

RL78/G14 Fast Prototyping Board

User's Manual

16-Bit Single-Chip Microcontrollers

RL78 Family

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(Rev.5.0-1 October 2020)

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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.

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the hardware functions of the RL78/G14 Fast Prototyping Board and electrical characteristics of the MCU.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to the RL78/G14 Fast Prototyping Board. Be sure to refer to the latest versions of these documents. The newest versions of the listed documents are available on the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
User's manual	Hardware specifications	RL78/G14 Fast Prototyping Board User's Manual	R20UT4573EJ (this manual)
Circuit schematics	Circuit schematics	RL78/G14 Fast Prototyping Board Circuit Schematics	R20UT4575EJ
Parts list	Parts list	RL78/G14 Fast Prototyping Board BOM LIST	R12TU0068EJ
Quick start guide	Simple instructions for setting up the board, formatted for a single sheet of A5 paper	RL78/G14 Fast Prototyping Board Quick Start Guide	R20UT4571EJ
User's manual for the hardware*	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation	RL78/G14 User's Manual: Hardware	R01UH0186EJ

Note: Download the documents for the RL78/G14 from the product page for the RL78/G14.

2. List of Abbreviations and Acronyms

Abbreviation	Full Form
Arduino™ UNO	Connectors compatible with the Arduino™ UNO R3 board are mounted on the fast prototyping board.
CPU	Central Processing Unit
DIP	Dual In-line Package
DNF	Do Not Fit
IDE	Integrated Development Environment
IRQ	Interrupt Request
HOCO	High-Speed On-Chip Oscillator
LOCO	Low-Speed On-Chip Oscillator
LED	Light Emitting Diode
MCU	Micro-controller Unit
n/a (NA)	Not applicable
n/c (NC)	Not connected
PC	Personal Computer
Pmod™	Pmod™ is a trademark of Digilent Inc. The Pmod™ interface specification is the property of Digilent Inc. For the Pmod™ interface specification, refer to the Pmod™ License Agreement page at the Web site of Digilent Inc.
RAM	Random Access Memory
RFP	Renesas Flash Programmer
ROM	Read Only Memory
SPI	Serial Peripheral Interface
TPU	Timer Pulse Unit
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
WDT	Watchdog timer

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1. Overview

1.1 Package Components

Thank you for purchasing the RL78/G14 Fast Prototyping Board evaluation tool from Renesas (hereinafter referred to as “this product”). This product consists of the following items.

- RL78/G14 Fast Prototyping Board (RTK5RLG140C00000BJ)
- Quick Start Guide

1.2 Purpose

This product is an evaluation tool for a Renesas MCU. This user's manual describes the technical details of hardware of this product.

1.3 Features

This product can handle the following tasks.

- Programming of the Renesas MCU
- Debugging of user code
- User circuits for switches and LEDs
- Sample programs*¹

Note: Sample programs are available for downloading from the Renesas Web site.

<http://www.renesas.com/rl78fpb>

1.4 Preparation

Install the integrated development environment (IDE) and required software from the following URL on the host PC.

<https://www.renesas.com/development-tools>

1.5 Board Specification Table

Table 1-1 shows the board specifications.

Table 1-1 Board Specification Table

Item	Specification
MCU (RL78/G14)	Part No.: R5F104MLAFB
	Package: 80-pin LFQFP
	On-chip memory: 512-KB ROM, 48-KB RAM, 8-KB data flash memory
Board size	54 mm x 95 mm
Power-supply voltage	VDD: 1.8 V to 5.5 V (EVDD is the same voltage as VDD.)
Power-supply circuit*2	USB connector: VBUS (5 V) or 3.3 V (default)
	External power-supply header*1: 1.8 V to 5.5 V
	Coin-cell battery*1: CR2032 (3 V)
Current drawn	Max. 200 mA
Main clock*1	X2: Crystal oscillator or ceramic resonator (lead type) for the main system clock X3: Crystal oscillator (surface-mount technology (SMT)) for the main system clock
Sub-clock	X1: Crystal oscillator (SMT) for the sub-clock
Push switches	Reset switch x 1
	User switch x 1
LEDs	Power indicator: green x 1
	User: green x 2
	ACT LED: green x 1
USB connector	Connector: Micro USB Type-B
Pmod™ connectors	Connectors: Angle type, 12 pins x 2
Arduino™ connectors	Connectors: 6 pins x 1, 8 pins x 2, 10 pins x 1 The interfaces are compatible with the Arduino™ UNO R3 board.
MCU headers*1	Headers: 40 pins x 2
Emulator reset header*1	Header: 2 pins x 1

Notes: 1. This part is not mounted.

2. The RL78/G14 on the board as shipped is intended to be supplied with 3.3-V power generated by the low-dropout regulator (LDO) from VBUS. The board must be remodeled if a voltage other than 3.3 V is to be supplied. For details, refer to Chapter 5, User Circuits.

1.6 Block Diagram

Figure 1-1 shows the block diagram of this product.

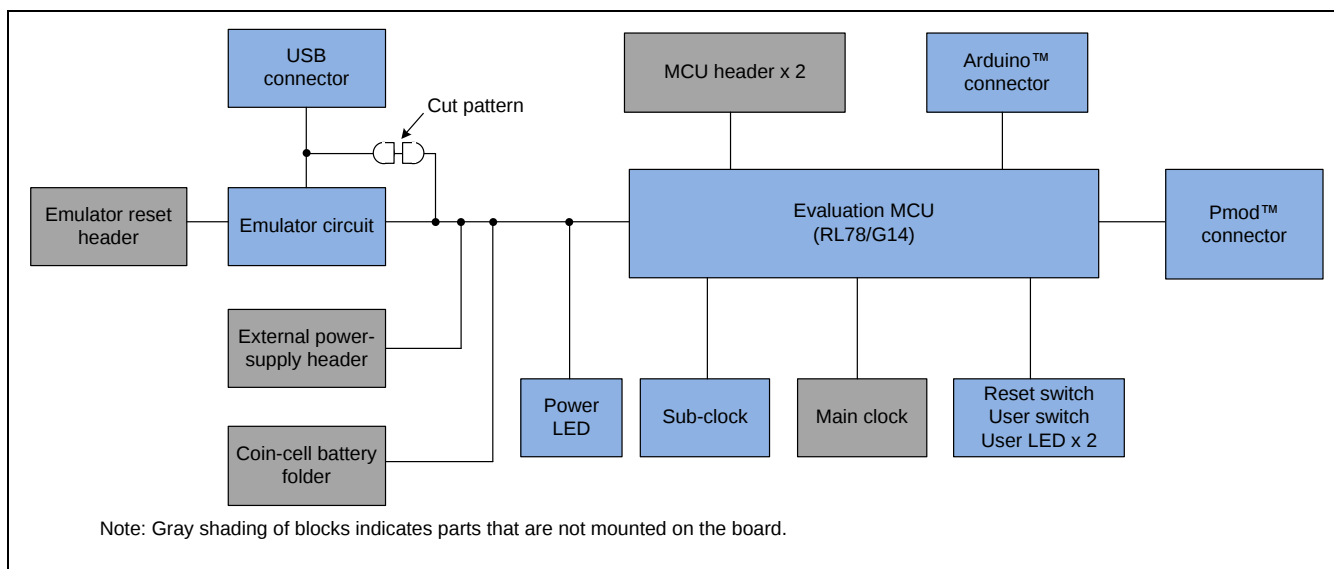


Figure 1-1 Block Diagram

2. Board Layout

Figure 2-1 shows the external appearance of the top side of this product.

