User's Manual

16

RL78/G1P Fast Prototyping Board

User's Manual

16-Bit Single-Chip Microcontrollers

RL78 Family

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
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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 basic specifications and correct usage of this product.

The target users are those who are using this product to evaluate the RL78/G1P microcontroller and debug programs. The readers of this manual must have basic knowledge about the features of microcontrollers and debuggers.

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/G1P 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/G1P Fast Prototyping Board User's Manual	R20UT4661EJ (this manual)
Circuit schematics	Circuit schematics for the RL78/G1P Fast Prototyping Board	RL78/G1P Fast Prototyping Board Circuit Schematics	R20UT4667EJ
Parts list	Parts list for the RL78/G1P Fast Prototyping Board	RL78/G1P Fast Prototyping Board BOM LIST	R12TU0079EJ
Quick start guide	Overview and start guide for the RL78/G1P Fast Prototyping Board	RL78/G1P Fast Prototyping Board Quick Start Guide	R20UT4660EJ
User's manual for the hardware*	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation	RL78/G1P User's Manual: Hardware	R01UH0895EJ

Note: Download the documents for the RL78/G1P from the product page for the RL78/G1P.

2. List of Abbreviations and Acronyms

Abbreviation	Full Form
Arduino™ Nano	Connectors compatible with the Arduino™ Nano 3.3 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
USB	Universal Serial Bus
UART	Universal Asynchronous Receiver/Transmitter
WDT	Watchdog timer

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1. Overview

1.1 Package Components

Thank you for purchasing the RL78/G1P Fast Prototyping Board evaluation tool from Renesas (hereinafter referred to as “this product”). This product consists of the following items.

- RL78/G1P Fast Prototyping Board (RTK5RLG1P0C00000BJ)
- Quick Start Guide

1.2 Purpose

This product is an evaluation tool for a Renesas MCU. This user’s manual describes the hardware specifications, the method of setting the switches on the board, and the basic procedures for setting this product up.

1.3 Features

This product can handle the following tasks.

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

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

https://www.renesas.com/rl78g1p_fpb

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 RL78/G1P Fast Prototyping Board: Table of Specifications

Table 1-1 shows the specifications of this product.

Table 1-1 RL78/G1P Fast Prototyping Board Specification Table

Item	Specification
MCU (RL78/G1P)	Part No.: R5F11ZBAAFP
	Package: 32-pin LQFP
	On-chip memory: 16-KB ROM, 1.5-KB RAM, 2-KB data flash memory
Board size	18 mm x 70 mm
Power-supply voltage*1	USB connector: VBUS (5-V) input
	Power-supply IC: VBUS (5-V) input, 3.3-V output
	External power-supply header*2: 2.7 V to 3.6 V
Current drawn	Max. 200 mA
Current measurement header*2	Header: 2 pins x 1
Main clock	No circuit on the board (the MCU's internal HOCO is used)
Sub-clock	—
Push switch	Reset switch x 1
LEDs	Power indicator: green x 1
	User: green x 1
	ACT LED: green x 1
USB connector	Connector: Micro USB Type-B
Pmod™ connector	Connector: Angle type, 12 pins x 1
Interface compatible with Arduino™ Nano 3.3	A set of 2.54-mm pitch connectors for Arduino™ Nano
MCU headers	Headers: 15 pins x 2 (shared with the interface compatible with Arduino™ Nano 3.3), headers*2: 6 pins
Emulator reset header*2	Header: 2 pins x 1

Notes: 1. The RL78/G1P on the board as shipped is intended to be supplied with 3.3-V power generated by the power-supply IC. The board must be remodeled if external power is to be supplied. For details, refer to Chapter 5, User Circuits.
2. This part is not mounted.

