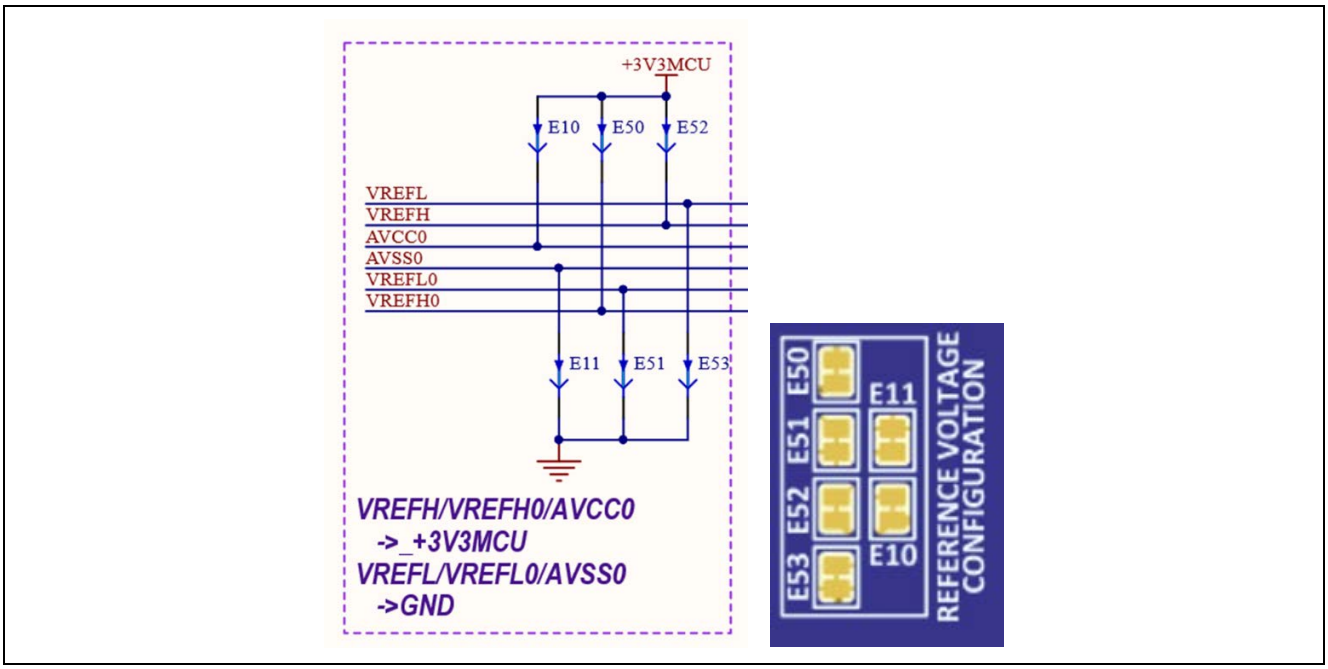


Figure 31. Analog and Reference Voltages

5.6.5.2 VCL

By default, the Main MCU pin VCL is connected to reference capacitor C51. To connect this pin to MCU pin header J2, copper jumper E55 must be closed. To disconnect the reference capacitor C51, copper jumper E54 must be open.

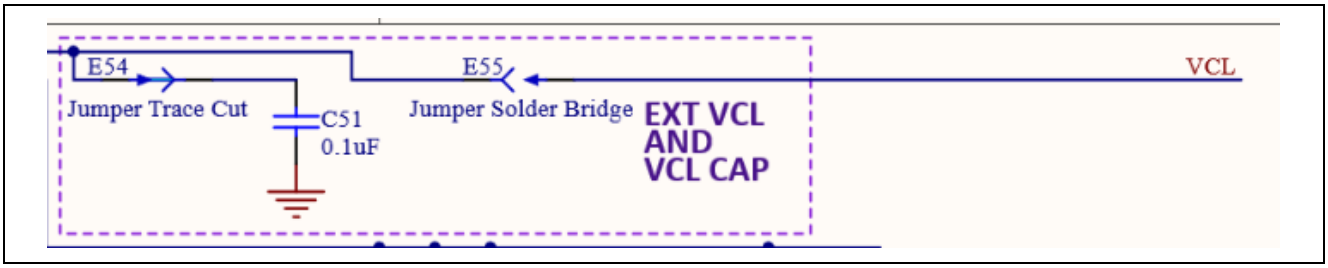


Figure 32. VCL and VCL Capacitor

5.6.5.3 Ext VCL0 and VCL0 Cap

By default, MCU pin VCL0 is connected to reference capacitor C17. To connect this pin to the MCU pin header xx, copper jumper E28 must be closed. To disconnect the reference capacitor C17, copper jumper E29 must be open.

