User's Manual

32

RX140 Group

Target Board for RX140

User's Manual

RENESAS 32-Bit MCU

RX Family/RX100 Series

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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.

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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 will be using it in evaluating MCUs and debugging programs.

The target readers of this manual require basic knowledge regarding the facilities of MCUs 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 Handling Precautions 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 Target Board for RX140. 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	Target Board for RX140 hardware specifications	Target Board for RX140 User's Manual	R20UT4893EJ (this manual)
Circuit schematics	Target Board for RX140 circuit schematics	Target Board for RX140 Circuit Schematics	R20UT4897EJ
Parts list	Target Board for RX140 parts list	Target Board for RX140 BOM LIST	R12TU0115EJ
User's manual for the hardware*	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation	RX140 Group User's Manual: Hardware	R01UH0905EJ

Note: Download the documents for the RX140 from the product page for the RX140.

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2. List of Abbreviations and Acronyms

Abbreviation	Full Form
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
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus

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1. Overview

1.1 Package Components

Thank you for purchasing the Target Board for RX140 evaluation tool from Renesas (hereinafter referred to as “this product”). This product consists of the Target Board for RX140 (RTK5RX1400C00000BJ).

1.2 Purpose

This product is an evaluation tool for a Renesas MCU. This user’s manual describes the hardware specifications, ways of setting switches, and the basic setup procedure.

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 applications*1
- Samples of peripheral-function initialization code*1

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

https://www.renesas.com/rxtb

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

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1.5 Target Board for RX140: Table of Specifications

Table 1-1 shows the specifications of this product.

Table 1-1 Target Board for RX140 Specification Table

Item	Specification
Evaluation MCU	Part No.: R5F51403ADFM
	Package: 64-pin LFQFP
	On-chip memory: 64-KB ROM, 16-KB RAM, 4-KB E2 data flash memory
Board size	Size: 54.0 mm x 90.0 mm
	Thickness: 1.6 mm
Power-supply circuit	USB connector: 5-V input
	Power-supply IC: 5-V input, 3.3-V output
	External power-supply header*: 3.3-V input, 2 pins x 1
Current drawn	Max. 200 mA
Current measurement header*	Header: 2 pins x 1
Main clock*	Crystal oscillator (surface-mount technology (SMT)) for the main system clock
	Crystal oscillator or ceramic resonator (lead type) for the main system clock
Sub-clock*	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	USB Micro-B
Pmod™ connector	Connector: Angle type, 12 pins
MCU headers*	Headers: 32 pins x 2
Patterns for cutting	17
Power-supply selection header*	Header: 3 pins x 1
Emulator reset header*	Header: 2 pins x 1

Note: This part is not mounted.

