

R9A02G021

Fast Prototyping Board for R9A02G021 Microcontroller
FPB-R9A02G021
User's Manual

All information contained in these materials, including products and product specifications, represents information on the product at the time of publication and is subject to change by Renesas Electronics Corp. without notice. Please review the latest information published by Renesas Electronics Corp. through various means, including the Renesas Electronics Corp. website (<http://www.renesas.com>).

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
6. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.

7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION ("Vulnerability Issues"). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-1 October 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

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

2. Processing at power-on

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

3. Input of signal during power-off state

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

4. Handling of unused pins

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

5. Clock signals

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

6. Voltage application waveform at input pin

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

7. Prohibition of access to reserved addresses

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

8. Differences between products

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

Renesas FPB-R9A02G021 Disclaimer

By using this FPB-R9A02G021, the User accepts the following terms, which are in addition to, and control in the event of disagreement, with Renesas' General Terms and Conditions available at <https://www.renesas.com/en-us/legal/disclaimer.html>.

The FPB-R9A02G021 is not guaranteed to be error free, and the entire risk as to the results and performance of the FPB-R9A02G021 is assumed by the User. The FPB-R9A02G021 is provided by Renesas on an "as is" basis without warranty of any kind whether express or implied, including but not limited to the implied warranties of good workmanship, fitness for a particular purpose, title, merchantability, and non-infringement of intellectual property rights. Renesas expressly disclaims any implied warranty.

Renesas does not consider the FPB-R9A02G021 to be a finished product and therefore the FPB-R9A02G021 may not comply with some requirements applicable to finished products, including, but not limited to recycling, restricted substances and electromagnetic compatibility regulations. Refer to Certifications section, for information about certifications and compliance information for the FPB-R9A02G021. It is the kit User's responsibility to make sure the kit meets any local requirements applicable to their region.

Renesas or its affiliates shall in no event be liable for any loss of profit, loss of data, loss of contract, loss of business, damage to reputation or goodwill, any economic loss, any reprogramming or recall costs (whether the foregoing losses are direct or indirect) nor shall Renesas or its affiliates be liable for any other direct or indirect special, incidental or consequential damages arising out of or in relation to the use of this FPB-R9A02G021, even if Renesas or its affiliates have been advised of the possibility of such damages.

Renesas has used reasonable care in preparing the information included in this document, but Renesas does not warrant that such information is error free nor does Renesas guarantee an exact match for every application or parameter to part numbers designated by other vendors listed herein. The information provided in this document is intended solely to enable the use of Renesas products. No express or implied license to any intellectual property right is granted by this document or in connection with the sale of Renesas products. Renesas reserves the right to make changes to specifications and product descriptions at any time without notice. Renesas assumes no liability for any damages incurred by you resulting from errors in or omissions from the information included herein. Renesas cannot verify, and assumes no liability for, the accuracy of information available on another company's website.

Precautions

This Fast Prototyping Board 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 fulfil the regulatory standards for an end product.

Proprietary Notice

All text, graphics, photographs, trademarks, logos, artwork, and computer code, collectively known as content, contained in this document is owned, controlled, or licensed by or to Renesas, and is protected by trade dress, copyright, patent and trademark laws, and other intellectual property rights and unfair competition laws. Except as expressly provided herein, no part of this document or content may be copied, reproduced, republished, posted, publicly displayed, encoded, translated, transmitted, or distributed in any other medium for publication or distribution or for any commercial enterprise, without prior written consent from Renesas.

SeeedGrove® is a registered trademark of Seeed Technology Inc.

"Pmod™" is the trademark of Digilent Inc. The Pmod Interface Specification is the property of Digilent Inc. For more information on the use of the Pmod trademark, please see our [Pmod License Agreement](#) page.

Arduino® is a registered trademark of Arduino SA.

Other brands and names mentioned in this document may be the trademarks or registered trademarks of their respective holders.

FPB-R9A02G021 User's Manual

Contents

1. Board Overview	4
1.1 Assumptions and Advisory Notes	5
2. Box Contents	6
3. Ordering Information	6
4. Hardware Architecture and Default Configuration	7
4.1 Board Architecture	7
4.2 Block Diagram	7
4.3 Component Placement Location and Dimension	8
4.4 Jumper Settings	10
4.4.1 Copper Jumpers	10
4.4.2 Traditional Pin Header Jumpers	10
4.4.3 Default Jumper Configuration	10
5. System Control and Ecosystem Access	18
5.1 Power	18
5.1.1 Power Supply Options	18
5.1.2 Power Supply Considerations	19
5.1.3 Power-up Behavior	19
5.2 Debug and Programming	20
5.2.1 J-Link Emulator On-Board	21
5.2.2 External Debugger	22
5.2.3 Settings in e ² studio and Renesas Flash Programmer	23
5.3 Ecosystem	24
5.3.1 Seeed Grove® Connector	26
5.3.2 Digilent Pmod™ Connectors	27
5.3.3 Arduino® Connector	31
5.4 Miscellaneous	33
5.4.1 LED	33
5.4.2 User and Reset Switches	34
5.4.3 MCU Boot Mode	35
6. Special Feature Access	36
6.1 Remote Control Signal Receiver	36
7. MCU Native Pin Access	37
7.1 Breakout Pin Headers	37
7.2 MCU Current Measurement	37

8. Certifications.....	38
8.1 EMC/EMI Standards.....	38
8.2 Material Selection, Waste, Recycling and Disposal Standards	38
8.3 Safety Standards	38
9. Design and Manufacturing Information	39
10. Website and Support	39
Revision History	40

Figures

Figure 1. FPB-R9A02G021 Board Top Side	5
Figure 2. FPB-R9A02G021 Board Bottom Side	5
Figure 3. FPB-R9A02G021 Board.....	6
Figure 4. FPB-R9A02G021 Board Block Diagram	7
Figure 5. Reference number for components on the FPB-R9A02G021 board (top side).....	8
Figure 6. Reference number for components on the FPB-R9A02G021 board (bottom side)	8
Figure 7. Dimensional drawing	9
Figure 8. Copper Jumpers	10
Figure 9. Power Supply Options.....	18
Figure 10. FPB-R9A02G021 Debug Interface.....	20
Figure 11. e ² Studio Settings.....	23
Figure 12. Renesas Flash Programmer Settings	23
Figure 13. Seeed Grove Connector.....	26
Figure 14. Seeed Grove Copper Jumpers (bottom side)	26
Figure 15. Pmod 1 Connector	27
Figure 16. Pmod 1 Copper Jumpers (bottom side)	28
Figure 17. Pmod 2 Connector	29
Figure 18. Pmod 2 Copper Jumpers (bottom side)	30
Figure 19. Pmod 2 INT / GPIO Selection Resistor (top side).....	30
Figure 20. Arduino Uno Connectors	32
Figure 21. Arduino Uno Copper Jumpers (bottom side).....	32
Figure 22. User LEDs	33
Figure 23. Power LED and Debug LED.....	33
Figure 24. User LEDs Copper Jumpers (bottom side)	34
Figure 25. Reset (S2) and User Switch (S1)	34
Figure 26. User Switch S1 Copper Jumper (bottom side).....	35
Figure 27. Boot Mode Jumper (J8).....	35
Figure 28. IR Receiver Module	36
Figure 29. Breakout Pin Headers J1 and J2.....	37
Figure 30. MCU +3.3 V Current Measurement Circuit	37

Figure 31. MCU +3.3 V Current Measurement Pin Header J3 and R49	37
---	----

Tables

Table 1. Board Architecture	7
Table 2. Default Jumper Settings for the MCU	11
Table 3. Default Jumper Settings for J-Link OB and External Debugger	12
Table 4. Default Jumper Settings for Arduino Uno	13
Table 5. Default Jumper Settings for Pmod 1	15
Table 6. Default Jumper Settings for Pmod 2	16
Table 7. Default Jumper Settings for Grove	17
Table 8. Default Jumper Settings for HMI Features	17
Table 9. Debug Mode	20
Table 10. Jumper Configuration for Debugging and Programming	20
Table 11. USB Debug Connector	21
Table 12. External Debugger Connection	22
Table 13. MCU and Ecosystem Connection	25
Table 14. Seeed Grove Connector	26
Table 15. Pmod 1 Connector	27
Table 16. Pmod 2 Connector	29
Table 17. Arduino Uno Connections	31
Table 18. FPB-FPB-R9A02G021 Board LED Functions	33
Table 19. FPB-R9A02G021 Board Switches	34
Table 20. Remote Control Signal Receiver	36
Table 21. FPB-R9A02G021 Board Design Package Contents	39

1. Board Overview

The FPB-R9A02G021, a Fast Prototyping Board for the R9A02G021 MCU, enables users to seamlessly evaluate the features of the R9A02G021 MCU and develop embedded systems applications using the e² studio IDE. The on-board features along with a choice of popular ecosystem add-on modules brings user big ideas to life.

The key features of the FPB-R9A02G021 board are categorized in three groups as follows:

MCU Native Pin Access

- R9A02G021CNE MCU (referred to as MCU)
- Max 48 MHz, RISC-V core
- 128 KB Code Flash, 4 KB Data Flash, 16 KB SRAM
- 48-pin, HWQFN package
- Native pin access through 2 x 24-pin male headers (not fitted)
- MCU current measurement point for precision current consumption measurement (not fitted)
- MCU internal clock
- Providing 32.768 kHz reference clock

Special Feature Access

- Remote Control Signal Receiver (not fitted)

System Control and Ecosystem Access

- Two +5 V input sources
 - USB
 - External power supply (using 2-pin header [not fitted])
- Built-in Segger J-Link Emulator On-Board programmer / debugger (cJTAG: 2-wire compact JTAG)
- User LEDs and switches
 - Two User LEDs (green)
 - Power LED (green) indicating availability of regulated power
 - Debug LED (yellow) indicating the debug connection
 - One User switch
 - One Reset switch
- Three popular ecosystem expansions
 - Seeed Grove® (I²C, Analog) connector (not fitted)
 - Two Digilent Pmod™ connectors
 - Pmod 1: Type-2A (expanded SPI), Type-3A (expanded UART) and Type-6A (expanded I²C)
 - Pmod 2: Type-3A (expanded UART) and Type-6A (expanded I²C)
 - Arduino® (Uno R3) connector
- MCU boot configuration jumper