1.6 Block Diagram

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

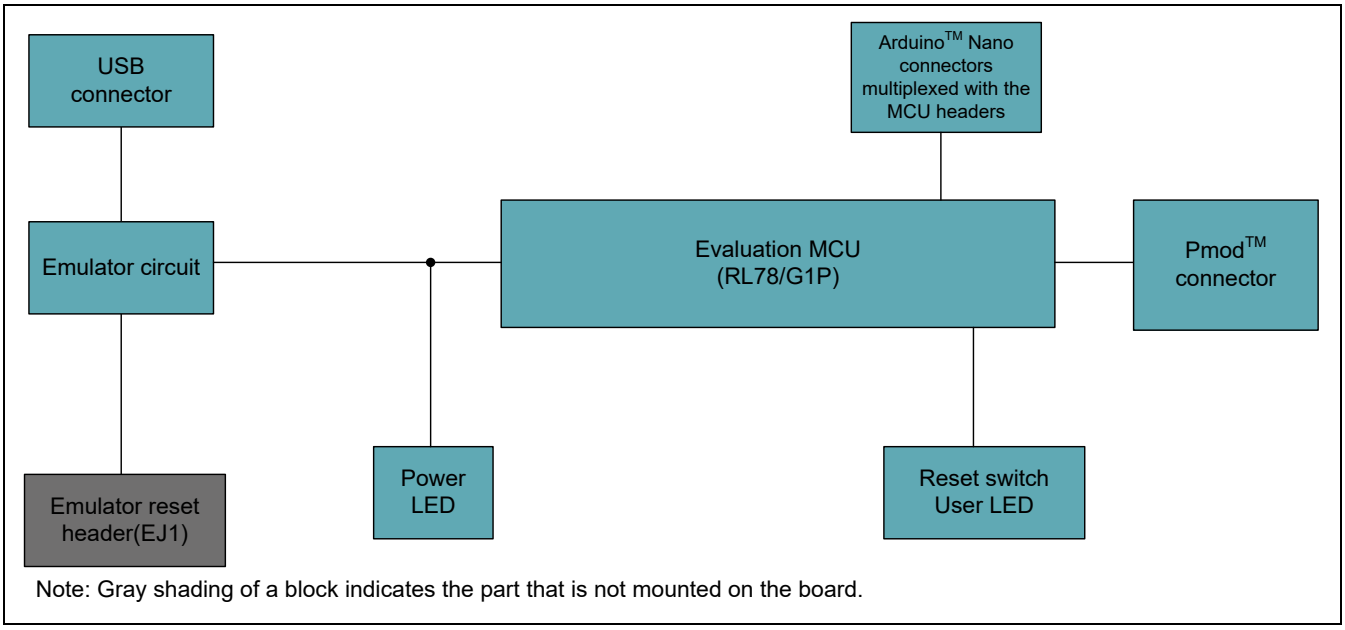

Figure 1-1 Block Diagram

2. Board Layout

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

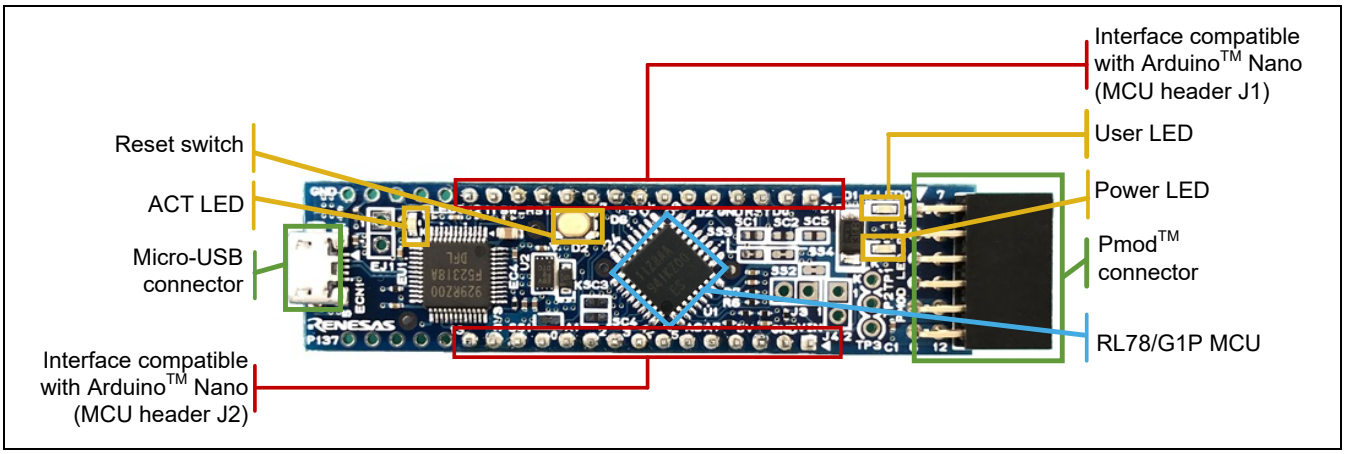

Figure 2-1 Board Layout (Top Side)

