

RA0L1 Group

Fast Prototyping Board for RA0L1 Microcontroller
Group
FPB-RA0L1 v1
User's Manual

Renesas RA Family
RA0 Series

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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.).

7. Prohibition of access to reserved addresses

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

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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.

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Renesas RA Family

FPB-RA0L1 v1
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Glossary

Table 1. List of Abbreviations and Acronyms

BoM	Bill of Materials
FPB	Fast Prototyping Board
FSP	Flexible Software Package
GPIO	General Purpose Input Output
I ² C (or IIC)	Inter-Integrated Circuit
IDE	Integrated Development Environment
I/O	Input/Output
IRQ	Interrupt Request
LDO	Low Dropout
LED	Light Emitting Diode
LFQFP	Lead Free Quad Flat Pack
MCU	Micro Controller Unit
MISO	SPI Master In Slave Out
MOSI	SPI Master Out Slave In
NC	Not Connected
PMOD™	Peripheral Module
RWM	Pulse Width Modulation
RXD	Receive Data
SCI	Serial Clock Line
SCL	Serial Clock Line
SDA	Serial Data Line
SMD	Surface Mount Device
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
SWD	Serial Wire Debug
TXD	Transmit Data
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

1. Board Overview

The FPB-RA0L1, a Fast Prototyping Board for the RA0L1 MCU Group, enables users to seamlessly evaluate the features of the RA0L1 MCU group and develop embedded systems applications using Flexible Software Package (FSP) and the e² studio IDE. Users can use on-board features along with their choice of popular ecosystems add-ons to bring their big ideas to life.

The key features of the FPB-RA0L1 board are categorized in three groups (consistent with the architecture of the board) as follows:

MCU and MCU Native Pin Access

- R7FA0L1074CFL MCU (referred to as RA MCU)
 - 32 MHz, Arm® Cortex®-M23 core
 - 64 KB Code Flash, 16 KB SRAM, 1 KB Data Flash
 - 48-pin LFQFP package
 - Native pin access through 24 x 2-pin male headers (not fitted)
 - MCU's VCC current measurement point for precision current consumption measurement
- Multiple clock sources – Oscillators for high-speed, medium-speed, and low-speed on-chip clock signals are available in the RA MCU. Signals from crystal oscillators at 32.768 kHz and 20.000 MHz (not fitted) can also be used for the sub-clock and main clock, respectively.

System Control and Ecosystem Access

- USB Full Speed Device (USB 2.0 Type-C™ connector)
- Two 5 V input sources
 - USB (Debug, Full Speed)
 - External power supply (using 2-pin header) (not fitted)
- On-board debugger (SWD)
- User LEDs and buttons
 - User LEDs (green) x 2
 - Power LED (green) indicating availability of regulated power
 - Debug/Power LED (yellow) indicating power and the debug connection
 - User button x 1
 - Reset button x 1
- Two popular ecosystem expansions
 - Digilent Pmod™ (SPI, UART, and I²C) connectors x 2
 - Arduino® (Uno R3) connectors

Special Feature Access

- Capacitive touch button x 2
- Touch button LED (green) x 2

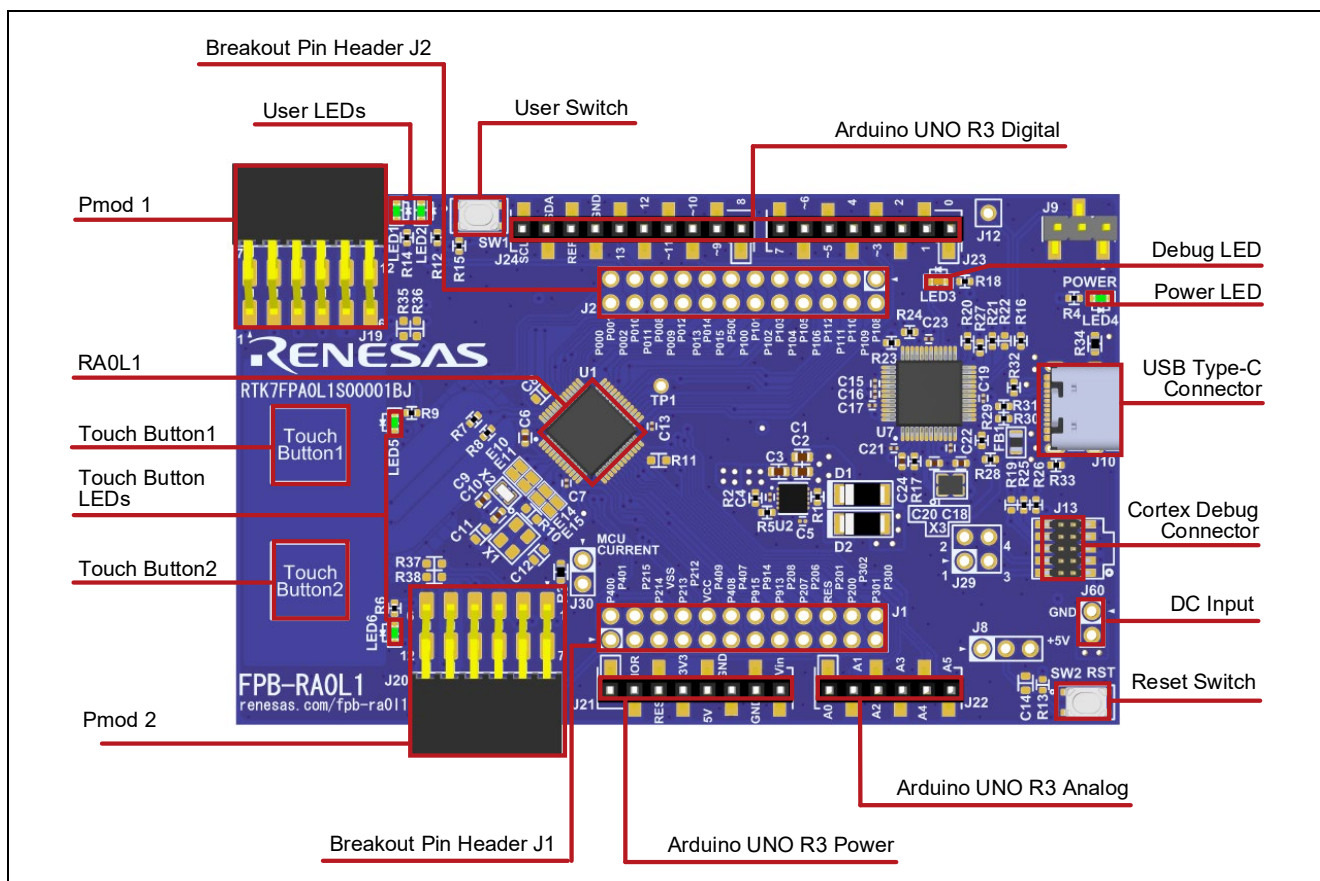


Figure 1. FPB-RA0L1 Board (Top View)

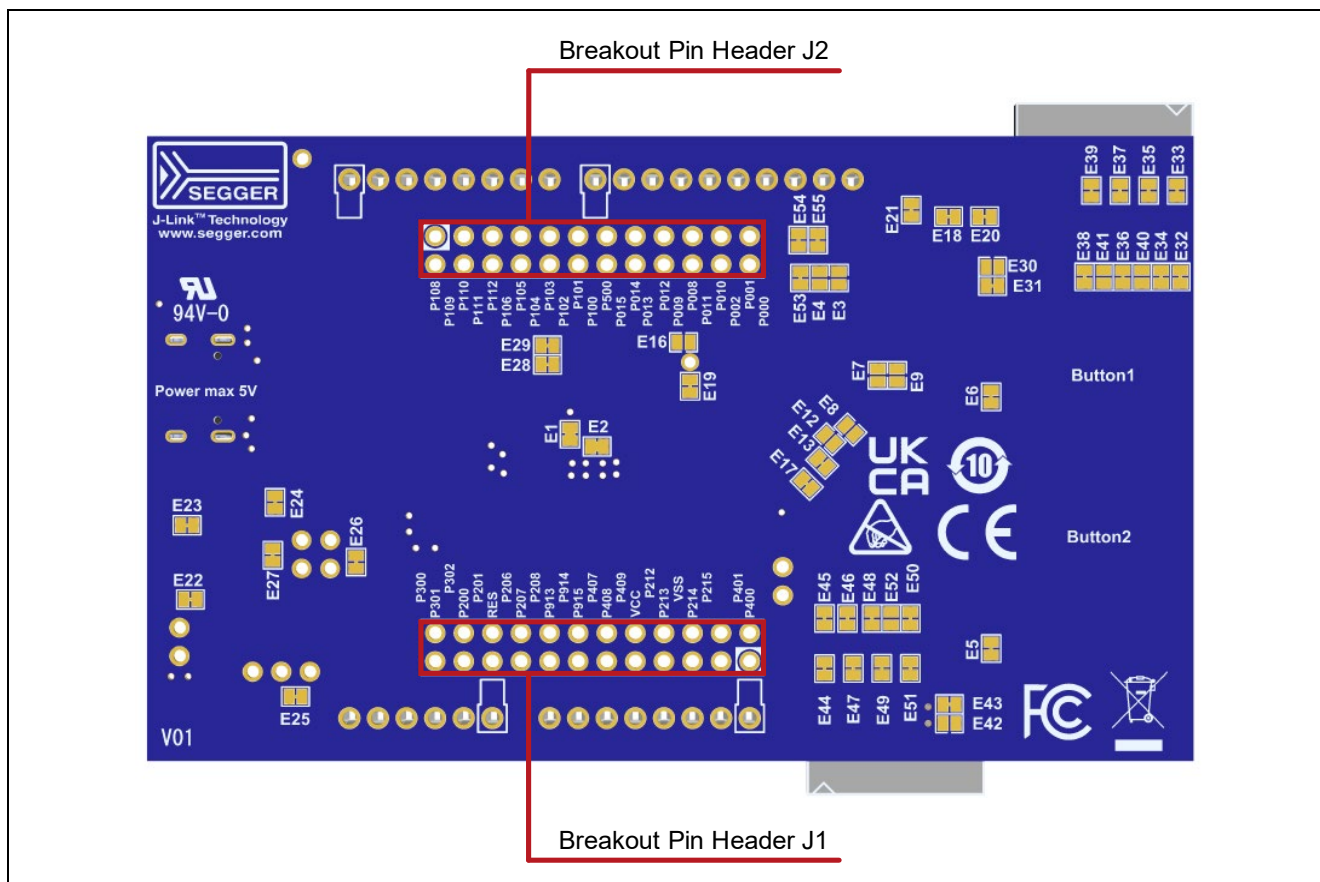


Figure 2. FPB-RA0L1 Board (Bottom View)

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 *FPB-RA0L1 Quick Start Guide* to get acquainted with the board.
- (3) [Flexible Software Package \(FSP\)](#) and Integrated Development Environment (IDE) such as [e² studio](#) are required to develop embedded applications on FPB-RA0L1 board.
- (4) Instructions to download and install software, create example projects, build them and program the FPB-RA0L1 board can be found in the [FPB-RA0L1 tutorial](#) and [Getting Started with Fast Prototyping Board for RA Family](#).
- (5) The MCU fitted to the FPB-RA0L1 board may not contain the latest version of the firmware.

2. Box Contents

The following components are included in the box.