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1.6 Block Diagram

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

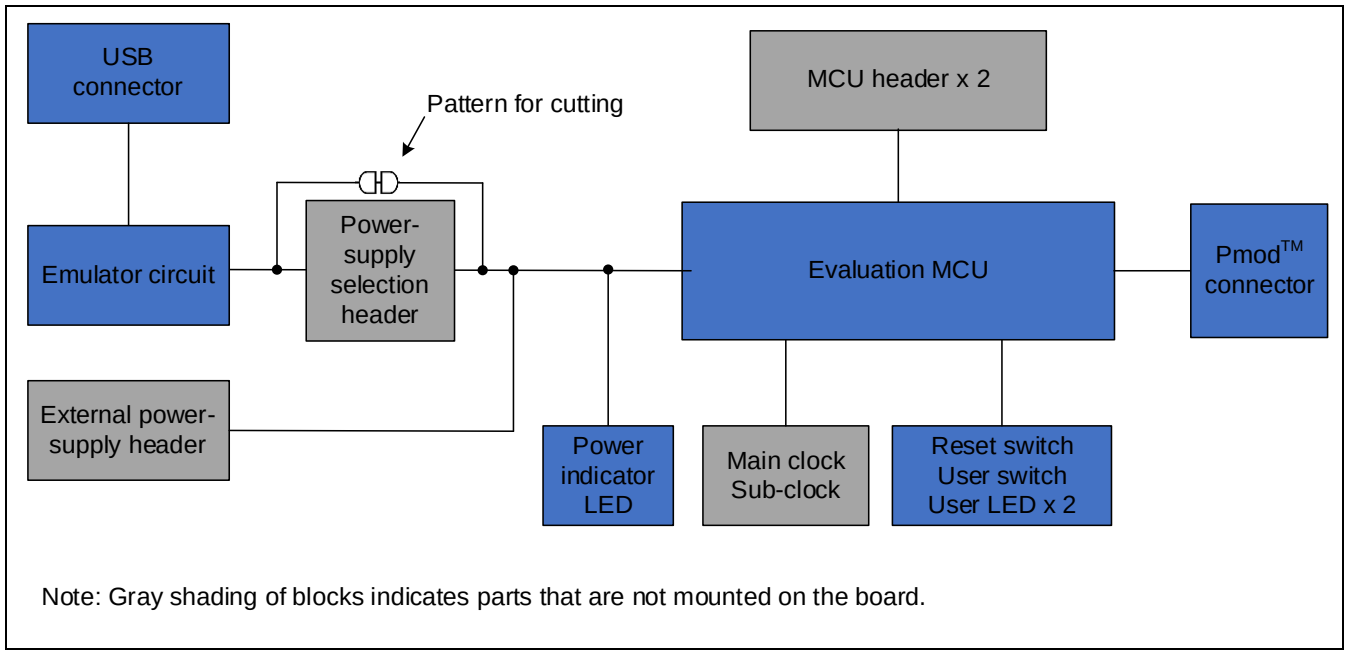


Figure 1-1 Block Diagram

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2. Board Layout

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

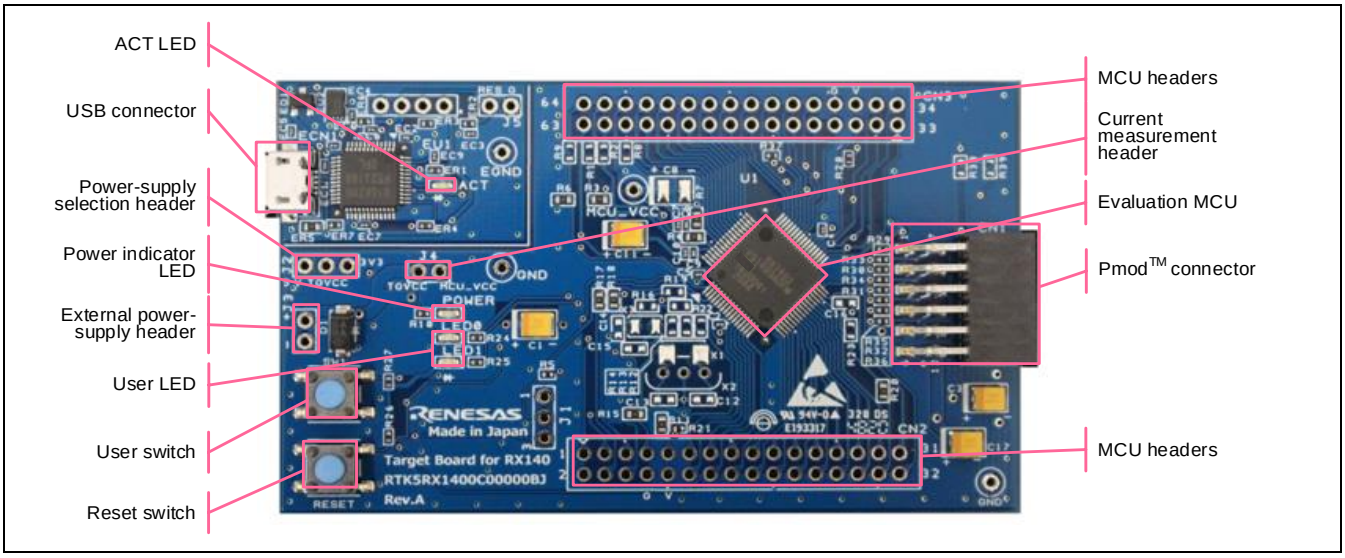


Figure 2-1 Board Layout (Top Side)