3. Parts Layout

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

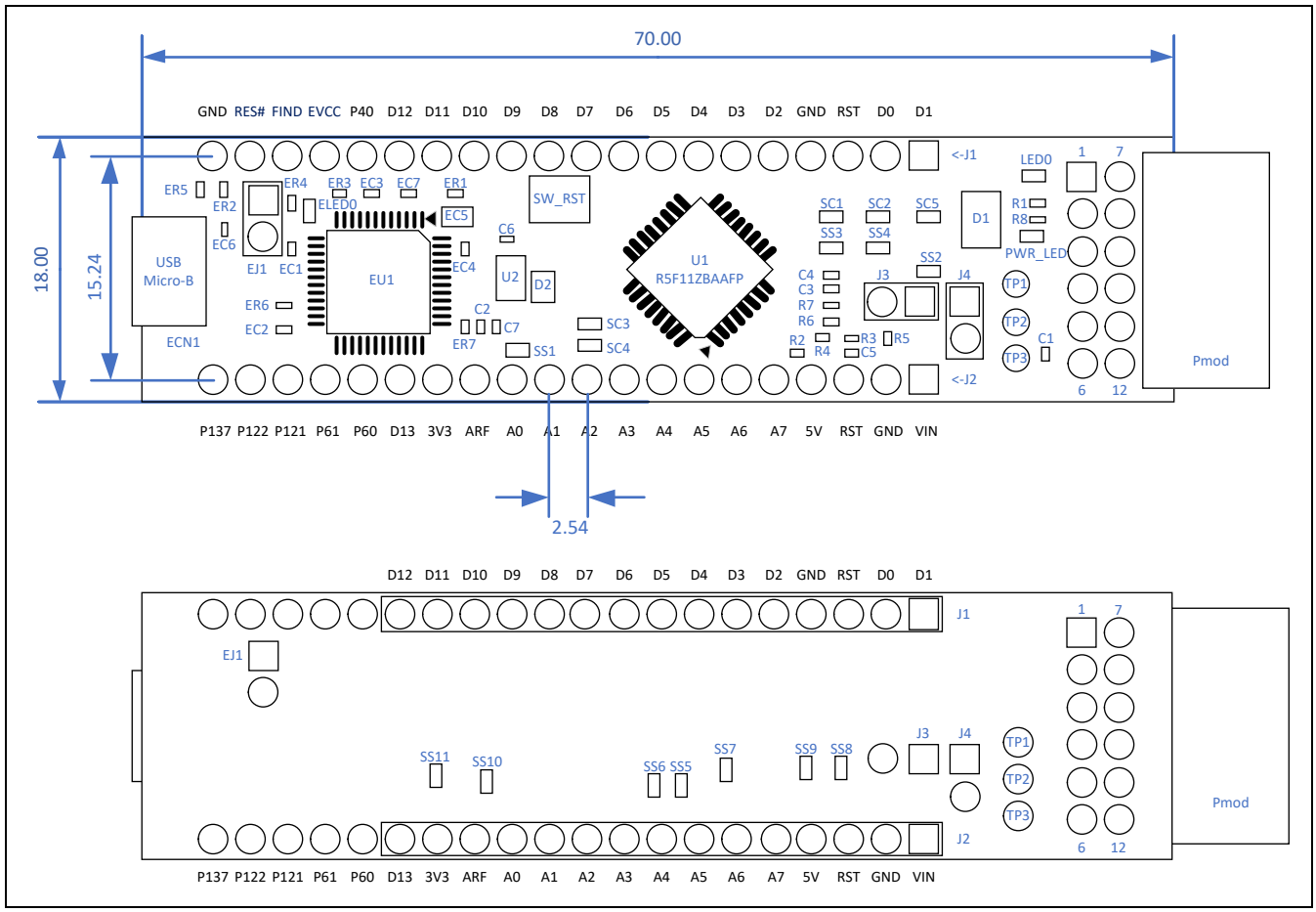

Figure 3-1 Parts Layout

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

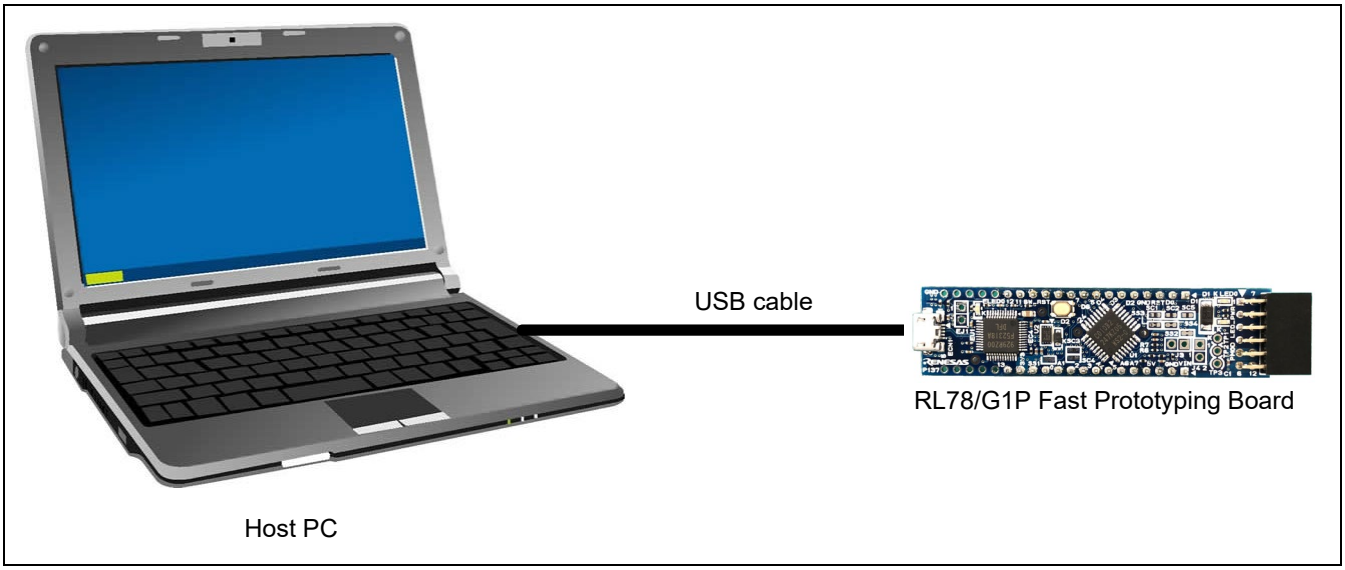

Figure 4-1 Operating Environment

5. User Circuits

5.1 RL78/G1P

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 LED

The optional user LED can be used for any purpose. LED0 is mounted on the board and is connected to the following port. The LED is green.

- LED0: Pin J1-2, connected to port P34

5.6 Pmod™ Connector

A Pmod™ connector can be connected to the RL78/G1P via type 2A or type 6 Pmod™ interface. Figure 5-1 and Table 5-1 show the pin assignments of the Pmod™ connector.