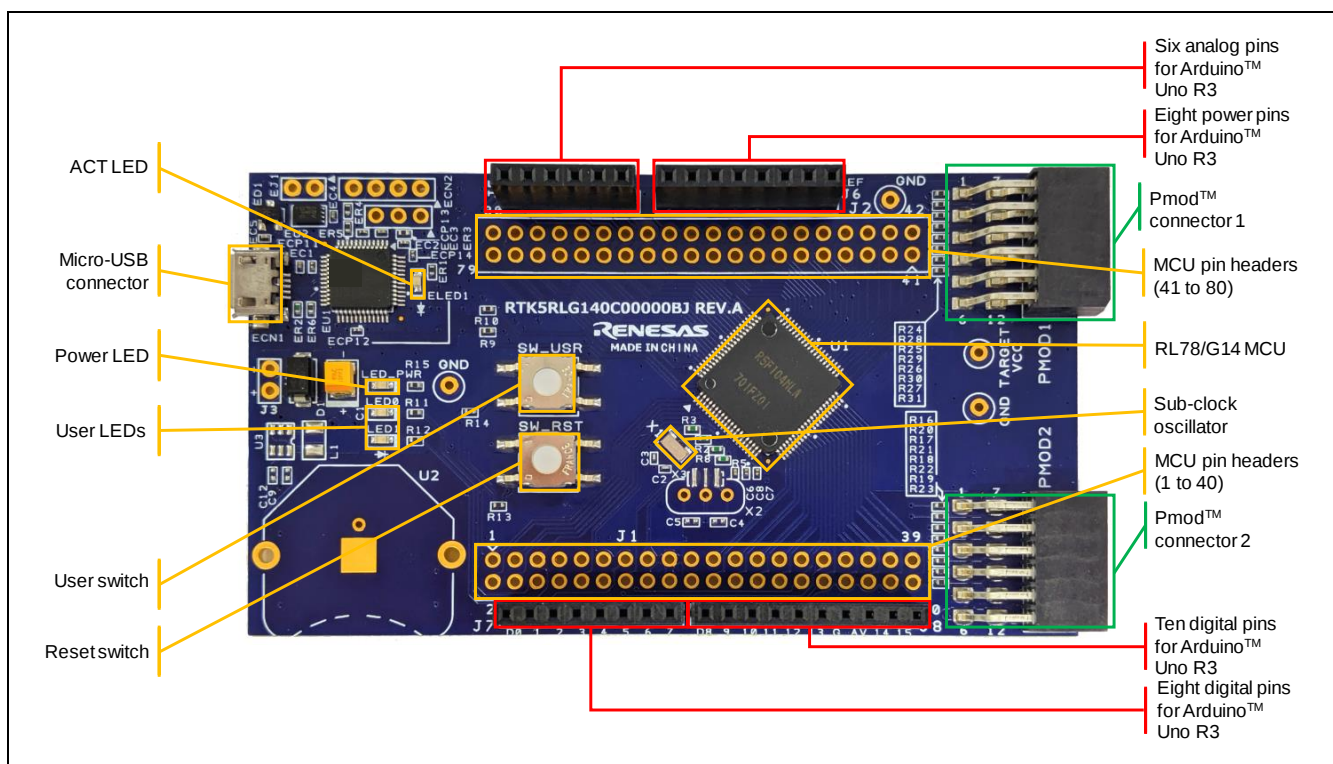


Figure 2-1 Board Layout (Top Side)

3. Parts Layout

Figure 3-1 shows the parts layout of this product.

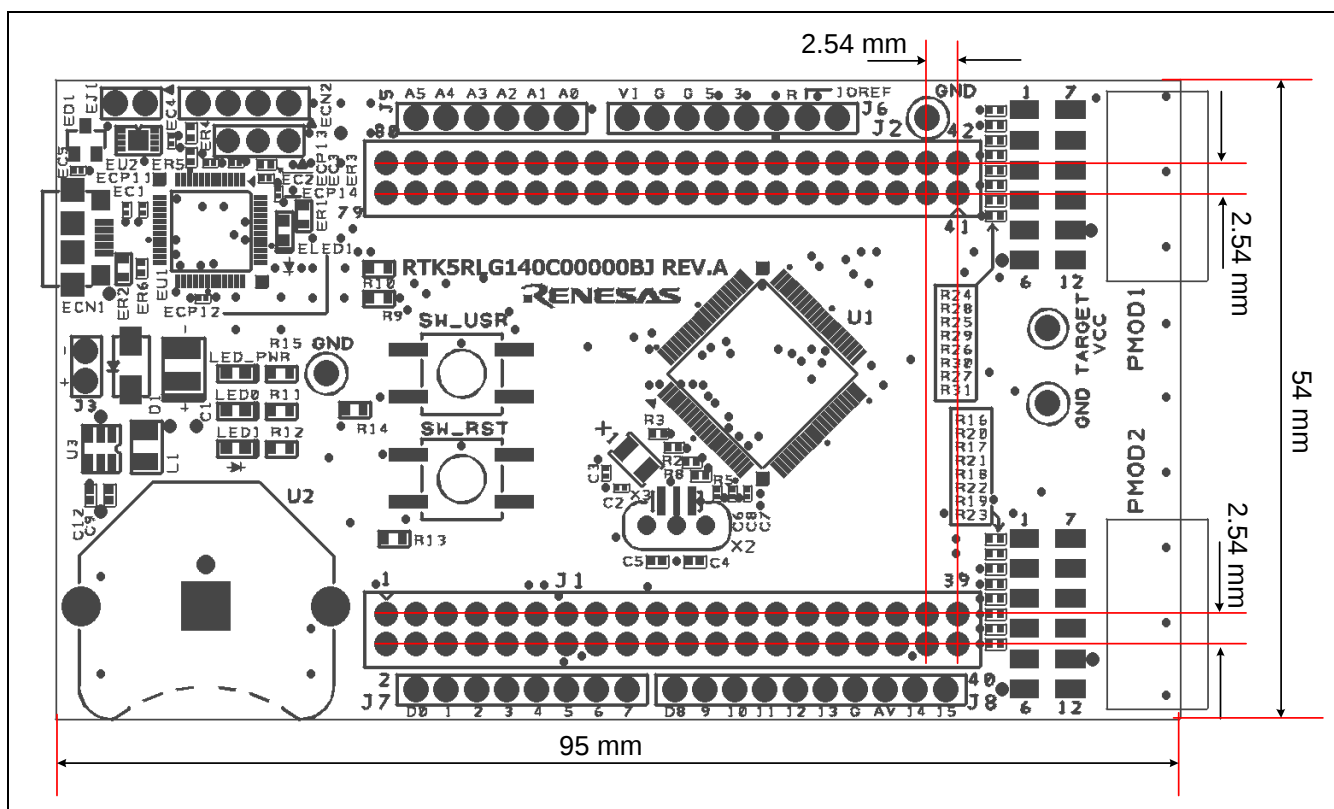


Figure 3-1 Parts Layout

4. Operating Environment

Figure 4-1 shows the operating environment of this product. Install the IDE from the following URL on the host PC. The installer automatically installs all required drivers along with the IDE.