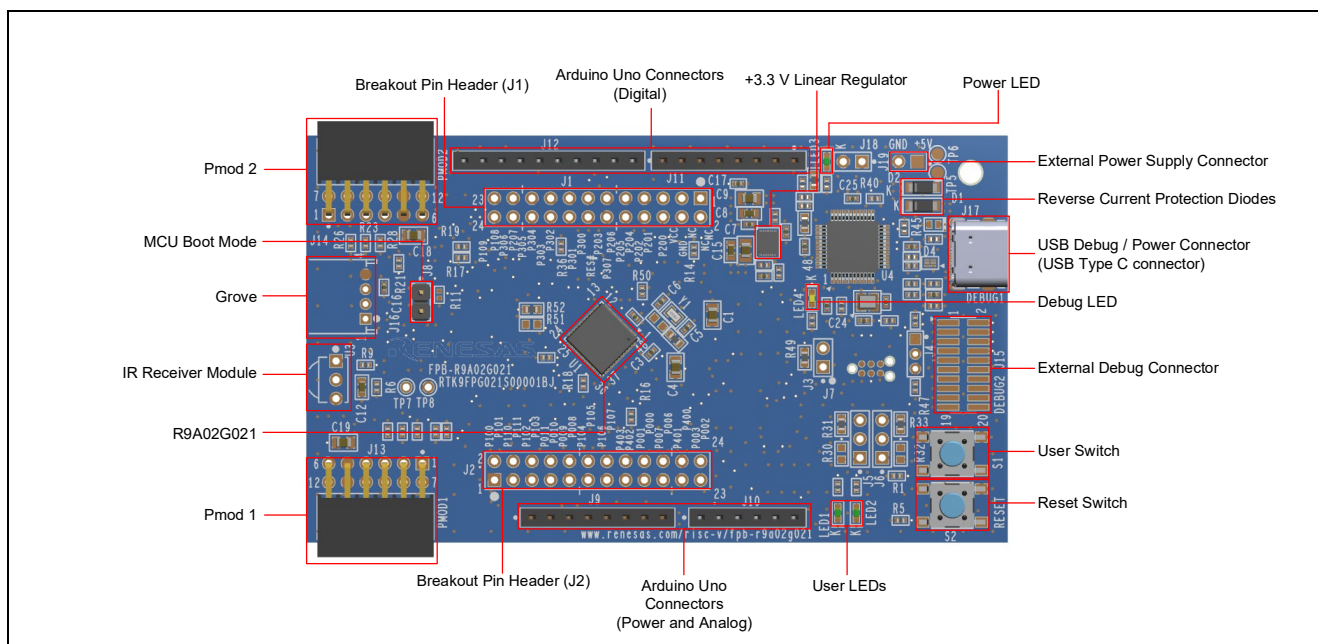


Figure 1. FPB-R9A02G021 Board Top Side

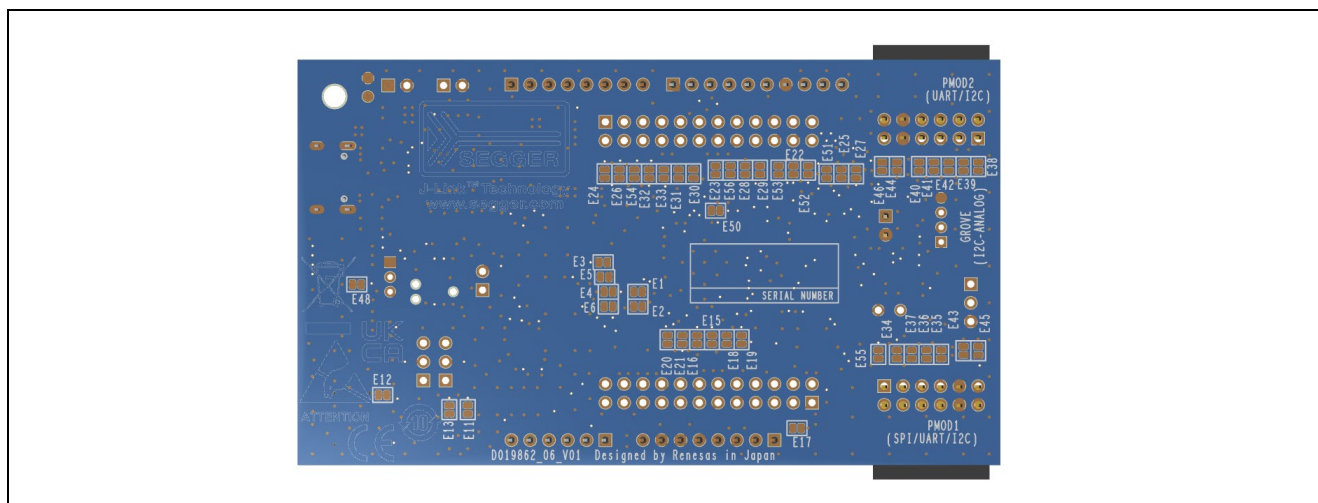


Figure 2. FPB-R9A02G021 Board Bottom Side

1.1 Assumptions and Advisory Notes

1. It is assumed that the user has a basic understanding of microcontrollers and embedded systems hardware.
2. An Integrated Development Environment (IDE) such as e² studio is required to develop embedded applications on FPB-R9A02G021 board.

2. Box Contents

The following components are included in the box:

1. FPB-R9A02G021 v1 board
2. Printed Quick Start Guide
3. Printed information for China RoHS

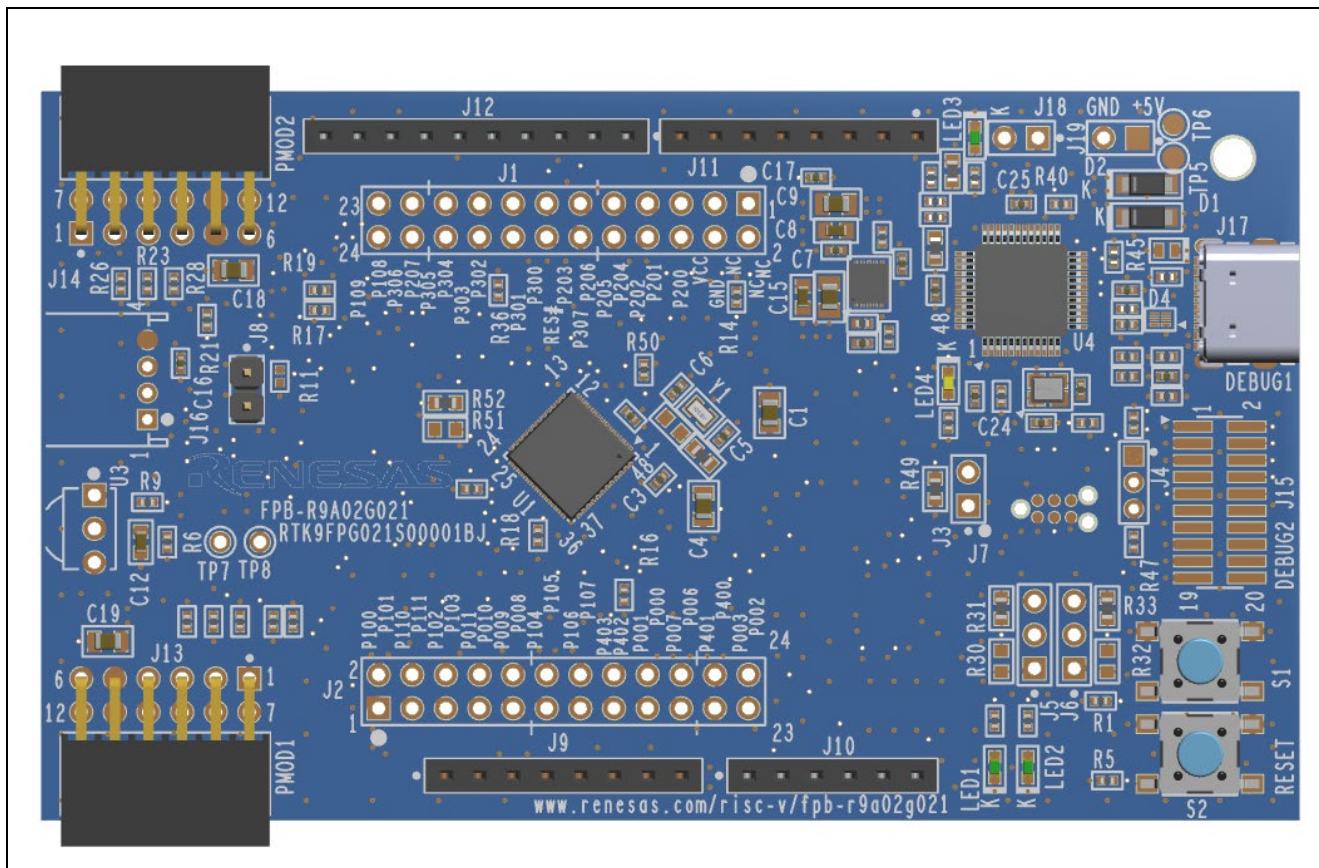


Figure 3. FPB-R9A02G021 Board

3. Ordering Information

- FPB-R9A02G021 v1 kit orderable part number: RTK9FPG021S00001BJ

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

4. Hardware Architecture and Default Configuration

4.1 Board Architecture

The FPB-R9A02G021 board is designed with an architecture similar to other boards in the Renesas FPB series. Alongside the MCU there is an on-board programmer / debugger, pin headers for access to all the pins on the MCU, a power supply regulator, some LEDs and switches, and several ecosystem I/O connectors (Grove, Pmod and Arduino).

Table 1. Board Architecture

Board Functionality	Features	Function present on all similar boards	Functionality is:
MCU Native Pin Access	MCU, breakout pin headers for all MCU I/O and power (not fitted), 2-pin header for MCU current measurement (not fitted)	Yes	MCU dependent
Special Feature Access	MCU special features: Remote control signal receiver (not fitted)	Optional	MCU dependent
System Control and Ecosystem Access	Power, debugger, user LEDs and switch, reset switch, ecosystem connectors, boot configuration	Yes	Same or similar across other FPB boards

4.2 Block Diagram

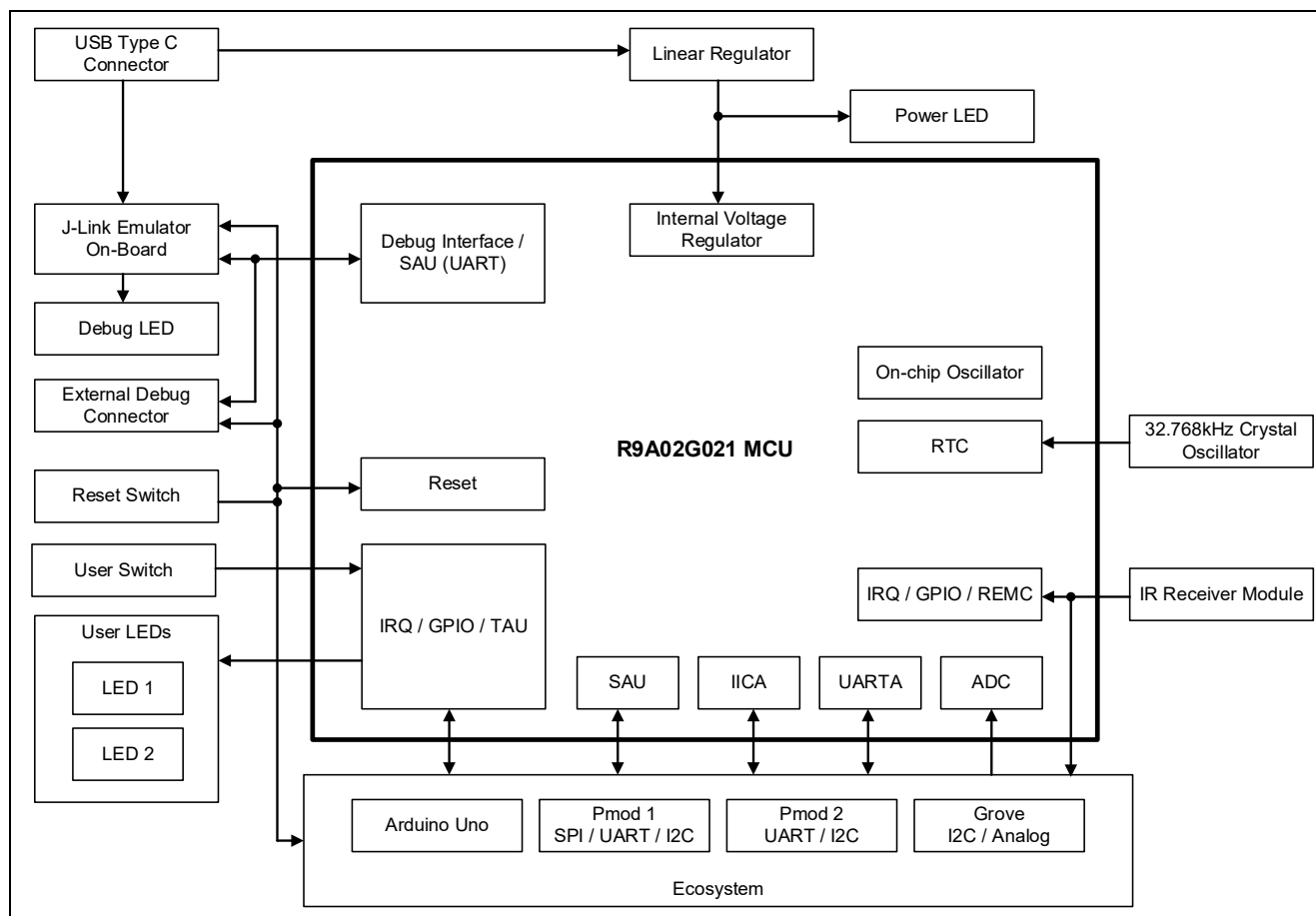


Figure 4. FPB-R9A02G021 Board Block Diagram

4.3 Component Placement Location and Dimension

Reference number for components on the FPB-R9A02G021 board is shown below.

