

## RX231 Group

### Target Board for RX231 User's Manual

RENESAS 32-Bit MCU

RX Family / RX200 Series

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## Precautions

The following precautions should be observed when operating Target Board for RX231 product:

The Target Board for RX231 is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this product and any sensitive equipment. Its use outside the laboratory, classroom, and study area or in area not conform to the protection requirements of the Electromagnetic Compatibility Directive could lead to prosecution.

This product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If any harmful interference to radio or television reception occurs by turning the equipment off or on, you are encouraged 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
- Contact the dealer or an experienced radio/TV technician for help

NOTE: It is recommended that wherever possible shielded interface cables are used.

This product is potentially susceptible to certain EMC phenomena. It is recommended to take following measures in order to migrate them;

- Do not use mobile phones within 10m of the product when in use.
- Take ESD precautions when handling the equipment.

The Target Board for RX231 neither represents an ideal reference design for an end product nor fulfils the regulatory standards for an end product.

# How to Use This Manual

## 1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the Target Board hardware functionality, and electrical characteristics, and not intend to be a guide to embedded programming or hardware design.

Particular attention should be paid to the precautionary notes when using the manual. These notes are attached at the end of each section and in the Usage Notes section, not within the body of the text.

The revision history only shows the summary of revised or added parts, and does not include all revisions. Refer to the text in this manual for details.

The following documents apply to the RX231 Group. Make sure to use the latest versions for reference, available on the Renesas Electronics Web site.

| Document Type           | Description                                                               | Document Title                          | Document No. |
|-------------------------|---------------------------------------------------------------------------|-----------------------------------------|--------------|
| User's Manual           | Describes the technical details of the Target Board for RX231 hardware.   | Target Board for RX231 User's Manual    | R20UT4168EJ  |
| Schematics              | Describes circuit schematics of the Target Board for RX231 in full detail | Target Board for RX231 Schematics       | R20UT4165EJ  |
| BOM LIST                | Describes Bill of Materials of the Target Board for RX231                 | Target Board for RX231 BOM LIST         | R12TU0041EJ  |
| Application Note        | Sample code description.                                                  | Target Board for RX231 Application Note | R20AN0466EJ  |
| User's Manual: Hardware | Provides technical details of the RX231 microcontroller.                  | RX231 Group User's Manual: Hardware     | R01UH0496EJ  |

## 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™        | Digilent Pmod™ Compatible connector. Pmod™ is registered to <a href="#">Digilent Inc.</a><br>Digilent-Pmod Interface Specification |
| RAM          | Random Access Memory                                                                                                               |
| RFP          | Renesas Flash Programmer                                                                                                           |
| ROM          | Read Only Memory                                                                                                                   |
| SPI          | Serial Peripheral Interface                                                                                                        |
| USB          | Universal Serial Bus                                                                                                               |

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## 1. Overview

### 1.1 Contents

Thank you for purchasing the Renesas evaluation tool " Target Board for RX231". This product consists of the following item.

Target Board for RX231

### 1.2 Purpose

The Target Board for RX231 is an evaluation tool for Renesas microcontrollers. This manual describes the technical details of the Target Board for RX231 hardware.

### 1.3 Features

The Target Board for RX231 includes the following features:

- Renesas microcontroller programming
- User code debugging
- Switch, LED user circuit
- Sample application<sup>\*1</sup>
- Sample peripheral function initialization code<sup>\*1</sup>

<sup>\*1</sup>: Available for download on the Renesas website.

### 1.4 Preparation

Install the integrated development environment (IDE) and necessary other software from the following URL on the host PC (before you get started).

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

## 1.5 Board Specification Table

**Table 1-1** shows the Target Board for RX231 specifications.

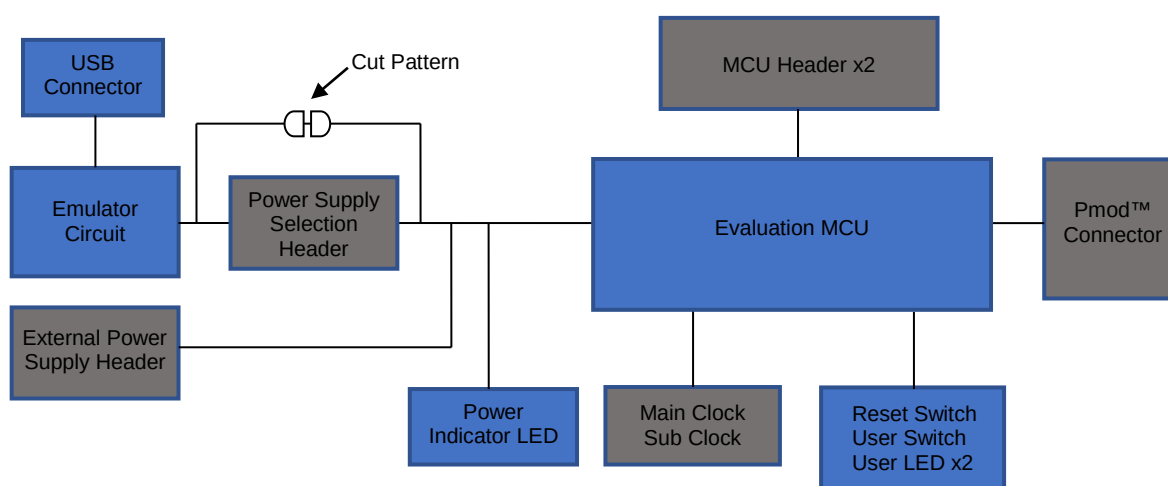
**Table 1-1: Board Specification Table**