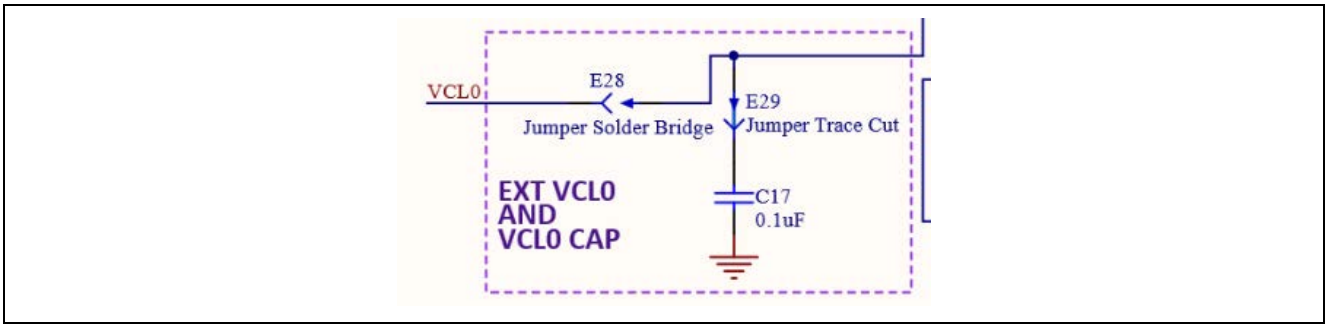


Figure 33. VCC_USB Circuit

5.6.5.4 VCC_USB

By default, the Main MCU pin VCC_USB is connected to the +3V3 MCU supply voltage. Alternatively, this pin may be connected to the MCU pin header J1. To do this, copper jumper E8 must be open and copper jumper E14 must be closed.

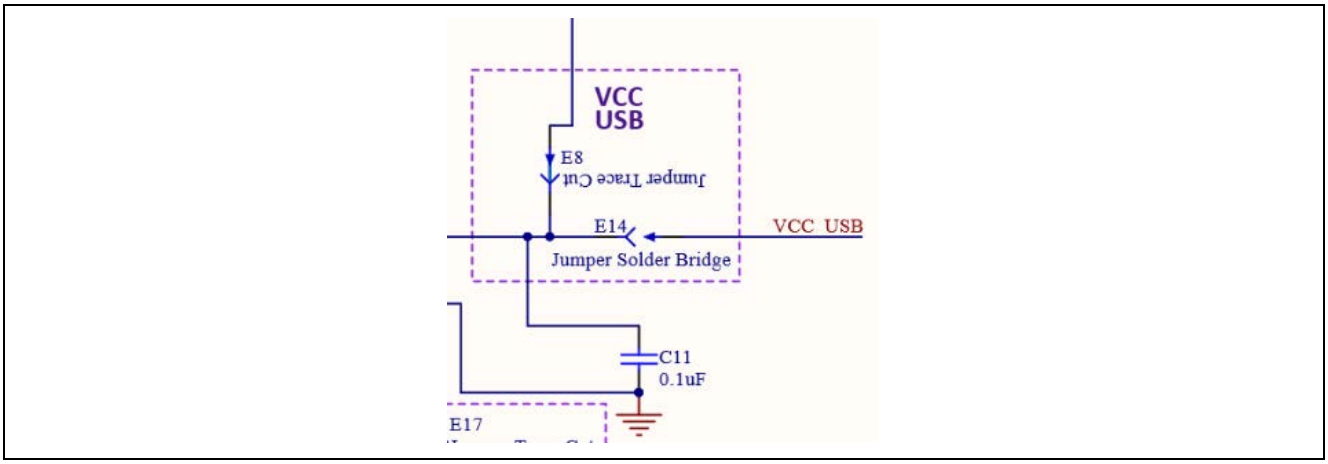


Figure 34. VCC_USB Circuit

5.6.5.5 Signal P205

By default, the Main MCU pin P205 is connected to a TSCAP-A capacitor. This pin may be connected to the MCU pin header J2. To do this, copper jumper E12 must be closed. The TSCAP-A capacitor may be disconnected by making copper jumper E15 open.