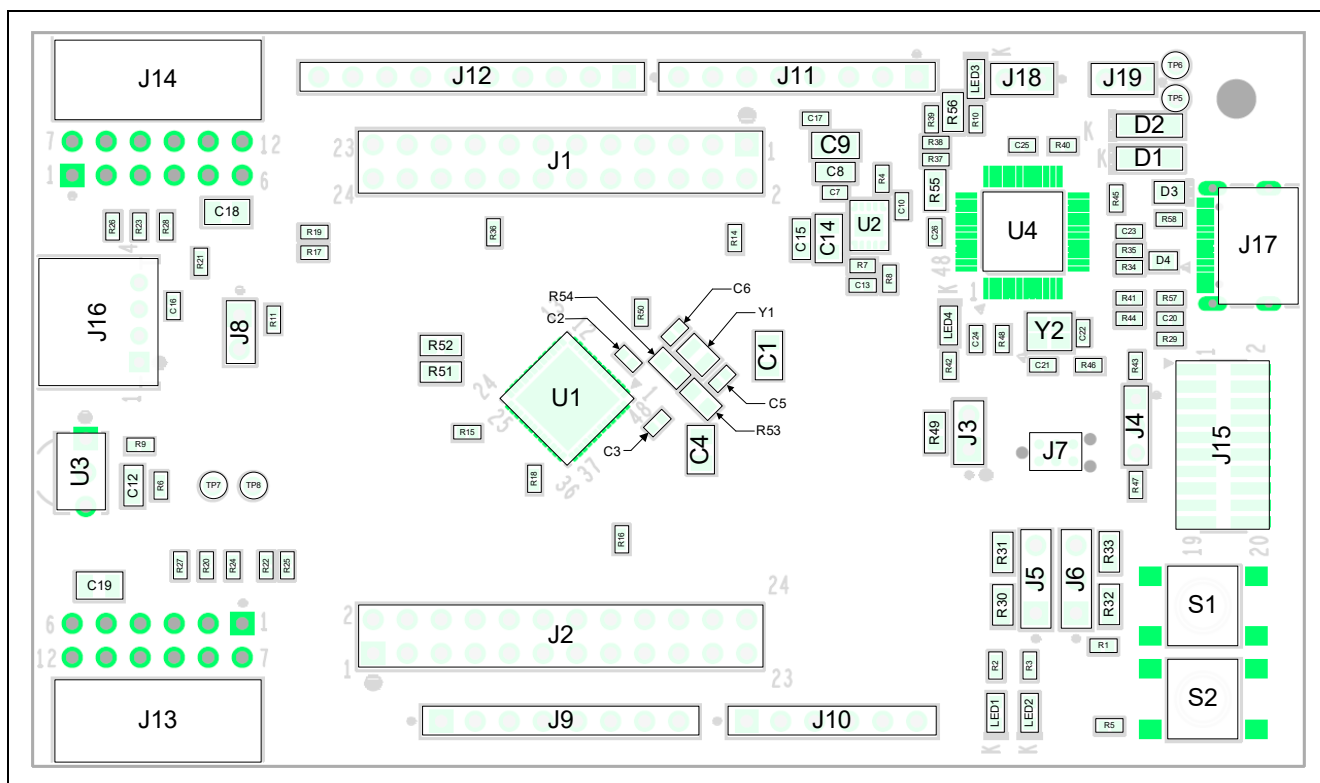


Figure 5. Reference number for components on the FPB-R9A02G021 board (top side)

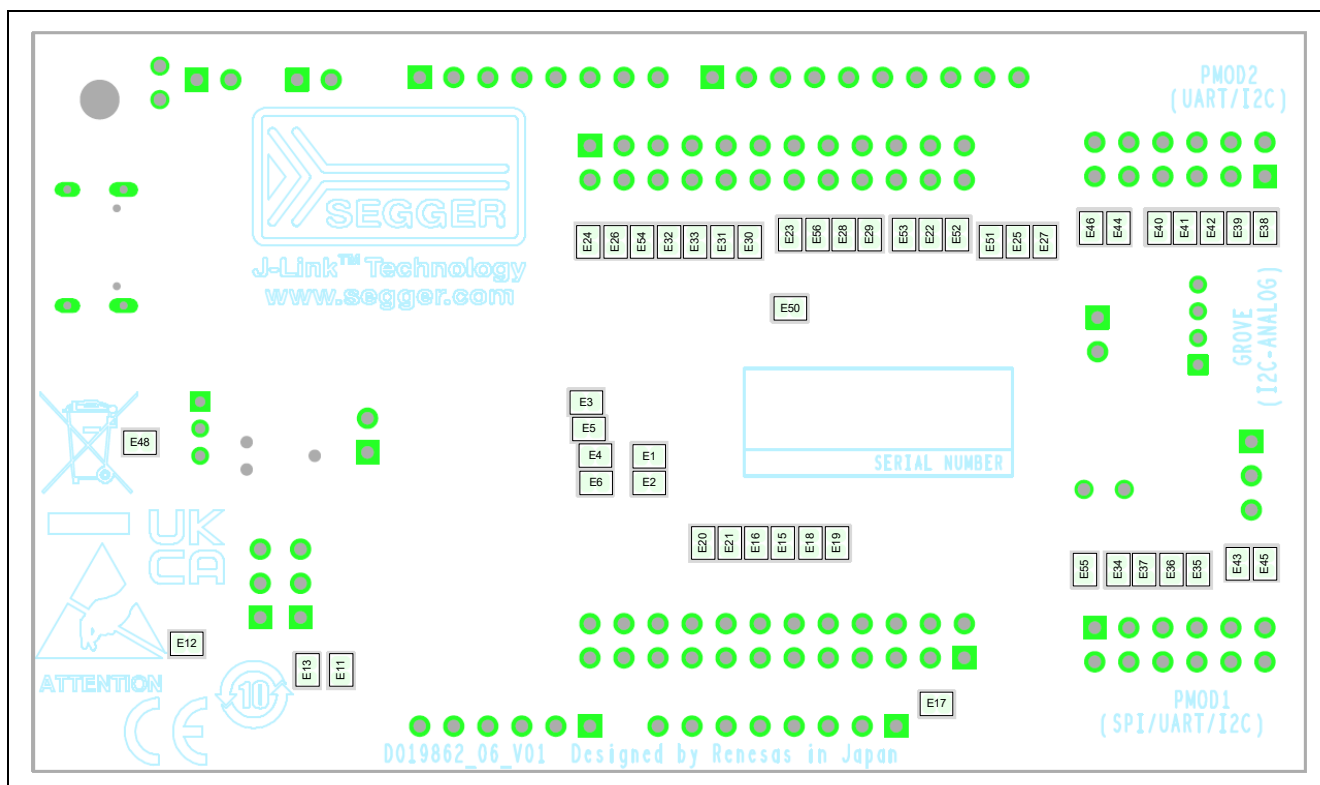


Figure 6. Reference number for components on the FPB-R9A02G021 board (bottom side)

Figure 7. Dimensional drawing

4.4 Jumper Settings

Two types of jumpers are provided on the FPB-R9A02G021 board.

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

The following sections describe each type and their default configuration.

4.4.1 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. 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 SMD resistor may be placed across the two pads and soldered in place. A zero-ohm resistor shorts the pads together.

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

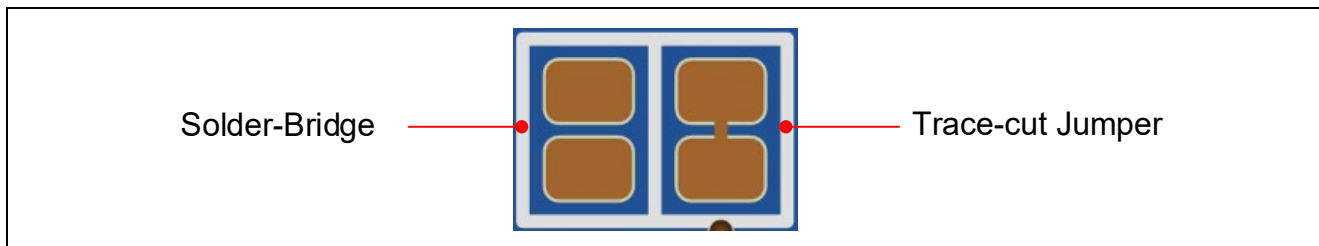


Figure 8. Copper Jumpers

4.4.2 Traditional Pin Header Jumpers

These jumpers are traditional small pitch jumpers that require an external shunt to open/close them. The traditional pin jumpers on the FPB-R9A02G021 board are 0.1" (2.54 mm) pitch headers and require compatible 2.54 mm shunt jumpers.

4.4.3 Default Jumper Configuration

The following table describes the default settings for each jumper on the FPB-R9A02G021 board. This includes copper jumpers (Ex designation) and traditional pin jumpers (Jx designation). This also includes some 0Ω resistors (Rx designation) because the resistors are used as jumper function.

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

Table 2. Default Jumper Settings for the MCU

Location	Circuit Group	Default (Open / Closed) (Fitted / Not fitted)	Function
E1	MCU	Open	Closed: P003 (AVREFM) connects to breakout pin header J2. (Remove capacitor C3 at closed)
			Open: P003 (AVREFM) disconnects from breakout pin header J2.
E2	MCU	Closed	Closed: P003 (AVREFM) connects to GND.
			Open: P003 (AVREFM) disconnects from GND.
E3	MCU	Open	Closed: P002 (AVREFP) connects to +3V3_MCU.
			Open: P002 (AVREFP) disconnects from +3V3_MCU.
E4	MCU	Closed	Closed: P002 (AVREFP) connects to +3.3 V.
			Open: P002 (AVREFP) disconnects from +3.3 V.
E5	MCU	Open	Closed: P002 (AVREFP) connects to Arduino Uno (AREF).
			Open: P002 (AVREFP) disconnects from Arduino Uno (AREF).
E6	MCU	Open	Closed: P002 (AVREFP) connects to breakout pin header J2. (Remove capacitor C3 at closed)
			Open: P002 (AVREFP) disconnects from breakout pin header J2.
J8	MCU BOOT MODE	Open	Closed: The MCU is configured for UART boot mode.
			Open: The MCU is configured for single chip mode.
R49	MCU CURRENT MEASUREMENT	Fitted	Fitted: +3.3 V connects to the MCU.
			Not fitted: The MCU current can be measured over this jumper.

Table 3. Default Jumper Settings for J-Link OB and External Debugger

Location	Circuit Group	Default (Open / Closed) (Fitted / Not fitted)	Function
J18	J-Link OB	Not fitted	Fitted (closed): J-Link Emulator On-board is held in reset. (R9A02G021 MCU free-running operation.)
			Not fitted (open): J-Link Emulator On-board is enabled.
E50	External Debugger, J-Link OB	Closed	Closed: P300 (TCKC) connects to the connector for external debugger J15 (TCKC) and J-Link Emulator On-board.
			Open: P300 (TCKC) disconnects from the connector for external debugger J15 (TCKC) and J-Link Emulator On-board.
E56	External Debugger, J-Link OB	Closed	Closed: P303 (RXD0_B) connects to the connector for external debugger J15 (RXD) and J-Link Emulator On-board.
			Open: P303(TO04) can be connected to Arduino Uno (D10 / SS / PWM) by closing the copper jumper E28.
R30, R31	External Debugger, J-Link OB	R30 = Not fitted R31 = Fitted	R30 = Not fitted and R31 = Fitted: The MCU connects to a host PC by Virtual COM (VCOM).
			R30 = Fitted and R31 = Not fitted: The external debugger connection is selected (for Debug in or UART Boot via External Debugger mode).
R32, R33	External Debugger, J-Link OB	R32 = Not fitted R33 = Fitted	R32 = Not fitted and R33 = Fitted: The MCU connects to a host PC by Virtual COM (VCOM).
			R32 = Fitted and R33 = Not fitted: The external debugger connection is selected (for Debug in or UART Boot via External Debugger mode).
J4	J-Link OB	Not fitted	Do not fit and use this jumper.
E48	External Debugger	Closed	Do not open this copper jumper.

Table 4. Default Jumper Settings for Arduino Uno

Location	Circuit Group	Default (Open / Closed)	Function
E15	Arduino Uno	Closed	Closed: P105 (ANI18) connects to Arduino Uno (A4).
			Open: P105 (ANI18) disconnects from Arduino Uno (A4).
E16	Arduino Uno	Closed	Closed: P106 (ANI19) connects to Arduino Uno (A5).
			Open: P106 (ANI19) disconnects from Arduino Uno (A5).
E17	Arduino Uno	Open	Closed: +5 V connects to Arduino Uno (5V).
			Open: +5 V disconnects from Arduino Uno (5V).
E22	Arduino Uno	Closed	Closed: P102 (SI20) connects to Arduino Uno (D12 / MISO).
			Open: P102 (SI20) disconnects from Arduino Uno (D12 / MISO).
E23	Arduino Uno	Closed	Closed: P107 (TO03_A) connects to Arduino Uno (D9 / PWM).
			Open: P107 (TO03_A) disconnects from Arduino Uno (D9 / PWM).
E24	Arduino Uno	Open	Closed: +3.3V (pull-up) connects to Arduino Uno (D3 / INT / PWM).
			Open: +3.3V (pull-up) disconnects from Arduino Uno (D3 / INT / PWM).
E25	Arduino Uno	Closed	Closed: +3.3V (pull-up) connect to P011 (SCLA1) and P010 (SDAA1).
			Open: +3.3V (pull-up) disconnect from P011 (SCLA1) and P010 (SDAA1).
E26	Arduino Uno	Closed	Closed: P100 (IRQ6_C / TO05) connects to Arduino Uno (D3 / INT / PWM).
			Open: P100 (IRQ6_C / TO05) disconnects from Arduino Uno (D3 / INT / PWM).
E27	Arduino Uno	Open	Closed: +5 V (pull-up) connects to P011 (SCLA1) and P010 (SDAA1).
			Open: +5 V (pull-up) disconnects from P011 (SCLA1) and P010 (SDAA1).