| Item                                                 | Specification                                                           |
|------------------------------------------------------|-------------------------------------------------------------------------|
| Evaluation MCU                                       | Part No: R5F52318ADFP                                                   |
|                                                      | Package: 100-pin LFQFP                                                  |
|                                                      | On-chip memory: ROM 512KB+8KB, RAM 64KB                                 |
| Board Size                                           | Size: 53.34mm x 90.0mm                                                  |
|                                                      | Thickness: 0.8mm                                                        |
| Power Supply                                         | USB connector: 5V Input                                                 |
|                                                      | Power supply IC: 5V Input, 3.3V Input                                   |
|                                                      | For external power supply header <sup>*1</sup> : 3.3V Input, 2-pin, x 1 |
| Current Consumption                                  | Max. 200mA                                                              |
| Current Consumption Measurement Header <sup>*1</sup> | Header: 2-pin, x 1                                                      |
| Main Clock <sup>*1</sup>                             | Surface mount type: HC-49                                               |
|                                                      | Lead type: 2.54mm Pitch Through Hole x 3                                |
| Sub Clock <sup>*1</sup>                              | Lead type: Through Hole x 2 (KYUSHU DENTSU CO., LTD.: NC-26 Equivalent) |
| Push Switch                                          | Reset switch x 1                                                        |
|                                                      | User switch x 1                                                         |
| LED                                                  | Power indicator: green x 1                                              |
|                                                      | User: green x 2                                                         |
|                                                      | ACT LED: green x 1                                                      |
| USB Connector                                        | Connector: USB-mini B, 5-pin                                            |
| Pmod™ Connector <sup>*1</sup>                        | Connector: Angle type, 12-pin                                           |
| MCU Header <sup>*1</sup>                             | Header: 50-pin, x 2                                                     |
| Cut Pattern                                          | 8 places                                                                |
| Power Selection Header <sup>*1</sup>                 | Header: 3-pin, x 1                                                      |
| Emulator Reset Header <sup>*1</sup>                  | Header: 2-pin, x 1                                                      |

<sup>\*1</sup>: Parts are not mounted (DNF).

## 1.6 Block Diagram

**Figure 1-1** shows the block diagram of the Target Board for RX231.



\*Gray hatching parts is not mounted.

**Figure 1-1: Block Diagram**



## 2. Board Layout

Figure 2-1 shows the external appearance of the top side of Target Board for RX231.