<https://www.renesas.com/development-tools>

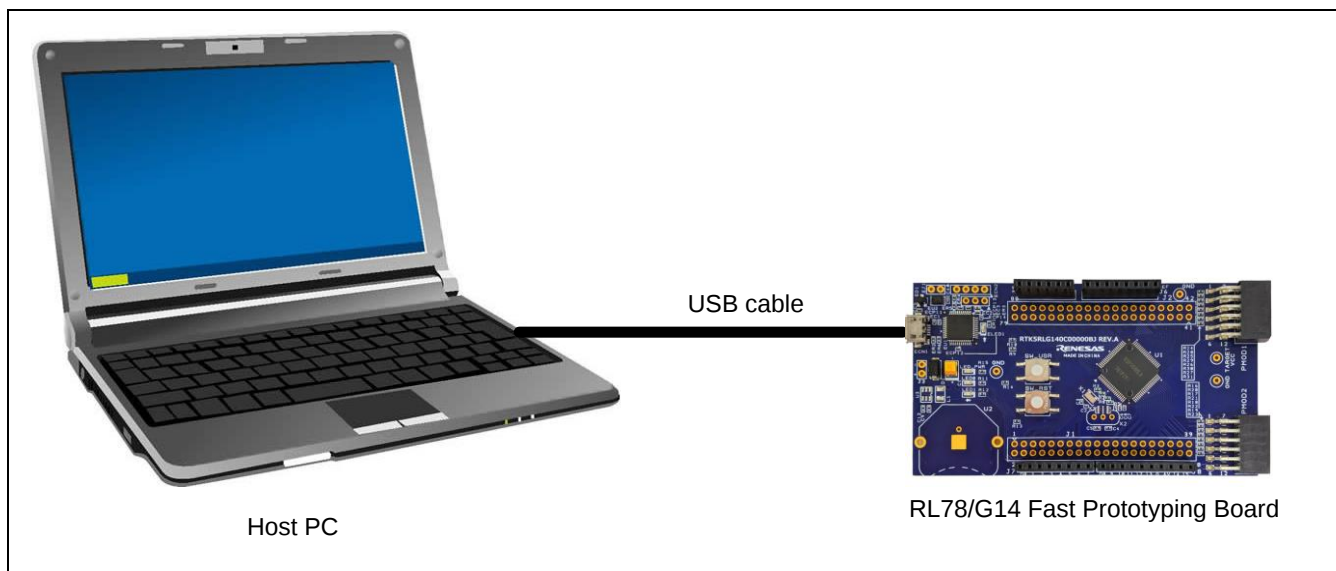


Figure 4-1 Operating Environment

5. User Circuits

5.1 RL78/G14

The MCU specifications for the power supply, system clock, and reset at the time of shipment are as follows.

- Power supply: Fixed 3.3 V (including the analog power supply)
- System clock: Operation with an on-chip oscillator
- Reset: Directed by the reset switch or IDE

5.2 USB Connector

The connector shape is micro-USB Type-B for the IDE and for the Renesas Flash Programmer (RFP). Connect the USB connector to the computer by a USB cable. If the power supply on the host side is on, the power is supplied to this product at the same time as connection of the cable.

Note: The package does not include a USB cable.

5.3 ACT LED

The ACT LED displays the state of operation of the emulator control software. The illumination conditions are listed below. The LED is green.

- Illuminated: Indicates that the emulator is connected to the target.
- Blinking: Indicates that the host PC has recognized the emulator.
- Not illuminated: Indicates that the emulator cannot be used for some reason (including its power being off).

5.4 Power LED

While the power LED is illuminated, power is being supplied to the board. The LED is green.

5.5 User LEDs

The optional user LEDs can be used for any purpose. LED0 and LED1 are mounted on the board and are respectively connected to the following ports. The LEDs are green.

- LED0: Pin 6, connected to port P43
- LED1: Pin 5, connected to port P44

5.6 Pmod™ Connectors

A Pmod™ connector can be connected to the RL78/G14 by a type 2A Pmod™ interface. Figure 5-1 and Table 5-1 show the pin assignments of the Pmod™ connectors.

