User's Manual

16

# RL78/I1C (512 KB) Fast Prototyping Board

User's Manual

16-Bit Single-Chip Microcontrollers

RL78 Family

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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 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 RL78/I1C (512 KB) 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/I1C (512 KB) Fast Prototyping Board User's Manual | R20UT4947EJ (this manual) |
| Circuit schematics | Circuit schematics | RL78/I1C (512 KB) Fast Prototyping Board Circuit Schematics | R20UT4948EJ |
| Parts list | Parts list | RL78/I1C (512 KB) Fast Prototyping Board BOM LIST | R12TU0136EJ |
| User's manual for the hardware* | Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation | RL78/I1C (512 KB) User's Manual: Hardware | R01UH0889EJ |

* Download the documents for the RL78/I1C (512 KB) from the product page for the RL78/I1C.

## 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 |
| USB | Universal Serial Bus |
| TPU | Timer Pulse Unit |
| UART | Universal Asynchronous Receiver/Transmitter |
| WDT | Watchdog timer |

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# Table of Contents

# 1. Overview

## 1.1 Package Components

Thank you for purchasing the RL78/I1C (512 KB) Fast Prototyping Board evaluation tool from Renesas (hereinafter referred to as “this product”). This product consists of the following items.

- RL78/I1C (512 KB) Fast Prototyping Board (RTK5RL10N0CPL000BJ)
- Quick Start Guide

## 1.2 Purpose

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

*1. Sample programs are available for downloading from the Renesas Web site.

https://www.renesas.com/rl78i1c-512kb_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 Board Specification Table

Table 1-1 shows the board specifications.

**Table 1-1 Board Specification Table**

| Item | Specification |
|---|---|
| MCU (RL78/I1C (512 KB)) | Part No.: R5F10NPLDFB |
| | Package: 100-pin LFQFP |
| | On-chip memory: 512-KB ROM, 32-KB RAM, 2-KB data flash memory |
| Board size | 53.34 mm x 111.76 mm |
| Power-supply voltage | VDD: 1.6 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 (setting as shipped) |
| | External power-supply header*1: 1.6 V to 5.5 V |
| Current drawn | Max. 200 mA |
| Main clock*1 | OSC1: Crystal oscillator (surface-mount technology (SMT)) for the high-speed system clock |
| Sub clock | OSC2: Crystal oscillator (SMT) for the sub clock |
| Push switches | Reset switch x 1 |
| | User switch x 1 |
| Debug/serial select switch | Selects debug mode (setting as shipped) or serial mode. |
| 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<br>The interfaces are compatible with the Arduino™ UNO R3 board. |
| MCU headers*1 | Headers: 50 pins x 2 |
| Emulator reset header*1 | Header: 2 pins x 1 |
| Coin-cell battery circuit | Holder for a CR2032 coin-cell battery |
| LCD drive voltage generator | Capacitor split method or external resistance division method*1 |
| Analog circuits | DSAD (anti-aliasing filter circuit) |
| | AVRT (0.8 V reference voltage for the 24-bit ΔΣ-type A/D converter) |
| MCU current measurement header*1 | Header: 2 pins x 1 |

*1. This part is not mounted.

*2. The RL78/I1C 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.