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3. Parts Layout

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

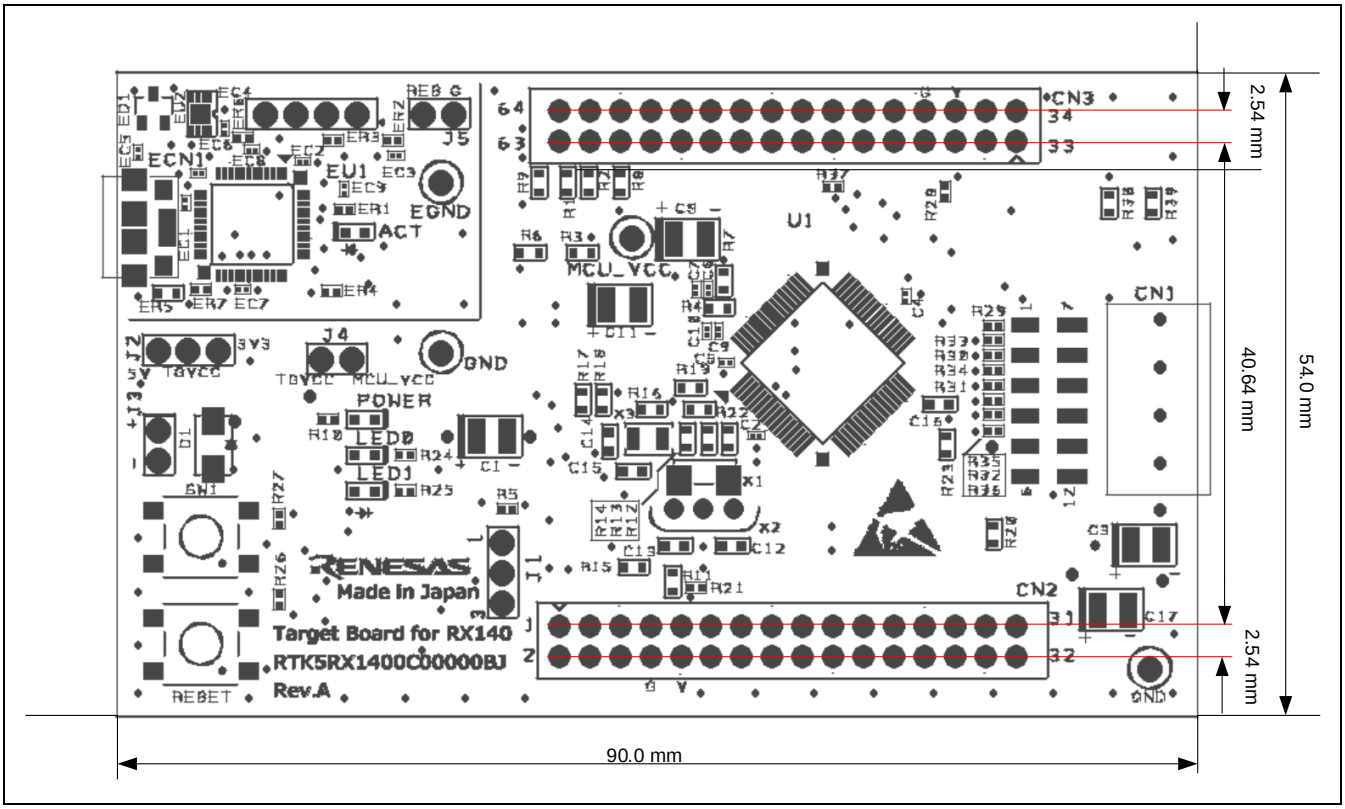


Figure 3-1 Parts Layout

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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

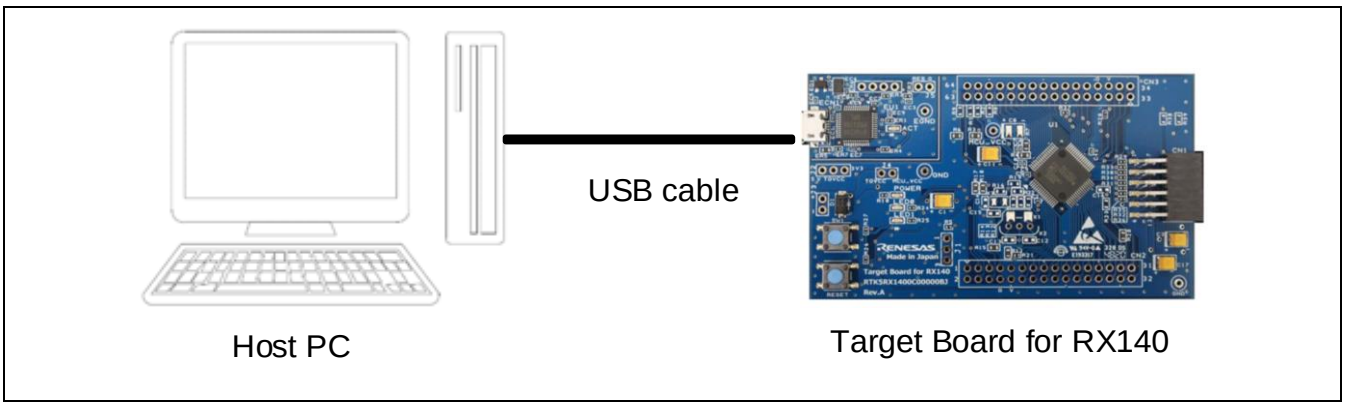


Figure 4-1 Operating Environment

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5. User Circuits

5.1 Evaluation MCU

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 shape of the connector is USB micro-B for the IDE and for the Renesas Flash Programmer (RFP). Connect the 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 machine (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.

The LED is not illuminated when the power-supply voltage is 2.2 V or lower.

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. The LED is not illuminated when the power-supply voltage is 2.2 V or lower.

- LED0: Pin 13, connected to port P31
- LED1: Pin 12, connected to port P32

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5.6 External Power-Supply Header

When the evaluation MCU is to have a desired power-supply voltage, 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 evaluation MCU. When this header is to be used, remove the pattern for cutting (SS3). Place the emulator in the forced reset state by short-circuiting the header (J5) (refer to section 5.13, Emulator Reset Header). Figure 5-1 shows the position of the pattern for cutting. Figure 5-2 shows the position of the external power-supply header.

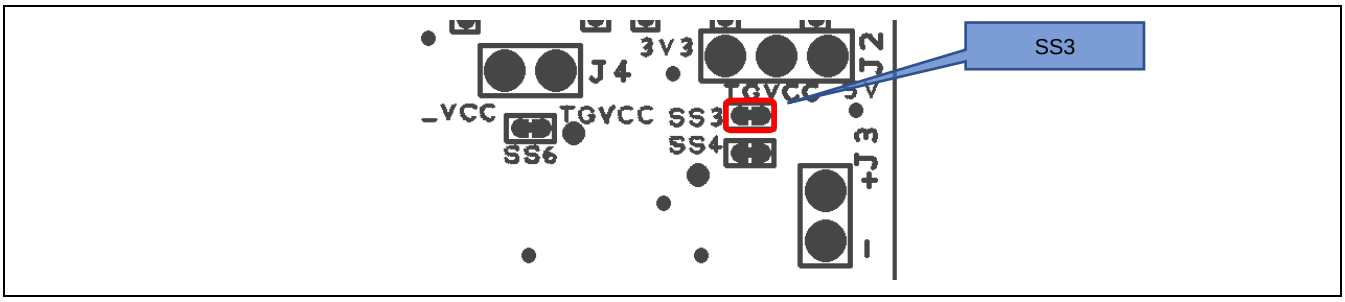


Figure 5-1 Position of the Pattern for Cutting (SS3) (Soldered Side)