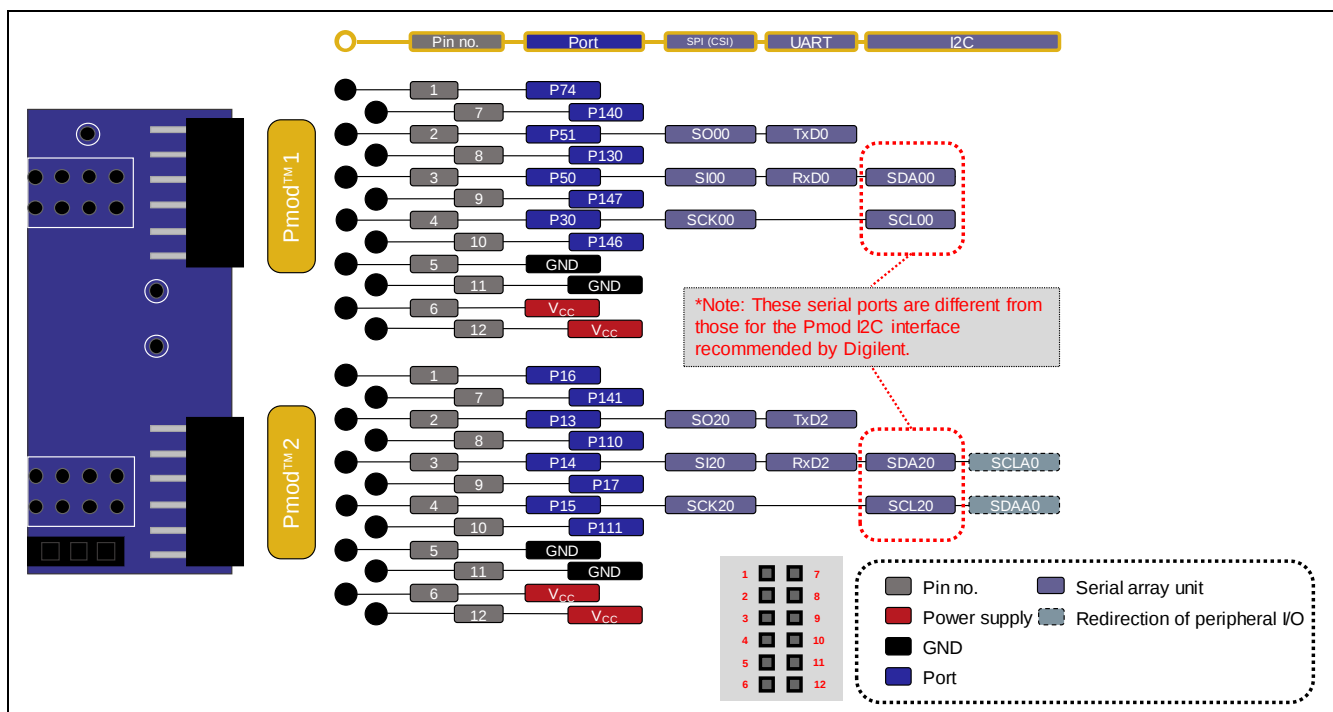


Figure 5-1 Pin Assignments of the Pmod™ Connectors

Table 5-1 Pin Assignments of Pmod™ 1

Pin No. of Pmod™ 1	Name of Pmod™ Signal	RL78/G14					
		Pin	Power Supply	Port	SPI (CSI)	UART	I2C
1	SS1	33	—	P74	—	—	—
2	MOSI	42	—	P51	SO00	TxD0	—
3	MISO	41	—	P50	SI00	RxD0	SDA00
4	SCK	40	—	P30	SCK00	—	SCL00
5	GND	—	VSS	—	—	—	—
6	VCC	—	VDD	—	—	—	—
7	INT	2	—	P140	—	—	—
8	RESET	72	—	P130	—	—	—
9	IO2	58	—	P147	—	—	—
10	IO3	57	—	P146	—	—	—
11	GND	—	VSS	—	—	—	—
12	VCC	—	VDD	—	—	—	—

Table 5-2 Pin Assignments of Pmod™ 2

Pin No. of Pmod™ 2	Name of Pmod™ Signal	RL78/G14					
		Pin	Power Supply	Port	SPI (CSI)	UART	I2C
1	SS1	48	—	P16	—	—	—
2	MOSI	51	—	P13	SO20	TxD2	—
3	MISO	50	—	P14	SI20	RxD2	SDA20/SCLA0
4	SCK	49	—	P15	SCK20	—	SCL20/SDAA0
5	GND	—	VSS	—	—	—	—
6	VCC	—	VDD	—	—	—	—
7	INT	1	—	P141	—	—	—
8	RESET	55	—	P110	—	—	—
9	IO2	47	—	P17	—	—	—
10	IO3	56	—	P111	—	—	—
11	GND	—	VSS	—	—	—	—
12	VCC	—	VDD	—	—	—	—

5.7 Arduino™ Connectors

The specification of the Arduino connectors is on the assumption that Arduino™ shields are to be connectable. 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.

Figure 5-2 and Table 5-3 show the pin assignments of the Arduino™ connectors.

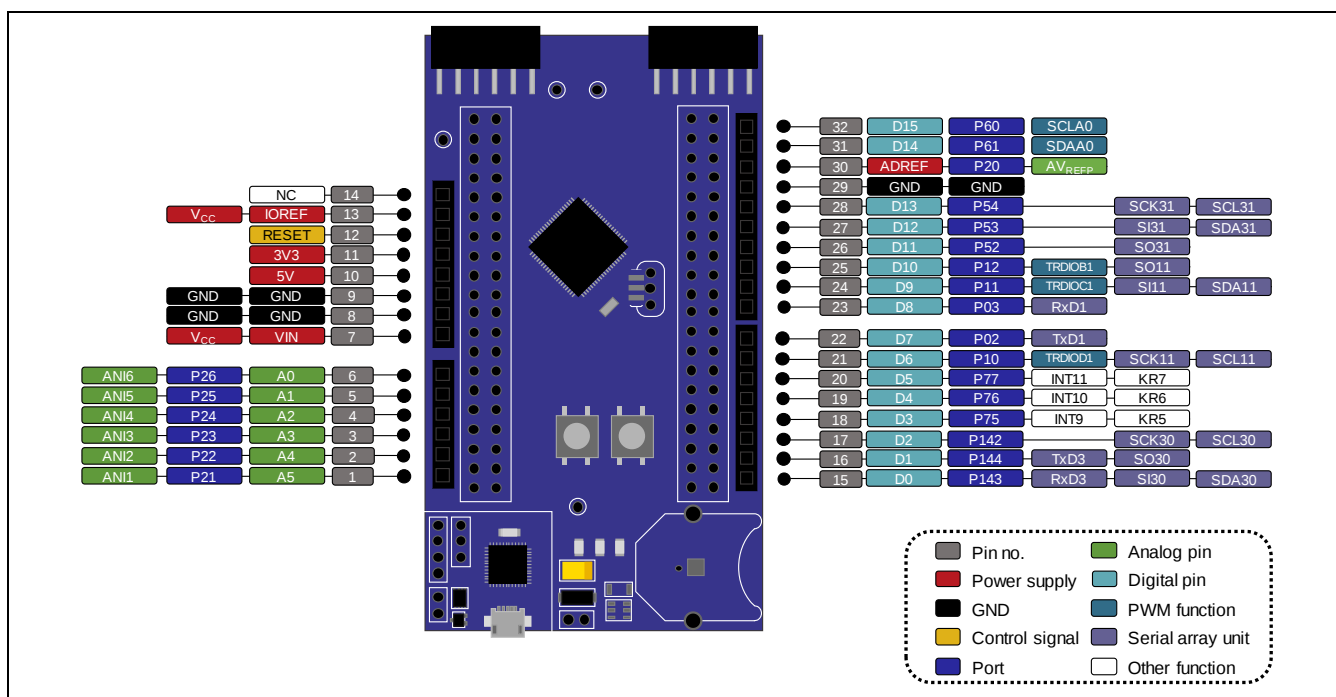


Figure 5-2 Pin Assignments of the Arduino™ Connectors

Table 5-3 Pin Assignments of the Arduino™ Connectors

Pin No. of Arduino™ Connector	Part No. in the Circuit Schematics	Name of Arduino™ Signal	RL78/G14						
			Pin	Power Supply	Port	Analog	PWM	Serial	Others
1	J5-1	A5	70	—	P21	ANI1	—	—	—
2	J5-2	A4	69	—	P22	ANI2	—	—	—
3	J5-3	A3	68	—	P23	ANI3	—	—	—
4	J5-4	A2	67	—	P24	ANI4	—	—	—
5	J5-5	A1	66	—	P25	ANI5	—	—	—
6	J5-6	A0	65	—	P26	ANI6	—	—	—
7	J6-1	VIN	—	VDD	—	—	—	—	—
8	J6-2	GND	—	VSS	—	—	—	—	—
9	J6-3	GND	—	VSS	—	—	—	—	—
10	J6-4	5V	—	—	—	—	—	—	—
11	J6-5	3V3	—	—	—	—	—	—	—
12	J6-6	RESET	—	—	—	—	—	—	RESET
13	J6-7	IOREF	—	VDD	—	—	—	—	—
14	J6-8	NC	—	—	—	—	—	—	—
15	J7-1	D0	79	—	P143	—	—	RxD3/SI30 /SDA30	—
16	J7-2	D1	78	—	P144	—	—	TxD3/SO30	—
17	J7-3	D2	80	—	P142	—	—	SCK30 /SCL30	—
18	J7-4	D3	32	—	P75	—	—	—	INTP9/KR5
19	J7-5	D4	31	—	P76	—	—	—	INTP10/KR6
20	J7-6	D5	30	—	P77	—	—	—	INTP11/KR7
21	J7-7	D6	54	—	P10	—	TRDIOD1	SCK11 /SCL11	—
22	J7-8	D7	75	—	P02	—	—	TxD1	—
23	J8-1	D8	74	—	P03	—	—	RxD1	—
24	J8-2	D9	53	—	P11	—	TRDIOC1	SI11 /SDA11	—
25	J8-3	D10	52	—	P12	—	TRDIOB1	SO11	—
26	J8-4	D11	43	—	P52	—	—	SO31	—
27	J8-5	D12	44	—	P53	—	—	SI31/SDA31	—
28	J8-6	D13	45	—	P54	—	—	SCK31 /SCL31	—
29	J8-7	GND	—	VSS	—	—	—	—	—
30	J8-8	ADREF	71	—	P20	AVREFP	—	—	—
31	J8-9	D14	22	—	P61	—	—	SDAA0	—
32	J8-10	D15	21	—	P60	—	—	SCLA0	—