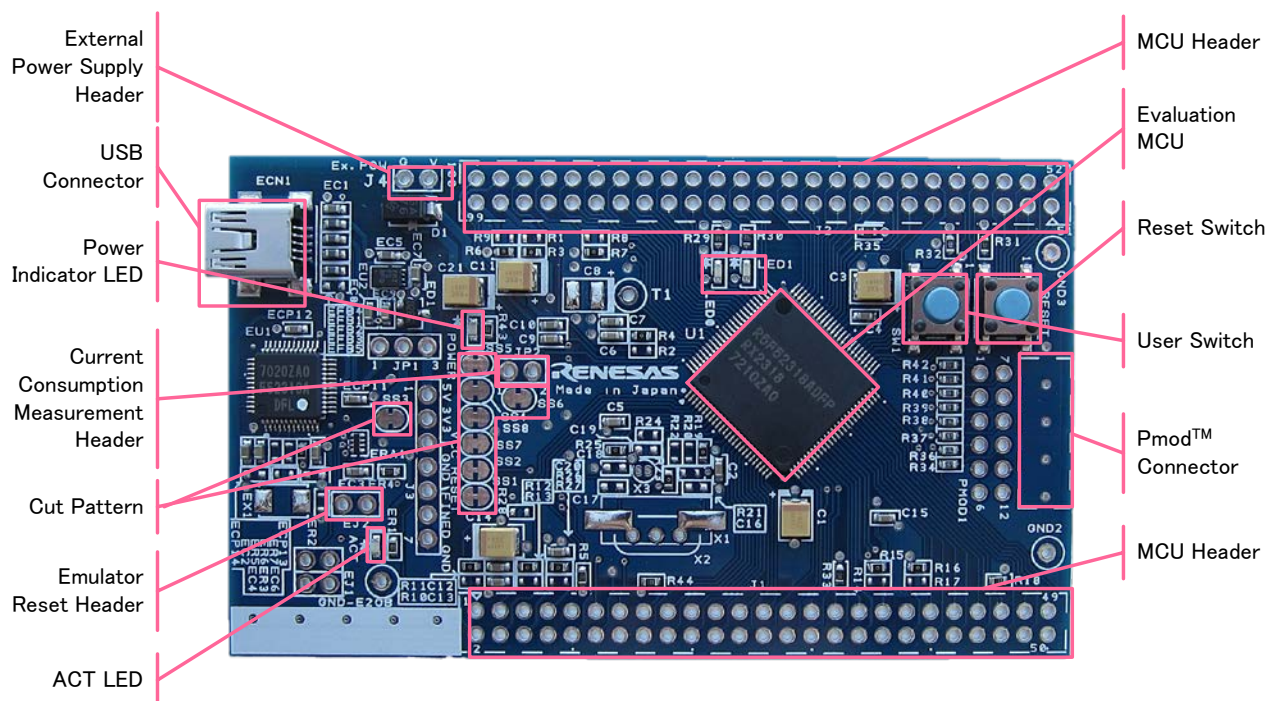


Figure 2-1: Board Layout (Top Side)

### 3. Parts Layout

Figure 3-1 shows the parts layout of Target Board for RX231.

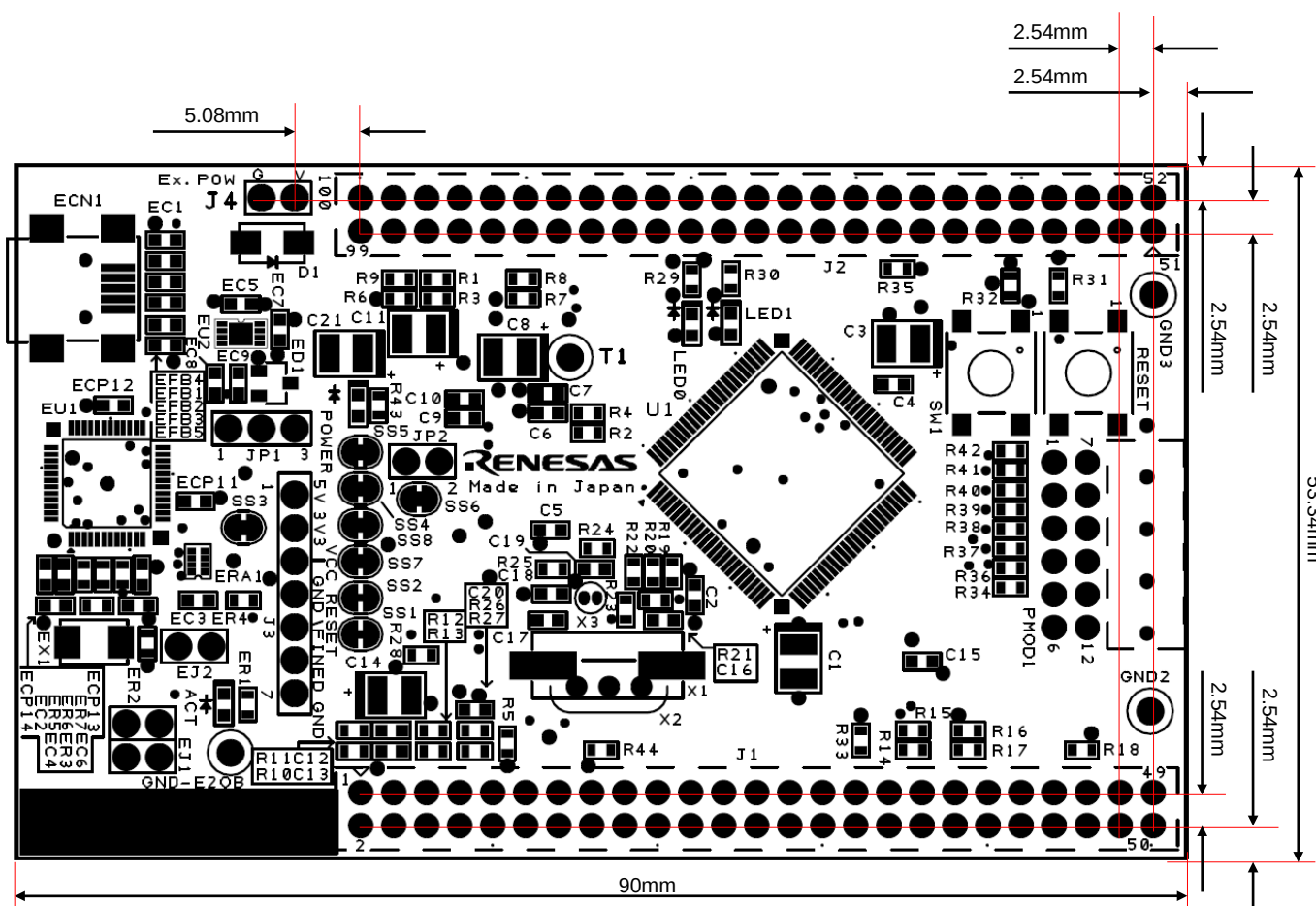
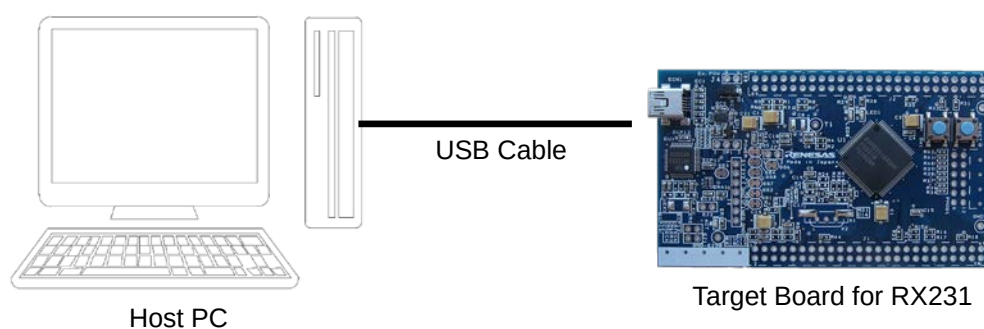