Location	Circuit Group	Default (Open / Closed)	Function
E28	Arduino Uno	Open	Closed: P303 (TO04) connects to Arduino Uno (D10 / SS / PWM).
			Open: P303 (TO04) disconnects from Arduino Uno (D10 / SS / PWM).
E29	Arduino Uno	Closed	Closed: P009 connects to Arduino Uno (D10 / SS / PWM).
			Open: P009 disconnects from Arduino Uno (D10 / SS / PWM).
E30	Arduino Uno	Open	Closed: P011 (TO07_B) connects to Arduino Uno (D6 / PWM).
			Open: P011 (TO07_B) disconnects from Arduino Uno (D6 / PWM).
E31	Arduino Uno	Closed	Closed: P104 connects to Arduino Uno (D6 / PWM).
			Open: P104 disconnects from Arduino Uno (D6 / PWM).
E32	Arduino Uno	Closed	Closed: P402 connects to Arduino Uno (D5 / PWM).
			Open: P402 disconnects from Arduino Uno (D5 / PWM).
E33	Arduino Uno	Open	Closed: P102 (TO01) connects to Arduino Uno (D5 / PWM).
			Open: P102 (TO01) disconnects from Arduino Uno (D5 / PWM).
E51	Arduino Uno	Closed	Closed: P011 (SCLA1) connects to Arduino Uno (SCL).
			Open: P011 (SCLA1) disconnects from Arduino Uno (SCL).
E52	Arduino Uno	Closed	Closed: P101 (SCK20) connects to Arduino Uno (D13 / SCK).
			Open: P101 (SCK20) disconnects from Arduino Uno (D13 / SCK).
E53	Arduino Uno	Closed	Closed: P103 (SO20 / TO02_A) connects to Arduino Uno (D11 / MOSI / PWM).
			Open: P103 (SO20 / TO02_A) disconnects from Arduino Uno (D11 / MOSI / PWM).
E54	Arduino Uno	Open	Closed: P207 connects to Arduino Uno (D4).
			Open: P207 disconnects from Arduino Uno (D4).

Table 5. Default Jumper Settings for Pmod 1

Location	Circuit Group	Default (Open / Closed) (Fitted / Not fitted)	Function
E34	Pmod 1	Closed	Closed: P102 (RXD2 / SI20) connects to Pmod 1 (RXD / MISO / SCL).
			Open: P102 (RXD2 / SI20) disconnects from Pmod 1 (RXD / MISO / SCL).
E35	Pmod 1	Closed	Closed: P101 (SCK20) connects to Pmod 1 (RTS / SCK / SDA).
			Open: P101 (SCK20) disconnects from Pmod 1 (RTS / SCK / SDA).
E36	Pmod 1	Open	Closed: P010 (SDAA1) connects to Pmod 1 (RTS / SCK / SDA).
			Open: P010 (SDAA1) disconnects from Pmod 1 (RTS / SCK / SDA).
E37	Pmod 1	Open	Closed: P011 (SCLA1) connects to Pmod 1 (RXD / MISO / SCL).
			Open: P011 (SCLA1) disconnects from Pmod 1 (RXD / MISO / SCL).
E43	Pmod 1	Closed	Closed: +3.3 V connects to Pmod 1 (VCC).
			Open: +3.3 V disconnects from Pmod 1 (VCC).
E45	Pmod 1	Open	Closed: +5 V connects to Pmod 1 (VCC).
			Open: +5 V disconnects from Pmod 1 (VCC).
E55	Pmod 1	Closed	Closed: P103 (TXD2 / SO20) connects to Pmod 1 (TXD / MOSI).
			Open: P103 (TXD2 / SO20) disconnects from Pmod 1 (TXD / MOSI).

Table 6. Default Jumper Settings for Pmod 2

Location	Circuit Group	Default (Open / Closed) (Fitted / Not fitted)	Function
E38	Pmod 2	Closed	Closed: P108 (IRQ4_B) connects to Pmod 2 (CTS / INT).
			Open: P108 (IRQ4_B) disconnects from Pmod 2 (CTS / INT).
E39	Pmod 2	Closed	Closed: P000 (RXD1) connects to Pmod 2 (RXD / SCL).
			Open: P000 (RXD1) disconnects from Pmod 2 (RXD / SCL).
E40	Pmod 2	Closed	Closed: P207 connects to Pmod 2 (RTS / SDA).
			Open: P207 disconnects from Pmod 2 (RTS / SDA).
E41	Pmod 2	Open	Closed: P010 (SDAA1) connects to Pmod 2 (RTS / SDA).
			Open: P010 (SDAA1) disconnects from Pmod 2 (RTS / SDA).
E42	Pmod 2	Open	Closed: P011 (SCLA1) connects to Pmod 2 (RXD / SCL).
			Open: P011 (SCLA1) disconnects from Pmod 2 (RXD / SCL).
E44	Pmod 2	Closed	Closed: +3.3 V connects to Pmod 2 (VCC).
			Open: +3.3 V disconnects from Pmod 2 (VCC).
E46	Pmod 2	Open	Closed: +5 V connects to Pmod 2 (VCC).
			Open: +5 V disconnects from Pmod 2 (VCC).
R52	Pmod 2	Fitted	Fitted: P202 (IRQ2_C / RIN0) connects to Pmod 2 (INT).
			Not fitted: P202 (IRQ2_C / RIN0) disconnects from Pmod 2 (INT).

Table 7. Default Jumper Settings for Grove

Location	Circuit Group	Default (Open / Closed)	Function
E18	Grove	Open	Closed: P105 (ANI18) connects to Grove (SCL / AN).
			Open: P105 (ANI18) disconnects from Grove (SCL / AN).
E19	Grove	Closed	Closed: P011 (SCLA1) connects to Grove (SCL / AN).
			Open: P011 (SCLA1) disconnects from Grove (SCL / AN).
E20	Grove	Closed	Closed: P010 (SDAA1) connects to Grove (SDA / AN).
			Open: P010 (SDAA1) disconnects from Grove (SDA / AN).
E21	Grove	Open	Closed: P106 (ANI19) connects to Grove (SDA / AN).
			Open: P106 (ANI19) disconnects from Grove (SDA / AN).

Table 8. Default Jumper Settings for HMI Features

Location	Circuit Group	Default (Open / Closed) (Fitted / Not fitted)	Function
E11	USER LEDS	Closed	Closed: P107 (TO03_A) connects to LED1.
			Open: P107 (TO03_A) disconnects from LED1.
E13	USER LEDS	Closed	Closed: P100 (TO05) connects to LED2.
			Open: P100 (TO05) disconnects from LED2.
E12	USER PUSH-SWITCH	Closed	Closed: P108 (IRQ4_B) connects to user switch S1.
			Open: P108 (IRQ4_B) disconnects from user switch S1.
R51	IR RECEIVER	Not fitted	Fitted: P202 (IRQ2_C / RIN0) connects to OUT pin of IR Receiver Module (U3).
			Not fitted: P202 (IRQ2_C / RIN0) disconnects from OUT pin of IR Receiver Module (U3).

5. System Control and Ecosystem Access

The FPB-R9A02G021 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-R9A02G021 board is designed for +5 V operation. An on-board Linear 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 MCU and other peripheral features.

Note: Power to the FPB-R9A02G021 board can't be supplied by an external debugger. An USB cable or external power supply must be used to power the board.

5.1.1 Power Supply Options

This section describes the different ways in which FPB-R9A02G021 board can be powered.

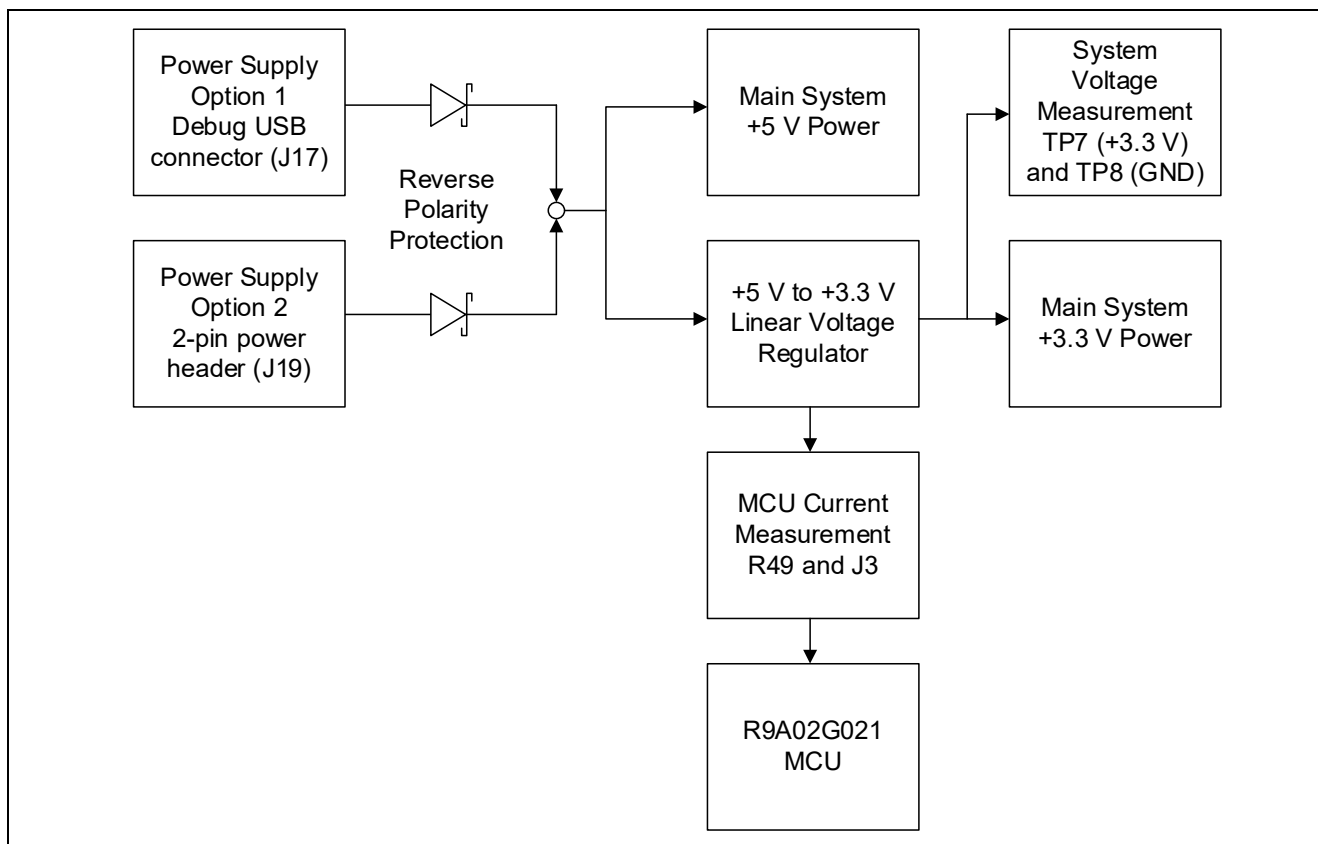


Figure 9. Power Supply Options

5.1.1.1 Option 1: USB

+5 V may be supplied from a host PC to the USB Type C connector (J17) labelled DEBUG1 on the board. Power from this source is connected to the main system +5 V power. Reverse current protection is provided between this connector and the main system +5 V power.

5.1.1.2 Option 2: Header Connector J19

+5 V may be supplied from an external power supply to connector J19. J19 can be fitted with a standard 2-pin header on a 0.1" (2.54 mm) pitch. Pin 1 is +5 V, and pin 2 is GND. Power from this source is connected to the main system +5 V power. Reverse current protection is provided between J19 and the main system +5 V power.