5.8 MCU Headers

The MCU headers are provided for by two sets of through holes (J1 and J2), each allowing for headers for a total of 40 pins. The pin headers have a pitch of 2.54 mm. The RL78/G14 is connected to the through holes for the headers in the same order of pin numbers, i.e. pin 1 to pin 1, pin 2 to pin 2, and so on, in order, until pin 80 (actual header components are not mounted).

5.9 Clock

Clock circuits are provided to handle the clock sources for the MCU. For details on the specifications of the MCU clocks, refer to the RL78/G14 User's Manual: Hardware. For details on the clock circuit of this product, refer to the circuit schematics of the RL78/G14 Fast Prototyping Board. Table 5-4 shows the details of the clocks on the RL78/G14 Fast Prototyping Board.

Table 5-4 Details of Clocks

Clock	Function and Usage	State as Shipped	Frequency	Package for the oscillator
X1	Crystal oscillator for the sub-clock	Mounted	32.768 kHz	SMT
X2	Crystal oscillator or ceramic resonator for the main system clock	Not mounted	n/a	Lead type
X3	Crystal oscillator for the main system clock	Not mounted	n/a	SMT

5.10 Reset Switch

Pressing the reset switch (SW_RST) applies a hardware reset to the RL78/G14.

5.11 User Switch

An optional user switch (SW_USR) is mounted. It is connected to pin 13 of the RL78/G14, which operates as pin function P137. The INTP0 interrupt is multiplexed on the same pin.

5.12 Emulator Reset Header

The emulator is placed in the forced reset state by short-circuiting the emulator reset header (EJ1). This allows stand-alone operation of the RL78/G14 independently of control by the IDE while the IDE is applying a forcible reset. Figure 5-3 shows the position of the emulator reset header (only through-holes are provided; an actual header component is not mounted).

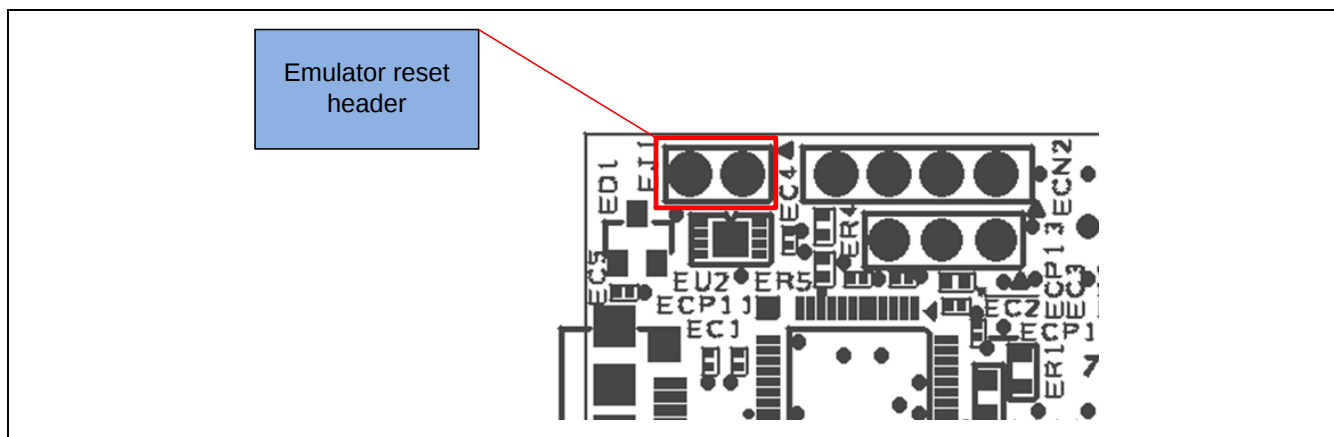


Figure 5-3 Position of the Emulator Reset Header (Top Side)

5.13 Power-Supply Selection Header

The operating voltage of the RL78/G14 can be changed to VBUS (5 V) or 3.3 V with the use of this header (J4). To change the operating voltage, mount a header (J4) and remove the pattern for cutting (SS11). Figure 5-4 shows the connection of the header for VBUS output, and Figure 5-5 shows the connection of the header for 3.3-V output. Figure 5-6 shows the location of the SS11 pattern to be cut. The 3.3-V output is initially selected by SS11 in the product as shipped.

If an Arduino™ shield is to be connected, remove the pattern (SS1) to be cut and short-circuit the pattern (SC1) to be short-circuited for that purpose. To use the RL78/G14 with an operating voltage of 3.3 V, changing SS1 and SC1 is not needed. Figure 5-7 shows the positions of SS1 and SC1.

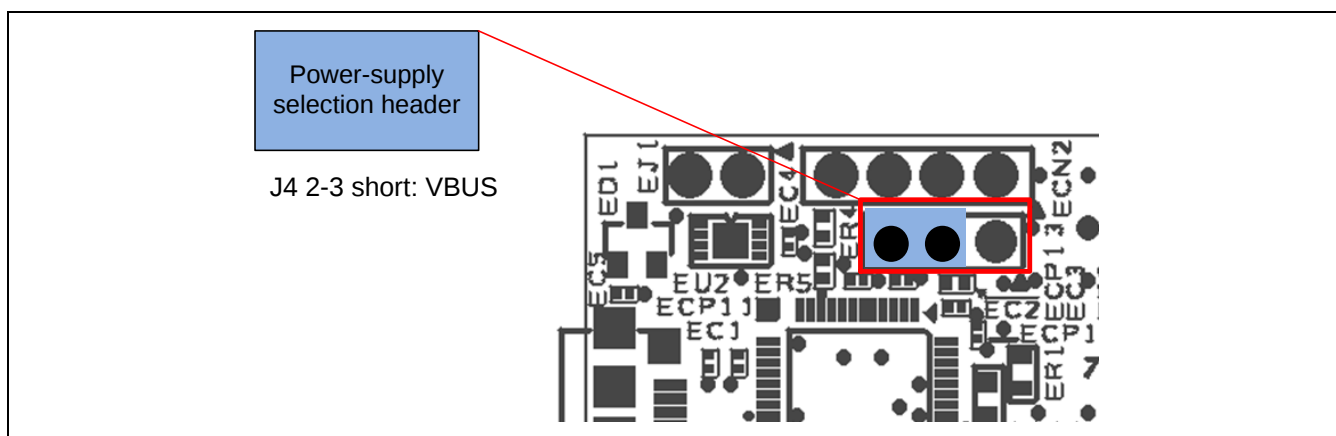


Figure 5-4 Header Setting for the VBUS Output (Top Side)