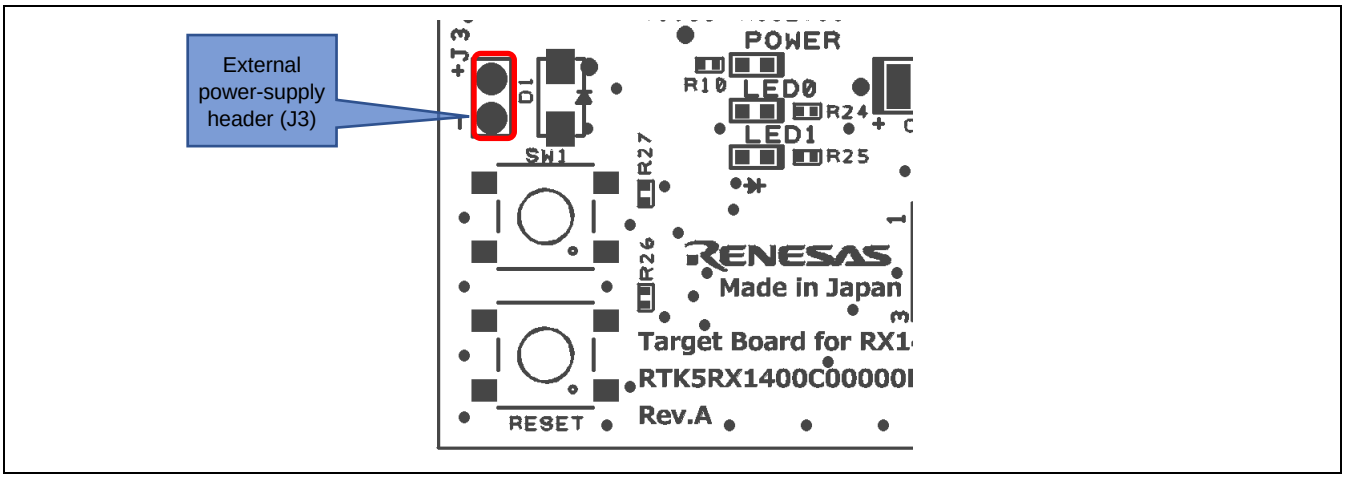


Figure 5-2 Position of the External Power-Supply Header (J3) (Top Side)

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5.7 Pmod™ Connector

The specification of the Pmod™ connector (CN1) is on the assumption that Pmod™ modules are to be connectable.

CN1 is for connection to Pmod™ Interface Type 6A (Type 6 + Type 1) modules* in the product as shipped. Remodeling of the board by removing patterns for cutting enables the connection of CN1 to Type 2A or Type 3A modules. Use Pmod™ modules for operation at the same potential as that for the evaluation MCU.

However, we do not guarantee connection to all types of Pmod™ module. Confirm the specifications of this product against any Pmod™ module you intend to use.

Note: The specifications of Type 6A differ from those described in the Pmod™ interface specification of Digilent.

Table 5-1 Pin Assignments of the Pmod™ Connector

Pin No. (CN1)	Specifications of the Connector			Evaluation MCU	
	Type 6A (I2C)	Type 2A (SPI)	Type 3A (UART)	Port	Pin No.
1	INT	CS	CTS/GPIO	PE5/IRQ5	46
				(PA6/CTS5#)*[1]	41
2	RESET	MOSI	TXD	PA0	45
				(PA4/SSDA5/SMOSI5/TXD5)*[2]	42
3	SCL	MISO	RXD	PA3/SMISO5/RXD5/SSCL5	43
4	SDA	SCK	RTS/GPIO	PA4/SSDA5/SMOSI5/TXD5	42
				(PA1/SCK5)*[3]	44
5	GND	GND	GND	—	—
6	VCC	VCC	VCC	—	—
7	GPIO	GPIO/INT	GPIO/INT	PB1/IRQ4	37
8	GPIO	GPIO/RESET	GPIO/RESET	PB3	36
9	GPIO	GPIO	GPIO	PB5	35
10	GPIO	GPIO	GPIO	PB6/PC0	34
11	GND	GND	GND	—	—
12	VCC	VCC	VCC	—	—

Notes: 1. If you wish to use CTS for Type 3A modules, change the connection of the pin to PA6 (remove SS11 and short-circuit SC1).
2. If you wish to use Type 2A or 3A modules, change the connection of the pin to PA4 (remove SS12 and short-circuit SC2).
3. If you wish to use Type 2A or 3A modules, change the connection of the pin to PA1 (remove SS13 and short-circuit SC3).