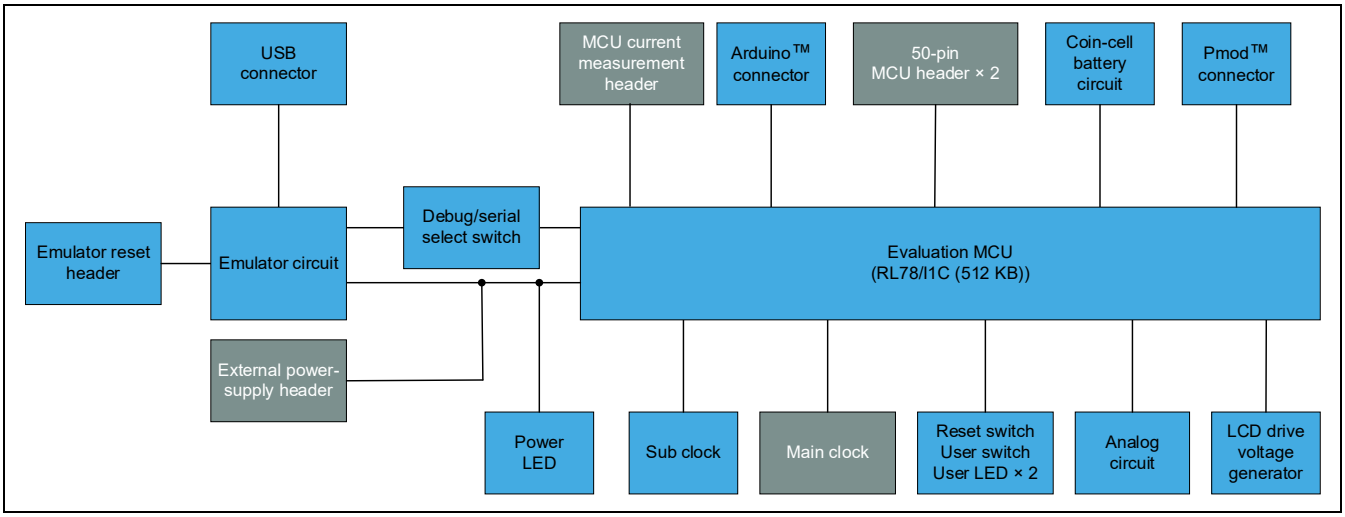


**Figure 1-1 Block Diagram**

# 2. Board Layout

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

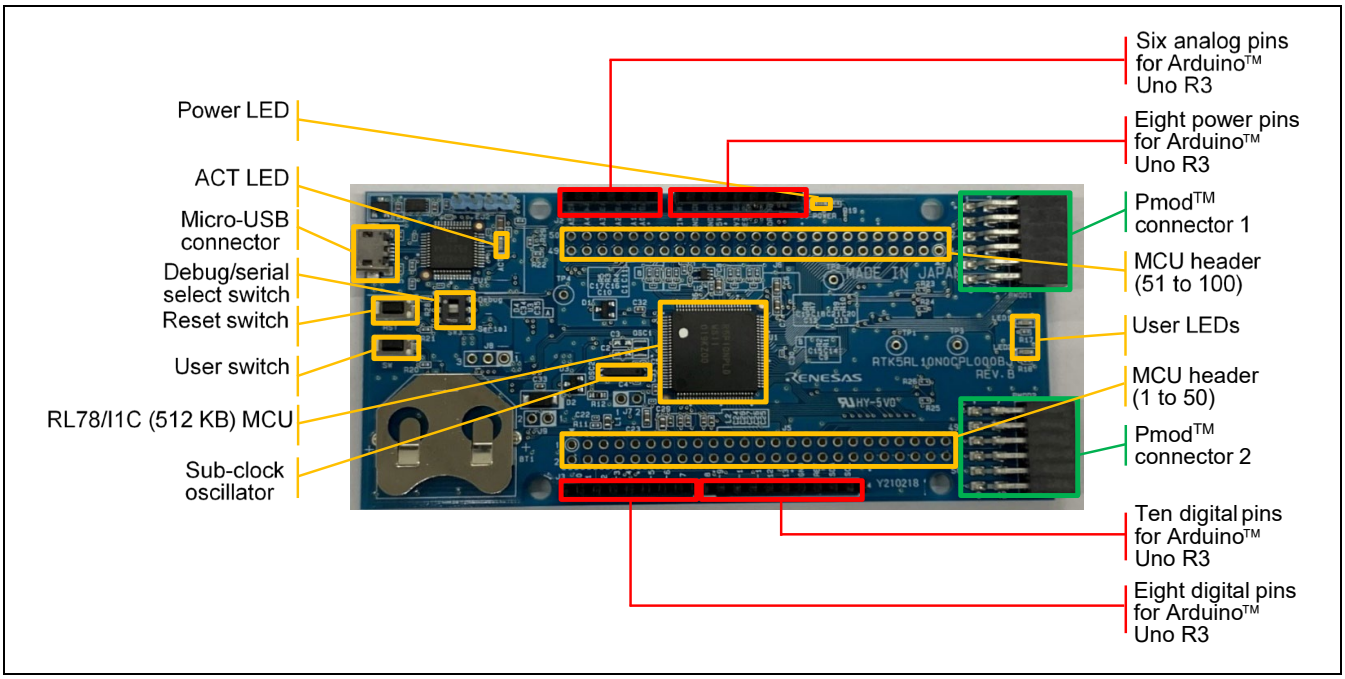


**Figure 2-1 Board Layout (Top Side)**

# 3. Parts Layout

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

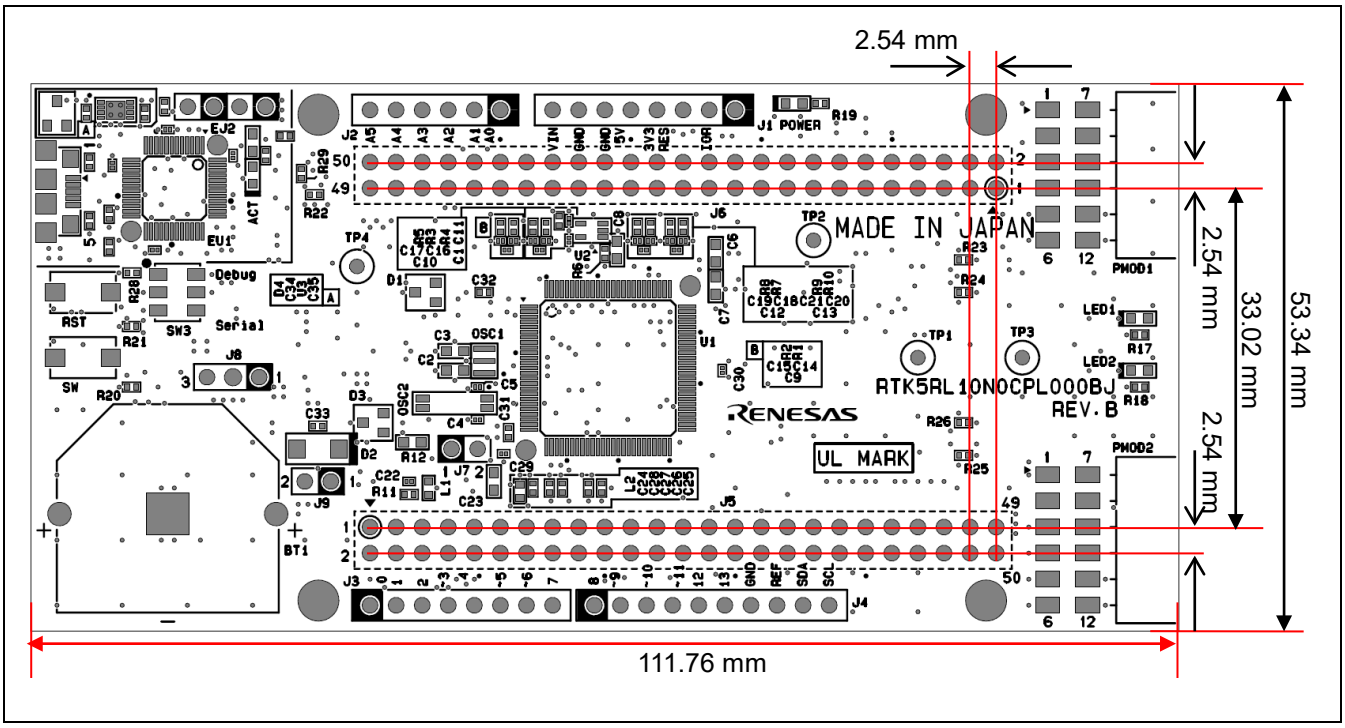


**Figure 3-1 Parts Layout**

# 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

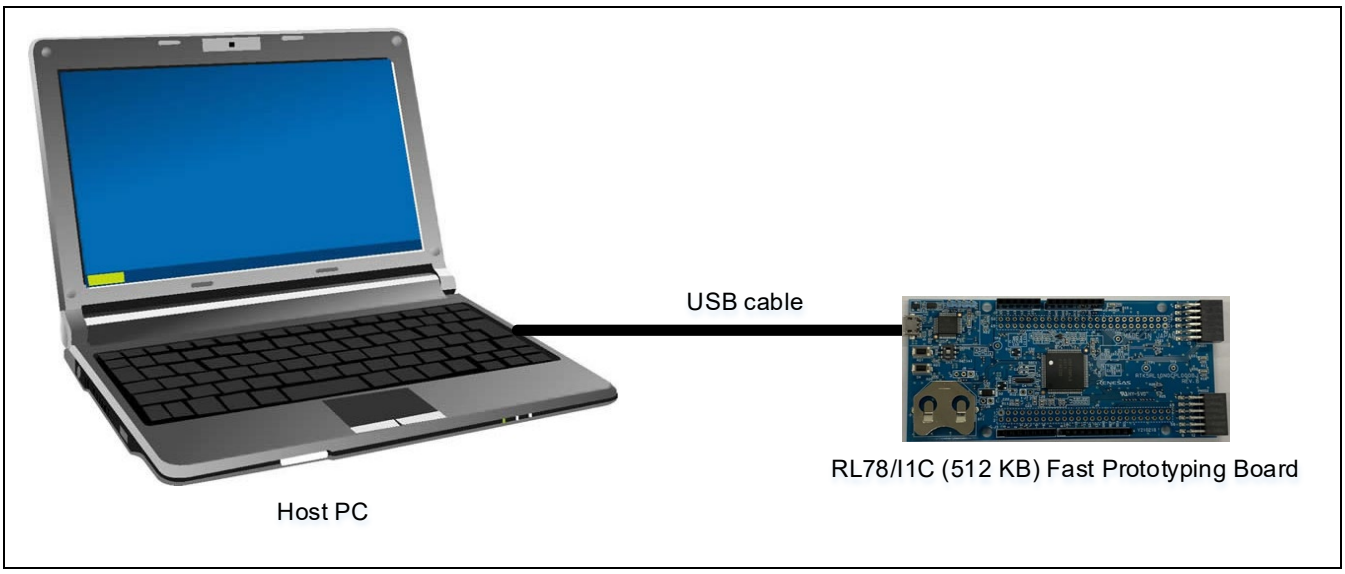


**Figure 4-1 Operating Environment**

# 5. User Circuits

## 5.1 RL78/I1C

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

- 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.

Note: The LED may not be illuminated when VDD is 2.2 V or lower.

- 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.

Note: The LED may not be illuminated when VDD is 2.2 V or lower.

## 5.5 User LEDs

The optional user LEDs can be used for any purpose. LED1 and LED2 are mounted on the board and are respectively connected to the following ports. The LEDs are green.

Note: The LEDs may not be illuminated when VDD is 2.2 V or lower.