- (1) FPB-RA0L1 v1 board
- (2) USB 2.0 Type-C™ cable (Type-C male to Type-C male)
- (3) Printed Quick Start Guide and China RoHS document

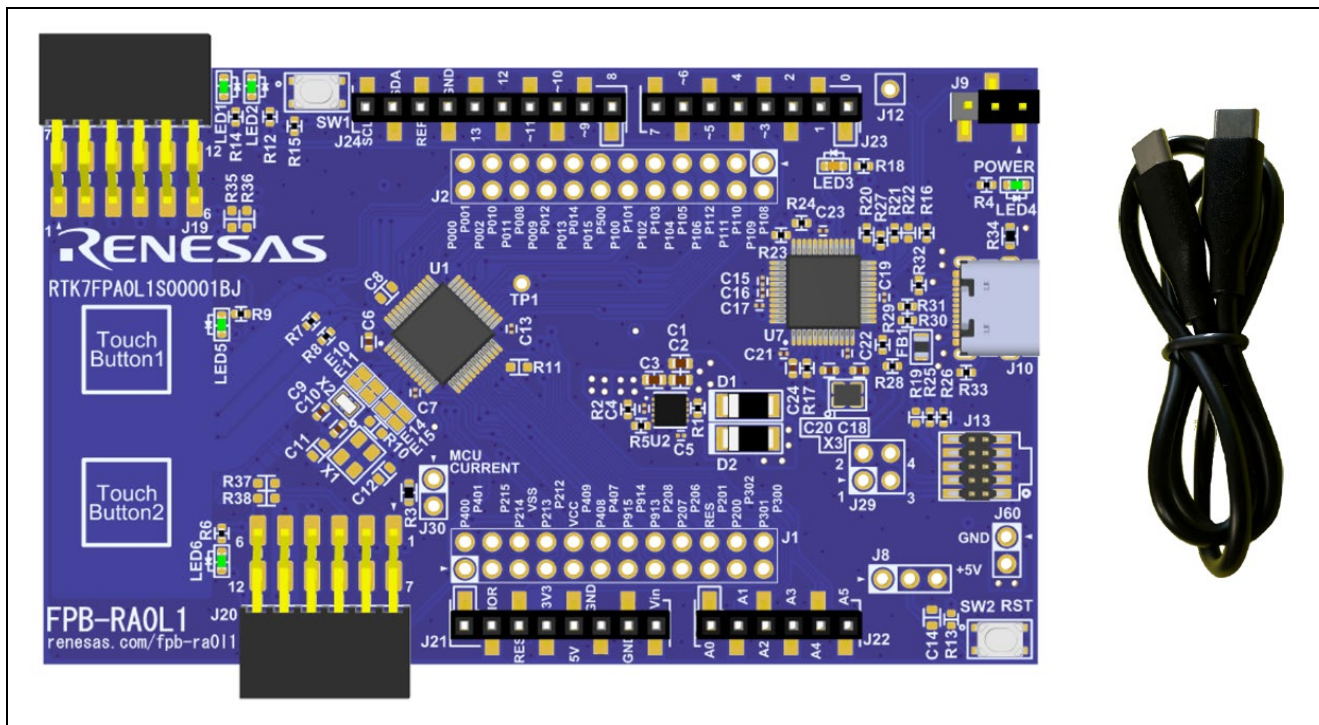


Figure 3. Configuration of the FPB-RA0L1 v1 Evaluation Kit

3. Ordering Information

- FPB-RA0L1 v1 orderable part number: RTK7FPA0L1S00001BJ
Note: The underlined character in the orderable part number represents the kit version.
- FPB-RA0L1 board dimensions: 56.00 mm (width) x 93.00 mm (length)

4. Hardware Architecture and Default Configuration

4.1 Board Architecture

The FPB-RA0L1 board is designed with a similar architecture to other boards in the FPB series. Alongside the RA MCU there is an on-board programmer, pin headers for access to all the pins on the RA MCU, a power supply regulator, some LEDs, switches, capacitive touch buttons, and several ecosystem I/O connectors (Pmod and Arduino).

Table 2. Kit Architecture

Board Functionality	Features	Function present on all similar boards	Functionality is:
MCU Native Pin Access	RA MCU, all MCU I/Os and power, and breakout pin headers for current measurement	Yes	RA MCU dependent
System Control and Ecosystem Access	Power, debugger, user LEDs and switches, reset switch, and ecosystem connectors	Yes	Same or similar across other FPB boards
Special Feature Access	Capacitive touch buttons	No	RA MCU dependent

4.2 Block Diagram

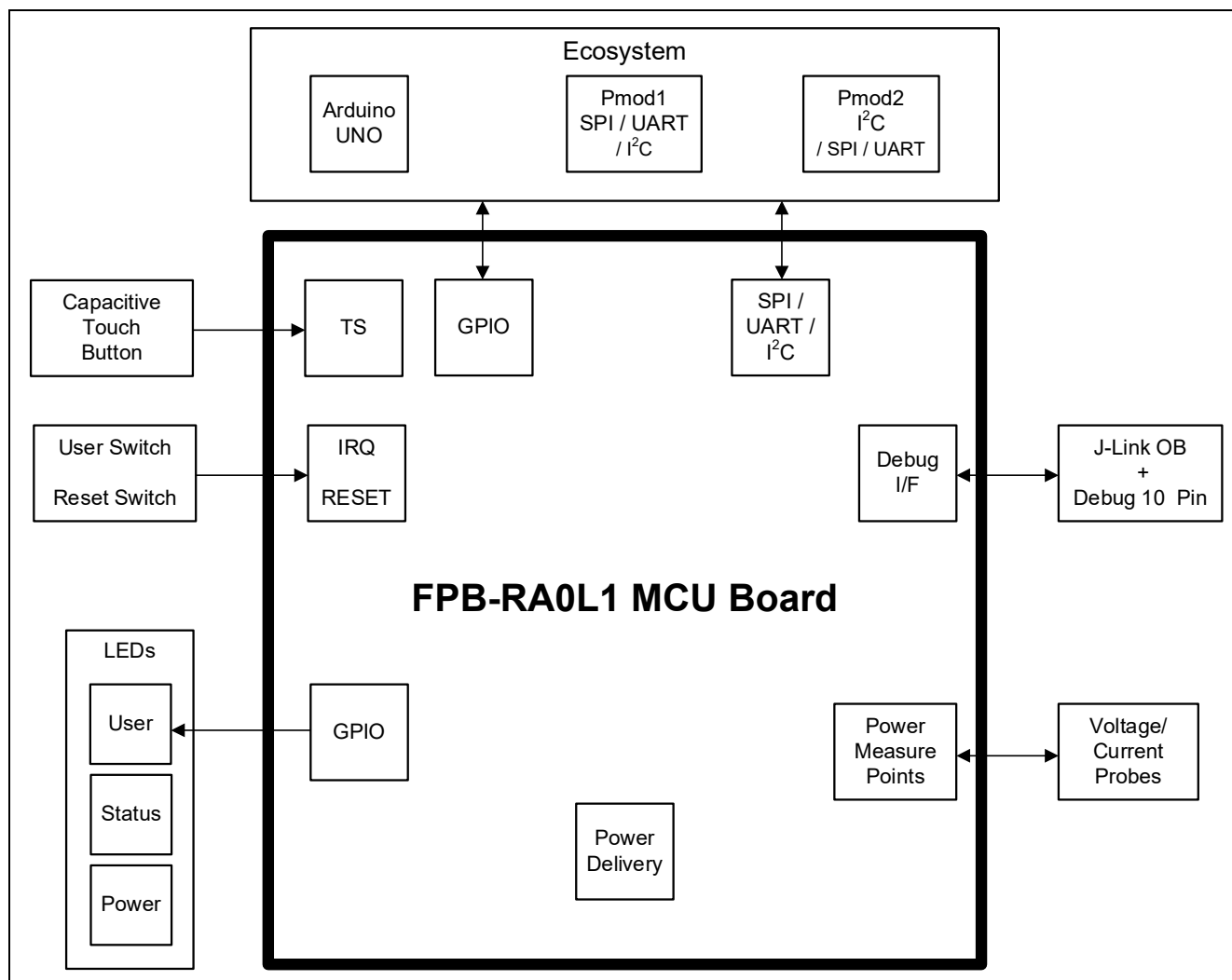


Figure 4. FPB-RA0L1 Board Block Diagram

4.3 Jumper Settings

Two types of jumpers are provided on the FPB-RA0L1 board.

- (1) Copper jumpers (**Jumper Trace Cut(closed)** and **Jumper Solder Bridge(open)**)
- (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 **Jumper Trace Cut (closed)** and **Jumper Solder Bridge (open)**.

A **Jumper Trace Cut (closed)** 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 **Jumper Solder Bridge (open)** 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 SMD resistor, inch 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 the Jumper Trace Cut(**closed**)). The connection is considered **open** if there is no electrical connection between the pads (default for the Jumper Solder Bridge(**open**)).

Jumper Trace Cut (closed)



Jumper Solder Bridge (open)

Figure 5. 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 header jumpers on the FPB-RA0L1 board are 0.1" (2.54 mm) pitch headers and require compatible 2.54 mm shunt jumpers.

4.3.3 Default Jumper Configuration

The following table describes the default settings for each jumper on the FPB-RA0L1 board. This includes copper jumpers (Ex designation) and traditional pin jumpers (Jx).

The circuit group for each jumper is the designation found in the board schematic (FPB-RA0L1 - Design Package). Functional details for many of the listed jumpers may be found in sections associated with each functional area of the kits.

Table 3. Default Jumper Settings

Location	Circuit Group	Default Open/Closed	Function
E1	Power	Closed	Connects 3.3 V to +3V3JLOB.
E2	Power	Closed	Connects 3.3 V to VCC.
E3	Power	Open	Connects P010/VREFH0 to VCC.
E4	Power	Open	Connects P011/VREFL0 to GND.
E53	Power	Closed	Connects P011/VREFL0 to J2-20.
E54	Power	Closed	Connects P010/VREFH0 to J2-21.
E20	User LED	Closed	Connects P002 to LED1.
E18	User LED	Closed	Connects P104 to LED2.
E6	Touch Button LED	Closed	Connects P401 to LED5.
E5	Touch Button LED	Closed	Connects P400 to LED6.
E7	Touch Button	Open	Connects P000/TS23 to J2-24.
E9	Touch Button	Open	Connects P001/TS22 to J2-23.
E16	Touch Button	Open	Connects P112/TSCAP to J2-5.
E19	Touch Button	Closed	Connects P112/TSCAP to 10 nF.
E8	Clock	Open	Connects P215/XCIN to J1-4.
E10	Clock	Closed	Connects P215/XCIN to the sub-clock.
E11	Clock	Closed	Connects P214/XCOUT to the sub-clock.
E12	Clock	Open	Connects P214/XCOUT to J1-5.
E13	Clock	Closed	Connects P213/X2/EXCLK to J1-7.
E14	Clock	Open	Connects P213/X2/EXCLK to the main clock.
E15	Clock	Open	Connects P212/X1 to the main clock.
E17	Clock	Closed	Connects P212/X1 to E52 and J1-8.
E21	User Switch	Closed	Connects P200 to SW1.
E22	Debugger	Closed	Connects VCC to J13-1.
E23	Debugger	Closed	Connects GND to J13-9.
E24	Debugger	Closed	Connects U7-P100 to J13-6.
E25	Debugger	Closed	Connects RES to U7-P112 and J13-10.
E26	Debugger	Closed	Connects P108/SWDIO to U7-P101 and J13-2.
E27	Debugger	Closed	Connects P300/SWCLK to U7-P102 and J13-4.
E28	Debugger	Closed	Connects P106/TXDA1_B to U7-P301.
E29	Debugger	Closed	Connects P105/RXDA1_B to U7-P302.
E31	Pmod1	Closed	Connects VCC to J19-6 and J19-12.
E32	Pmod1	Closed	Connects P103/SSI00_A to J19-1.

Location	Circuit Group	Default Open/Closed	Function
E34	Pmod1	Closed	Connects P101/SO00_A/TXDA0_D to J19-2.
E36	Pmod1	Closed	Connects P100/SI00_A/RXDA0_D to J19-3.
E38	Pmod1	Closed	Connects P102/SCK00_A to J19-4.
E33	Pmod1	Closed	Connects P201/IRQ5_B to J19-7.
E35	Pmod1	Closed	Connects P013 to J19-8.
E37	Pmod1	Closed	Connects P012 to J19-9.
E39	Pmod1	Closed	Connects P009 to J19-10.
E40	Pmod1	Open	Connects P110/SCLA0_C to J19-3.
E41	Pmod1	Open	Connects P109/SDAA0_C to J19-4.
E43	Pmod2	Closed	Connects VCC to J20-6 and J20-12.
E44	Pmod2	Closed	Connects P409/IRQ6_B to J20-1.
E46	Pmod2	Closed	Connects P213 to J20-2.
E48	Pmod2	Closed	Connects P408/SCLA1_F to J20-3.
E50	Pmod2	Closed	Connects P407/SDAA1_F to J20-4.
E45	Pmod2	Closed	Connects P206 to J20-7.
E47	Pmod2	Closed	Connects P915 to J20-8.
E49	Pmod2	Closed	Connects P302 to J20-9.
E51	Pmod2	Closed	Connects P301 to J20-10.
E52	Pmod2	Open	Connects P212/SI11_A to J20-3.
E55	Arduino	Closed	Connects P010/VREFH0 to the Arduino® connector.
J8	Debugger	Not fitted	1-2 closed: Connects RES to U7-P112 and J13-10. 2-3 closed: Connects RES to GND.
J9	Debugger	1-2 closed	1-2 closed: Pulls up U7-RES (on-board debug). 2-3 closed: Connects U7-RES to GND (MCU alone or debug in).
J29	Debugger	Not fitted	1-2 closed: Connects P108/SWDIO to U7-P101 and J13-2. 3-4 closed: Connects P300/SWCLK to U7-P102 and J13-4.

Note: J1 and J2: Breakout Pin Header

J13: Debug connector

U7: RA4M2 (J-Link OB)

J19: Pmod 1

J20: Pmod 2

5. System Control and Ecosystem Access

The FPB-RA0L1 board provides a power supply regulator, an on-board debugger, simple I/O (switches and LEDs), and popular I/O ecosystem connectors. These are all described in detail below.