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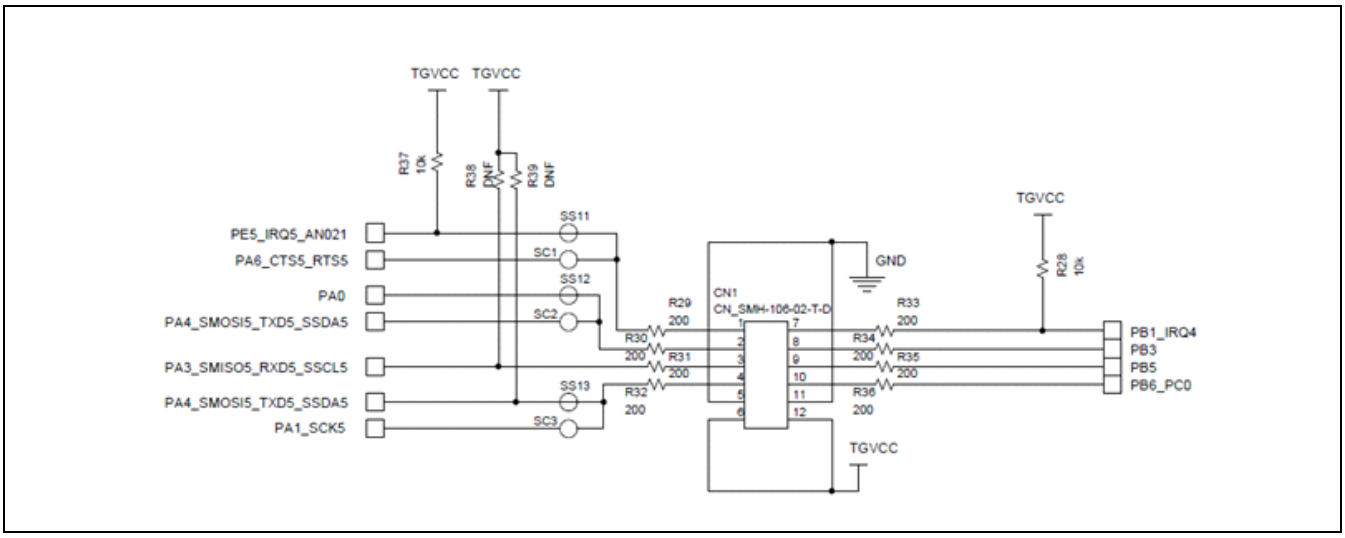


Figure 5-3 Circuit Schematic for the Pmod™ Connector

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5.8 Current Measurement Headers

The current measurement header (J4) is used to measure the current drawn by the evaluation MCU (an actual header component is not mounted on the board as shipped). 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 (SS6) on the soldered side. Figure 5-4 shows the positions of the header and pattern for cutting.

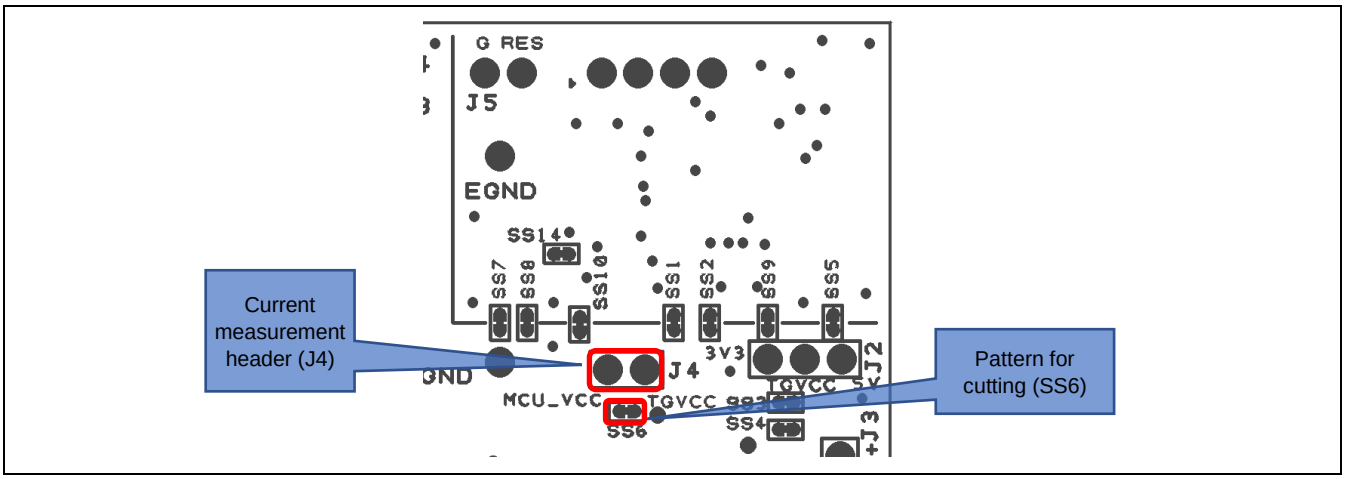


Figure 5-4 Positions of the Current Measurement Header (J4) and Pattern for Cutting (SS6) (Soldered Side)

5.9 MCU Headers

MCU headers are provided for by two sets of through holes (CN2 and CN3) for 32-pin headers (actual header components are not mounted on the board as shipped). The pin headers have a pitch of 2.54 mm and are connected to the evaluation MCU. Pin numbers of the MCU headers correspond to those of the evaluation MCU, and most pins are connected (with pin 2 as an exception).

5.10 Reset Switch

Pressing the RESET switch applies a hardware reset to the evaluation MCU.

5.11 User Switch

An optional user switch (SW1) is mounted. It is connected to pin 14 of the evaluation MCU, which operates as pin function P30. The IRQ0 interrupt is multiplexed on the same pin.

5.12 Patterns for Cutting

Patterns must be cut or repaired by soldering if necessary. Figure 5-5 shows examples of the states of patterns for cutting.