5.1.2 Power Supply Considerations

Voltage of Main System +5 V Power will be lower than the power supply voltage because of the forward voltage (max 0.55V@1A) of the reverse current protection diode. Please note the voltage drop, because Main System +5 V Power is +5 V power source which supplies to external devices connected to Arduino, Pmod 1 and Pmod 2.

Note: The maximum current that could be supplied to the FPB-R9A02G021 board is 1 A. Please be aware that the larger the current is, the higher the temperature of reverse current protection diode and +3.3V linear regulator will be.

5.1.3 Power-up Behavior

When powered, the green LED labelled LED3 will light up.

5.2 Debug and Programming

The FPB-R9A02G021 board can be debugged using the built-in J-Link Emulator On-Board debugger (Debug on-board mode) and an external debugger (Debug in mode).

Table 9. Debug Mode

Debug Mode	Debug MCU (One that connects to the IDE on PC)	Target MCU (One that is being debugged)	Debugging Interface / Protocol	Connector used
Debug on-board	J-Link Emulator On-Board debugger	R9A02G021 (on-board)	cJTAG	USB DEBUG1 Connector (J17)
Debug in	External Debugger	R9A02G021 (on-board)	cJTAG	20-pin 1.27mm pitch SMD Connector (J15 [not fitted])

Notes:

- See Table 11 for the USB DEBUG1 connector pin definition.
- See Table 12 for the 20-pin 1.27 mm pitch SMD connector pin definition.

The built-in J-Link Emulator On-Board debugger or an external debugger can be used also for programming to the FPB-R9A02G021 board. The FPB-R9A02G021 board can be programmed using VCOM of the built-in J-Link Emulator On-Board debugger (UART Boot via VCOM mode) or an external debugger (UART Boot via External Debugger mode).

The following table summarizes the jumper configuration for debugging and programming.

Table 10. Jumper Configuration for Debugging and Programming

Debugging / Programming Mode	Debugging / Programming Interface	VCOM	R30 (Not fitted)	R31	R32 (Not fitted)	R33	J8	J18 (Not fitted)
Debug on-board	cJTAG	Available	Open	Closed	Open	Closed	Open	Open
Debug in	cJTAG	Not available	Closed	Open	Closed	Open	Open	Closed
UART Boot via VCOM	UART Boot	Available as UART Boot resource	Open	Closed	Open	Closed	Closed	Open
UART Boot via External Debugger	UART Boot	Not available	Closed	Open	Closed	Open	Closed	Closed

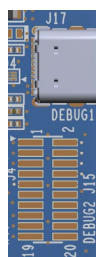


Figure 10. FPB-R9A02G021 Debug Interface

5.2.1 J-Link Emulator On-Board

USB DEBUG1 (Type C) connector (J17) connects the J-Link Emulator On-Board debugger to a host PC, allowing re-programming and debugging of the MCU firmware.

The J-Link Emulator On-Board debugger connects to the MCU using the cJTAG interface. Please note that connecting the same host PC to multiple FPB-R9A02G021 boards is not possible.

Table 11. USB Debug Connector

USB Debug Connector		FPB-R9A02G021
Pin	Description	Signal / Bus
J17-A4_B9	VBUS [0]	+5V_USB_DBG
J17-B4_A9	VBUS [1]	+5V_USB_DBG
J17-A5	CC1	5.1kΩ Pull-down
J17-B5	CC2	5.1kΩ Pull-down
J17-A6	DP1	USB_JLOB_DP
J17-B6	DP2	USB_JLOB_DP
J17-A7	DN1	USB_JLOB_DM
J17-B7	DN2	USB_JLOB_DM
J17-A8	SBU1	NC
J17-B8	SBU2	NC
J17-A1_B12	GND [0]	GND
J17-B1_A12	GND [1]	GND

The yellow LED4, shows the visual status of the debug interface. When the FPB-R9A02G021 board is powered on, and LED4 is blinking, it indicates that the J-Link Emulator On-Board debugger is not connected to a host PC. When LED4 stays on, it indicates that it is connected to a host PC.

5.2.2 External Debugger

The 20-pin 1.27 mm pitch SMD connector at J15 (not fitted) supports cJTAG interface and UART boot. This connector may be used for external debug of the MCU.

Table 12. External Debugger Connection

External Debugger Connection			FPB-R9A02G021
Pin	cJTAG Pin Name	UART Boot Pin Name	Signal / Bus
J15-1	VTref		+3.3 V
J15-2	TMSC	Not used	P301 (TMSC)
J15-3	GND		GND
J15-4	TCKC	Not used	P300 (TCKC)
J15-5	GND		GND
J15-6	Not used	TXD	P302 (TXD0_B)
J15-7	Key (Omitted pin)		NC
J15-8	Not used	RXD	P303 (RXD0_B)
J15-9	GNDDetect		GND (cut E48 to open)
J15-10	RESET		RES#
J15-11	5V-Supply		NC
J15-12	NC		NC
J15-13	5V-Supply		NC
J15-14	NC		NC
J15-15	GND		GND
J15-16	NC		NC
J15-17	GND		GND
J15-18	NC		NC
J15-19	GND		GND
J15-20	NC		NC

5.2.3 Settings in e² studio and Renesas Flash Programmer

FPB-R9A02G021 needs to be configured in Debug on-board shown in Table 10 when the MCU is debugged or re-programmed at Debug on-board mode with e² studio. Figure 11 shows the settings for e² studio when creating a new project for the FPB-R9A02G021 board.

[Debug hardware]: Select [J-Link RISC-V]

[Target Device]: Select [R9A02G021]

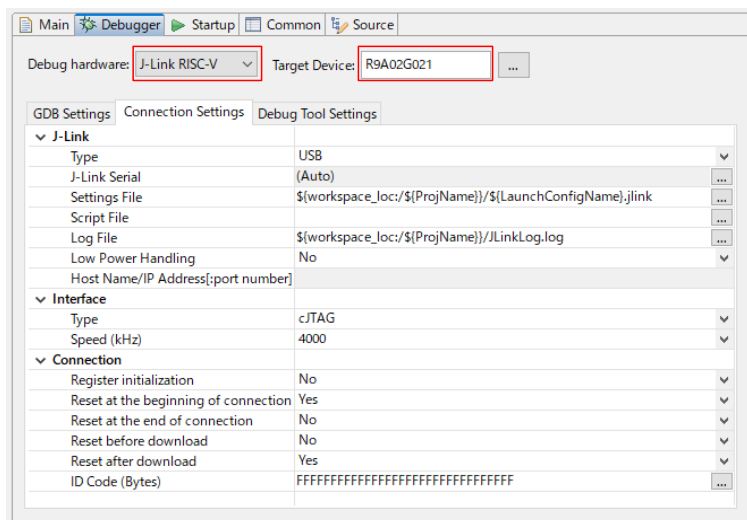


Figure 11. e² Studio Settings

FPB-R9A02G021 needs to be configured in UART Boot via VCOM shown in Table 9 when the MCU is re-programmed at UART Boot via VCOM mode with Renesas Flash Programmer. Figure 12 shows the settings for Renesas Flash Programmer when creating a new project for the FPB-R9A02G021 board.

Connect an USB cable between the FPB-R9A02G021 and a host PC and create a new project.

[Microcontroller]: Select [RISC-V MCU]

[Project Name]: Define project name

[Project Name]: Select project folder location

[Tool]: Select [COM port]

[Tool Details]: Select COM port which shows JLink CDC UART Port

The MCU doesn't entry into UART (SAU) boot mode by Power-on reset. Therefore, the user needs to push the reset switch on the FPB-R9A02G021 board and then click on Connect button.

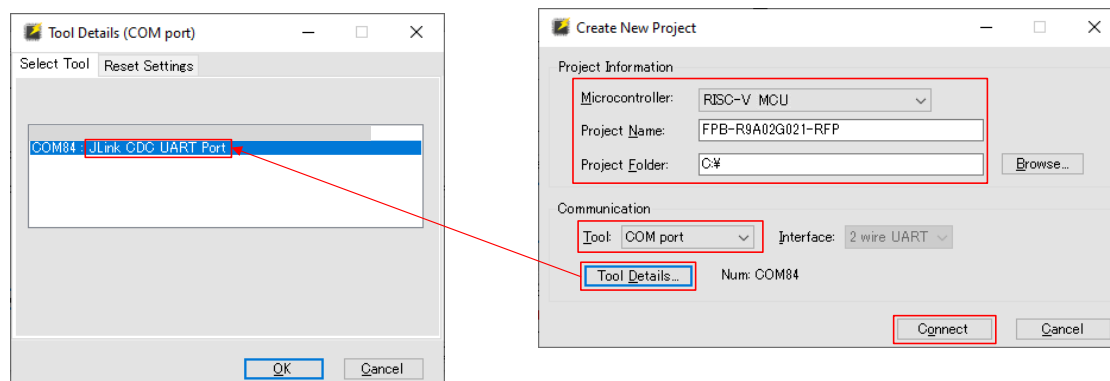


Figure 12. Renesas Flash Programmer Settings

5.3 Ecosystem

The Ecosystem connectors provide users the option to connect several third party add-on modules compatible with three popular ecosystems using the following connectors:

1. Seeed Grove® connector (not fitted)
2. Two Digilent Pmod™ connectors
Pmod 1: Type-2A (expanded SPI), Type-3A (expanded UART) and Type-6A (expanded I²C)
Pmod 2: Type-3A (expanded UART) and Type-6A (expanded I²C)
3. Arduino® (Uno R3) connectors

Note.1: We do not guarantee connection to all types of third party add-on modules. Confirm the specifications of this product against any third party add-on modules you intend to use.

Note.2: Third party add-on modules may not be able to connect the FPB-R9A02G021 board simultaneously because the MCU pins which are connected to third party add-on modules are multiplexed. Confirm the specifications of this product and R9A02G021 User's Manual: Hardware.

Table 13 summarizes connection between the MCU and the ecosystem connectors. The cells filled in green indicate that the signals are connected by default, and the cells filled in yellow indicate that the signals can be optionally connected by jumpers setting and resistors fitting. The blank cells indicate no connection between the MCU and the ecosystem connectors.

Due to port limitation of the MCU, one port may be connected to several ecosystem connectors. Please configure the jumpers and the resistors according to user's ecosystem configuration by referring Table 13.

■ I²C

I²C is connected to Pmod 1, Pmod 2, Grove and Arduino. The I²C channel in the MPU is same module, so that I²C slave devices are needed to select by slave address.

The I²C can be configure either +3.3 V and +5 V pull-up by solder jumper E25 and E27.

P011 (SCLA1 / TO07_B) of the I²C is shared with a PWM signal of Arduino. I²C is unavailable when P011 port is configured to PWM function.

■ SPI

SPI is connected to Pmod 1 and Arduino. The SPI channel in the MPU is same module, so that SPI slave devices are needed to select by chip select signal when both Pmod 1 and Arduino are connected to SPI slave devices.

P102 (SI20 / TO01) of the SPI is shared with a PWM signal of Arduino. SPI is unavailable when P102 port is configured to PWM function.

The P102 (SI20 / RXD2) and P103 (SO20 / TXD2) of the SPI are multiplexed with UART, and the UART is assigned to Pmod 1. SPI is unavailable when the ports are configured to the UART.

■ UART

UARTs are connected to Pmod 1, Pmod 2 and Arduino. The UART channels connected to Pmod 2 and Arduino is independent, so that devices that connected to Pmod 2 and Arduino can be used simultaneously.

The UART (RXD and TXD) connected to Pmod 1 is multiplexed MISO and MOSI of the SPI. UART for Pmod 1 is unavailable at configured to SPI.

■ Miscellaneous

The signals connected to ecosystem connectors are also shared with IR receiver, user LEDs and user switch. Please select the function you intend to use by jumper setting and resistor fitting.