5.1 Power

The FPB-RA0L1 board is designed for 5 V operation. An on-board Low Dropout (LDO) regulator is used to convert the 5 V supply to a 3.3 V supply. The 3.3 V supply is used to power the RA MCU and other peripheral features.

5.1.1 Power Supply Options

This section describes the different ways in which FPB-RA0L1 board can be powered.

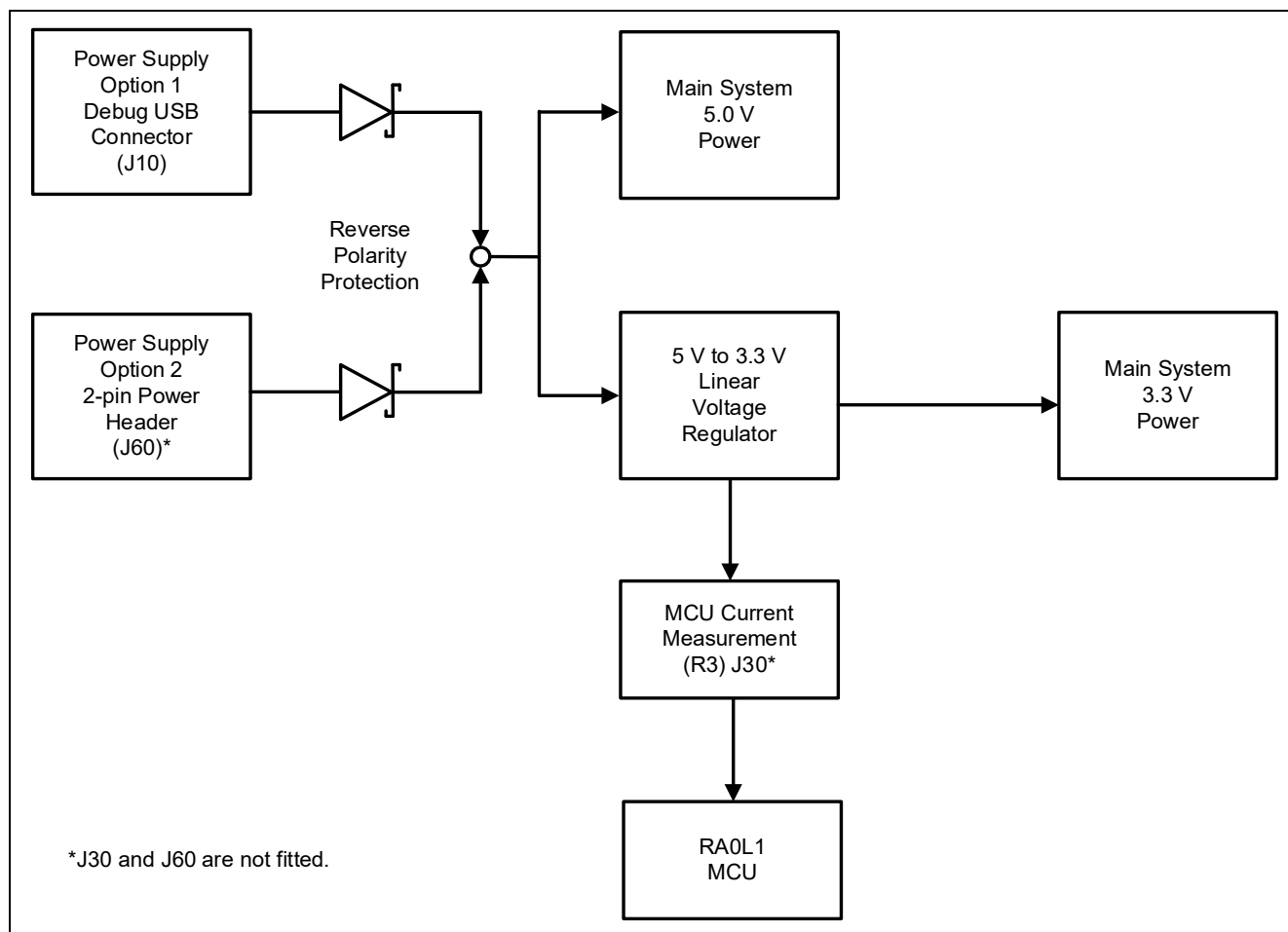


Figure 6. Power Supply Options

5.1.1.1 Option 1: Debug USB (Default Setting)

5 V may be supplied from an external USB host to the USB debug connector (J10). 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: Header Connector J60

5 V may be supplied from an external power supply to the header connector (J60) on the board. J60 (not fitted) is a 2-pin through-hole that can accommodate a 0.1" (2.54 mm) pin header or connector. Power from this source is connected to the main system 5 V power. Reverse current protection is provided between the 5 V header connector and the main system 5 V power supply.

5.1.2 Power Supply Considerations

The on-board LDO regulator which supplies 3.3 V has a built-in current limit of 2.0 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 from a typical USB host is 500 mA maximum. Depending on the configuration of the kit, multiple power sources may be required.

5.1.3 Power-up Behavior

When power is supplied, green LED4 marked POWER will illuminate. Yellow LED3 (DEBUG LED) will also illuminate.

5.2 Debug

The FPB-RA0L1 board can be programmed and debugged by using the built-in SEGGER J-Link® on-board debugger and can support the two debug modes listed below.

Table 4. Debug Modes

Debug Mode	Debug MCU*	Target MCU (MCU to be Debugged)	Debug Interface	Connector Used
On-Board Debug	RA4M2 (on-board)	RA0L1 (on-board)	SWD	USB 2.0 Type-C™ connector (J10)
Debug In	External debug tools	RA0L1 (on-board)	SWD	10-pin connector (J13)

* MCU to be connected to an IDE running on a PC

The following table summarizes the pin-header jumper configurations for each of the debug modes.

Table 5. Pin-header Jumper Configurations for Each of the Debug Modes

Debug Mode	J9
On-Board Debug	1-2
Debug In	2-3

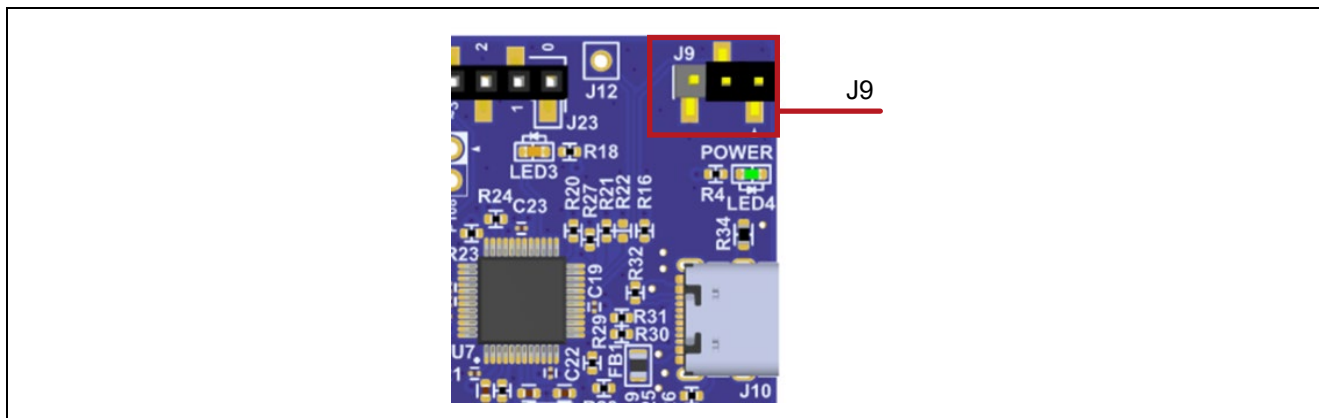


Figure 7. Jumper for Debug Modes

5.2.1 On-Board Debug

The on-board debug functionality is provided using RA4M2 (J-Link OB) and SEGGER J-Link® firmware. The USB 2.0 Type C™ connector (J10) for debugging connects the RA4M2 (J-Link OB) 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 FPB-RA0L1 board.

The RA4M2 (J-Link OB) is connected to the target MCU through the SWD interface.

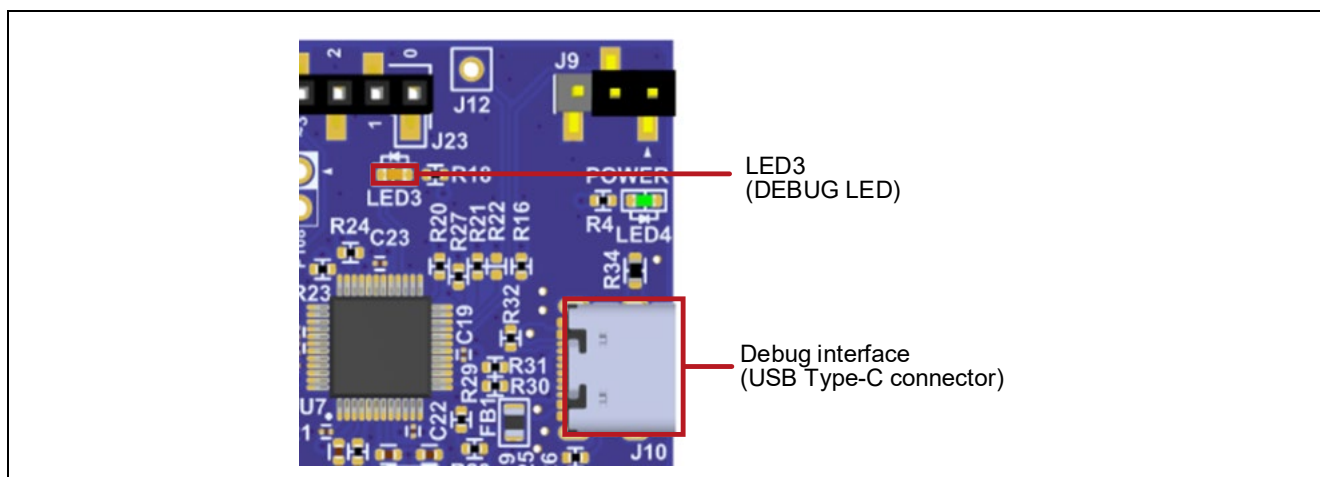
Table 6. Debug USB Connector

Debug USB Connector J10		FPB-RA0L1
Pin	Description	Signal/Bus
A4, B4, A9, B9	+5VDC	+5V_USB_DBG
A7, B7	Data-	USB_JL_OB_DM (U7 pin 14)
A6, B6	Data+	USB_JL_OB_DP (U7 pin 15)
CC1, CC2	USB ID, jack internal switch, cable inserted	Pull down
SH1, SH2, SH3, SH4	Shell	VSS
A1, B1, A12, B12	Ground	VSS

Signal/Bus names are shown on the board schematic (FPB-RA0L1 - design package) and are compliant with that.

Yellow indicator LED3 shows the status of the debug interface. When the FPB-RA0L1 board is powered on and LED3 is blinking, it indicates that the RA4M2 (J-Link OB) is not connected to the host PC. When LED3 is lit, it indicates that the RA4M2 (J-Link OB) is connected to the host PC.

When LED3 is blinking while connected to the host PC, it indicates that data is being transferred between the RA4M2 (J-Link OB) and the host PC.

**Figure 8. FPB-RA0L1 Debug Interface (FPB-RA0L1 Top View)**

5.2.2 Debug In

The 10-pin Cortex® debug connector J13 supports the SWD(Serial Wire Debug) interface, allowing debugging of the target RA0L1 using an external debug tool.

To configure the FPB-RA0L1 board to use the Debug In mode, configure the pin-header jumpers using Table 5.

Table 7. 10-pin Debug Connector

Debug Connector J13		FPB-RA0L1
Pin	SWD Pin Name	Signal/Bus
J13-1	Vtref	3.3 V
J13-2	SWDIO	P108/SWDIO
J13-3	GND	VSS
J13-4	SWCLK	P300/SWCLK
J13-5	GND	VSS
J13-6	-	NC
J13-7	Key	NC
J13-8	-	NC
J13-9	GND Detect	VSS
J13-10	nRESET (sSRST)	RES

5.2.3 Debugger Settings in e² studio

Figure 9 shows the settings for e² studio when creating a new project for the FPB-RA0L1 board.

[Debug hardware]: Select [J-Link (ARM)].

[Target Device]: Select [R7FA0L107].