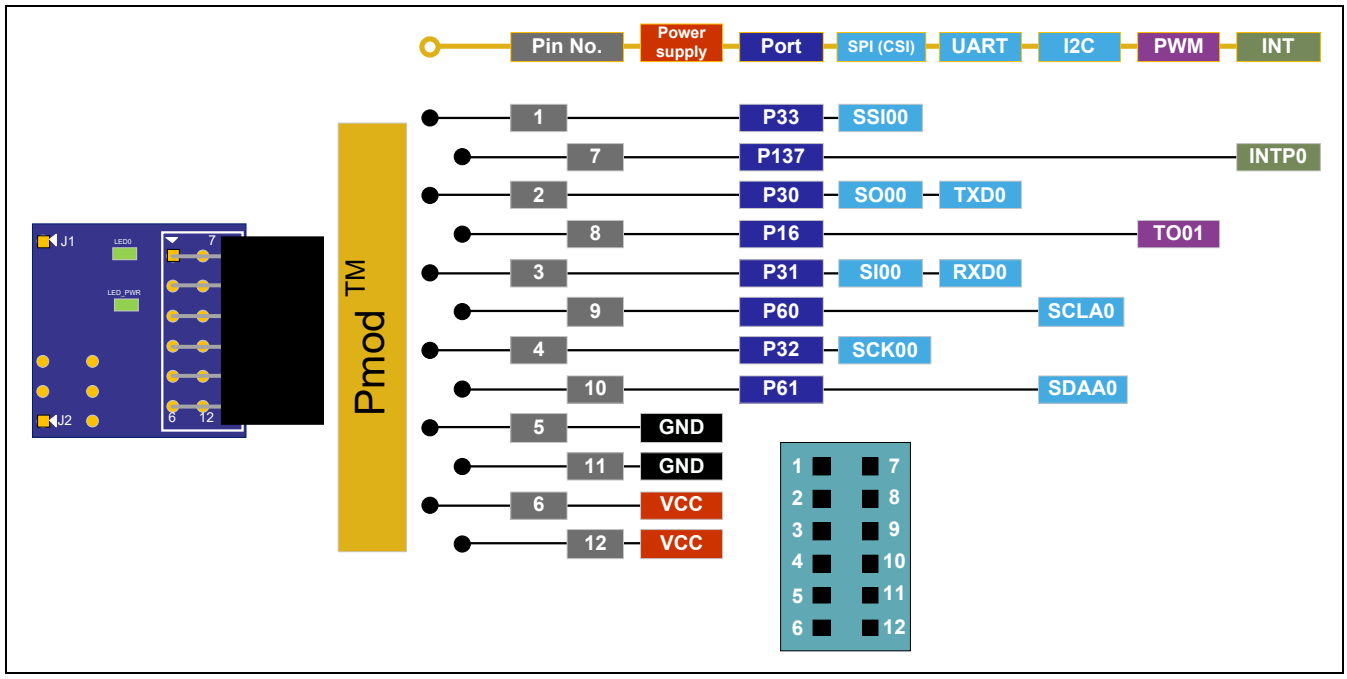

Figure 5-1 Pin Assignments of the Pmod™ Connector

Table 5-1 Pin Assignments of Pmod™

Pin No. of Pmod™	Name of Pmod™ Signal	RL78/G1P					
		Pin	Power Supply	Port	SPI (CSI)	UART	I2C*
1	SS	13	—	P33	$\overline{\text{SSI00}}$	—	—
2	MOSI	16	—	P30	SO00	TxD0	—
3	MISO	15	—	P31	SI00	RxD0	—
4	SCK	14	—	P32	$\overline{\text{SCK00}}$	—	—
5	GND	—	VSS	—	—	—	—
6	VCC	—	VDD	—	—	—	—
7	INT	3	—	P137	—	—	—
8	RESET	18	—	P16	—	—	—
9	IO2	9	—	P60	—	—	SCLA0
10	IO3	10	—	P61	—	—	SDAA0
11	GND	—	VSS	—	—	—	—
12	VCC	—	VDD	—	—	—	—

Note: Pins 7 to 12 correspond to pins 1 to 6 of the type 6 Pmod™ interface.

5.7 Arduino™ Nano Connector

The specification of the Arduino™ Nano connector is on the assumption that Arduino™ Nano shields are to be connectable. However, we do not guarantee connection to all types of Arduino™ Nano shield. Confirm the specifications of this product against any Arduino™ Nano shield you intend to use.

Figure 5-2 and Table 5-2 show the pin assignments of the Arduino™ Nano connector.