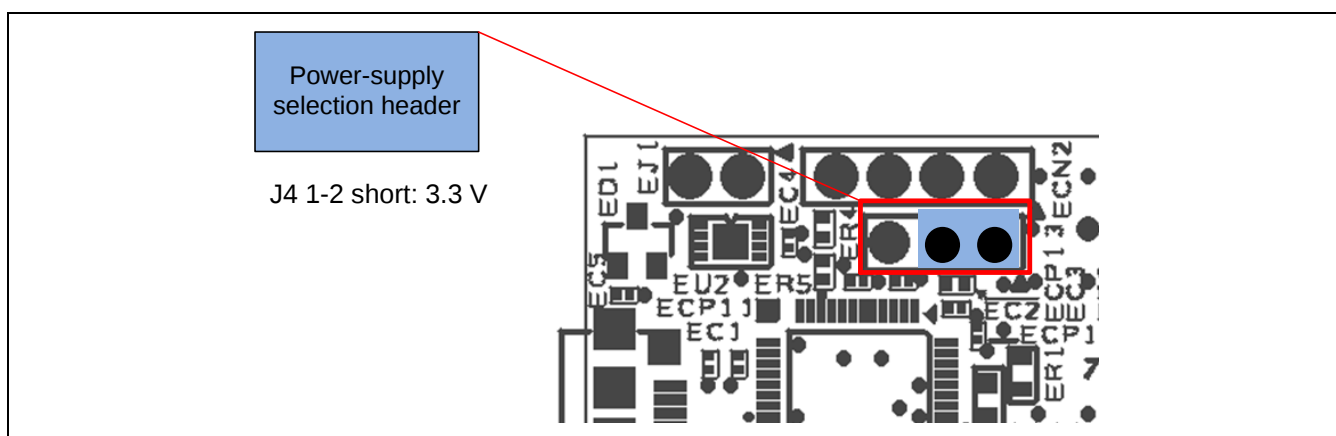


Figure 5-5 Header Setting for the 3.3-V Output (Top Side)

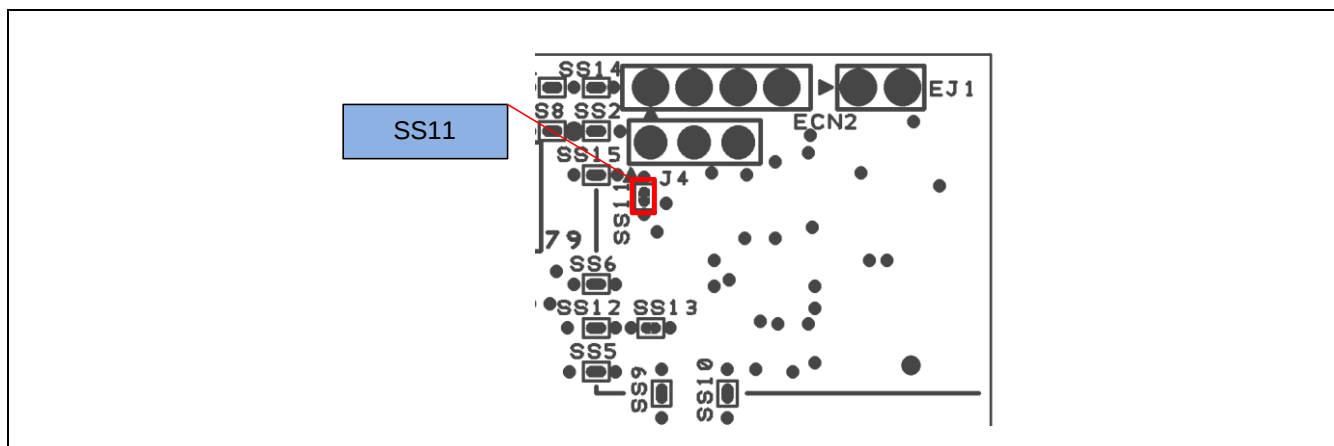


Figure 5-6 Position of SS11 (Soldered Side)

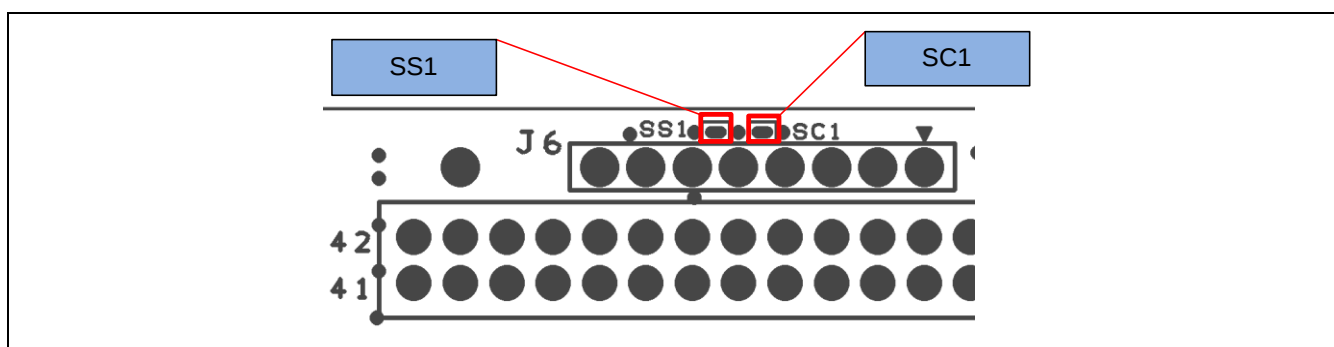


Figure 5-7 Position of SS1 and SC1 (Soldered Side)

5.14 External Power-Supply Header

When operating the RL78/G14 at a desired external input voltage other than the 3.3 V from the regulator or the 5-V VBUS, or when more current is required than the USB is capable of supplying, use the external power-supply header (J3) to supply power. The usable voltages depend on the RL78/G14.

When using this header, remove the pattern (SS11) for cutting on the soldered side (see Figure 5-6). In addition, short-circuit the emulator reset header (EJ1) as described in section 5.12, Emulator Reset Header, to place the emulator in the forced reset state.

Figure 5-8 shows the position of the external power-supply header (through-holes are provided but an actual header is not mounted).

When power other than 3.3 V is being supplied through the external power-supply header, the connection of Arduino™ shields is not possible.