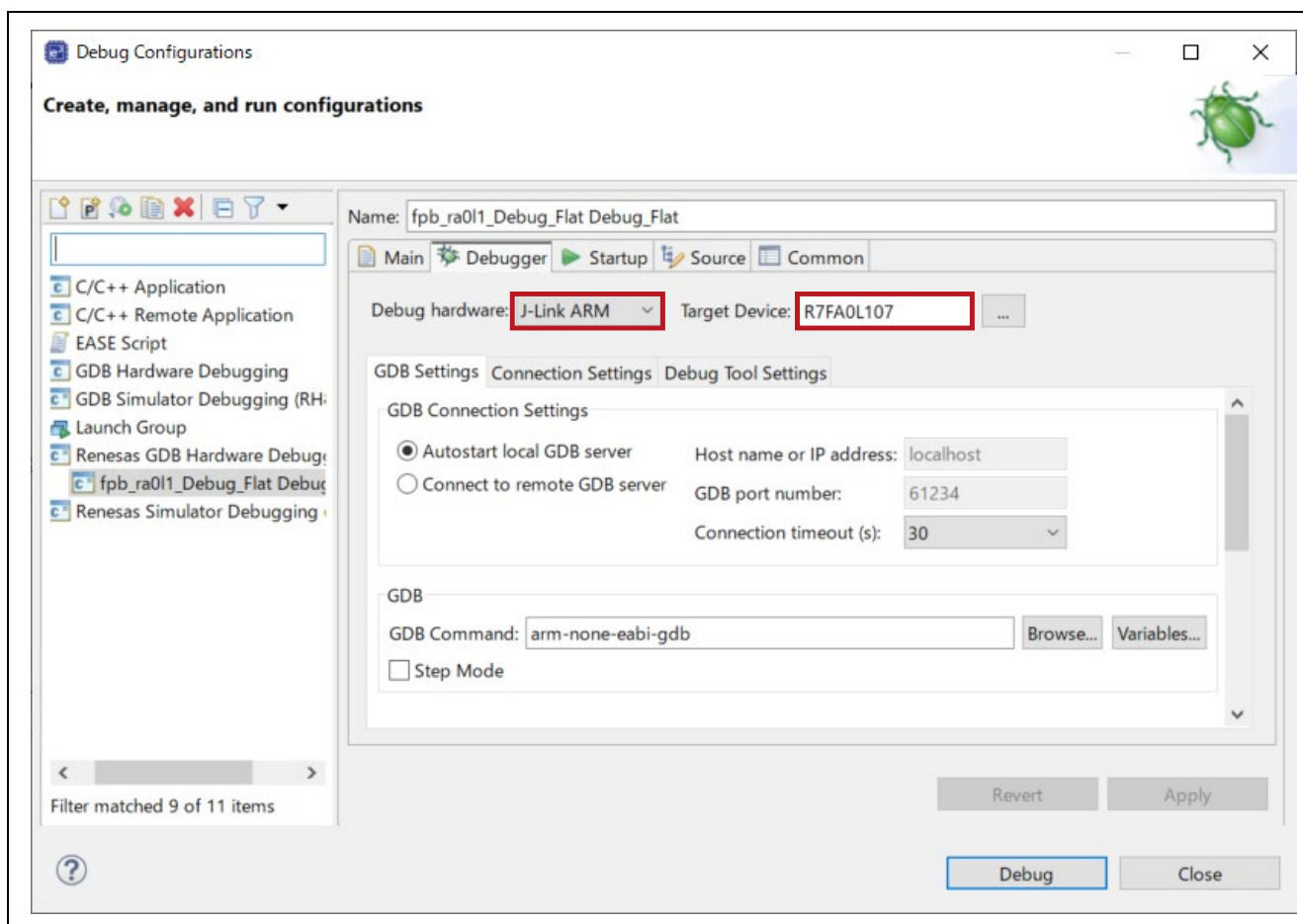


Figure 9. e² studio Debugger Settings

5.2.4 VCOM port

The FPB-RA0L1 board can perform USB-UART conversion by using the RA4M2 (J-Link OB). It is recognized by the host as the VCOM port (J-Link CDC UART Port) and connected to the RA0L1 UART by using the FPB-RA0L1 board (refer to Table 8).

Table 8. UART Assignments

RA0L1 Pin	RA0L1 Signal
U1-31	P105/RXD_A1_B
U1-30	P106/TXD_A1_B

The RxD (RA4M2: P301) pin on the J-Link OB side is pulled up for the input direction. When this pin is not to be used for the J-Link UART and pulling up of this pin would affect the connected P106/TXD_A1_B, reset the RA4M2 (by short-circuiting J9).

5.3 Ecosystem

The Ecosystem connectors allow users to simultaneously connect several third-party add-on modules compatible with two popular ecosystems using the following connectors:

- (1) Digilent Pmod™ (SPI, UART, and I²C) connector x 2
- (2) Arduino® (Uno R3) connector

5.3.1 Digilent Pmod™ Connectors

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

These interfaces may be configured in firmware to support several Pmod types such as Type 2A (expanded SPI), Type 3A (expanded UART), and 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 SAU peripheral in “Simplified SPI” mode and so do not offer the full functionality of the SCI peripheral. Please see the hardware manual for full details of the SAU “Simplified SPI” mode.

5.3.1.1 Pmod 1

A 12-pin right angle connector is fitted at Pmod 1. The connections support Pmod Type 2A (expanded SPI), Type 3A (expanded UART), and Type 6A (I²C). Type 2A and Type 3A are used for the connections by default. Type 6A can be used by changing copper jumper settings (Ex designation). This interface may additionally be re-configured in firmware as several other Pmod types.

UARTA0 (TXDA0_D and RXDA0_D) of Pmod 1 is used in common with the Arduino® connector. If the signals are simultaneously to be used with the Arduino® connector, use TXD0_A and RXD0_A of the SAU for Pmod 1.

IICA0 (SCLA0_C and SDAA0_C) of Pmod 1 is also used in common with the Arduino® connector.

Table 9. Pmod 1 Connector

Pmod 1 Connector			FPB-RA0L1	Pmod 1 Configuration	
Pin	Option Type 2A/3A (Default)	Option Type 6A	Signal/Bus	Short	Open
J19-1	CS/CTS	INT	P103/SSI00_A/IRQ5_A	E32	-
J19-2	MOSI/TXD	RESET	P101/SO00_A/TXDA0_D/TXD0_A	E34	-
J19-3	MISO/RXD	-	P100/SI00_A/RXDA0_D/RXD0_A	E36	E40
	-	SCL	P110/SCLA0_C	E40	E36
J19-4	SCK/RTS	-	P102/SCK00_A	E38	E41
	-	SDA	P109/SDAA0_C	E41	E38
J19-5	GND		VSS	-	-
J19-6	VCC		3.3 V	E31	-
J19-7	INT/GPIO	GPIO	P201/IRQ5_B	E33	-
J19-8	RESET/GPIO	GPIO	P013	E35	-
J19-9	CS2/GPIO	GPIO	P012	E37	-
J19-10	CS3/GPIO	GPIO	P009	E39	-
J19-11	GND		VSS	-	-
J19-12	VCC		3.3 V	E31	-

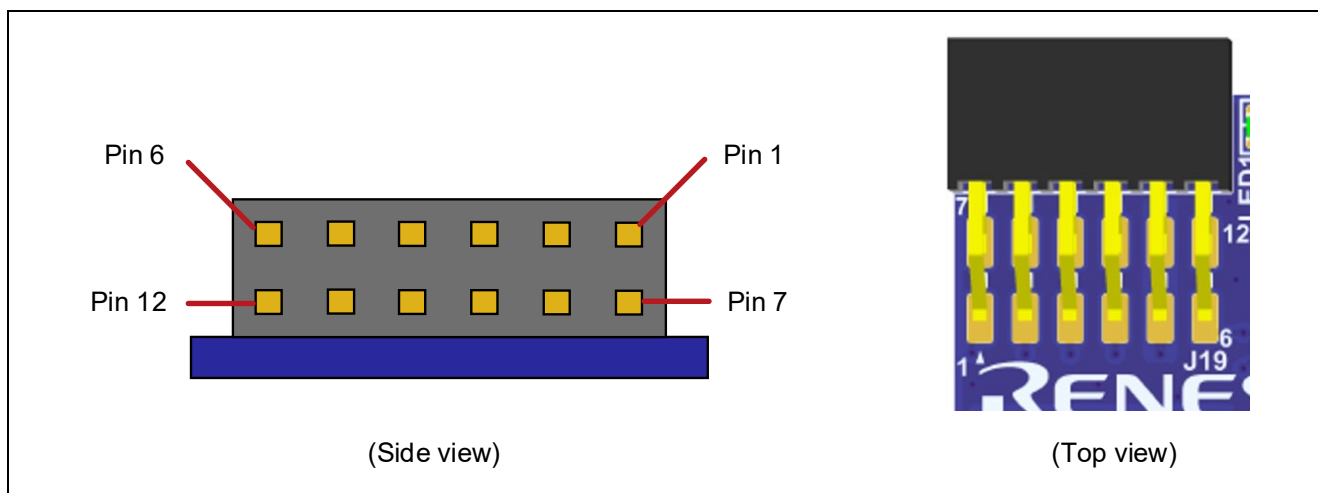


Figure 10. Pmod 1 Connector

The Pmod 1 interface supports 3.3-V devices by default. Ensure that any Pmod device installed is compatible with a 3.3-V supply.

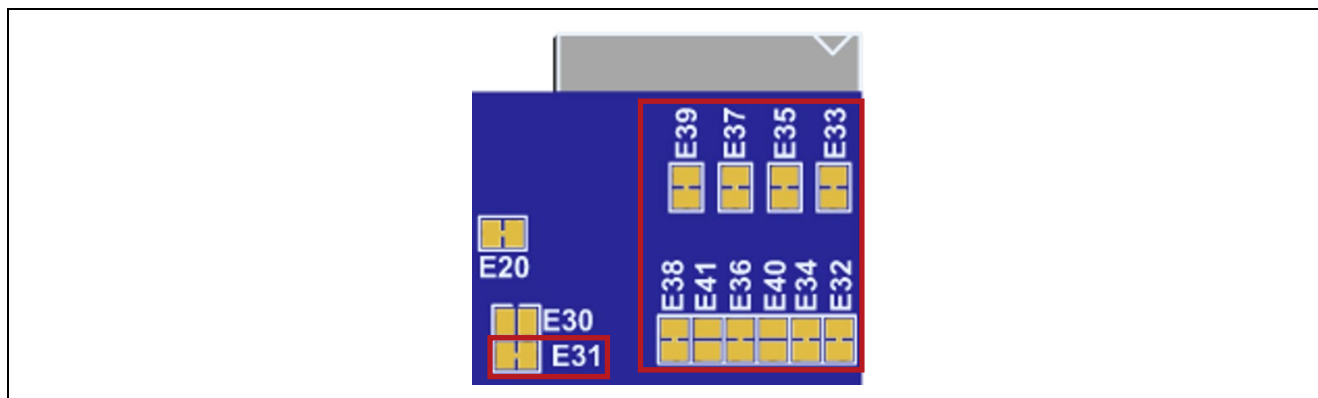


Figure 11. Pmod 1 Copper Jumpers (FPB-RA0L1 Bottom View)

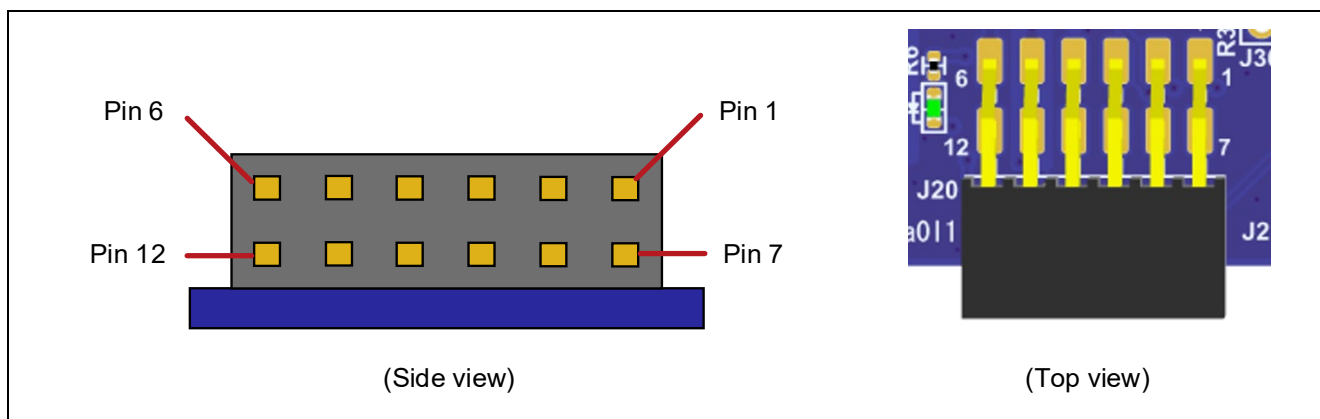
5.3.1.2 Pmod 2

A 12-pin right angle connector is fitted at Pmod 2. The connections support Pmod Type 2A (expanded SPI), Type 3A (expanded UART), and Type 6A (I²C). Type 6A is used for the connections by default. Type 2A and Type 3A can be used by changing copper jumper settings (Ex designation). This interface may additionally be re-configured in firmware as several other Pmod types.