- LED1: Pin 62, connected to port P10
- LED2: Pin 61, connected to port P11

## 5.6 Pmod™ Connectors

A Pmod™ connector can be connected to the RL78/I1C by a type 2A Pmod™ interface. Figure 5-1, Table 5-1, and Table 5-2 show the pin assignments of the Pmod™ connectors.

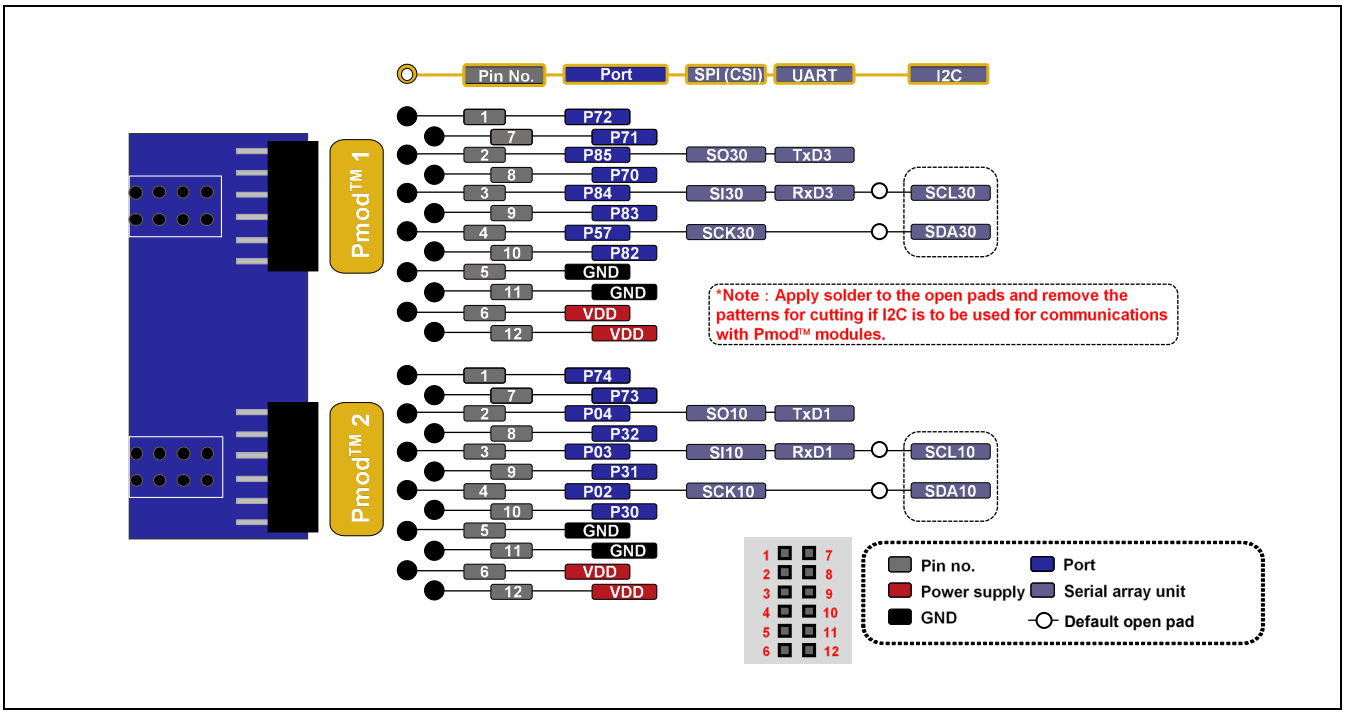


**Figure 5-1 Pin Assignments of the Pmod™ Connectors**

**Table 5-1 Pin Assignments of Pmod™ 1**

| Pin No. of Pmod™ 1 | Name of Pmod™ Signal | RL78/I1C | | | | | |
|---|---|---|---|---|---|---|---|
| | | Pin | Power Supply | Port | SPI (CSI) | UART | I2C* |
| 1 | SS1 | 47 | — | P72 | — | — | — |
| 2 | MOSI | 72 | — | P85 | SO30 | TxD3 | — |
| 3 | MISO | 73 | — | P84 | SI30 | RxD3 | — |
| | (SCL) | (74) | | (P57) | — | — | (SCL30) |
| 4 | SCK | 74 | — | P57 | SCK30 | — | — |
| | (SDA) | (73) | | (P84) | — | — | (SDA30) |
| 5 | GND | — | GND | — | — | — | — |
| 6 | VCC | — | VDD | — | — | — | — |
| 7 | INT | 48 | — | P71 | — | — | — |
| 8 | RESET | 49 | — | P70 | — | — | — |
| 9 | IO2 | 50 | — | P83 | — | — | — |
| 10 | IO3 | 51 | — | P82 | — | — | — |
| 11 | GND | — | GND | — | — | — | — |
| 12 | VCC | — | VDD | — | — | — | — |

* The Pmod™ connector on the board as shipped is set up for use with SPI (CSI)/UART. If I2C is to be used, remove two short pads (SI30 and SCK30) and short-circuit two open pads (SCL30 and SDA30) on the soldered side as shown below.