Figure 3-1: Parts Layout

## 4. Operating Environment

**Figure 4-1** shows the operating environment of the Target Board for RX231. Install the integrated development environment (IDE) from the following URL on the host PC. All the other required drivers are will be automatically installed with the IDE.

<https://www.renesas.com/rxtb>



**Figure 4-1: Operating Environment**

## 5. User Circuit

### 5.1 Evaluation MCU

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

Power supply: 3.3 V fixed (including analog power supply)

System clock: Operated with on-chip oscillator

Reset: Reset switch, IDE reset instruction

### 5.2 USB Connector

The connector shape is USB mini -B for Integrated Development Environment (IDE) and for Renesas Flash Programmer (RFP). Connect to the computer via the USB cable. If the power supply on the host side is ON, the Target Board for RX231 will be automatically power-supplied with the cable connection.

Note: USB cable is not included in the package.

### 5.3 ACT LED

The ACT LED displays the operation status of the emulator control software. The lighting conditions are shown below. The lighting color is green.

Light On: Indicates that the emulator is connected to the target.

Flickering: Indicates that the host machine (PC) has recognized the emulator.

Light Off: Indicates that the emulator cannot be used for some reason. (Including power off)

### 5.4 Power LED

The power LED lights on, when the board is power- supplied. The lighting color is green.

### 5.5 User LED

The user LED is an optional LED to be used if necessary the board is mounted with LED 0 and LED 1, connected to the following ports respectively. The lighting color is green.

LED0: 80pin, Port PD6

LED1: 79pin, Port PD7

## 5.6 Pmod™ Connector

The Pmod™ connector (PMOD1) has a through hole at a pitch of 2.54 mm and is connected to the evaluation MCU according to Pmod™ Interface Type 2 A. Note that the Pmod™ connector has the pin assignment different from other headers. **Figure 5-1** shows the pin assignment of the Pmod™ connector and **Table 5-1** shows the signal assign of the Pmod™ connector. The channel for RSP is assigned to 0, and the channel for interrupts is assigned to IRQ5 respectively. (Connector parts are not mounted)

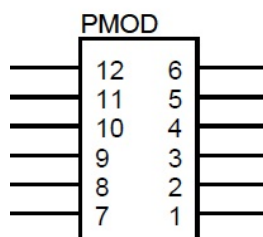


Figure 5-1: Pmod™ Connector Pin Assignment (Top View)

Table 5-1: Pmod™ Connector Signal Assignment

| Pmod™ Connector |                  |                |     |     |                  |                |     |
|-----------------|------------------|----------------|-----|-----|------------------|----------------|-----|
| Pin             | Circuit Net Name | Evaluation MCU |     | Pin | Circuit Net Name | Evaluation MCU |     |
|                 |                  | Port           | Pin |     |                  | Port           | Pin |
| 1               | PMOD1-CS         | PA4            | 66  | 7   | PMOD1-IRQ        | P15            | 31  |
| 2               | PMOD1-MOSI       | PA6            | 64  | 8   | PMOD1-RST        | P17            | 29  |
| 3               | PMOD1-MISO       | PA7            | 63  | 9   | PMOD1-IO0        | PC3            | 49  |
| 4               | PMOD1-SCK        | PA5            | 65  | 10  | PMOD1-IO1        | PC2            | 50  |
| 5               | GROUND           | -              | -   | 11  | GROUND           | -              | -   |
| 6               | TARGET_VCC       | -              | -   | 12  | TARGET_VCC       | -              | -   |