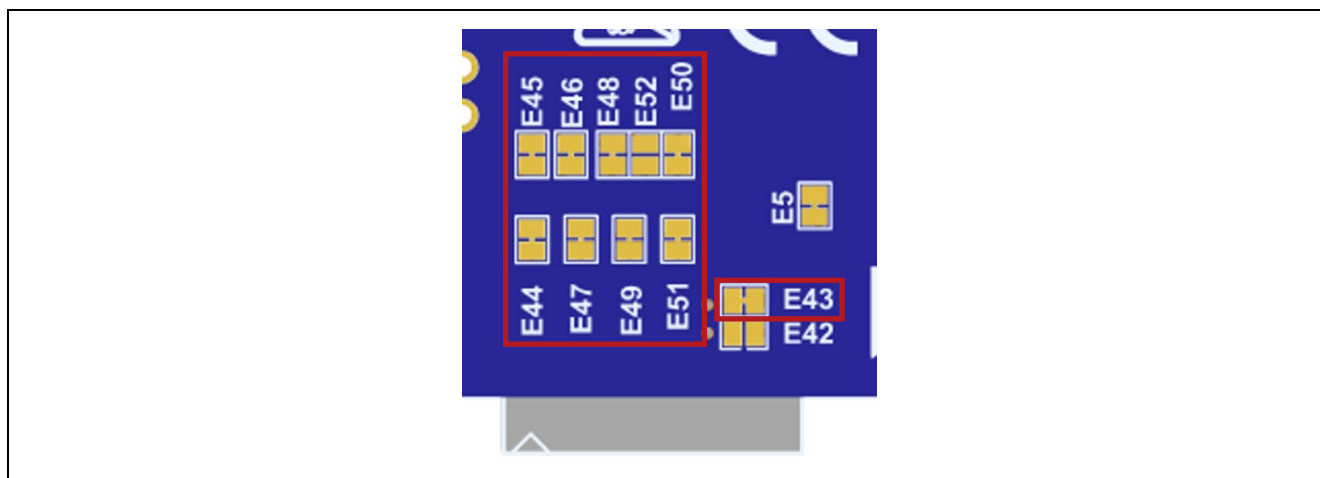
SPI11 (SO11_A, SI11_A, and SCK11_A) of Pmod 2 is used in common with the Arduino® connector.

Table 10. Pmod 2 Connector

Pmod 2 Connector			FPB-RA0L1	Pmod 2 Configuration	
Pin	Option Type 2A/3A	Option Type 6A (Default)	Signal/Bus	Short	Open
J20-1	CS/CTS	INT	P409/IRQ6_B	E44	-
J20-2	MOSI/TXD	RESET	P213/SO11_A/TXDA0_B	E46	-
J20-3	-	SCL	P408/SCLA1_F	E48	E52
	MISO/RXD	-	P212/SI11_A/RXDA0_B	E52	E48
J20-4	SCK/RTS	SDA	P407/SDAA1_F/SCK11_A	E50	-
J20-5	GND		VSS	-	-
J20-6	VCC		3.3 V	E43	-
J20-7	INT/GPIO	GPIO	P206/IRQ0_C	E45	-
J20-8	RESET/GPIO	GPIO	P915	E47	-
J20-9	CS2/GPIO	GPIO	P302	E49	-
J20-10	CS3/GPIO	GPIO	P301	E51	-
J20-11	GND		VSS	-	-
J20-12	VCC		3.3 V	E43	-

**Figure 12. Pmod 2 Connector**

The Pmod 2 interface supports 3.3-V devices by default. Ensure that any Pmod device installed is compatible with a 3.3-V supply.

**Figure 13. Pmod 2 Copper Jumpers (FPB-RA0L1 Bottom View)**

5.3.2 Arduino® Connector

An Arduino® Uno R3 compatible connector interface is provided.

However, we do not guarantee connection to all types of Arduino® shield. Confirm the specifications of this product against any Arduino® shield you intend to use.

IICA0 (SCLA0_C and SDAA0_C) of the Arduino® connector is used in common with Pmod 1.

SPI11 (SO11_A, SI11_A, and SCK11_A) of the Arduino® connector is used in common with Pmod 2.

Table 11. Arduino® Connector

Arduino® Connector		FPB-RA0L1
Pin	Description	Signal/Bus
J21-1	NC	NC
J21-2	IOREF	3.3 V
J21-3	RESET	RES
J21-4	3V3	3.3 V
J21-5	5V	5.0 V
J21-6	GND	VSS
J21-7	GND	VSS
J21-8	VIN	NC

J22-1	A0	P015/AN007
J22-2	A1	P014/AN006
J22-3	A2	P013/AN005
J22-4	A3	P012/AN004
J22-5	A4	P009/AN003
J22-6	A5	P008/AN002

J23-1	RX/D0	P207/RXDA0_A
J23-2	TX/D1	P208/TXDA0_A
J23-3	2	P111/IRQ1_C
J23-4	~3	P201/TO05_B
J23-5	4	P100
J23-6	~5	P101/TO07_A
J23-7	~6	P500/TO03_D
J23-8	7	P103

J24-1	8	P109
J24-2	~9	P301/TO06_B
J24-3	~10	P110/TO01_A
J24-4	~11	P213/SO11_A/TO02_B
J24-5	12	P212/SI11_A
J24-6	13	P407/SCK11_A
J24-7	GND	VSS
J24-8	AREF	P010/VREFH0
J24-9	SDA	P913/SDAA0_A
J24-10	SCL	P914/SCLA0_A

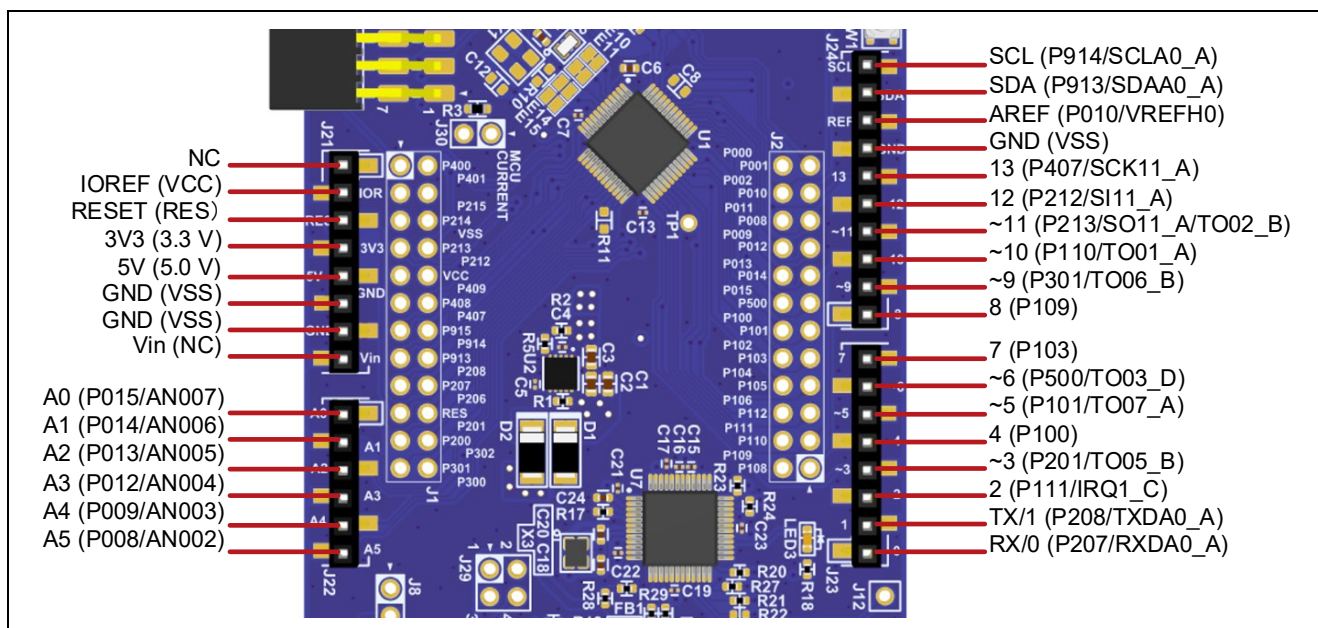


Figure 14. Arduino® Connectors (FPB-RA0L1 Top View)

5.4 Miscellaneous

5.4.1 User, Debug, and Power LEDs

Two user LEDs, one debug LED, and one power LED are provided on the FPB-RA0L1 board. Behavior of the LEDs on the FPB-RA0L1 board is described in the following table.

Table 12. FPB-RA0L1 Board LED Functions

Designator	Color	Function	RA MCU Control Port
LED1	Green	User LED	P002 (illuminated by the high level)
LED2	Green	User LED	P104 (illuminated by the high level)
LED3	Yellow	Debug LED	Port for the RA4M2 (J-Link OB)
LED4	Green	Power on indicator	VCC

The user and touch-button LEDs can be isolated from the RA MCU so that the associated ports can be used for other purposes. To disconnect LED1 from P002, Jumper Trace Cut (closed) E20 must be open. To disconnect LED2 from P104, Jumper Trace Cut (closed) E18 must be open.

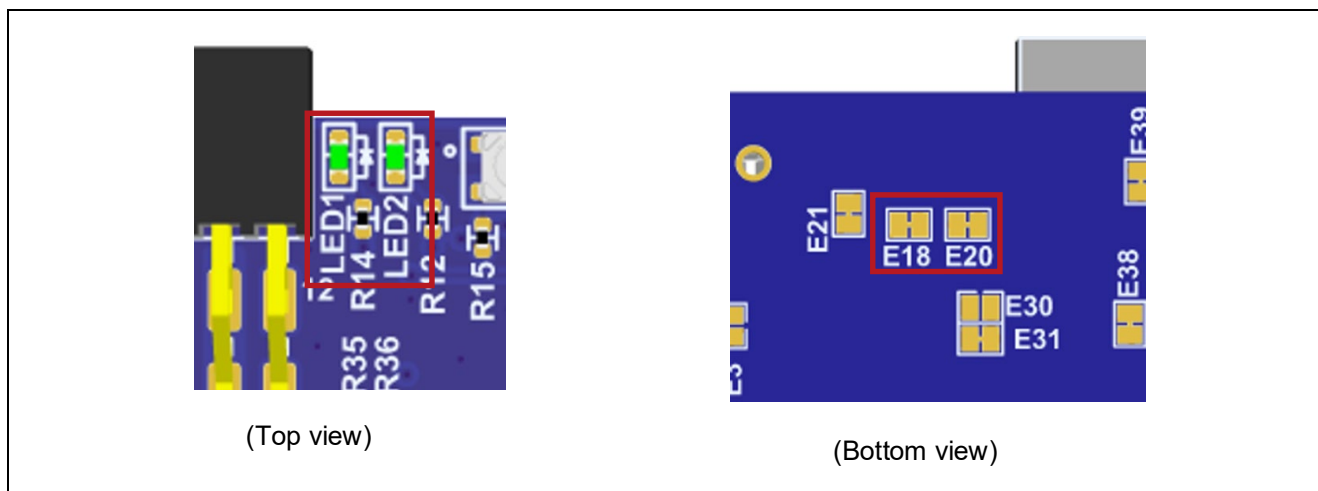


Figure 15. User LEDs and Jumpers for User LEDs

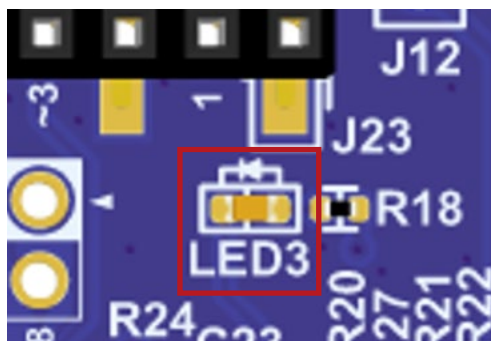


Figure 16. Debug LED (FPB-RA0L1 Top View)



Figure 17. Power LED (FPB-RA0L1 Top View)

5.4.2 User and Reset Switches

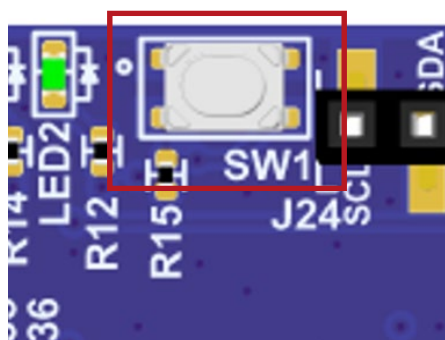
Two miniature, momentary, mechanical push-button type SMD switches are mounted on the FPB-RA0L1 board.

Pressing the reset switch (SW2) generates a reset signal to restart the RA MCU.