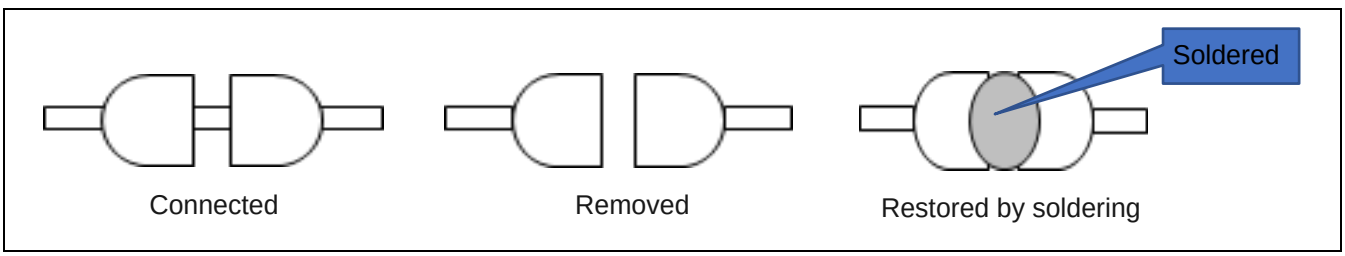


Figure 5-5 Examples of States of Patterns for Cutting

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5.13 Emulator Reset Header

The emulator is placed in the forced reset state by short-circuiting its reset header (J5) (actual header components are not mounted on the board as shipped). The emulator alone can be operated in the forced reset state without controlling the evaluation MCU from the IDE. Figure 5-6 shows the position of the emulator reset header.

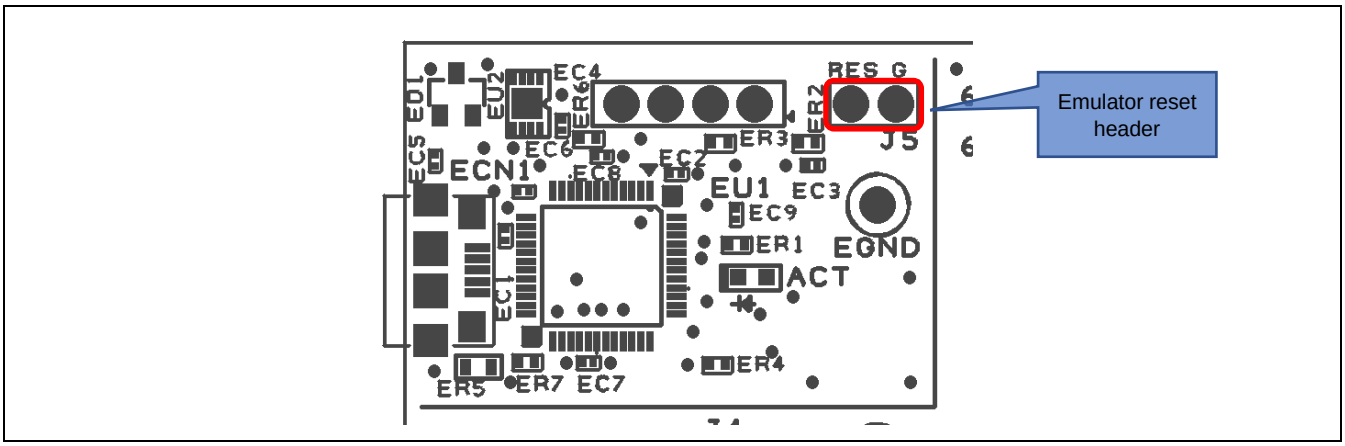


Figure 5-6 Position of the Emulator Reset Header (J5) (Top Side)

5.14 Power-Supply Selection Header

The operating voltage of the evaluation MCU can be set to 5 V or 3.3 V. Mount the header (J2) and remove the pattern for cutting (SS3) to change the operating voltage. Figure 5-7 shows the position of the pattern for cutting (SS3). Figure 5-8 shows the states of the header for selecting the 3.3-V output and the 5-V output. SS3 selects the 3.3-V output by default at the time of shipment.

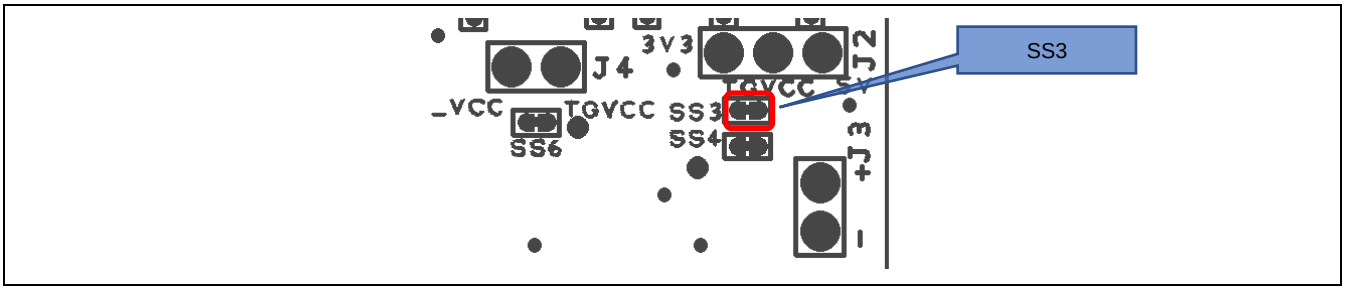


Figure 5-7 Position of the Pattern for Cutting (SS3) (Soldered Side)