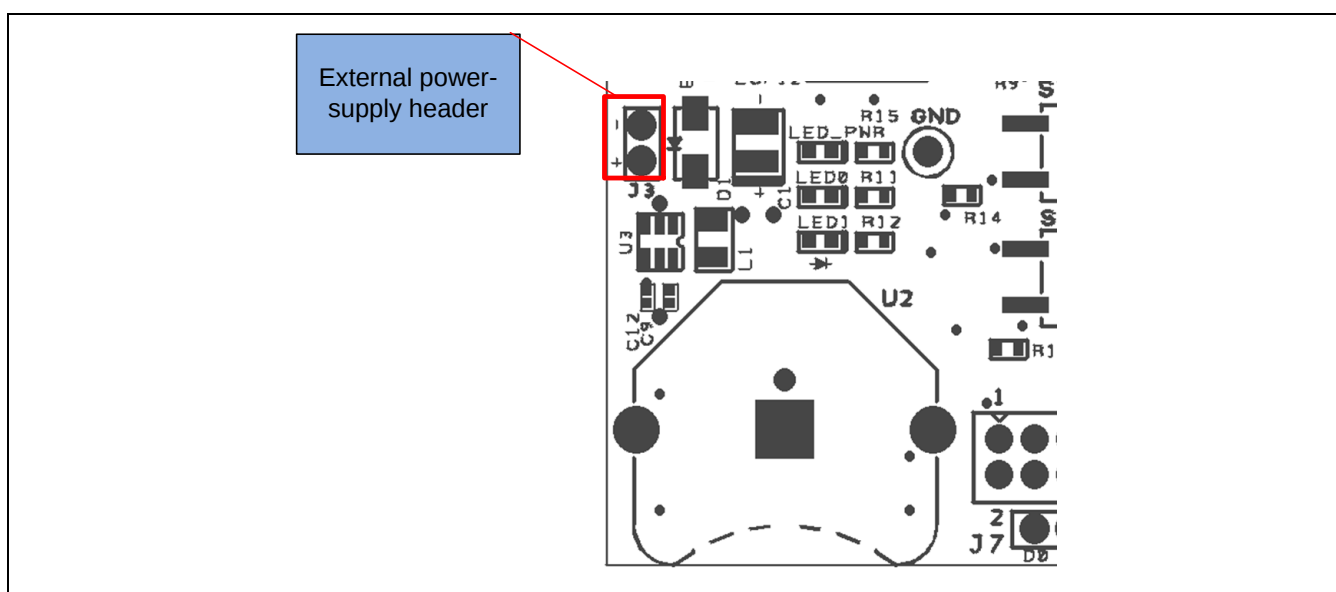


Figure 5-8 Position of the External Power-Supply Header (Top Side)

5.15 Coin-Cell Battery Circuit

In this product, a CR2032 battery can provide the power for RL78/G14 operation. To supply power with a coin-cell battery, U2, U3, C9, C12, and L1 components must be mounted. Figure 5-9 shows the position of those parts.

For the recommended parts, refer to the RL78/G14 Fast Prototyping Board BOM LIST.

When using the coin-cell battery, remove the pattern (SS11) for cutting on the soldered side (see Figure 5-6). In addition, short-circuit the emulator reset header (EJ1) as described in section 5.12, Emulator Reset Header, to place the emulator in the forced reset state.

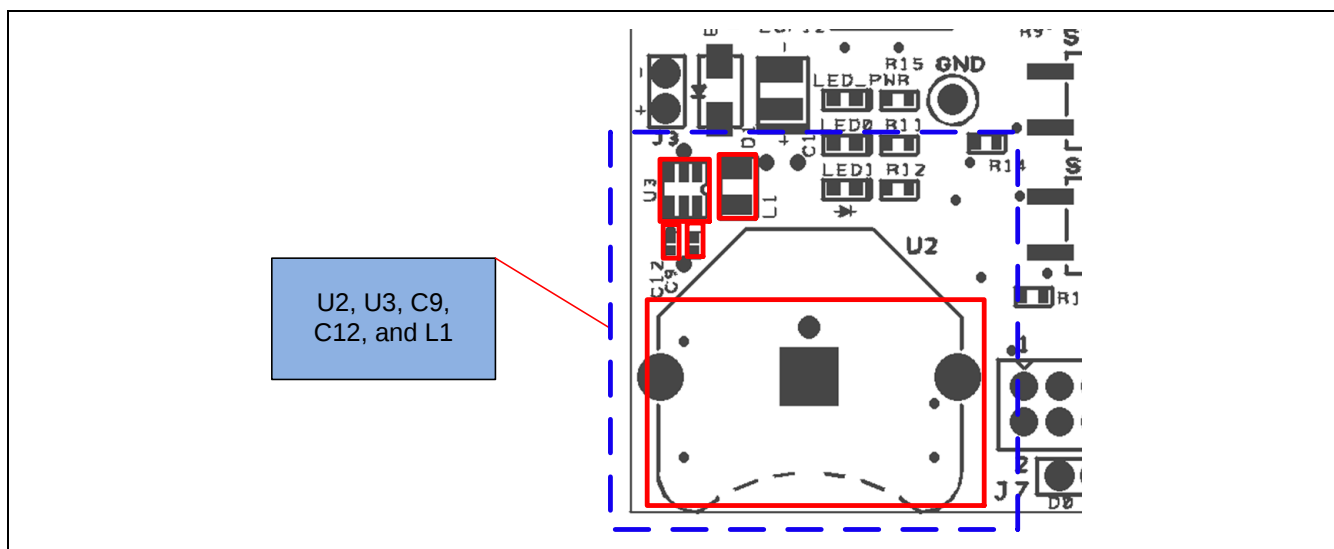


Figure 5-9 Position of U2, U3, C9, C12, and L1 (Top Side)

6. Handling Precautions

6.1 Power to be Supplied

When power is supplied to this product via the USB, note that the maximum current that the regulator (ISL9005AIRNZ-T from Renesas) can supply is 300 mA.

6.2 Remodeling the Board

Any modification of the board (including removing the patterns for cutting) shall be conducted at the user's own responsibility.

6.3 Limitation on the Number of Connected RL78/G14 Fast Prototyping Boards

Connecting the same host PC to multiple RL78/G14 Fast Prototyping Boards is not possible.

6.4 Power-Supply Circuits and Usage Conditions

Different power supplies can be selected by remodeling the board. Table 6-1 shows the relationship between power-supply circuits and usage conditions.

Table 6-1 Power-Supply Circuits and Usage Conditions

Power-Supply circuit	Usage Condition				
	Power supplied to the RL78/G14	Use of Arduino™ shields*1	Use of boards supported by Pmod™*1	Use of an emulator and IDE	Remodeling the board*2
As shipped (default)	3.3 V	Possible	Possible	Possible	Not required
Power-supply selection header	VBUS (5 V) or 3.3 V	Possible	Possible	Possible	Required - J4: mounted; SS11: removed - SS1: removed; SC1: short-circuited (only for VBUS)
External power-supply header	1.8 V to 5.5 V	Only possible with 3.3 V	Possible	Not possible (The emulator circuit is in the reset state.)	Required - J3: mounted; SS11: removed - EJ1: mounted; EJ1: short-circuited
Coin-cell battery circuit	3.3 V	Possible	Possible	Not possible (The emulator circuit is in the reset state.)	Required - U2, U3, C9, C12, and L1: mounted - SS11: removed; EJ1: mounted; EJ1: short-circuited

Notes: 1. Connecting the RL78/G14 Fast Prototyping Board to an Arduino™ shield or a board supported by Pmod™ shall be conducted at the user's own responsibility and should only proceed after confirming the specifications of the power supply and interfaces.