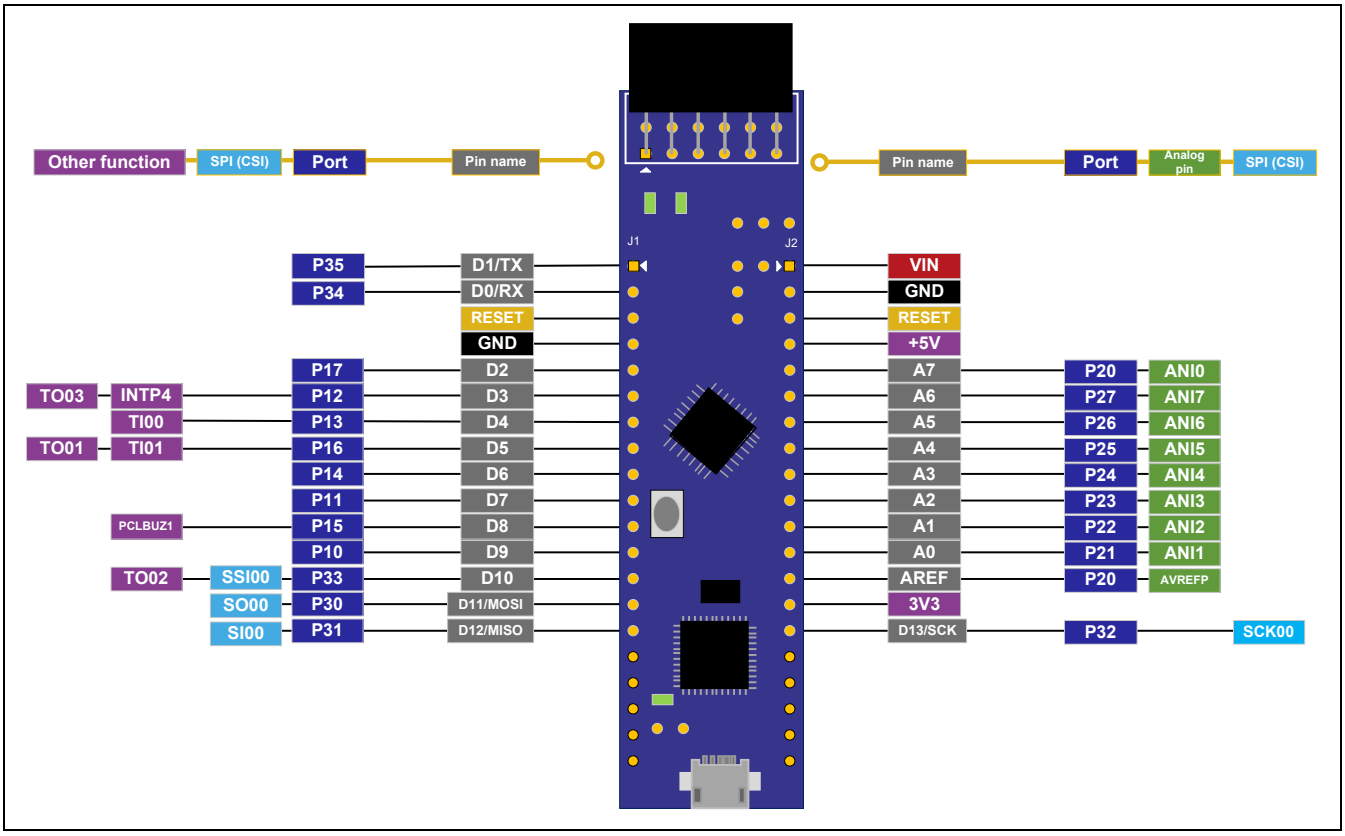

Figure 5-2 Pin Assignments of the Arduino™ Nano Connector

Table 5-2 Pin Assignments of the Arduino™ Nano Connector

Part No. in the Circuit Schematics	Name of Arduino™ Nano Signal	RL78/G1P					
		Pin	Power Supply	Port	Analog	Serial	Others
J1-1	PD1/TXD	11	—	P35/(P30)*1	—	(TXD0)*1	—
J1-2	PD0/RXD	12	—	P34/(P31)*2	—	(RXD0)*2	—
J1-3	RESET/PC6	2	—	—	—	—	$\overline{\text{RESET}}$
J1-4	GND	—	VSS	—	—	—	—
J1-5	PD2/INT0	17	—	P17	—	—	—
J1-6	PD3/OC2B/INT1	22	—	P12	—	—	TO03/INTP4
J1-7	PD4/T0/XCK	21	—	P13	—	—	TI00
J1-8	PD5/T1/OC0B	18	—	P16	—	—	TI01/TO01
J1-9	PD6/OC0A/AIN0	20	—	P14	—	—	—
J1-10	PD7/AIN1	23	—	P11	—	—	—
J1-11	PB0/CLK0/ICP1	19	—	P15	—	—	PCLBUZ1
J1-12	PB1/OC1A	24	—	P10	—	—	—
J1-13	PB2/OC1B/SS	13	—	P33	—	$\overline{\text{SSI00}}$	TO02
J1-14	PB3/MOSI/OC2	16	—	P30	—	SO00	—
J1-15	PB4/MISO	15	—	P31	—	SI00	—
J2-1	VIN	—	—	—	—	—	—
J2-2	GND	—	VSS	—	—	—	—
J2-3	RESET/PC6	2	—	—	—	—	$\overline{\text{RESET}}$
J2-4	5V	—	—	—	—	—	—
J2-5	ADC7	29	—	—	ANI0	—	—
J2-6	ADC6	25	—	—	ANI7	—	—
J2-7	PC5/ADC5/SCL	26	—	P26/(P60)*3	ANI6	(SCLA0)*3	—
J2-8	PC4/ADC4/SDA	27	—	P25/(P61)*4	ANI5	(SDAA0)*4	—
J2-9	PC3/ADC3	32	—	P24	ANI4	—	—
J2-10	PC2/ADC2	31	—	P23	ANI3	—	—
J2-11	PC1/ADC1	30	—	P22	ANI2	—	—
J2-12	PC0/ADC0	28	—	P21	ANI1	—	—
J2-13	AREF	29	—	—	AVREFP	—	—
J2-14	3V3	—	VDD	—	—	—	—
J2-15	PB5/SCK	14	—	P32	—	$\overline{\text{SCK00}}$	—

Notes: 1. Using the function enclosed in () requires remodeling of the board in the form of short-circuiting a pattern that has been cut (SC2) and cutting another part of the pattern (SS4). This also connects the given signal to J1-14.
2. Using the function enclosed in () requires remodeling of the board in the form of short-circuiting a pattern that has been cut (SC1) and cutting another part of the pattern (SS3). This also connects the given signal to J1-15.
3. Using the function enclosed in () requires remodeling of the board in the form of short-circuiting a pattern that has been cut (SC3) and cutting another part of the pattern (SS5).
4. Using the function enclosed in () requires remodeling of the board in the form of short-circuiting a pattern that has been cut (SC4) and cutting another part of the pattern (SS6).

5.8 MCU Headers

In this product, through-holes having a pitch of 2.54 mm are assigned to six pins and connected to the RL78/G1P separately from the MCU headers which are also for use as an Arduino™ Nano interface. For the connections of the RL78/G1P pins to the headers which are also for use as an Arduino™ Nano interface, refer to Table 5-2, Pin Assignments of the Arduino™ Nano Connector. For the connections between the six pins of the RL78/G1P which have been assigned to through-holes, refer to Table 5-3 below.

Table 5-3 Pin Assignments of the MCU Headers

Part No. in the Circuit Schematics	RL78/G1P			
	Pin	Port	Serial	Others
J1-16	1	P40	—	TOOL0 This pin is occupied by debugging, so it cannot be used as P40 at that time.
J2-16	9	P60	SCLA0	—
J2-17	10	P61	SDAA0	—
J2-18	5	P121	—	—
J2-19	4	P122	—	EXCLK
J2-20	3	P137	—	INTP0

Note: Pins from J1-17 to J1-20 are not for connection.

5.9 Clock

An internal clock of the MCU is used. For details on the specifications of the MCU clocks, refer to the RL78/G1P User's Manual: Hardware.

5.10 Reset Switch

Pressing the reset switch (SW_RST) applies a hardware reset to the RL78/G1P.

5.11 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/G1P 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 (EJ1) (only through-holes are provided; an actual header component is not mounted).