## 5.7 External Power Supply Header

When operating the evaluation MCU at an arbitrary voltage, or requiring current more than the USB current capacity, use the external power supply header (J4) for power supply. The available voltage depends on the evaluation MCU. When using this header, cut SS1, SS2, SS4, SS5, SS7, SS8 and the bottom side cut pattern and separate the emulator and the target electrically. **Figure 5-2** and **Figure 5-4** show the position of the cut pattern, **Figure 5-3** shows the position of the external power supply header. (header parts are not mounted)

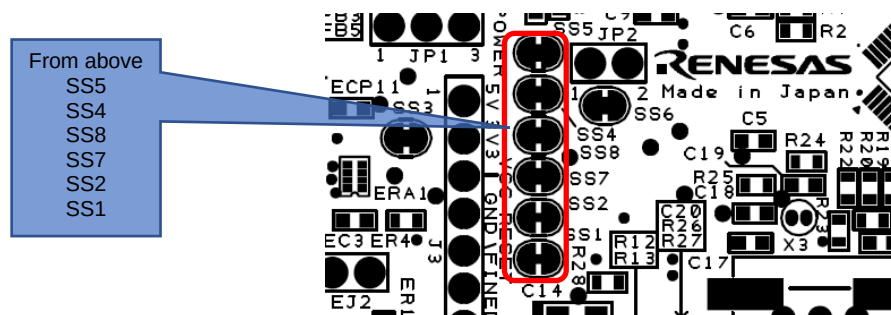


Figure 5-2: Position of Pattern SS1, SS2, SS4, SS5, SS7, SS8

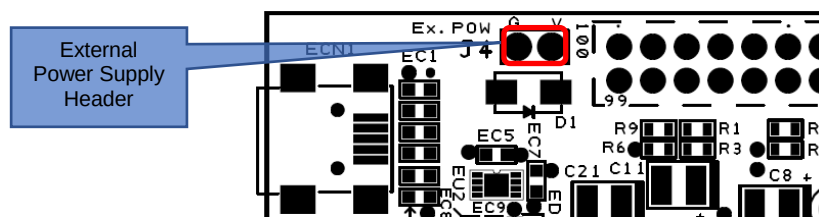


Figure 5-3: Position of External Power Supply

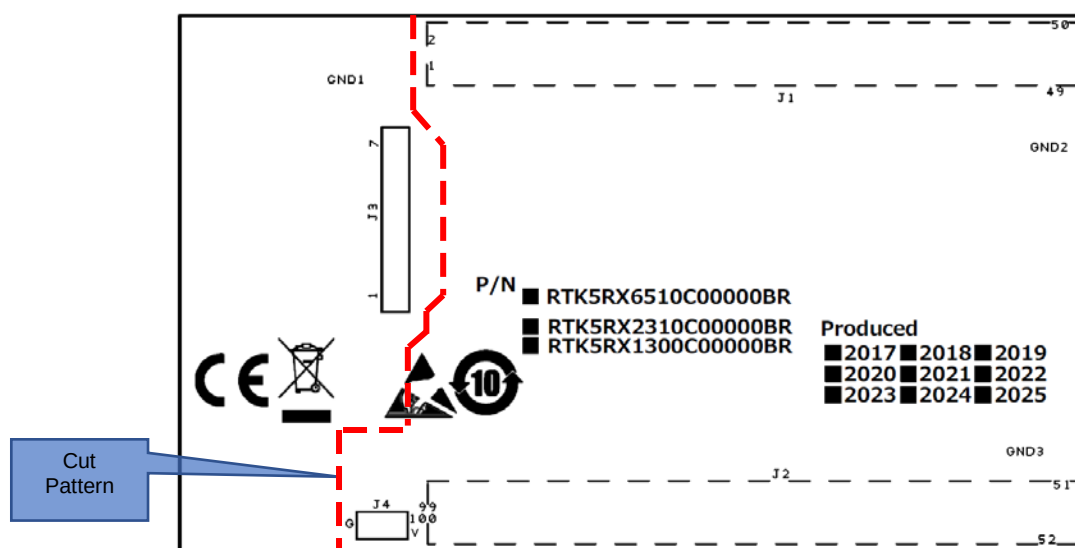


Figure 5-4: Position of Bottom Side Cut Pattern.