Table 13. MCU and Ecosystem Connection

MCU	Ecosystem				
I/O Port	Pmod 1	Pmod 2	Grove	Arduino	Misc. (LED, Switch, IR Receiver)
P201	INT				
P202		INT			IR Receiver Module
P204	RESET				
P205	GPIO				
P206	GPIO				
P307		GPIO			
P303				PWM	
P304				D7	
P305				D8	
P207		RTS		D4	
P306		GPIO			
P108		CTS / INT			User Switch S1
P109	CTS / CS / INT				
P100				D3 / INT / PWM	User LED2
P101	RTS / SCK			D13 / SCK	
P110				D2 / INT	
P111		RESET			
P102	RXD / MISO			D12 / MISO	
				PWM	
P103	TXD / MOSI			D11 / MOSI / PWM	
P011	SCL	SCL	SCL	SCL	
				PWM	
P010	SDA	SDA	SDA	SDA	
P009				D10 / SS	
P008				D0 / RX	
P104				D6	
P105			AN	A4	
P106			AN	A5	
P107				D9 / PWM	User LED1
P403				D1 / TX	
P402				D5	
P001		TXD			
P000		RXD			
P007				A3	
P006				A2	
P401				A1	
P400				A0	

5.3.1 Seeed Grove® Connector

A Seeed Grove I²C / Analog connector is provided at J16 (not fitted). The MCU acts as a two-wire serial master, and a connected module acts as a two-wire serial slave. Alternatively, this port can be configured to support two analog (ADC) inputs.

The signals connected to Grove connector are shared with other ecosystem connectors. See Table 13 and FPB-R9A02G021 board schematic in detail.

Table 14. Seeed Grove Connector

Seeed Grove Connector		FPB-R9A02G021	Seeed Grove Configuration	
Pin	Description	Signal / Bus	Close	Open
J16-1	SCL / AN	P011 (SCLA1)	E19	E18
		P105 (ANI18)	E18	E19
J16-2	SDA / AN	P010 (SDAA1)	E20	E21
		P106 (ANI19)	E21	E20
J16-3	VCC	+3.3 V		
J16-4	GND	GND		

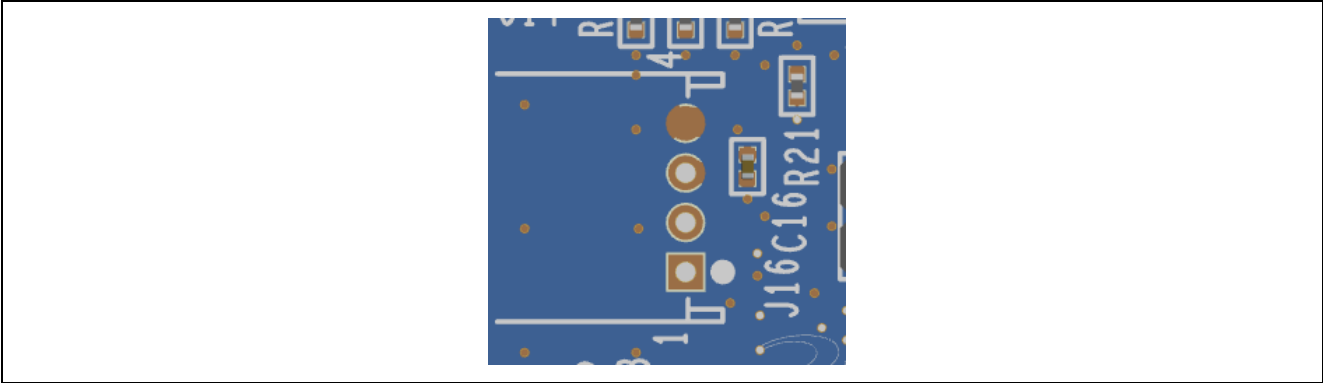


Figure 13. Seeed Grove Connector

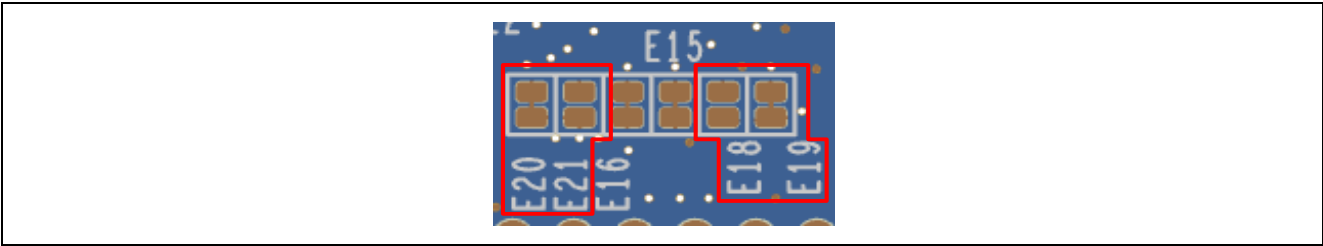


Figure 14. Seeed Grove Copper Jumpers (bottom side)

5.3.2 Digilent Pmod™ Connectors

5.3.2.1 Pmod 1

A 12-pin Pmod Type-2A (expanded SPI), Type-3A (expanded UART) and Type-6A (expanded I²C) connector is provided at connector J13 labelled PMOD1. At Type-2A, the MCU acts as the SPI master, and the connected module acts as an SPI slave device. At Type-6A, the MCU acts as a two-wire serial master, and a connected module acts as a two-wire serial slave.

Table 15. Pmod 1 Connector

Pmod1 Connector			FPB-R9A02G021	Pmod 1 Configuration	
Pin	Description Type-2A, 3A	Option Type-6A	Signal / Bus	Close	Open
J13-1	CS / CTS / GPIO	INT	P109 (IRQ5_B)		
J13-2	MOSI / TXD	RESET	P103 (TXD2 / SO20) *1	E55	
J13-3	MISO / RXD		P102 (RXD2 / SI20) *1	E34	E37
		SCL	P011 (SCLA1) *1	E37	E34
J13-4	SCK / RTS / GPIO		P101 (SCK20) *1	E35	E36
		SDA	P010 (SDAA1) *1	E36	E35
J13-5	GND		GND		
J13-6	VCC		+3.3 V	E43	E45
			+5 V	E45	E43
J13-7	GPIO / INT (slave to master)		P201 (IRQ3_C)		
J13-8	GPIO / RESET (master to slave)		P204		
J13-9	GPIO / CS2		P205		
J13-10	GPIO / CS3		P206		
J13-11	GND		GND		
J13-12	VCC		+3.3 V	E43	E45
			+5 V	E45	E43

*1: The signals are shared with other ecosystem connectors. See Table 13 and FPB-R9A02G021 board schematic in detail.

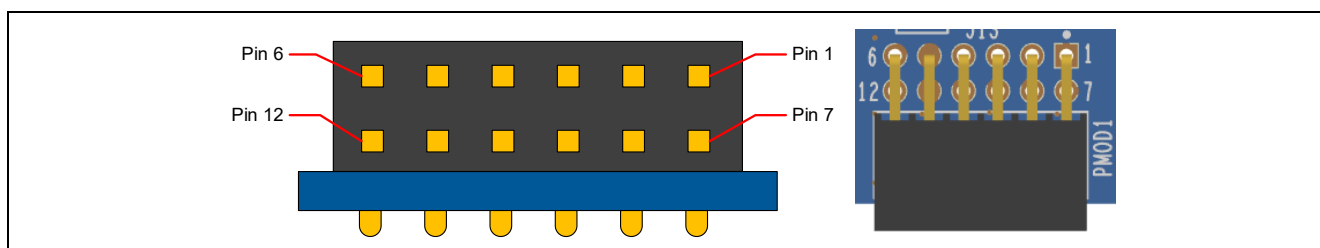


Figure 15. Pmod 1 Connector

The default setting of the Pmod 1 interface supports +3.3 V devices. Please ensure that any Pmod device installed is compatible with a +3.3 V supply.

Pmod Type-6A Operation

Pmod 1 can be configured to support Pmod Type-6A connector specification supporting I²C connections. There is also an alternative +5 V power source option. In order to configure Pmod 1 for Type-6A operation, modify the copper jumpers as described in Table 15. The copper jumpers are shown in Figure 16.

Note: Exercise caution while modifying power source trace jumpers, E43 and E45. Permanent damage to the FPB-R9A02G021 board and/or connected modules may result.

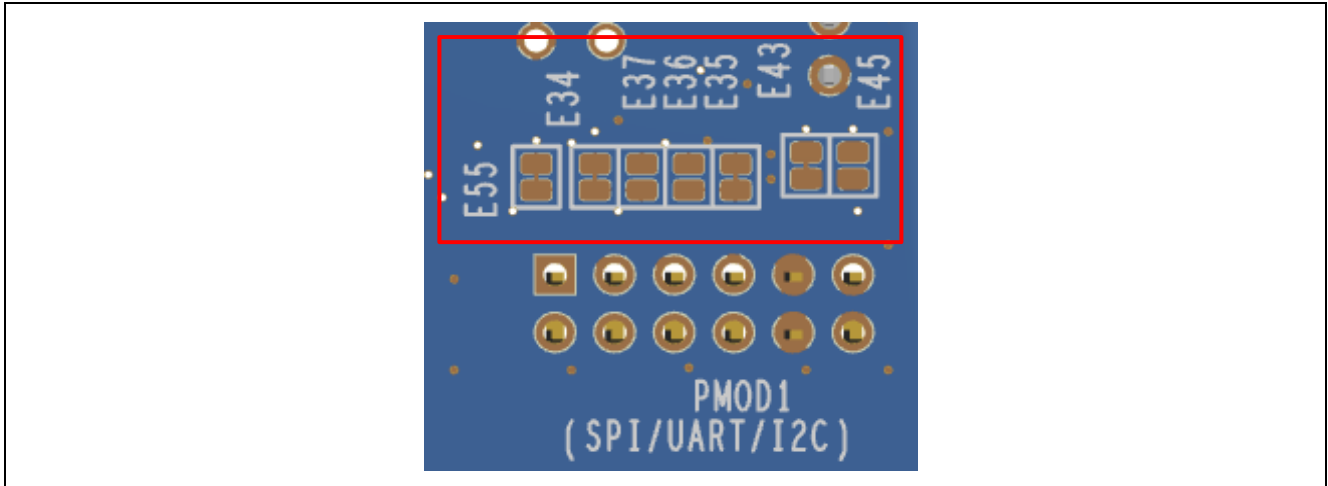


Figure 16. Pmod 1 Copper Jumpers (bottom side)

5.3.2.2 Pmod 2

A 12-pin Pmod Type-3A (expanded UART) and Type-6A (expanded I²C) connector is provided at connector J14 labelled PMOD2. At Type-6A, the MCU acts as a two-wire serial master, and a connected module acts as a two-wire serial slave.

Table 16. Pmod 2 Connector

Pmod2 Connector			FPB-R9A02G021	Pmod 2 Configuration	
Pin	Description Type-3A	Option Type-6A	Signal / Bus	Close	Open
J14-1	CTS / GPIO	INT	P108 (IRQ4_B) *1	E38	
J14-2	TXD	RESET	P001 (TXD1)		
J14-3	RXD		P000 (RXD1)	E39	E42
		SCL	P011 (SCLA1) *1	E42	E39
J14-4	RTS / GPIO		P207 *1	E40	E41
		SDA	P010 (SDAA1) *1	E41	E40
J14-5	GND		GND		
J14-6	VCC		+3.3 V	E44	E46
			+5 V	E46	E44
J14-7	GPIO / INT (slave to master)		P202 (IRQ2_C) *1	R52	R51
J14-8	GPIO / RESET (master to slave)		P111		
J14-9	GPIO		P307		
J14-10	GPIO		P306		
J14-11	GND		GND		
J14-12	VCC		+3.3 V	E44	E46
			+5 V	E46	E44

*1: The signals are shared with other ecosystem connectors, user switches and IR receiver module. See Table 13 and FPB-R9A02G021 board schematic in detail.

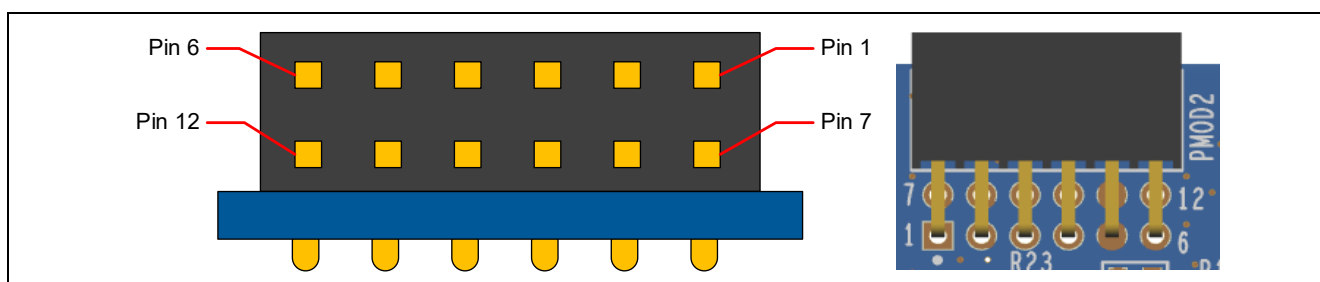


Figure 17. Pmod 2 Connector

The default setting of the Pmod 2 interface supports +3.3 V devices. Please ensure that any Pmod device installed is compatible with a +3.3 V supply.