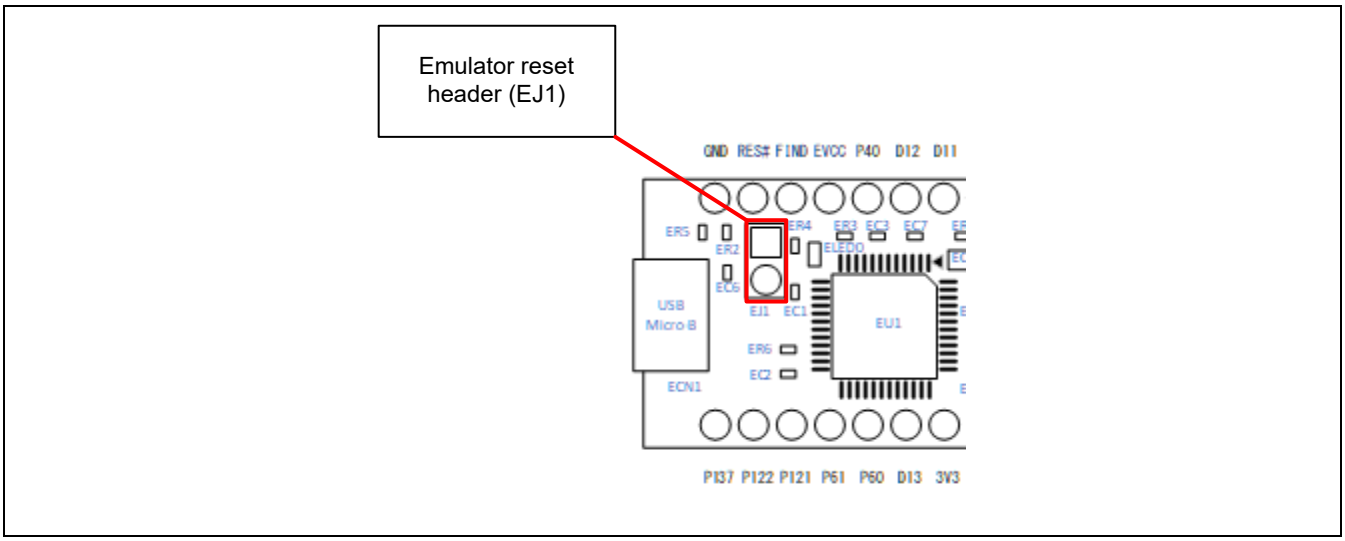

Figure 5-3 Position of the Emulator Reset Header

5.12 External Power-Supply Header

When operating the RL78/G1P at a desired external input voltage, or when more current is required than the USB is capable of supplying, use the external power-supply header (J4) to supply power. The usable voltage range is from 2.7 V to 3.6 V.

When using this header, remove the pattern (SS1) for cutting on the soldered side (see Figure 5-4). In addition, short-circuit the emulator reset header (EJ1) as described in section 5.11, Emulator Reset Header, to place the emulator in the forced reset state.

Figure 5-4 shows the position of the external power-supply header (the J4 header component is not mounted).