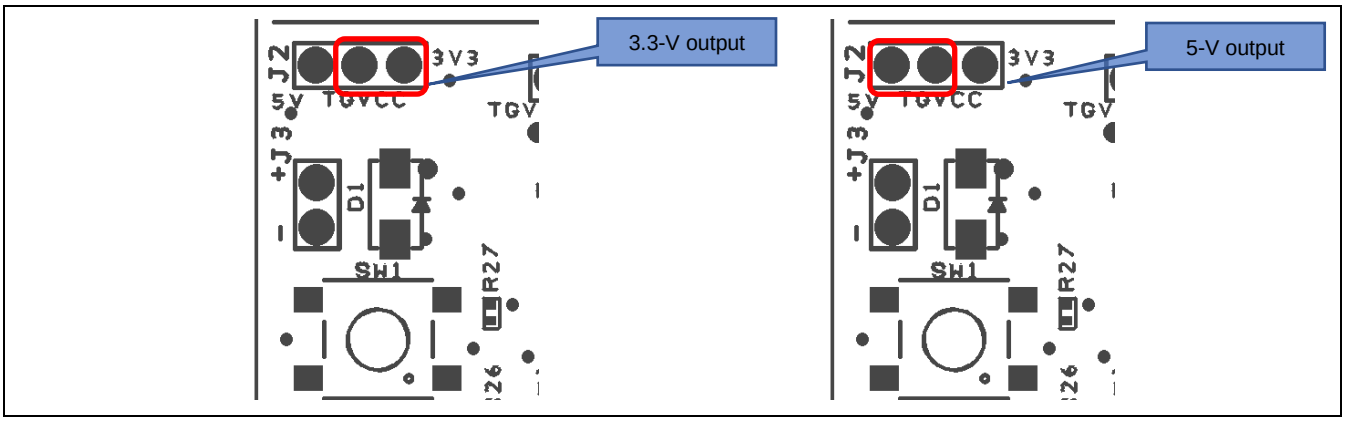


Figure 5-8 Position of the Power-Supply Selection Header (J2) (Top Side)

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6. Configurations

6.1 Modifying the Target Board for RX140

This section describes how to change the setting of this product by using option-link resistors.

An option-link resistor is a 0-Ω surface-mount resistor, which is used to short-circuit or isolate a part of circuits. The subsequent sections contain lists of option-link resistors for individual functions. Fit or remove option-link resistors to switch functions with reference to the list. **Resistor numbers in bold blue type** indicate the initial state of the configuration on the Target Board for RX140 as shipped. For the positions of the option links, refer to chapter 3, Parts Layout.

When removing soldered components, do not apply a soldering iron to the Target Board for RX140 for more than 5 seconds. This time restriction is to avoid any damage components mounted nearby on the board.

6.2 Analog Power Supply

Table 6-1 and Table 6-2 show the option-link resistors for the analog power supply.

Table 6-1 Option-Link Resistors for the Analog Power Supply of the 12-Bit A/D and D/A Converters

Analog Power-Supply Source of the 12-Bit A/D and D/A Converters	Mounted	Not Mounted	Remark
Power supplied to MCU_VCC	**R3, R6**	**R1, R9**	—
MCU headers	R1, R9	R3, R6	AVCC0 and AVSS0 are assigned to an MCU header (CN3 side).

Table 6-2 Option-Link Resistors for the Reference Power Supply of the 12-Bit A/D Converter

Reference Power-Supply Source of the 12-Bit A/D Converter	Mounted	Not Mounted	Remark
Power supplied to MCU_VCC	**R4, R7**	**R2, R8**	—
MCU headers	R2, R8	R4, R7	VREFH0/PJ6 and VREFL0/PJ7 are assigned to an MCU header (CN3 side).

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6.3 On-Chip Oscillator

Table 6-3 and Table 6-4 show the option-link resistors for the operation of the on-chip oscillator.

Table 6-3 Option-Link Resistors for the HOCO

Setting of the HOCO	Mounted	Not Mounted	Remark
Oscillating	**R11, R15**	**R12, R14**	—
Halted	R12, R14	R11, R15	Mount a crystal oscillator on X1 or X2 and the load capacitance as C12 or C13.

Table 6-4 Option-Link Resistors for the LOCO

Setting of the LOCO	Mounted	Not Mounted	Remark
Oscillating	**R17, R18**	**R19, R22**	—
Halted	R19, R22	R17, R18	Mount a crystal oscillator on X3 and the load capacitance as C14 or C15.

6.4 TSCAP Pin

Table 6-5 shows the option-link resistors for the TSCAP pin.

Table 6-5 Option-Link Resistors for the TSCAP Pin

Selection of the PC4/TSCAP Pin	Mounted	Not Mounted	Remark
PC4	**R20**	**R23**	—
TSCAP	R23	R20	Mount the load capacitance as C16.

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7. Handling Precautions

7.1 Adding Load

When load is added while power is being supplied via the USB, the maximum current is 300 mA during operation at 3.3 V.

When load is added while power is being supplied externally, the maximum current is 500 mA regardless of the operating voltage.

7.2 Remodeling the Board

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

7.3 Limitation on the Number of Connected Target Board for RX140 Modules

Connecting the same host PC to multiple Target Board for RX140 modules is not possible.

7.4 PG7/FINED Pin

For the RX140, PG7 is multiplexed with FINED (a FINE interface pin for the on-chip emulator). The emulator is connected to the PG7/FINED pin at the time of shipment of this product.

When the emulator is to be used for debugging, PG7 is not available as a port pin. To use the port function of PG7, place the emulator in the forced reset state by short-circuiting the header (J5) (refer to section 5.13, Emulator Reset Header). When another header (J1) is mounted and pin 1-2 is selected, the RX140 operates in single-chip mode and PG7 is assigned to an MCU header.