### 5.8 Current Consumption Measurement Header

The current consumption measurement header (JP2) is used for measuring current consumption of the evaluation MCU. The current consumption can be measured by connecting an ammeter to the evaluation MCU. Note that the cut pattern (SS6) should be cut when using this header. **Figure 5-5** shows the position of the header and cut pattern. (header parts are not mounted)

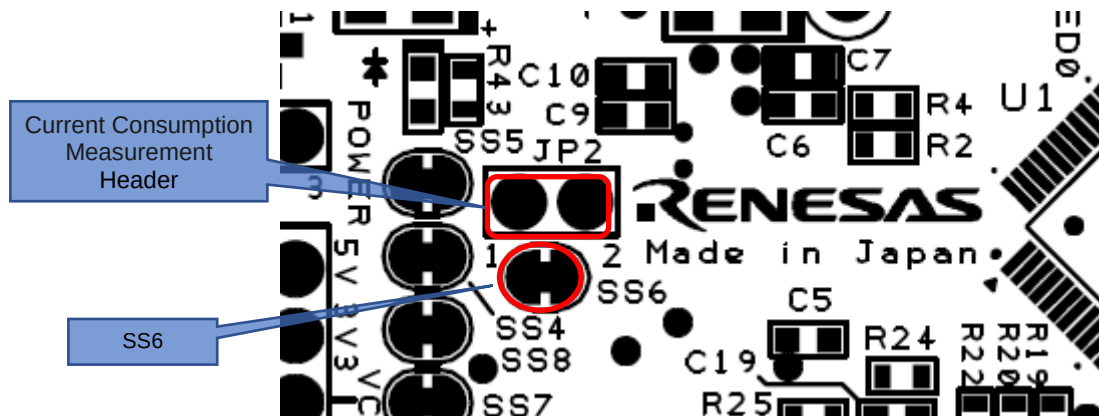


Figure 5-5: Position of Current Consumption Measurement Header and SS6 Cut Pattern

### 5.9 MCU Header

The MCU header is installed with two 50-pin headers (J1, J2). The headers are allocated with interval of 2.54 mm pitch. The evaluation MCU and the header are connected according to each pin number as 1pin to 1pin, and 2pin to 2pin in order until 100pin. (except 5, 8, 9 pins) (header parts are not mounted)

### 5.10 RESET Switch

Press the RESET switch to turn on the hard reset for the evaluation MCU.

### 5.11 User Switch

The user switch (SW 1) is an optional switch to be used if necessary. It is connected to 59pin and PB 1 port of the evaluation MCU. The interrupt is assigned to IRQ 4.

### 5.12 Cut Pattern

All cut patterns are set to the connected state at the time of factory shipment. Cut or repair soldering if necessary. **Figure 5-6** show the example of the cut patterns

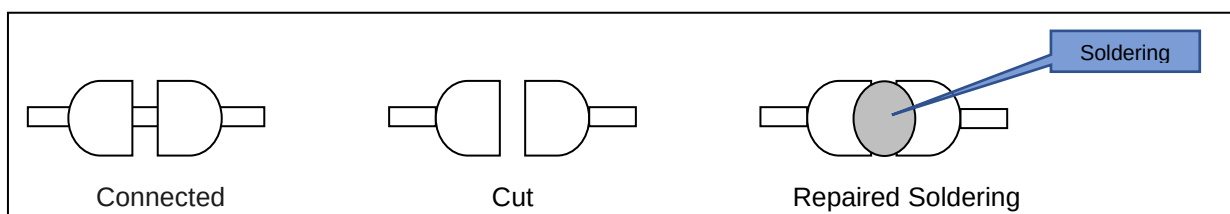


Figure 5-6: Cut Pattern Treatment Example

When repairing the cut pattern on the bottom side, repair soldering for SS7 and SS8 shown in **Figure 5-2**.

### 5.13 Emulator Reset Header

The emulator enters the forced reset state by short-circuiting the emulator reset header (EJ2). The evaluation MCU can be operated independently without controlling the IDE. **Figure 5-7** shows the emulator reset header position. (header parts are not mounted)

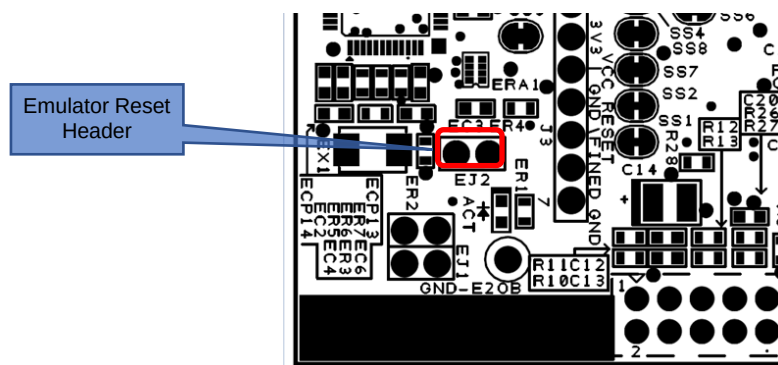


Figure 5-7: Position of Emulator Reset Header

### 5.14 Power Supply Selection Header

The operating voltage of the evaluation MCU can be changed. (5 V or 3.3 V) However, when using this header (JP 1), please remove the cut-pattern (SS3). **Figure 5-8** shows the header status of 5 V output, and **Figure 5-9** shows the header status of 3.3 V output. The location of the SS3 cut pattern is shown in **Figure 5-8**. (Header parts are not mounted)