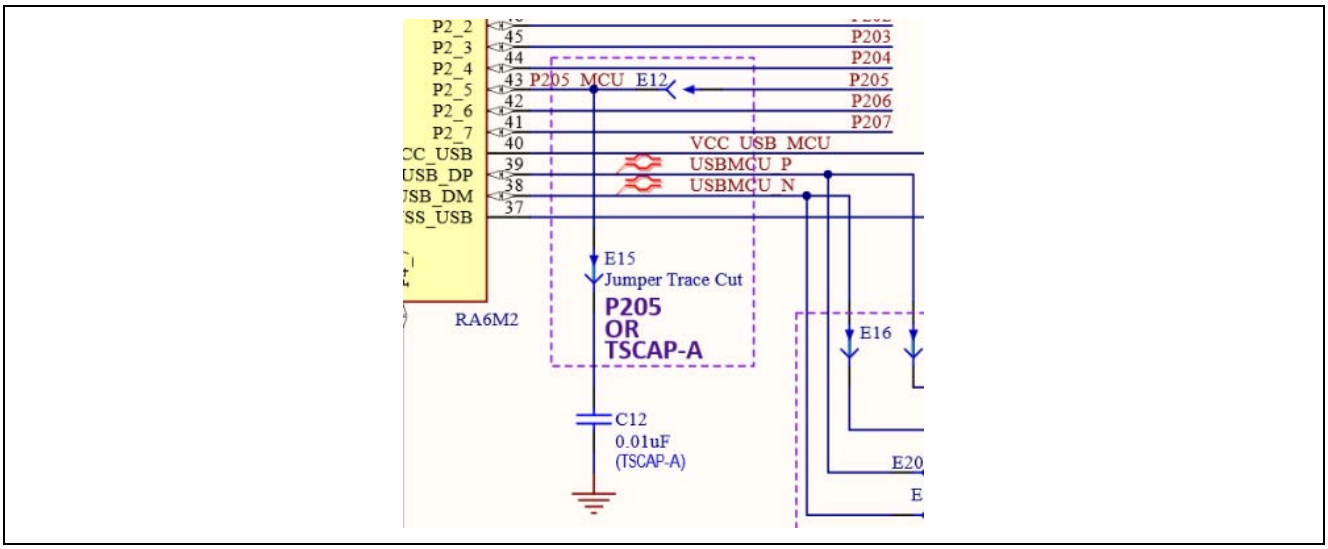


Figure 35. P205 Circuit

6. Certifications

The EK-RA6M2 v1 meets the following certifications/standards. See page 3 of this user's manual for the disclaimer and precautions.

6.1 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 requirmeents set out in the Council Directives on the Approximation of the laws of the Member States relating to electromagnetic Compatibility Directive 2004/108/EEC.

  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

6.2 Material Selection, Waste, Recycling and Disposal Standards

- EU RoHS

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

6.3 Safety Standards

- UL 94V-0

7. Design and Manufacturing Information

The design and manufacturing information about EK-RA6M2 v1 board are available in the “EK-RA6M2v1 Design Package” available on renesas.com/ra/ek-ra6m2.

- Design package file name: ek-ra6m2-v1-designpackage.zip
- Design package contents

File Type	Content	File/Folder Name
File (PDF)	Schematics	ek-ra6m2-v1-schematics
File (PDF)	Mechanical Drawing	ek-ra6m2-v1-mechdwg
File (PDF)	3D Drawing	ek-ra6m2-v1-3d
File (PDF)	BOM	ek-ra6m2-v1-bom
Folder	Manufacturing Files	Manufacturing Files
Folder	Design Files	Design Files - Altium

8. 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-RA6M2 Resources	renesas.com/ra/ek-ra6m2
RA Product Information	renesas.com/ra
RA Product Support Forum	renesas.com/ra/forum
Renesas Support	renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Oct.02.19	—	Initial release
1.01	Apr.09.20	—	Second release
1.02	Jul.29.20	7, 8, 19 22	Updates to Jumper Settings Updates to Pin Header J2 Pin Assignment

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