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

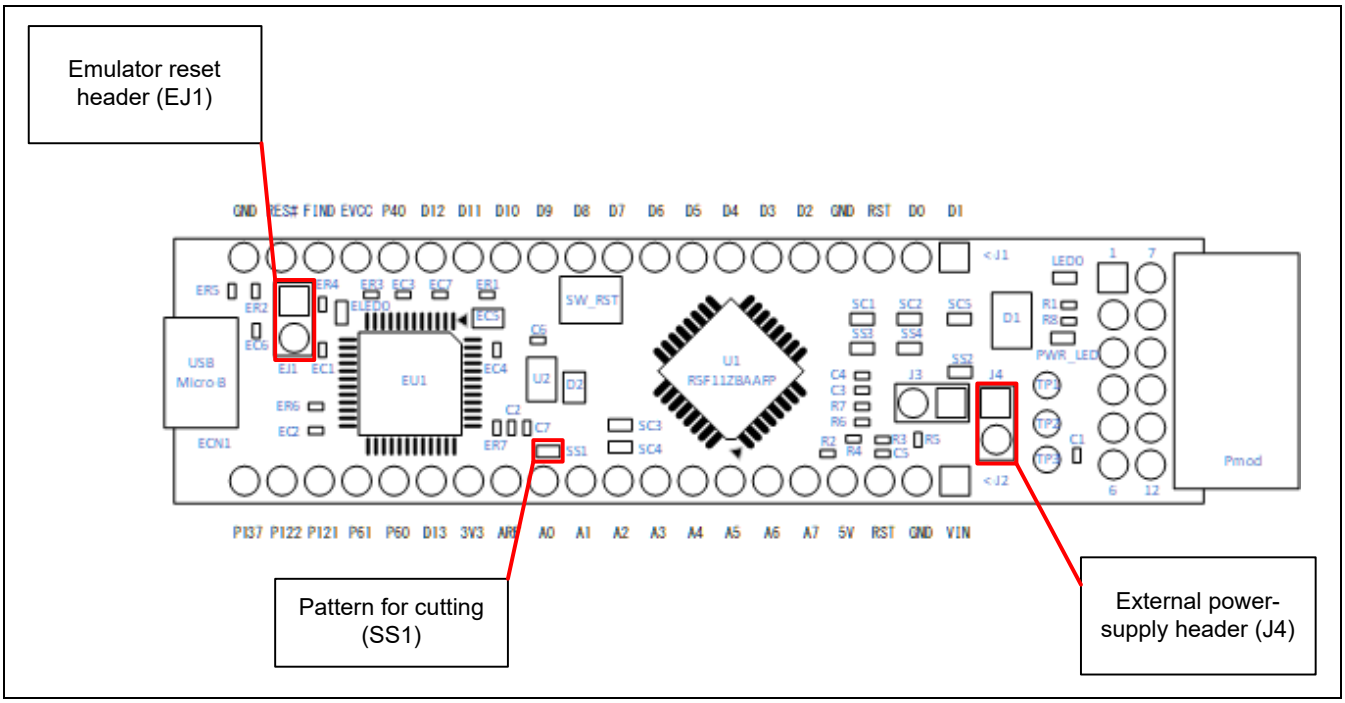

Figure 5-4 Position of the External Power-Supply Header

5.13 Current Measurement Header

The current measurement header (J3) is used to measure the current drawn by the evaluation MCU (the J3 header component is not mounted). The current drawn can be measured by connecting an ammeter to the evaluation MCU. When this header is to be used, remove the relevant pattern for cutting (SS2). Figure 5-5 shows the positions of the header and pattern for cutting.

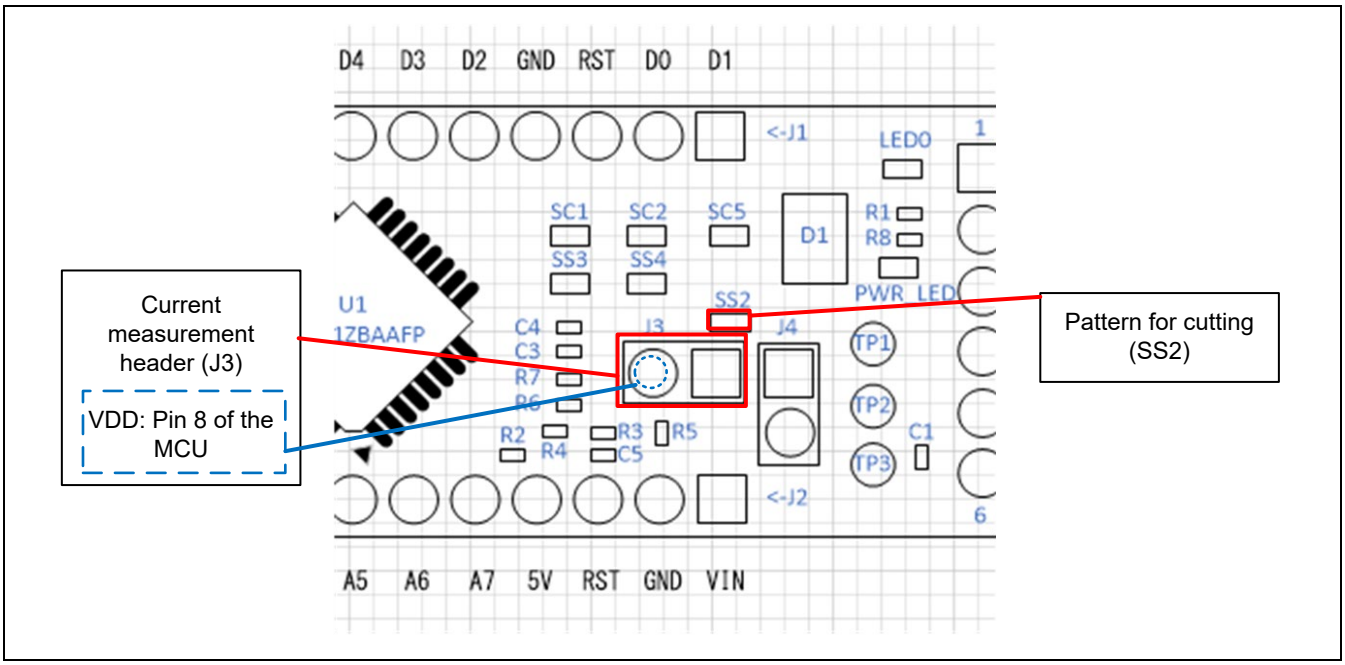

Figure 5-5 Positions of the Current Measurement Header (J3) and Pattern for Cutting (SS2)

6. Handling Precautions

6.1 Power to be Supplied

The maximum current that the power-supply IC (ISL9005AIRNZ-T from Renesas) can supply is 300 mA during operation at 3.3 V.

If power is to be supplied to this product via the USB, take care with the regard to the load that the USB-power source is capable of driving.

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/G1P Fast Prototyping Boards

Connecting the same host PC to multiple RL78/G1P 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/G1P	Use of Arduino™ Nano 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
External power-supply header	2.7 V to 3.6 V	Only possible with 3.3 V	Possible	Not possible (The emulator circuit is in the reset state.)	Required • J4: mounted; SS1: removed • EJ1: mounted; EJ1: short-circuited

Notes: 1. Connecting the RL78/G1P Fast Prototyping Board to an Arduino™ Nano 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/G1P Fast Prototyping Board.

- [Debug hardware]: Select [E2 Lite (RL78)].
- [Power Target From The Emulator]: Select [No].
- [Target Device]: Select [R5F11ZBA].