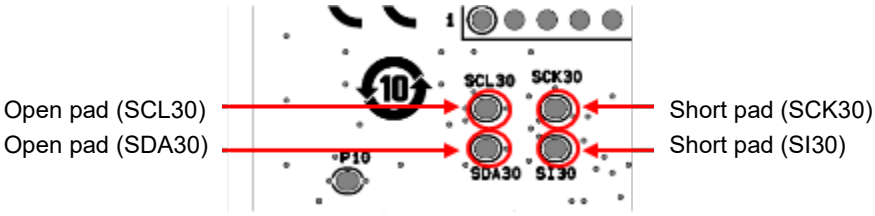


**Figure 5-2 Positions of Open and Short Pads (Pmod™ 1) (Soldered Side)**

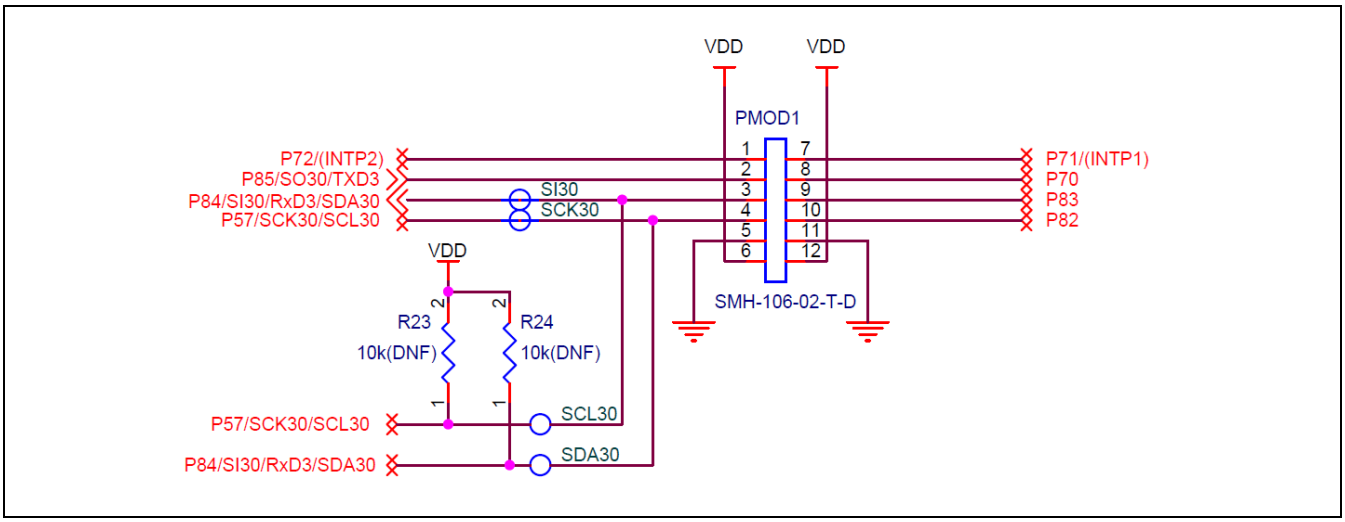


**Figure 5-3 Circuit Schematic of Pmod™ 1**

**Table 5-2 Pin Assignments of Pmod™ 2**

| Pin No. of Pmod™ 2 | Name of Pmod™ Signal | RL78/I1C | | | | | |
|---|---|---|---|---|---|---|---|
| | | Pin | Power Supply | Port | SPI (CSI) | UART | I2C* |
| 1 | SS1 | 45 | — | P74 | — | — | — |
| 2 | MOSI | 3 | — | P04 | SO10 | TxD1 | — |
| 3 | MISO | 4 | — | P03 | SI10 | RxD1 | — |
| | (SCL) | (5) | | (P02) | — | — | (SCL10) |
| 4 | SCK | 5 | — | P02 | SCK10 | — | — |
| | SDA | (4) | | (P03) | — | — | (SDA10) |
| 5 | GND | — | VSS | — | — | — | — |
| 6 | VCC | — | VDD | — | — | — | — |
| 7 | INT | 46 | — | P73 | — | — | — |
| 8 | RESET | 39 | — | P32 | — | — | — |
| 9 | IO2 | 40 | — | P31 | — | — | — |
| 10 | IO3 | 41 | — | P30 | — | — | — |
| 11 | GND | — | VSS | — | — | — | — |
| 12 | VCC | — | VDD | — | — | — | — |

* The Pmod™ connector on the board as shipped is set up for use with SPI (CSI)/UART. If I2C is to be used, remove two short pads (SI10 and SCK10) and short-circuit two open pads (SCL10 and SDA10) on the back of the board as shown below.