7.5 Power-Supply Circuits and Usage Conditions

Different power supplies can be selected by remodeling the board. Table 7-1 shows the relationship between power-supply circuits and usage conditions.

Table 7-1 Power-Supply Circuits and Usage Conditions

Power-Supply circuit	Usage Condition			
	Power supplied to the RX140	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	Not required
Power-supply selection header	VBUS (5 V) or 3.3 V	Possible	Possible	Required • J2: mounted; SS3: removed
External power-supply header	1.8 V to 5.5 V	Possible	Not possible (The emulator circuit is in the reset state.)	Required • SS3: removed • J3 and J5: mounted; J5: short-circuited

Notes: 1. Connecting this product to 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.

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8. Developing Code

8.1 Using the e² studio

Figure 8-1 shows the settings of the e² studio when creating a new project for the Target Board for RX140.

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

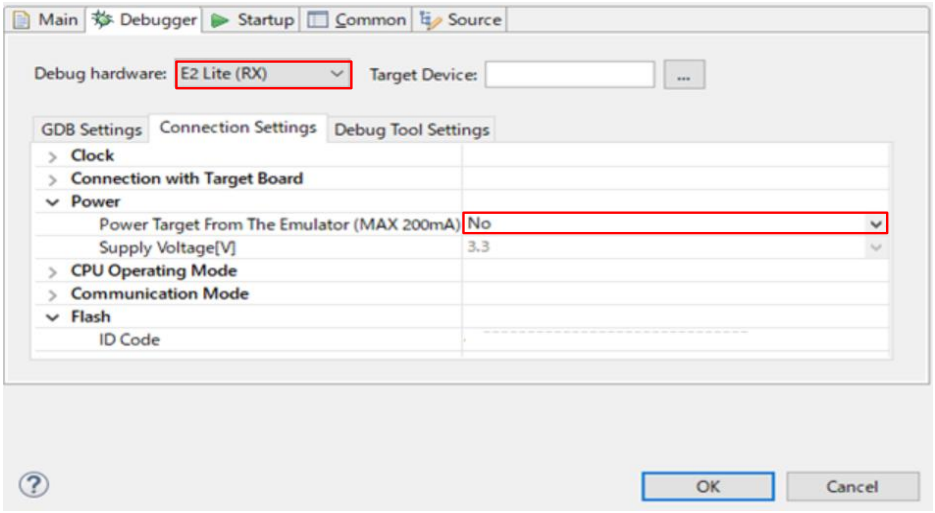


Figure 8-1 Settings of the e² studio

Note: Do not connect another Target Board for RX140 to your PC while this product is already connected.

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8.2 Using CS+

Figure 8-2 and Figure 8-3 show the settings of CS+ when creating a new project for the Target Board for RX140.

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

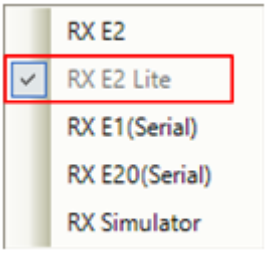


Figure 8-2 Panel for Selecting the Debug Tool

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

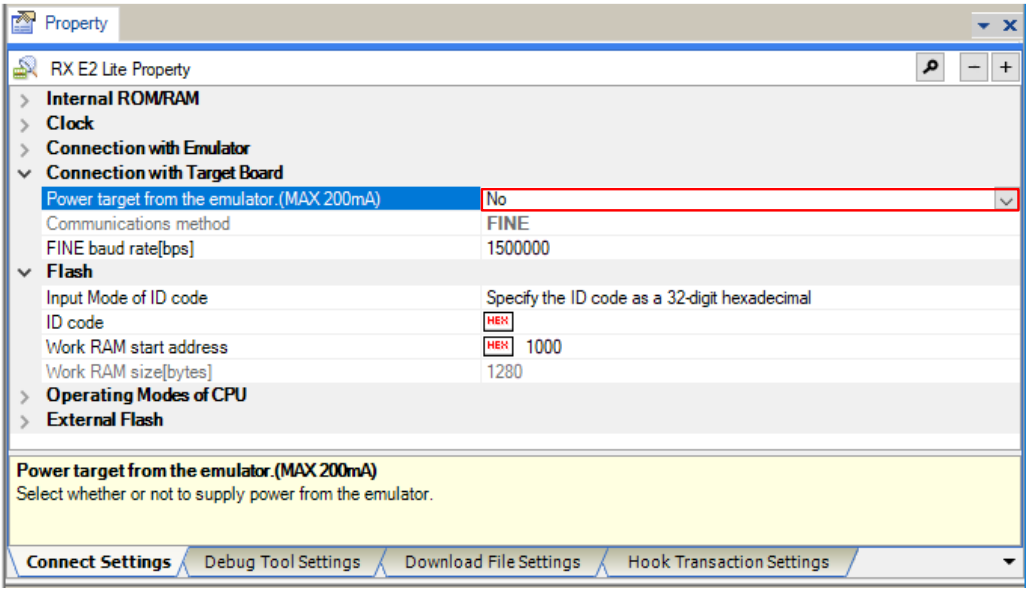


Figure 8-3 [Connect Settings] Tabbed Page of CS+

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9. Additional Information

Technical Support

For details on the RX140-group microcontrollers, refer to the RX140 Group User's Manual: Hardware.

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

The latest information is available from this Web page: https://www.renesas.com/rxtb.

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 Target Board for RX140 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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