Pmod Type-6A Operation

Pmod 2 can be configured to support Pmod Type-6A connector specification supporting I²C connections. There is also an alternative +5 V power source option. In order to configure Pmod 2 for Type-6A operation, modify the copper jumpers as described in Table 16. The copper jumpers are shown in Figure 18.

Note: Exercise caution while modifying power source trace jumpers, E44 and E46. Permanent damage to the FPB-R9A02G021 board and/or connected modules may result.



Figure 18. Pmod 2 Copper Jumpers (bottom side)

P202 (IRQ2_C / RIN0) of the MCU can be connected to OUT pin of the IR receiver module and Pmod 2 INT / GPIO (J14-Pin7). P202 (IRQ2_C / RIN0) is not connected to OUT pin of the IR receiver module but connected to Pmod 2 INT / GPIO (J14-Pin7) at shipping. It is needed to remove 0Ω resistor (SMD 0603) from R52 and fit 0Ω resistor (SMD 0603) to R51 for using the IR receiver module.

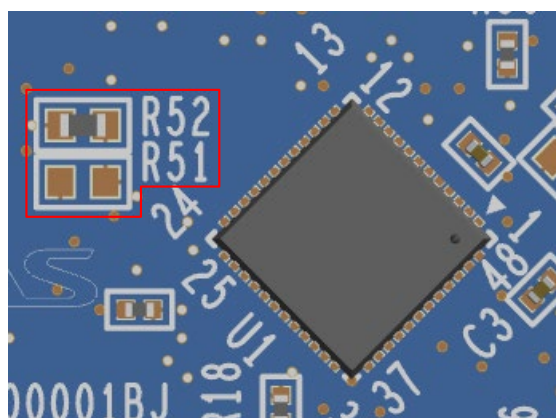


Figure 19. Pmod 2 INT / GPIO Selection Resistor (top side)

5.3.3 Arduino® Connector

Arduino Uno R3 compatible connector interface is provided at connector J9, J10, J11 and J12.

Table 17. Arduino Uno Connections

Arduino Compatible Connector		FPB-R9A02G021	Arduino Configuration	
Pin	Description	Signal / Bus	Close	Open
J9-1	NC	NC		
J9-2	IOREF	+3.3 V		
J9-3	RESET	RES#		
J9-4	3.3V	+3.3 V		
J9-5	5 V	+5 V	E17	
J9-6	GND	GND		
J9-7	GND	GND		
J9-8	VIN	NC		
J10-1	A0	P400 (ANI2)		
J10-2	A1	P401 (ANI3)		
J10-3	A2	P006 (ANI4)		
J10-4	A3	P007 (ANI5)		
J10-5	A4	P105 (ANI18) *1	E15	
J10-6	A5	P106 (ANI19) *1	E16	
J11-1	D0 / RX	P008 (RXDA1)		
J11-2	D1 / TX	P403 (TXDA1)		
J11-3	D2 / INT0	P110 (IRQ7_B)		
J11-4	D3 / INT1 / PWM	P100 (IRQ6_C / TO05) *1	E24 *3, E26	
J11-5	D4	P207 *1	E54	
J11-6	D5 / PWM	P402	E32	E33
		P102 (TO01) *1	E33	E32
J11-7	D6 / PWM	P104	E31	E30
		P011 (TO07_B) *1	E30	E31
J11-8	D7	P304		
J12-1	D8	P305		
J12-2	D9 / PWM	P107 (TO03_A) *1	E23	
J12-3	D10 / SS / PWM	P009	E29	E28
		P303 (TO04) *1 *2	E28	E29
J12-4	D11 / MOSI / PWM	P103 (SO20 / TO02_A) *1	E53	
J12-5	D12 / MISO	P102 (SI20) *1	E22	
J12-6	D13 / SCK	P101 (SCK20) *1	E52	
J12-7	GND	GND		
J12-8	AREF	AVREFP	E5	E3, E4, E6
J12-9	SDA	P010 (SDAA1) *1		
J12-10	SCL	P011 (SCLA1) *1	E51	

*1: The signals are shared with other ecosystem connectors, user switches and LEDs. See Table 12 and FPB-R9A02G021 board schematic in detail.

*2: The signal is shared with VCOM (RXD0_B).

*3: By shorting the copper jumper connects J11-Pin4 to +3.3 V through 10kΩ. The copper jumper may be shorted when P100 is assigned to IRQ6_C.

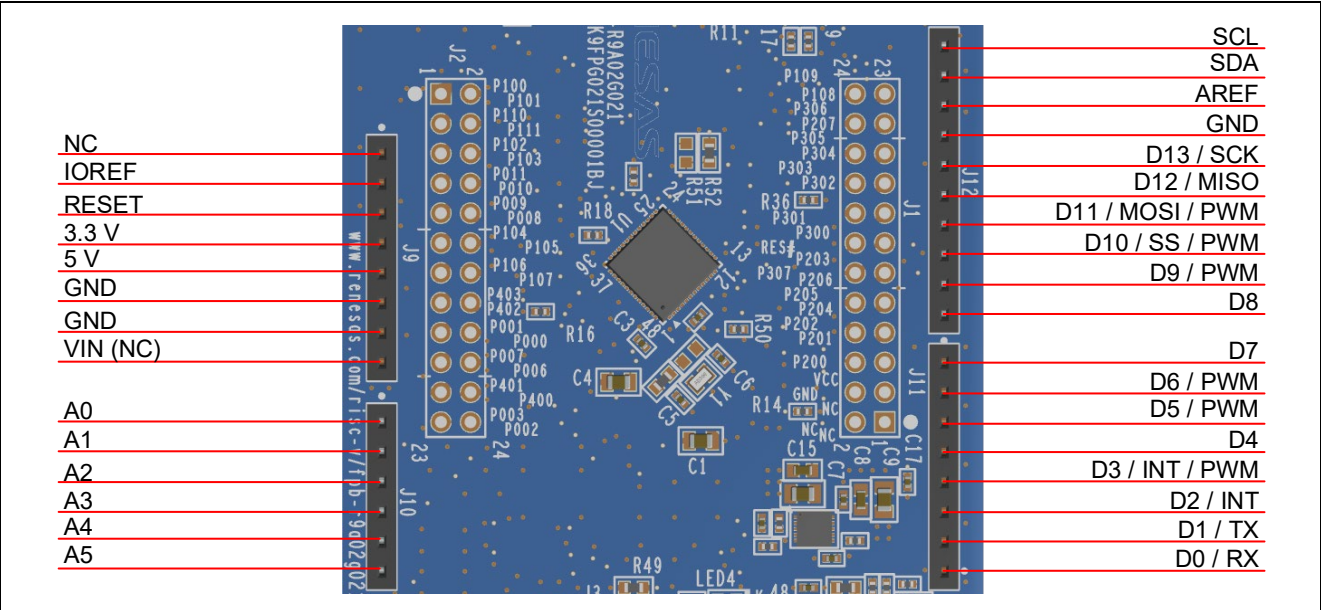


Figure 20. Arduino Uno Connectors

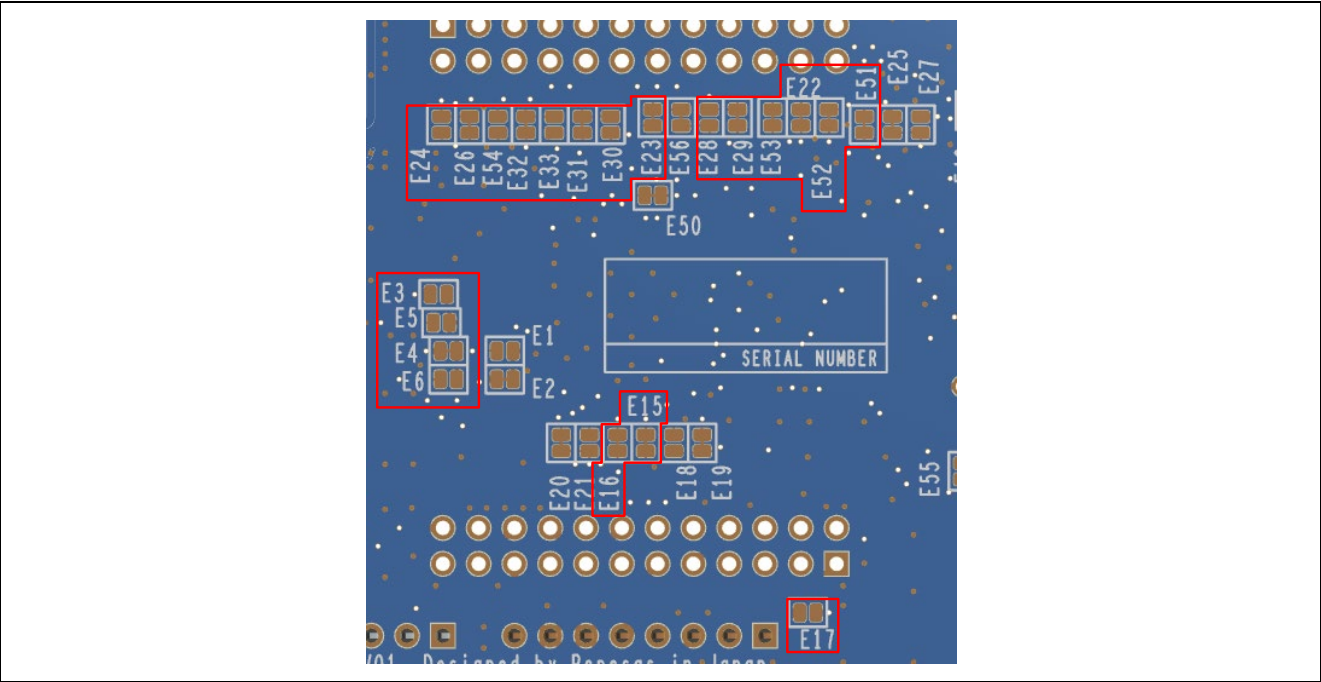


Figure 21. Arduino Uno Copper Jumpers (bottom side)

5.4 Miscellaneous

5.4.1 LED

Four LEDs are provided on the FPB-R9A02G021 board.

Functions of the LEDs on the FPB-R9A02G021 board is described in the following table.

Table 18. FPB-FPB-R9A02G021 Board LED Functions

Reference number	Color	Function	MCU Control Port
LED1	Green	User LED	P107 (TO03_A) *1
LED2	Green	User LED	P100 (TO05) *2
LED3	Green	Power on indicator	+3.3 V
LED4	Yellow	Debug LED	J-Link Emulator On-Board debugger MCU

*1: The signal is shared with Arduino (D9 / PWM).

*2: The signal is shared with Arduino (D3 / INT / PWM).

The User LEDs may be disconnected from the MCU so that the associated ports can be used for other purposes. To disconnect LED1 from P015, copper jumper E11 must be open. To disconnect LED2 from P100, copper jumper E13 must be open.