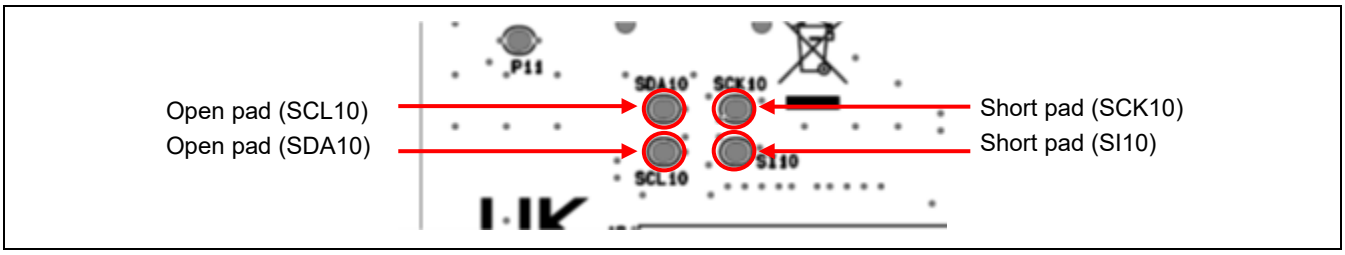


**Figure 5-4 Positions of Open and Short Pads (Pmod™ 2) (Soldered Side)**

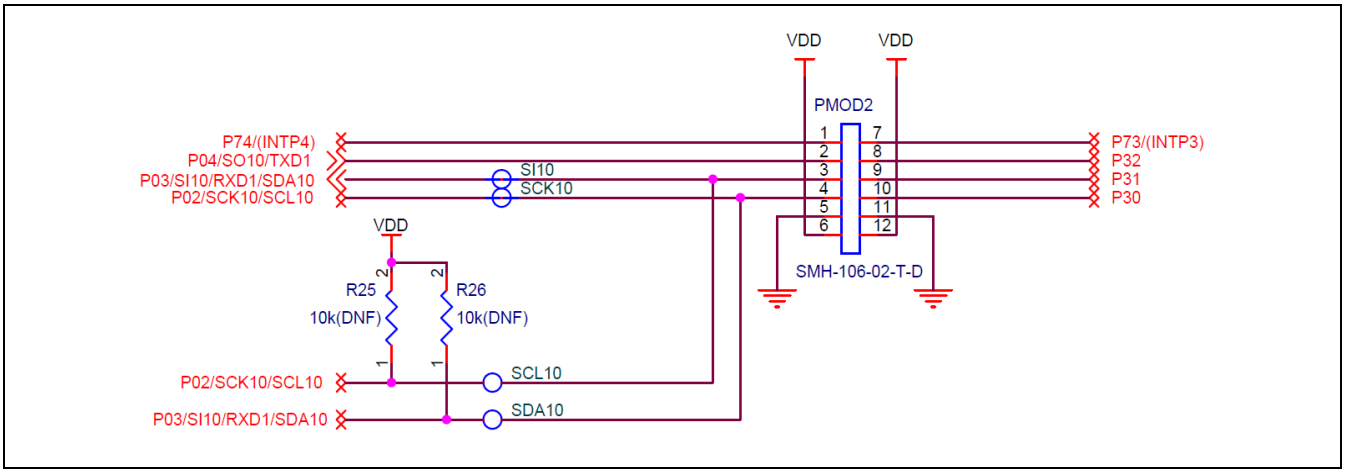


**Figure 5-5 Circuit Schematic of Pmod™ 2**

## 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 5-6 and Table 5-3 show the pin assignments of the Arduino™ connectors.