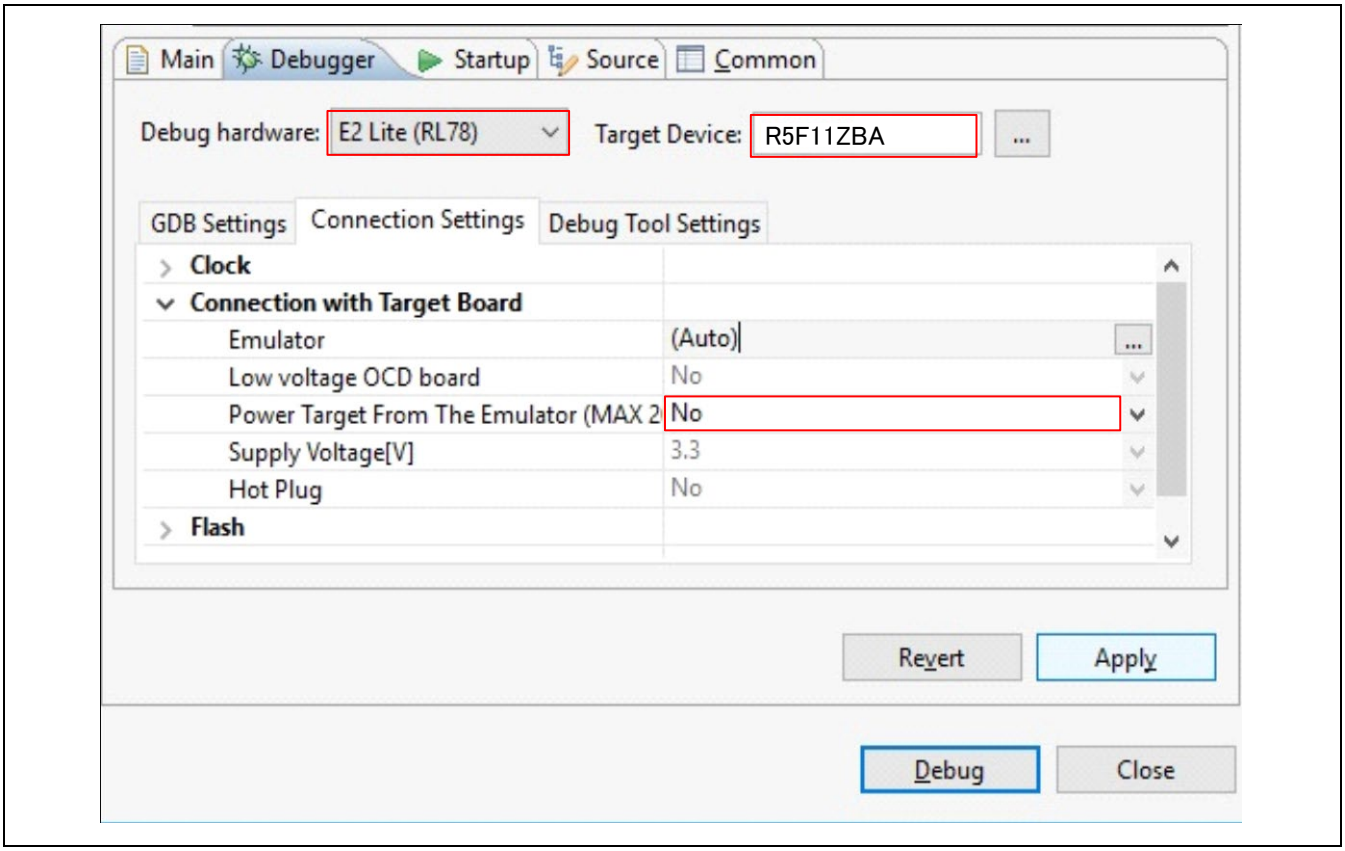

Figure 7-1 Settings of the e² studio

Note: Do not connect another RL78/G1P 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/G1P Fast Prototyping Board.

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

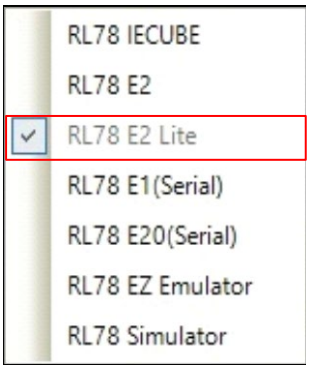

Figure 7-2 Panel for Selecting the Debug Tool

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

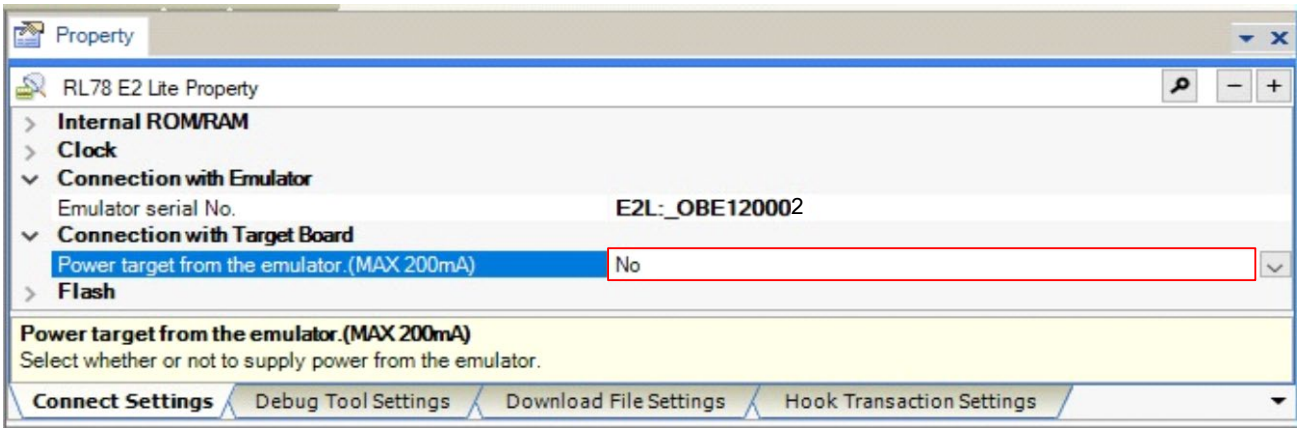

Figure 7-3 [Connect Settings] Tabbed Page of CS+

8. Additional Information

Technical Support

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

For details on the R78/G1P microcontrollers, refer to the RL78/G1P 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/eu/en/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/G1P 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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