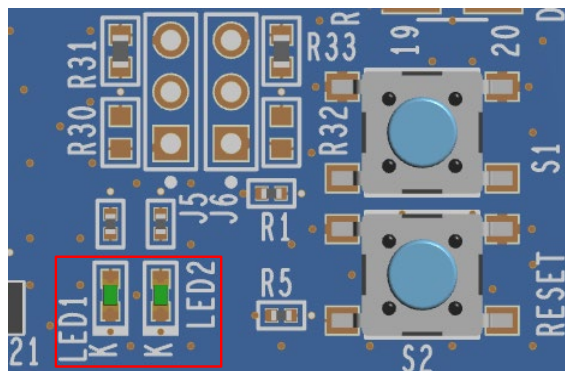


Figure 22. User LEDs

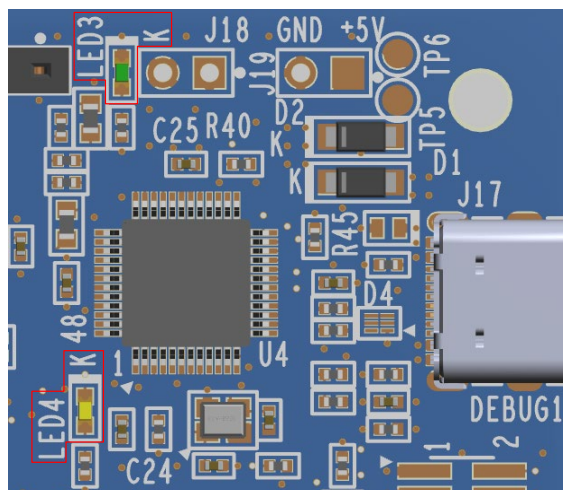


Figure 23. Power LED and Debug LED

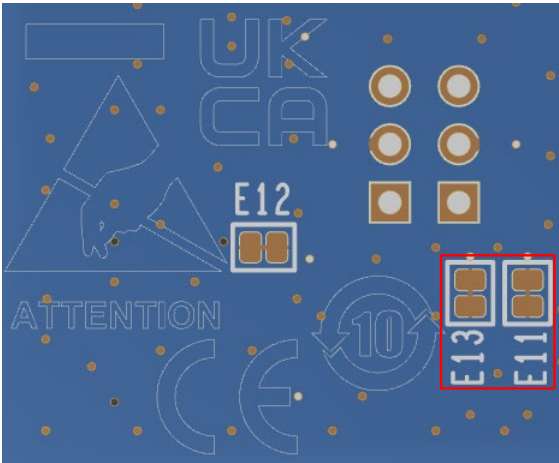


Figure 24. User LEDs Copper Jumpers (bottom side)

5.4.2 User and Reset Switches

Two miniature, momentary, mechanical push-button type SMD switches are mounted on the FPB-R9A02G021 board.

Pressing the reset switch (S2) generates a reset signal to restart the MCU.

Table 19. FPB-R9A02G021 Board Switches

Reference number	Function	MCU Control Port
S1	User Switch	P108 (IRQ4_B) *1
S2	MCU Reset Switch	RES#

*1: The signal is shared with Pmod 2 (CTS / INT).

The User Switch S1 may be isolated from the MCU, so that the associated port can be used for other purposes. To disconnect S1 from P108, trace cut jumper E12 must be open.

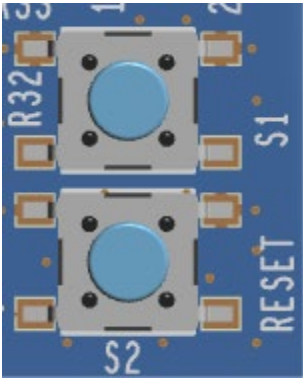


Figure 25. Reset (S2) and User Switch (S1)

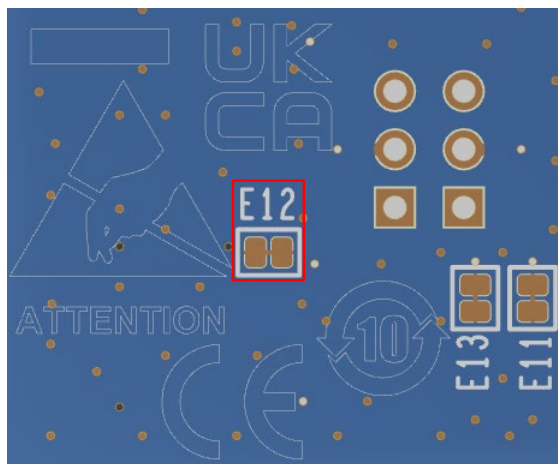


Figure 26. User Switch S1 Copper Jumper (bottom side)

5.4.3 MCU Boot Mode

A two-pin header (J8) can be fitted to select the boot mode (P203) of the MCU. For normal operation (single-chip mode), leave J8 open. To enable UART boot mode, place a shunt jumper on J8.



Figure 27. Boot Mode Jumper (J8)

6. Special Feature Access

6.1 Remote Control Signal Receiver

The FPB-R9A02G021 Board can be equipped with IR Receiver Module for remote control receive function. TSOP32438 (VISHAY) might be used for the FPB-R9A02G021 board. Refer to the manufacturer website for specification of the IR Receiver Module.

P202 (IRQ2_C / RIN0) of the MCU is connected to OUT pin of the IR receiver module and Pmod 2 INT / GPIO (J14-Pin7). It is needed to fit 0Ω resistor (SMD 0603) to R51 and remove 0Ω resistor (SMD 0603) from R52 at using the remote control receive function. Refer to Figure 19 regarding to location for R51 and R52.

Table 20. Remote Control Signal Receiver

IR Receiver Module		FPB-R9A02G021
Pin	Description	Signal / Bus
U3-1	OUT	P202 (IRQ2_C / RIN0)
U3-2	GND	GND
U3-3	VS	+3.3 V

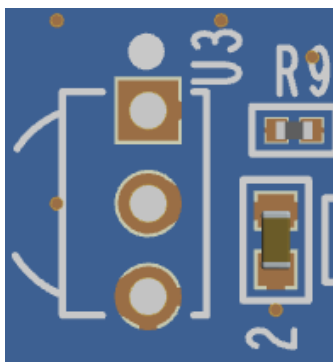


Figure 28. IR Receiver Module

7. MCU Native Pin Access

7.1 Breakout Pin Headers

The FPB-R9A02G021 board pin headers (not fitted), J1 and J2, provide access to all MCU interface signals, and to voltage of the MCU power port. Each header pin is labelled with the voltage or port connected to that pin. Refer to the R9A02G021 MCU User's Manual: Hardware for details of each port function, and the FPB-R9A02G021 board schematic for pin header port assignments.

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

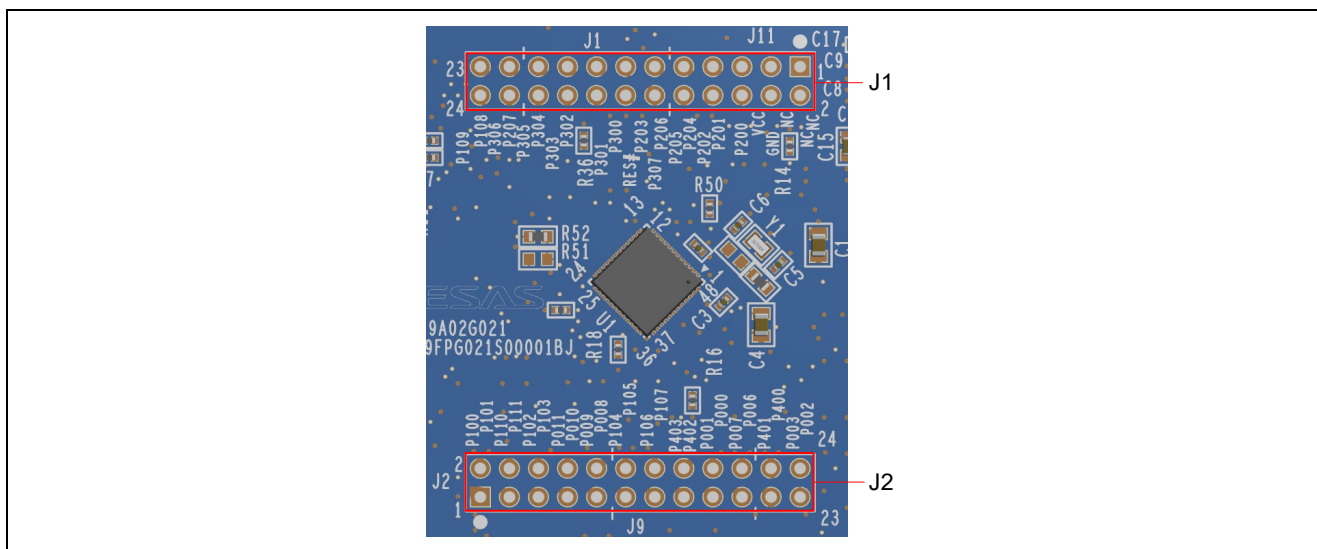


Figure 29. Breakout Pin Headers J1 and J2

7.2 MCU Current Measurement

Two pin header J3 (not fitted) is provided on the FPB-R9A02G021 board to measure the MCU current.

Resistor R49 is 0Ω (SMD 0603) as supplied. It should be removed in order to measure the current consumption using an ammeter connected between the pin header pins.

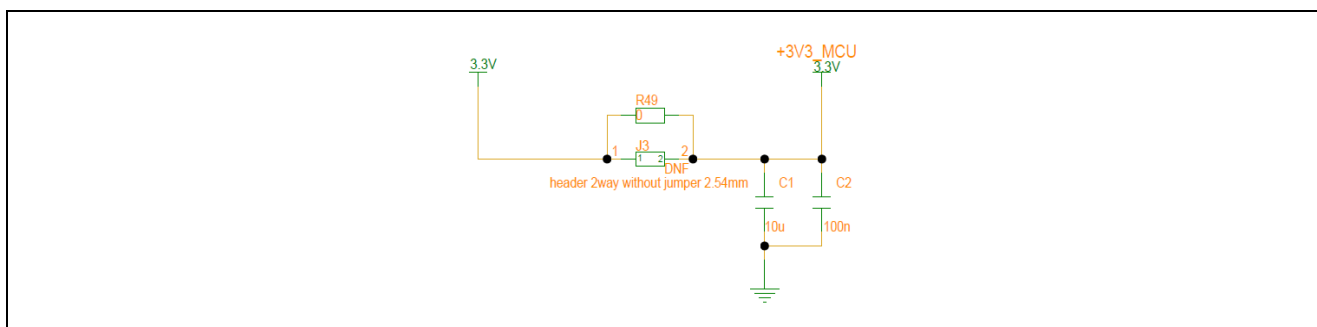


Figure 30. MCU +3.3 V Current Measurement Circuit

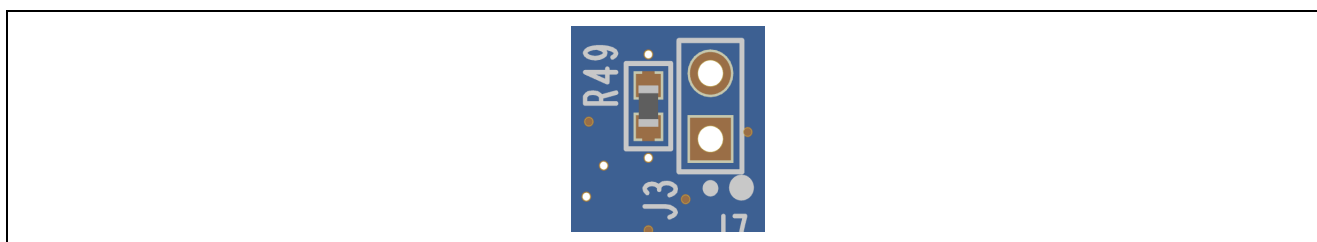


Figure 31. MCU +3.3 V Current Measurement Pin Header J3 and R49

8. Certifications

The FPB-R9A02G021 board meets the following certifications/standards. See page 4 of this user's manual for the disclaimer and precautions.

8.1 EMC/EMI Standards

- 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.

- Taiwan: Chinese National Standard 13438, C6357 compliance, Class A limits
- Australia/New Zealand AS/NZS CISPR 32:2015, Class A

8.2 Material Selection, Waste, Recycling and Disposal Standards

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

8.3 Safety Standards

- UL 94V-0

9. Design and Manufacturing Information

The design and manufacturing information for the FPB-R9A02G021 kit is available in the “FPB-R9A02G021 Design Package” available on renesas.com/risc-v/fpb-r9a02g021.

- Design package file name: fpb-r9a02g021-v1-designpackage.zip
- Design package contents

Table 21. FPB-R9A02G021 Board Design Package Contents

File Type	Content	File / Folder Name
File (PDF)	Schematics	fpb-r9a02g021-v1-schematics
File (PDF)	Mechanical Drawing	fpb-r9a02g021-v1-mechdwg
File (PDF)	3D Drawing	fpb-r9a02g021-v1-3d
File (PDF)	BoM	fpb-r9a02g021-v1-bom
Folder	Manufacturing Files	Manufacturing Files
Folder	Design Files	Design Files-Cadence Allegro

10. Website and Support

Visit the following URLs to learn about the kit and the RISC-V microcontrollers, download tools and documentation, and get support.

FPB-R9A02G021 Resources

renesas.com/risc-v/fpb-r9a02g021

RISC-V Product Information

renesas.com/risc-v

RISC-V Videos

renesas.com/risc-v/videos

Renesas Support

renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Oct.31.23	—	Initial release

FPB-R9A02G021 User's Manual

Publication Date: Oct.31.23

Published by: Renesas Electronics Corporation

FPB-R9A02G021 User's Manual

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Renesas Electronics:](#)

[RTK9FPG021S00001BJ](#)