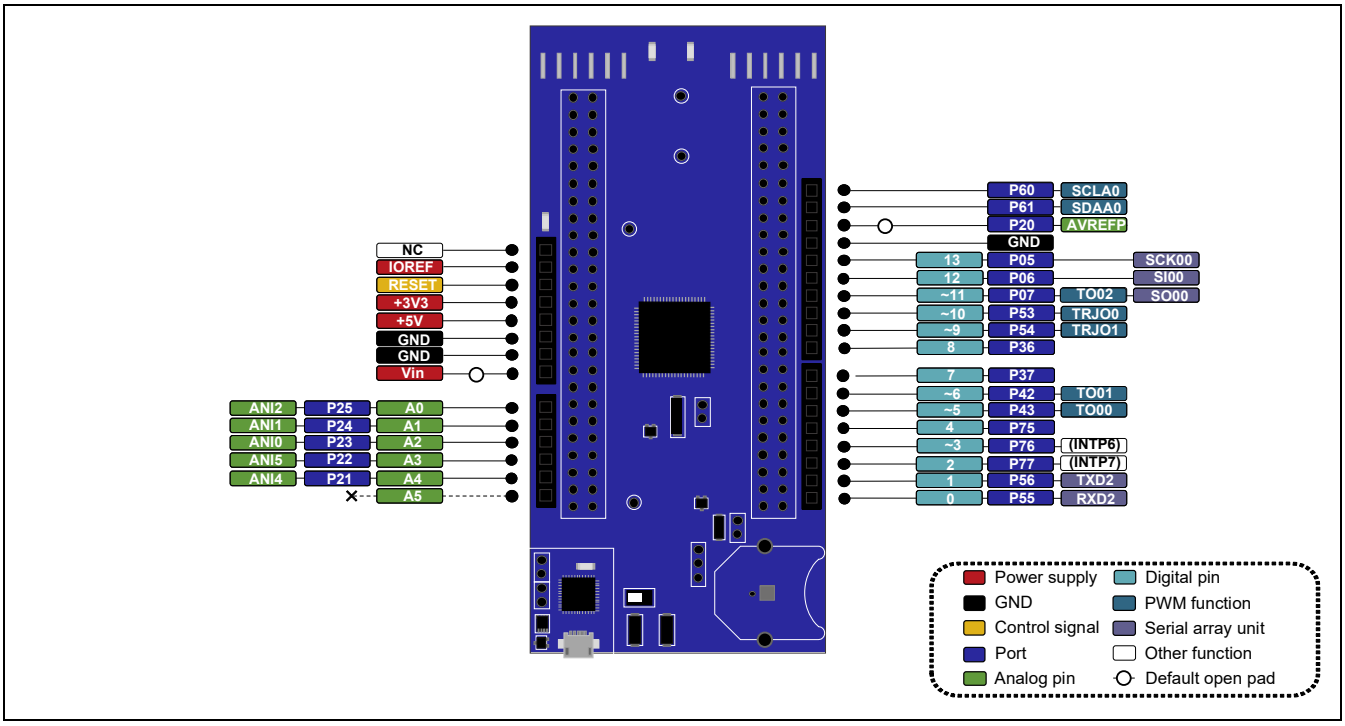


**Figure 5-6 Pin Assignments of the Arduino™ Connectors**

**Table 5-3 Pin Assignments of the Arduino™ Connectors**

| Part No. in the Circuit Schematics | Name of Arduino™ Signal | RL78/I1C | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Pin | Power Supply | Port | Analog | PWM | Serial | Others |
| J1-1 | N.C. | — | — | — | — | — | — | — |
| J1-2 | IOREF | — | VDD | — | — | — | — | — |
| J1-3 | RESET | — | — | — | — | — | — | RESET |
| J1-4 | 3V3 | — | 3V3 | — | — | — | — | — |
| J1-5 | 5V | — | +5V | — | — | — | — | — |
| J1-6 | GND | — | GND | — | — | — | — | — |
| J1-7 | GND | — | GND | — | — | — | — | — |
| J1-8 | (VIN)*1 | — | VDD | — | — | — | — | — |
| J2-1 | A0 | 94 | — | P25 | ANI2 | — | — | — |
| J2-2 | A1 | 95 | — | P24 | ANI1 | — | — | — |
| J2-3 | A2 | 96 | — | P23 | ANI0 | — | — | — |
| J2-4 | A3 | 97 | — | P22 | ANI5 | — | — | — |
| J2-5 | A4 | 98 | — | P21 | ANI4 | — | — | — |
| J2-6 | A5 | — | — | — | — | — | — | — |
| J3-1 | 0 | 76 | — | P55 | — | — | RxD2 | — |
| J3-2 | 1 | 75 | — | P56 | — | — | TxD2 | — |
| J3-3 | 2 | 42 | — | P77 | — | — | — | (INTP7) |
| J3-4 | ~3 | 43 | — | P76 | — | — | — | (INTP6) |
| J3-5 | 4 | 44 | — | P75 | — | — | — | — |
| J3-6 | ~5 | 6 | — | P43 | — | TO00 | — | — |
| J3-7 | ~6 | 8 | — | P42 | — | TO01 | — | — |
| J3-8 | 7 | 34 | — | P37 | — | — | — | — |
| J4-1 | 8 | 35 | — | P36 | — | - | - | — |
| J4-2 | ~9 | 77 | — | P54 | — | TRJO1 | - | — |
| J4-3 | ~10 | 78 | — | P53 | — | TRJO0 | - | — |
| J4-4 | ~11 | 100 | — | P07 | — | TO02 | SO00 | — |
| J4-5 | 12 | 1 | — | P06 | — | — | SI00 | — |
| J4-6 | 13 | 2 | — | P05 | — | — | SCK00 | — |
| J4-7 | GND | — | GND | — | — | — | — | — |
| J4-8 | (AREF)*2 | 99 | — | P20 | AVREFP | — | — | — |
| J4-9 | SDA | 26 | — | P61 | — | — | SDAA0 | — |
| J4-10 | SCL | 25 | — | P60 | — | — | SCLA0 | — |

*1. Not connected at the time of shipment.

*2. AREF of Arduino™ is not connected as shipped. When AREF is to be used, short-circuit the open pad (REF) on the back of the board as shown below.