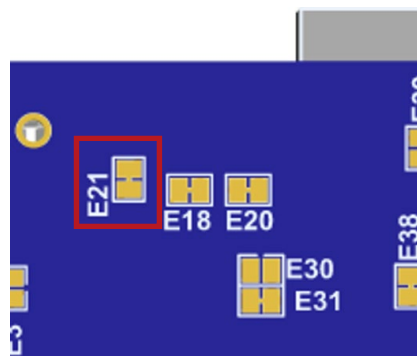
Table 13. FPB-RA0L1 Board Switches

Designator	Function	RA MCU Control Port
SW1	User Switch	P200/NMI/IRQ0_A
SW2	RA MCU Reset Switch	RES

User switch SW1 may be isolated from the RA MCU, so that the associated port can be used for other purposes. To disconnect SW1 from P200, Jumper Trace Cut (closed) E21 must be open.



(Top view)



(Bottom view)

Figure 18. User Switch (SW1) and Jumper Trace Cut (Closed) E21

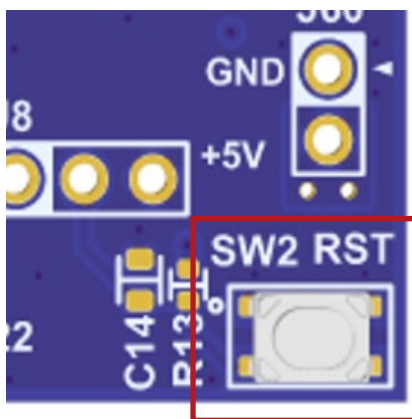


Figure 19. Reset Switch (SW2)

5.4.3 MCU Clocks

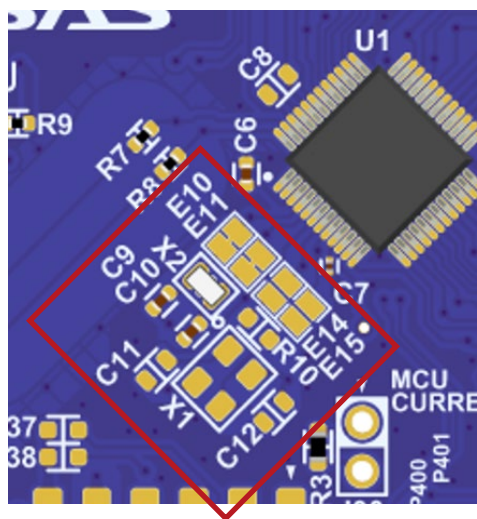
The FPB-RA0L1 board is fitted with a sub-clock oscillator crystal (X2: SC20S-7PF20PPM from Seiko Instruments), providing a precision 32.768 kHz reference clock. The option has also been provided to fit an RA MCU oscillator crystal (X1: not fitted), providing a precision 20.000 MHz reference clock.

A recommended component for X1 is ABM8-20.000MHZ-10-B1U-T from Abracon.

Table 14 lists the settings of jumpers and fitted components for use with the sub-clock and main clock.

Table 14. Settings of the Main Clock and Sub-clock for the FPB-RA0L1 Board

Designator	Additional Component	Jumper Setting (Closed)	Jumper Setting (Open)
X1	X1, R10, C11, C12	E14, E15	E13, E17
X2	None	E10, E11	E8, E12



6. Special Feature Access

6.1 Capacitive Touch Buttons

Two capacitive touch buttons are provided on the FPB-RA0L1 board.

Table 15 lists the port assignments of the capacitive touch buttons on the FPB-RA0L1 board.

Table 15. Capacitive Touch Buttons on the FPB-RA0L1 Board

Designator	RA MCU Control Port
Touch Button1	P001/TS22
Touch Button2	P000/TS23

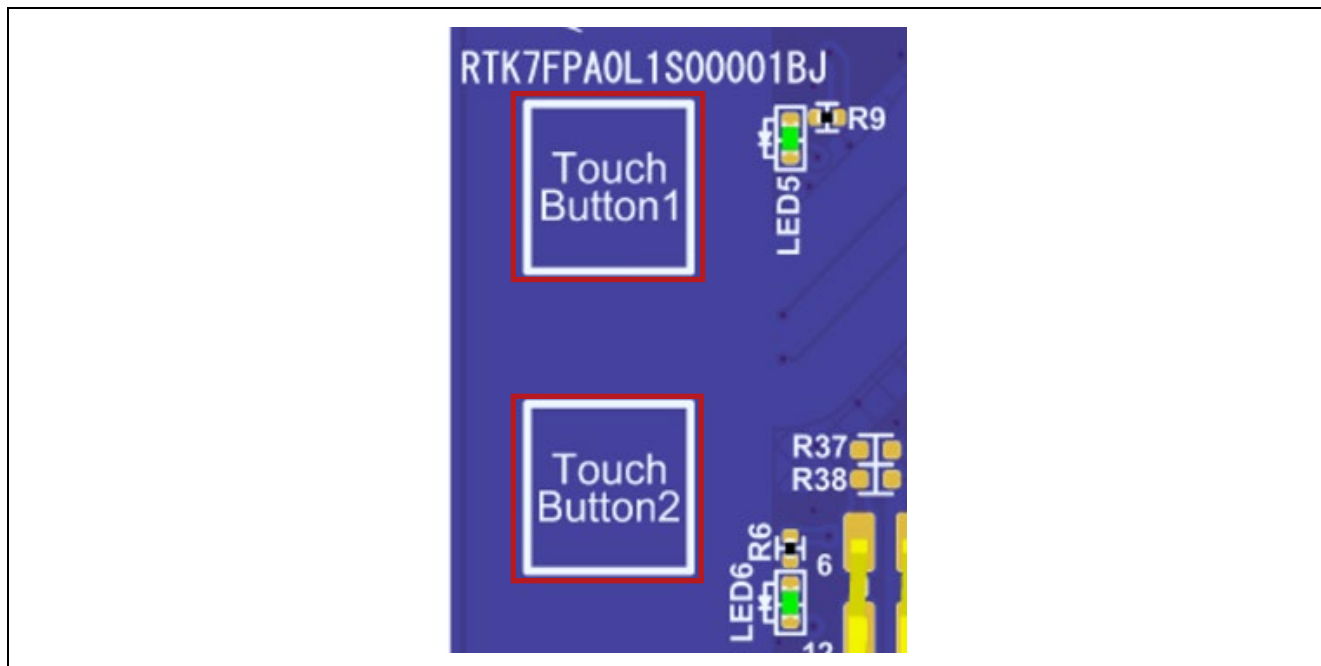


Figure 21. Capacitive Touch Buttons (FPB-RA0L1 Top View)

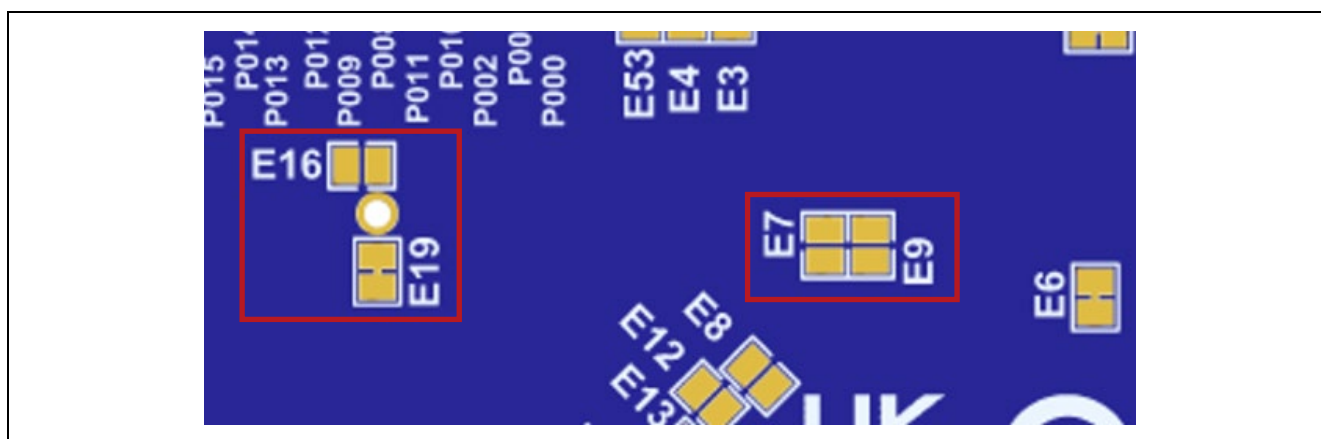


Figure 22. Jumpers for Capacitive Touch Buttons (FPB-RA0L1 Bottom View)

To use P001 as a normal port, Jumper Solder Bridge (open) E7 must be closed.

To use P000 as a normal port, Jumper Solder Bridge (open) E9 must be closed.

P112 is used as TSCAP by default and is connected to a 10-nF capacitor.

To use P112 as a normal port, Jumper Solder Bridge (open) E16 must be closed and Jumper Trace Cut (closed) E19 must be open.

6.2 Touch-button LEDs

Touch-button LEDs are provided near the two touch buttons on the FPB-RA0L1 board as indicators for those buttons.

Table 16 lists the port assignments of the touch-button LEDs on the FPB-RA0L1 board.

Table 16. Touch-button LEDs on the FPB-RA0L1 Board

Designator	Color	RA MCU Control Port
LED5	Green	P401 (illuminated by the low level)
LED6	Green	P400 (illuminated by the low level)

The touch-button LEDs can be used for any desired purpose in addition to the usage as indicators for the touch buttons. The LEDs can also be isolated from the RA MCU so that the associated ports can be used for other purposes. To disconnect LED5 from P401, Jumper Trace Cut (closed) E6 must be open. To disconnect LED6 from P400, Jumper Trace Cut (closed) E5 must be open.