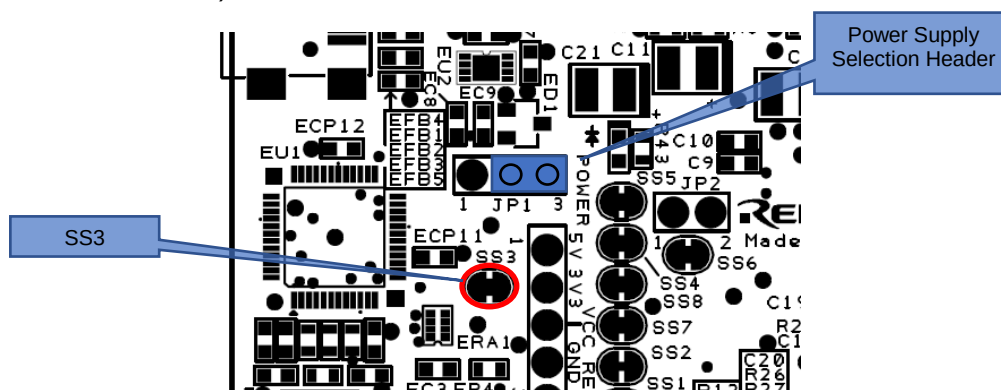


Figure 5-8: Header setting of 5V output, SS3 cut pattern position

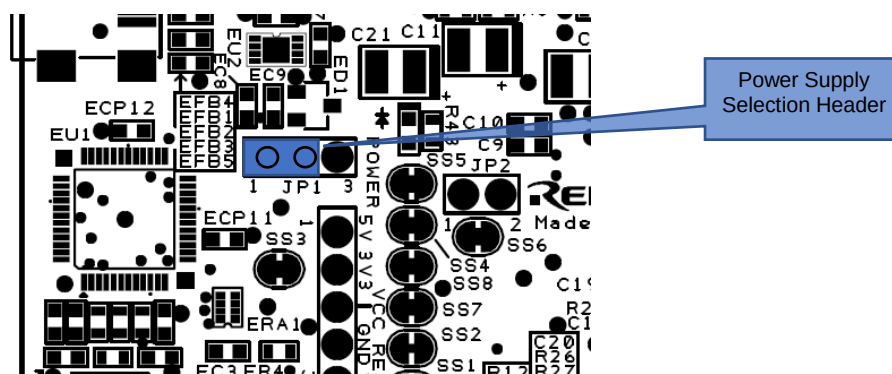


Figure 5-9: Header setting of 3.3V output



## 6. Configuration

### 6.1 Modifying the Target Board for RX231

This section describes how to change the Target Board for RX231 setting by using option link resistance.

An option link resistor is a 0Ω surface mount resistor, which is used to short or isolate a part of circuits. See the 6.2 below for the list of option links by function. Fit or remove the option link resistor to switch functions by referring to the list. **Bold fonts in blue** indicates the default configuration at the shipment. For the position of option links, see the chapter 3 “Part Layout”.

When removing soldered components, do not press a soldering iron on the Target Board for RX231 for more than 5 seconds to avoid any damage around the target area.

### 6.2 Analog Power Supply

The option links for analogue power supply are shown in **Table 6-1**, **Table 6-2**, and **Table 6-3**.

**Table 6-1: 12bit A/D, 12bit D/A Analog Power Supply Option Link**

| 12bit A/D, 12bit D/A Analog power supply source | Fit           | DNF           | Remarks |
|-------------------------------------------------|---------------|---------------|---------|
| <b>3.3V on the board</b>                        | <b>R3, R6</b> | <b>R1, R9</b> | -       |
| MCU Header                                      | R1, R9        | R3, R6        | -       |

**Table 6-2: 12bit A/D Reference Voltage Option Link**

| 12bit A/D Reference voltage supply source | Fit           | DNF           | Remarks                                          |
|-------------------------------------------|---------------|---------------|--------------------------------------------------|
| <b>3.3V on the board</b>                  | <b>R4, R7</b> | <b>R2, R8</b> | -                                                |
| MCU Header                                | R2, R8        | R4, R7        | The bypass capacitors of C6, C7, C8 are invalid. |

**Table 6-3: 12bit D/A Reference Voltage Option Link**

| 12bit D/A Reference power supply source | Fit             | DNF             | Remarks                                             |
|-----------------------------------------|-----------------|-----------------|-----------------------------------------------------|
| <b>3.3V on the board</b>                | <b>R11, R12</b> | <b>R10, R13</b> | -                                                   |
| MCU Header                              | R10, R13        | R11, R12        | The bypass capacitors of C12, C13, C14 are invalid. |

### 6.3 On-chip Oscillator

The option links for on-chip oscillator operation are shown in **Table 6-4**, **Table 6-5**.