2. Modifications after shipment for remodeling the board are stated in this column.

7. Developing Code

7.1 Using the e² studio

Figure 7-1 shows the settings of the e² studio when creating a new project for the RL78/G14 Fast Prototyping Board.

- [Debug hardware]: Select [E2 Lite (RL78)].
- [Power Target From The Emulator]: Select [No].
- [Target Device]: Select [R5F104ML].

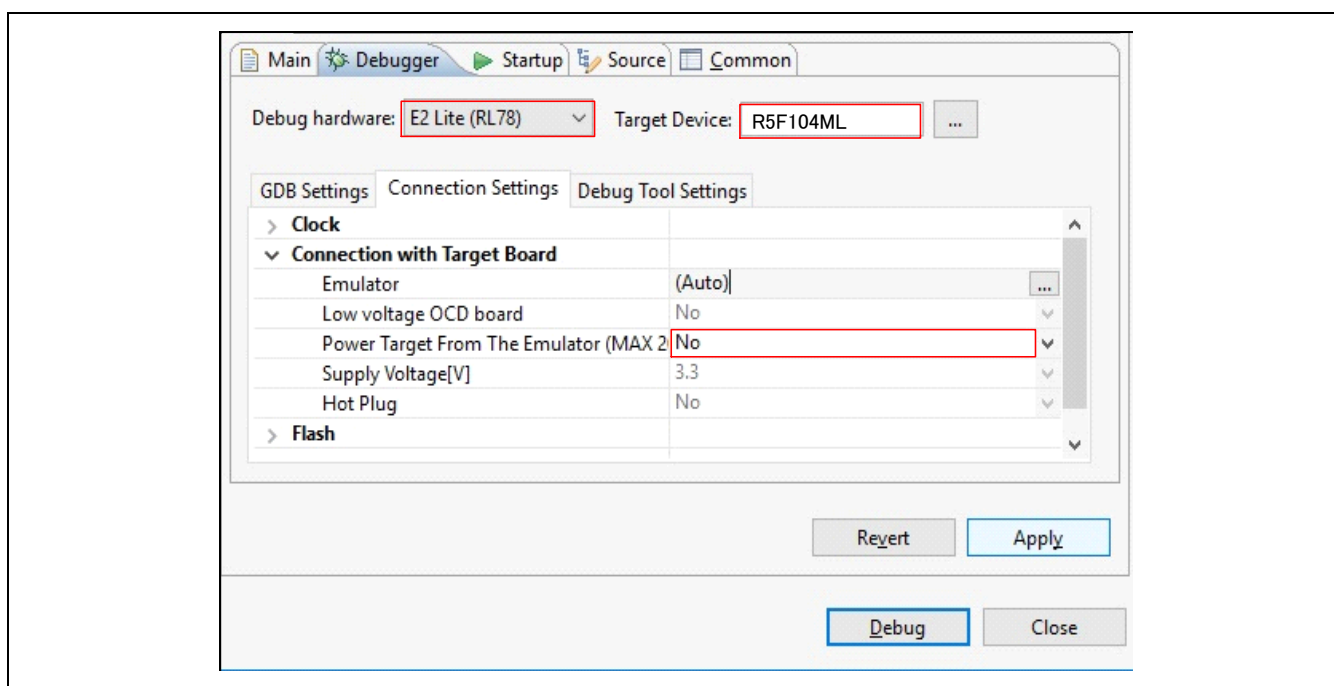


Figure 7-1 Settings of the e² studio

Note: Do not connect another RL78/G14 Fast Prototyping Board to your PC while this product is already connected.

7.2 Using CS+

Figure 7-2 and Figure 7-3 show the settings of CS+ when creating a new project for the RL78/G14 Fast Prototyping Board.

- [Using Debug Tool]:
Select [RL78 E2 Lite (E)] from [Using Debug Tool] in the [Debug] menu.

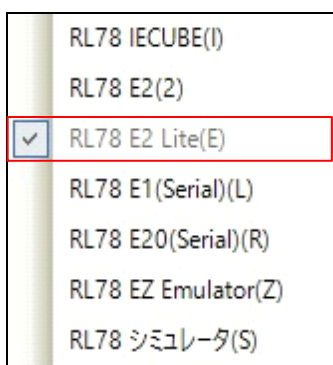


Figure 7-2 Panel for Selecting the Debug Tool

- [Power target from the emulator]: Select [No].

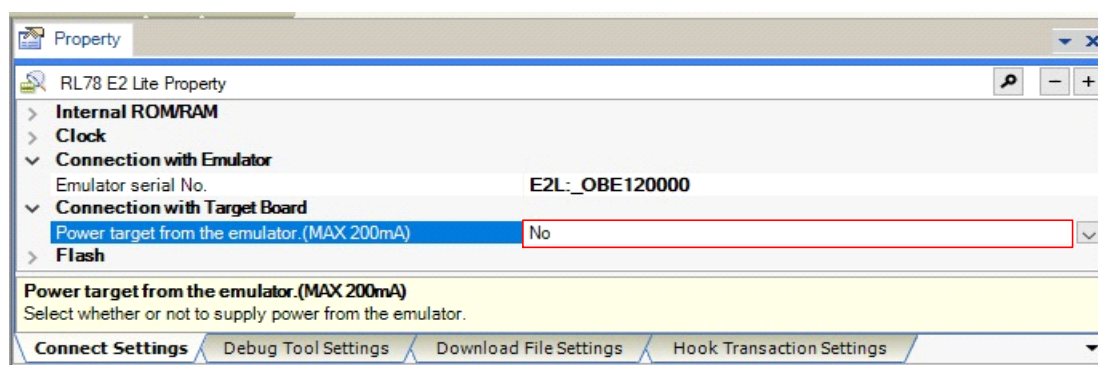


Figure 7-3 [Connect Settings] Tabbed Page of CS+

8. Additional Information

Technical Support

For details on the usage of the IDE, refer to its help menu.

For details on the RL78/G14 microcontrollers, refer to the RL78/G14 User's Manual: Hardware.

For details on the RL78 assembly language, refer to the RL78 Family User's Manual: Software.

Technical Contact Details

America: techsupport.america@renesas.com

Europe: <https://www.renesas.com/en-eu/support/contact.html>

Global & Japan: <https://www.renesas.com/support/contact.html>

General information on Renesas microcontrollers can be found on the Renesas website at:
<https://www.renesas.com/>

Note

Do not install the RL78/G14 Fast Prototyping Board or sample code into your product.

The operation of sample code is not guaranteed. Confirm the operation on your own responsibility.

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Revision History	RL78/G14 Fast Prototyping Board User's Manual
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Rev.	Date	Description	
		Page	Summary
1.00	Sep.13.19	—	First Edition issued
1.01	Aug.1.20	8	Modification of RAM capacity in table 1–1
1.02	Oct.1.22	13	Modified figure 5-4 and 5-5

RL78/G14 Fast Prototyping Board User's Manual

Publication Date: Rev.1.02 Oct.01.2022

Published by: Renesas Electronics Corporation

RL78/G14