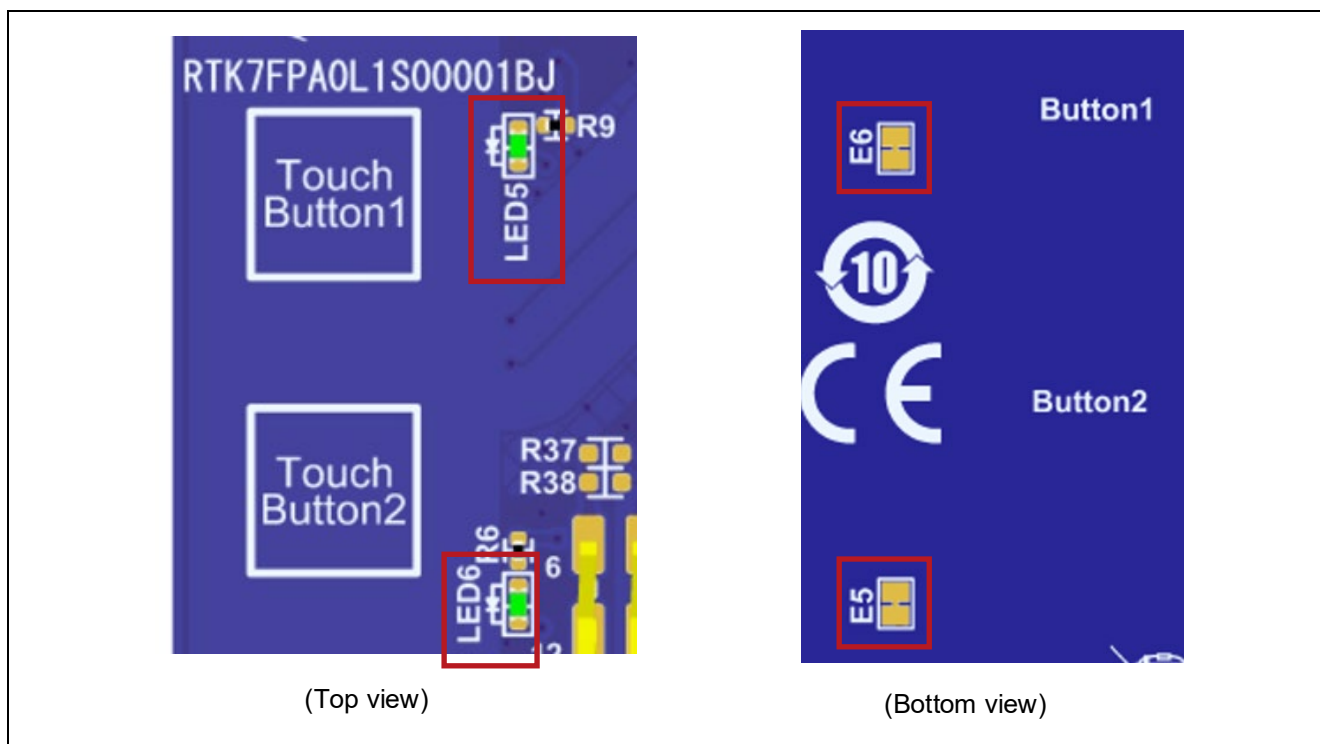


Figure 23. Touch-button LEDs and Jumpers for Touch-button LEDs

7. MCU Native Pin Access

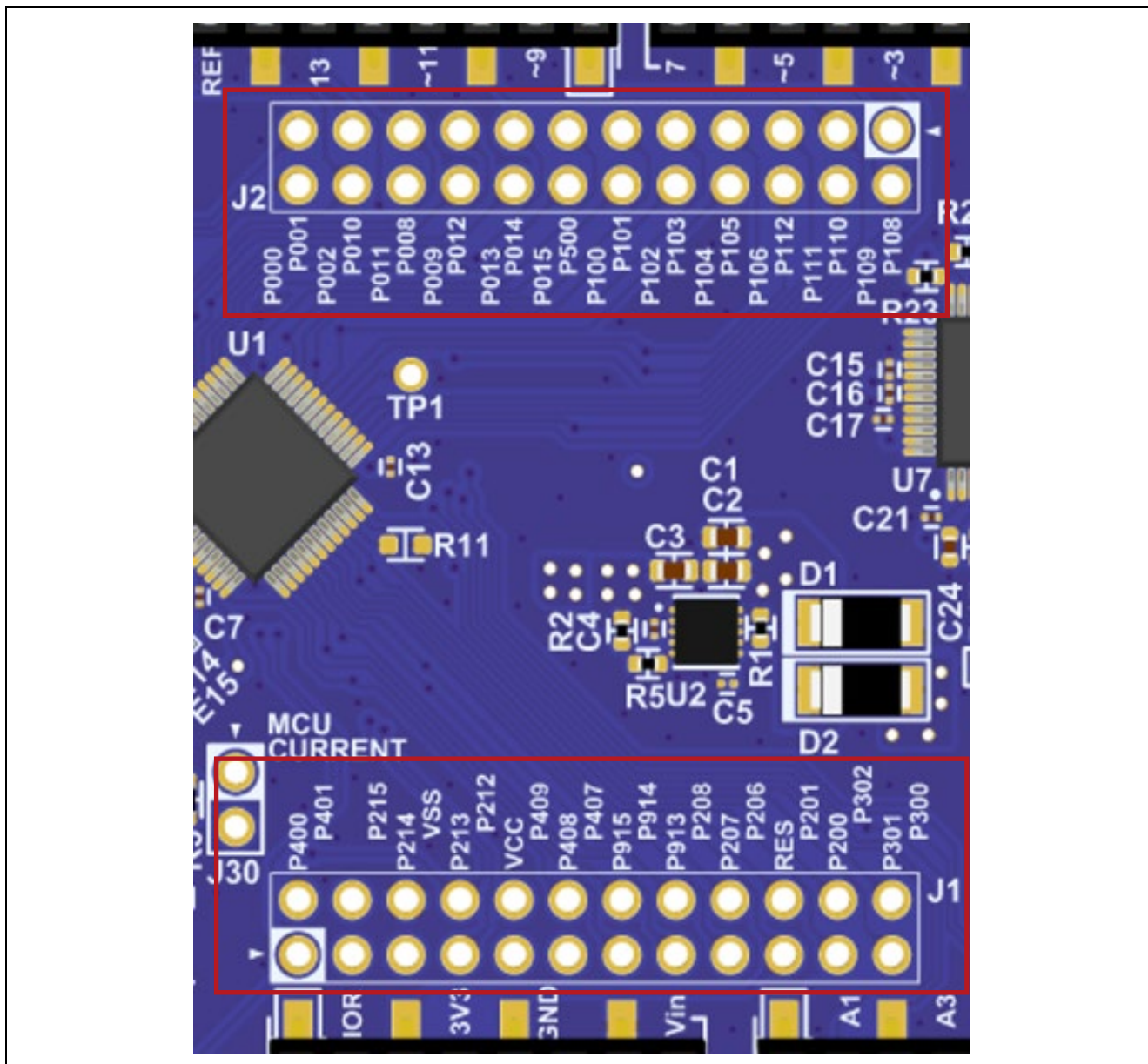


Figure 24. Native Pin Access (Breakout Pin Headers J1 and J2) (FPB-RA0L1 Top View)

7.1 Breakout Pin Headers

The FPB-RA0L1 board pin headers, J1 (not fitted) and J2 (not fitted), provide access to all RA MCU interface signals, and to voltages for all RA MCU power ports. Each header pin is labelled with the voltage or port connected to that pin. Refer to the RA0L1 Group User's Manual for details of each port function, and the FPB-RA0L1 board schematic for pin header port assignments.

The placement of the breakout pin headers allows for a standard 0.100" (2.54 mm) center breadboard to be placed on both pin headers simultaneously. This can be used for prototyping and testing of custom circuitry for use with the RA MCU.

Table 17. Breakout Pin Header J1

J1 Pin No.	Circuit Net Name	RA0L1 MCU	J1 Pin No.	Circuit Net Name	RA0L1 MCU
1	P400	U1-1	2	P401	U1-2
3	-	-	4	P215	U1-4
5	P214	U1-5	6	VSS	-
7	P213/SO11_A/TXDA0B/TO02_B	U1-7	8	P212/SI11_A/RXDA0_B	U1-8
9	VCC	-	10	P409	U1-10
11	P408/SCLA1_F	U1-11	12	P407/SCK11_A/SDAA1_F	U1-12
13	P915	U1-13	14	P914/SCLA0_A	U1-14
15	P913/SDAA0_A	U1-15	16	P208/TXDA0_A	U1-16
17	P207/RXDA0_A	U1-17	18	P206/IRQ0_C	U1-18
19	RES	U1-19	20	P201/IRQ5_B/TO05_B	U1-20
21	P200/IRQ0/NMI	U1-21	22	P302/TS0	U1-22
23	P301/TO06_B	U1-23	24	P300/SWCLK	U1-24

Table 18. Breakout Pin Header J2

J2 Pin No.	Circuit Net Name	RA0L1 MCU	J2 Pin No.	Circuit Net Name	RA0L1 MCU
1	P108/SWDIO	U1-25	2	P109/SDAA0_C	U1-26
3	P110/SCLA0_C/TO01_A	U1-27	4	P111/IRQ1_C	U1-28
5	P112/TSCAP	U1-29	6	P106/TXDA1_B	U1-30
7	P105/RXDA1_B	U1-31	8	P104	U1-32
9	P103/SSI00_A/IRQ5_A	U1-33	10	P102/SCK00_A	U1-34
11	P101/SO00_A/TXDA0_D/TXD0_A/TO07_A	U1-35	12	P100/SI00_A/RXDA0_D/RXD0_A	U1-36
13	P500/TO03_D	U1-37	14	P015/AN007	U1-38
15	P014/AN006	U1-39	16	P013/AN005	U1-40
17	P012/AN004	U1-41	18	P009/AN003	U1-42
19	P008/AN002	U1-43	20	P011/VREFL0	U1-44
21	P010/VREFH0	U1-45	22	P002	U1-46
23	P001/TS22	U1-47	24	P000/TS23	U1-48

7.2 MCU Current Measurement

Included near the RA0L1 is resistor R3 and test connector J30 (not fitted) to measure the VCC current of the RA0L1.

Resistor R3 is 0 Ω (SMD 0603). It should be removed in order to measure the current consumption using an ammeter connected between J30 (not fitted) pins 1 and 2.

Alternatively, it could be removed and replaced with a suitable low value resistor, and then a voltmeter used to measure the voltage between J30 pins 1 and 2. The current drawn by RA0L1 can then be calculated using Ohm's Law.

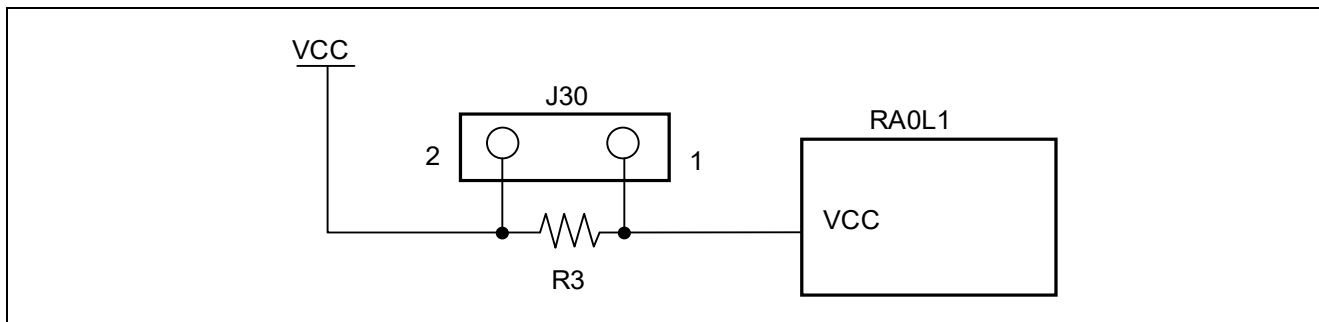


Figure 25. RA0L1 VCC Current Measurement Circuit Diagram

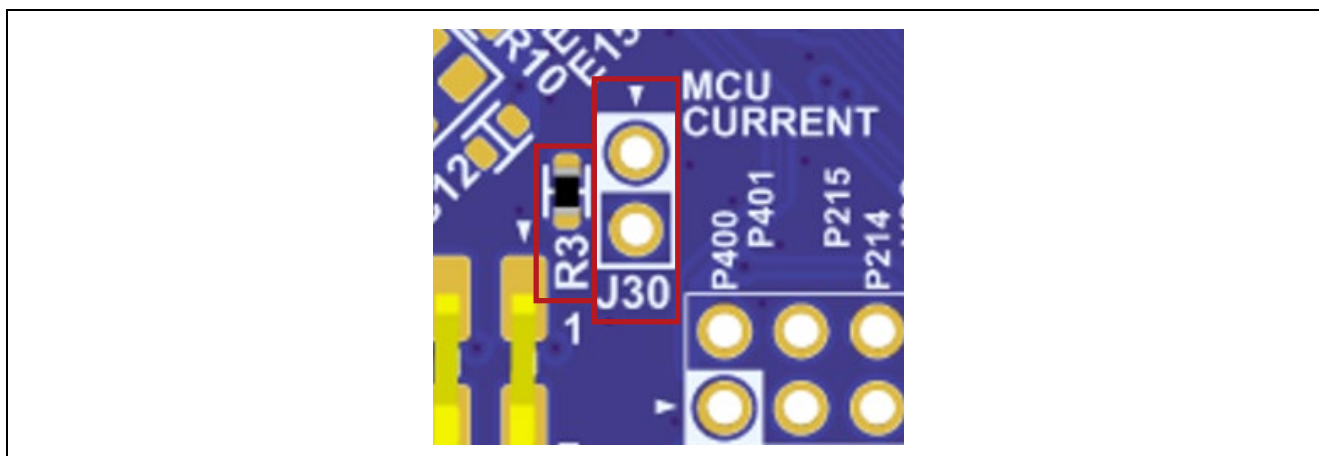


Figure 26. RA0L1 VCC Current Measurement Point (J30) and R3 (FPB-RA0L1 Top View)

8. Recommended Parts

Table 19 lists recommended part numbers for optional components that can be fitted as required.

Table 19. Optional Components

Designator(s)	Description	Manufacturer	Part Number
X1	20 MHz Crystal	ABRACON	ABM8-20.000MHZ-10-B1U-T
J1, J2	24-pin dual pin header	Parts with 12 x 2 pins and 2.54-mm pitch, which fit into the board holes with a diameter of 1.10 mm	
J60, J30	2-pin male header	Parts with 2.54-mm pitch, which fit into the board holes with a diameter of 1.10 mm	

9. Certifications

The FPB-RA0L1 board meets the following certifications/standards. See the beginning of this user's manual for the disclaimer and precautions.

9.1 EMC/EMI Standards

FCC Notice (Class A)



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

NOTE- This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Innovation, Science and Economic Development Canada ICES-003 Compliance:

CAN ICES-3 (A)/NMB-3(A)

CE Class A (EMC)



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

Warning – This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be 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

9.2 Material Selection, Waste, Recycling and Disposal Standards

EU RoHS

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

WEEE Directive (2012/19/EU) & The Waste Electrical and Electronic Equipment Regulations 2013



The WEEE (Waste Electrical and Electronic Equipment) regulations put responsibilities on producers for the collection and recycling or disposal of electrical and electronic waste. Return of WEEE under these regulations is applicable in the UK and European Union.

This equipment (including all accessories) is not intended for household use. After use the equipment cannot be disposed of as household waste, and the WEEE must be treated, recycled and disposed of in an environmentally sound manner.

Renesas Electronics Europe GmbH can take back end of life equipment. Register for this service at;
<https://www.renesas.com/eu/en/support/regional-customer-support/weee>

9.3 Safety Standards

UL 94V-0

10. Design and Manufacturing Information

The design and manufacturing information for the FPB-RA0L1 v1 board is available in the “FPB-RA0L1 v1 Design Package” available on renesas.com/fpb-ra0l1.