**Table 6-4: HOCO Option Link**

| HOCO setting       | Fit             | DNF             | Remarks                                                                 |
|--------------------|-----------------|-----------------|-------------------------------------------------------------------------|
| <b>Oscillation</b> | <b>R19, R23</b> | <b>R20, R22</b> | -                                                                       |
| Stop               | R20, R22        | R19, R23        | Mount a crystal resonator on X1 or X2 and load capacitance on C16, C17. |

**Table 6-5: LOCO Option Link**

| LOCO setting       | Fit        | DNF | Remarks                                                           |
|--------------------|------------|-----|-------------------------------------------------------------------|
| <b>Oscillation</b> | <b>R25</b> | -   | -                                                                 |
| Stop               | -          | R25 | Mount a crystal resonator on X3 and load capacitance on C18, C19. |

## 7. Handling Precautions

### 7.1 Board Thickness

Please be extra careful when handling the Target Board for RX231 as the board is thin (0.8 mm).

### 7.2 Additional Load

When adding loads by USB power supply, the maximum operational current is 300 mA at 3.3 V, current is 100 mA at 5 V operation.

When adding loads by external power supply, the maximum operational current is 500 mA under any operating voltage.

### 7.3 Substrate Remodelling

Any modification of the board (including changing the cut pattern) shall be conducted on a user's own responsibility.

### 7.4 Target Board connection limit

It is not possible to connect to multiple Target Boards from the same host PC.

## 8. Code Development

Figure 8-1 shows the setting of e2 studio when creating a new project for the Target Board for RX231.

Debug hardware: Select [E2 Lite (RX)].

Power supply from the emulator: Select [No].

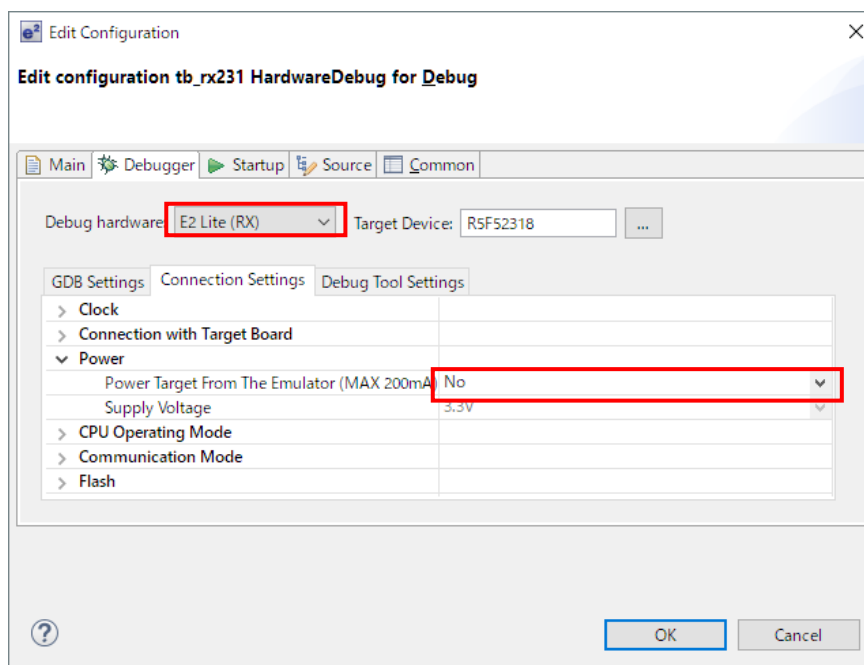


Figure 8-1: e2 studio settings

(Note) Do not connect another Target Board to your PC while connecting the Target Board for RX231.

## 9. Additional Information

### Technical Support

For details on the RX231 Group microcontrollers, refer to the RX231 Group Hardware Manual.

For details on the RX assembly language, refer to the RX Family Software Manual.

The latest information is available from the WEB site <https://www.renesas.com/rxtb>.

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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/>

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| REVISION HISTORY | Target Board for RX231 User's Manual |
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| Rev. | Date         | Description |                                                               |
|------|--------------|-------------|---------------------------------------------------------------|
|      |              | Page        | Summary                                                       |
| 1.00 | Oct 13, 2017 | -           | First Edition issued                                          |
| 1.01 | Jul 20, 2018 | 7           | Section 1.4 Changes URL.<br>Changes the wording.              |
|      |              | 8           | Section 1.6 Adds Block Diagram.                               |
|      |              | 12          | Section 5.2 Clarified the application.                        |
|      |              | 16          | Section 5.14 Partly changed wording, added factory condition. |
|      |              | 18          | Section 7.4 Removes Communication with RFP.                   |
|      |              | 18          | Section 7.4 Adds Target Board connection limit.               |
|      |              | 19          | Section 8 Words of note unified in Target Board.              |

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Target Board for RX231 User's Manual

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