Design package file name: fpb-ra0l1-v1-designpackage.zip

Design package contents:

Table 20. FPB-RA0L1 Board Design Package Contents

File Type	Content	File/Folder Name
File (PDF)	Schematics	fpb-ra0l1-v1-schematics
File (PDF)	Mechanical Drawing	fpb-ra0l1-v1-mechdwg
File (PDF)	BoM	fpb-ra0l1-v1-bom
File (PDF)	3D Drawing	fpb-ra0l1-v1-3d
Folder	Manufacturing Files	Manufacturing Files
Folder	Design Files	Design Files-Altium

11. Website and Support

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

FPB-RA0L1 Resources	renesas.com/fpb-ra0l1
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

12. Note on Usage

The FPB-RA0L1 v1 board has the following notes.

1. When connecting an external debugger to J13, check the position of pin 1 of the connector to be connected.

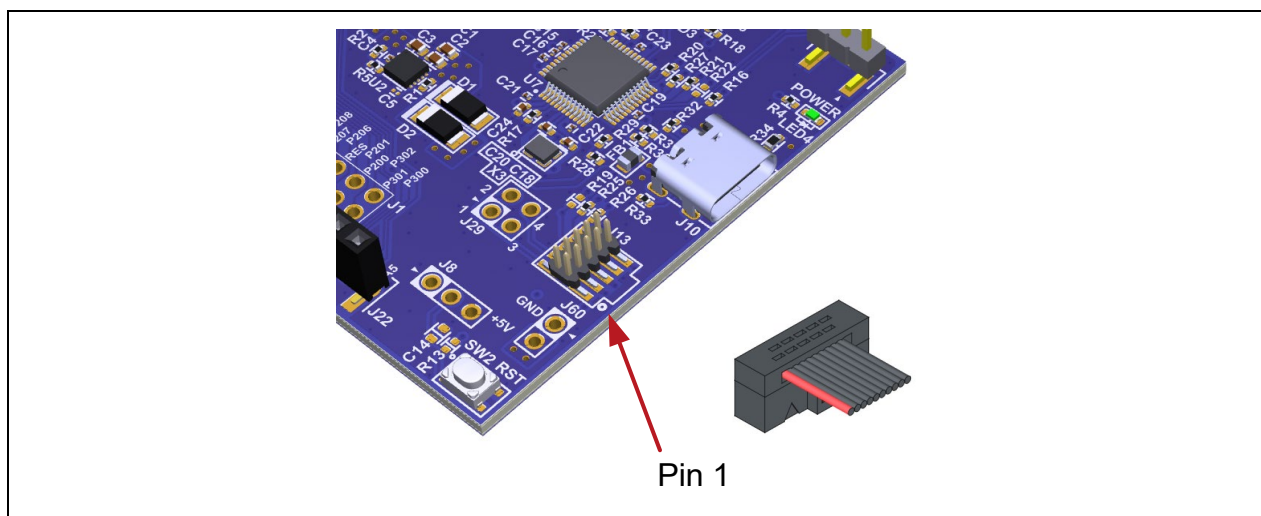


Figure 27. Position of J13-1 (FPB-RA0L1 Top View)

2. P106/TXDA1_B and P105/RXD1A_B are connected to the RA4M2 (J-Link OB). When these components are not used as the VCOM port of J-Link, cut E28 and E29 of the Jumper Trace Cut (closed).

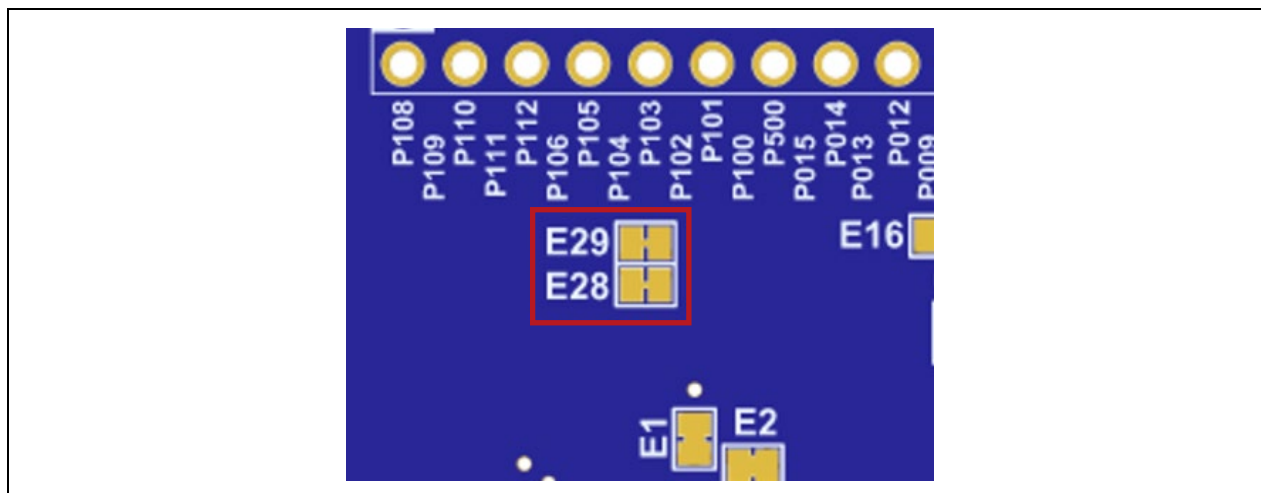


Figure 28. Jumper Trace Cut (Closed) for the VCOM Port (FPB-RA0L1 Bottom View)

13. Appendix

13.1 Layout Diagram of Components on the FPB-RA0L1 Board

The layout diagram of components on the FPB-RA0L1 board is shown below.

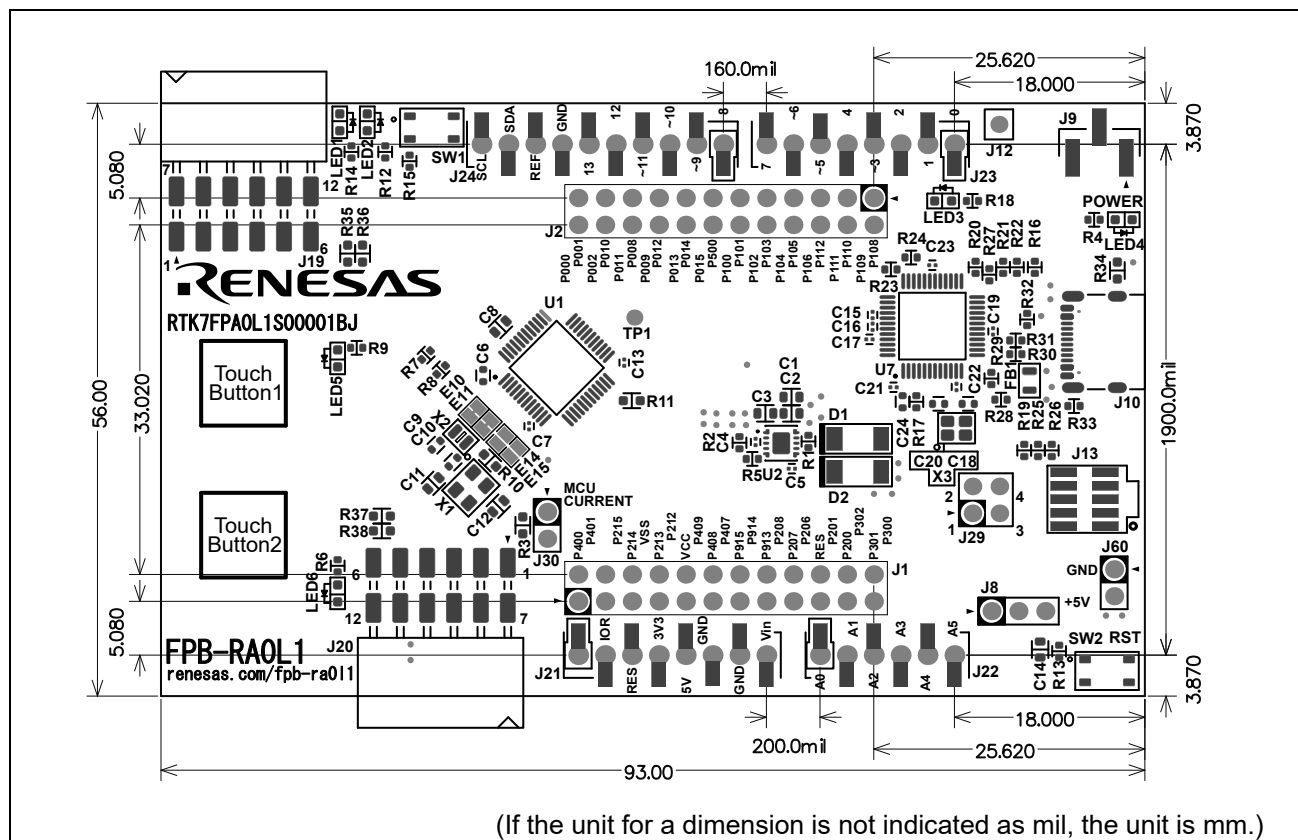


Figure 29. Layout Diagram of Components on the FPB-RA0L1 Board (Top View)

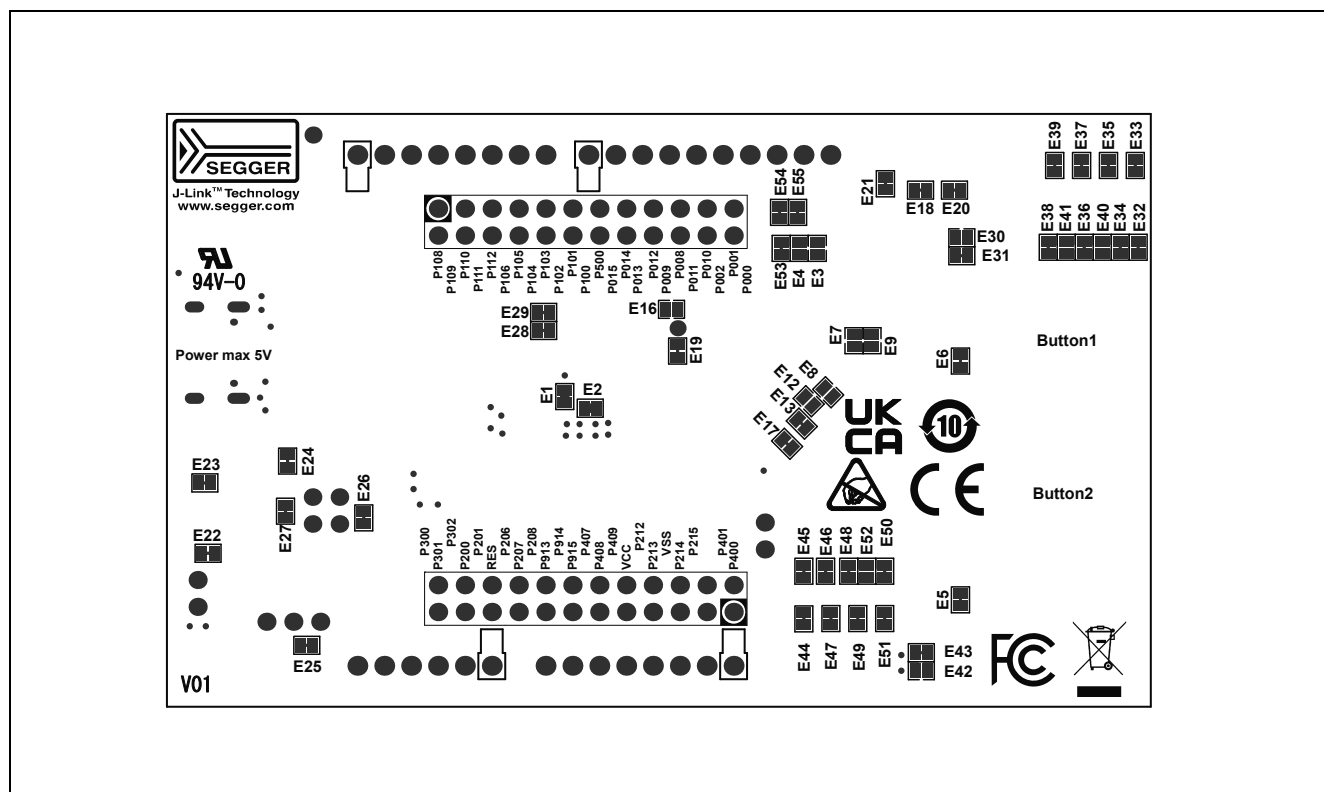


Figure 30. Layout Diagram of Components on the FPB-RA0L1 Board (Bottom View)

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jul.05.25	—	First Edition issued

FPB-RA0L1 v1 – User's Manual

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