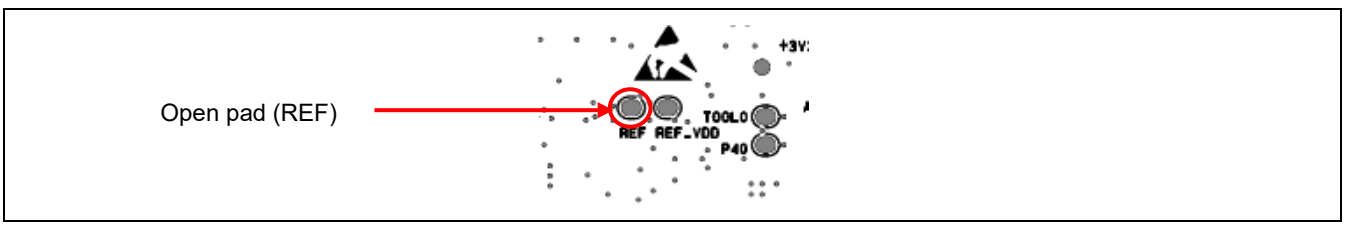


**Figure 5-7 Position of the Open Pad (REF) (Soldered Side)**

## 5.8 MCU Headers

The MCU headers are provided for by two sets of through holes (J5 and J6), each allowing for headers for a total of 50 pins. The pin headers have a pitch of 2.54 mm and the RL78/I1C is connected to the through holes for the headers.

Table 5-4 (J5) and Table 5-5 (J6) show the correspondence between the RL78/I1C pins and the MCU header connections.

**Table 5-4 Pin Assignments of the 50-Pin Connector for the MCU Headers (J5)**

| J5 | RL78/I1C | | Direction as Seen from the RL78/I1C | Note |
|---|---|---|---|---|
| | Name of Signal | Pin No. | | |
| 1 | P51/SEG33/SMO01/TxD4 | 80 | I/O | *1 |
| 2 | P52/SEG34/SMO02/RxD4 | 79 | I/O | *1 |
| 3 | P53/SEG35/TRJO0/RxDMG1/(INTP9) | 78 | I/O | — |
| 4 | P54/SEG36/TRJO1/TxDMG1 | 77 | I/O | — |
| 5 | P55/SEG37/RxD2/IrRxD/RxDMG0/(INTP8) | 76 | I/O | — |
| 6 | P56/SEG38/TxD2/IrTxD/TxDMG0 | 75 | I/O | — |
| 7 | P07/INTP2/TI02/TO02/SO00/TxD0/TOOLTxD | 100 | I/O | — |
| 8 | P06/TI03/TO03/SI00/RxD0/SDA00/TOOLRxD | 1 | I/O | — |
| 9 | P05/INTP3/TI04/TO04/SCK00/SCL00 | 2 | I/O | — |
| 10 | P43/TI00/TO00/PCLBUZ0/INTP7 | 6 | I/O | — |
| 11 | P130 | 7 | Output | — |
| 12 | P42/INTP6/TI01/TO01/PCLBUZ1 | 8 | I/O | — |
| 13 | P40/TOOL0/(RTCOUT) | 9 | I/O | *2 |
| 14 | P152/RTCIC2/INTP12 | 10 | I/O | — |
| 15 | P151/RTCIC1/INTP13 | 11 | I/O | — |
| 16 | P150/RTCOUT/RTCIC0/INTP14 | 12 | I/O | SW |
| 17 | P137/INTP0 | 16 | Input | — |
| 18 | LVDVBAT | 24 | Input | — |
| 19 | P60/(TI00)/(TO00)/SCLA0 | 25 | I/O | — |
| 20 | P61/(TI01)/(TO01)/SDAA0 | 26 | I/O | — |
| 21 | P62/(TI02)/(TO02) | 27 | I/O | — |
| 22 | P125/VL3/INTP1/(TI05)/(TO05) | 33 | I/O | *3 |
| 23 | P37/SEG31/(COM0) | 34 | I/O | — |
| 24 | P36/SEG30/(COM1) | 35 | I/O | — |
| 25 | P35/SEG29/(COM2) | 36 | I/O | — |
| 26 | P34/SEG28/(COM3) | 37 | I/O | — |
| 27 | P33/(PCLBUZ0)/SEG27/(COM4/SEG0) | 38 | I/O | — |
| 28 | P77/KR7/(INTP7)/SEG23 | 42 | I/O | — |
| 29 | P76/KR6/(INTP6)/SEG22 | 43 | I/O | — |
| 30 | P75/KR5/(INTP5)/SEG21 | 44 | I/O | — |
| 31 | P03/TI06/TO06/SI10/RxD1/SDA10 | 4 | I/O | — |
| 32 | P04/INTP4/TI05/TO05/SO10/TxD1 | 3 | I/O | — |
| 33 | P32/(PCLBUZ1)/SEG26/(COM5/SEG1) | 39 | I/O | — |

| | | | | |
|---|---|---|---|---|
| 34 | P02/INTP5/TI07/TO07/SCK10/SCL10 | 5 | I/O | — |
| 35 | P30/(TI07)/(TO07)/SEG24/(COM7/SEG3) | 41 | I/O | — |
| 36 | P31/(TI06)/(TO06)/SEG25/(COM6/SEG2) | 40 | I/O | — |
| 37 | P73/KR3/(INTP3)/SEG19 | 46 | I/O | — |
| 38 | P74/KR4/(INTP4)/SEG20 | 45 | I/O | — |
| 39 | P71/KR1/(INTP1)/SEG17 | 48 | I/O | — |
| 40 | P72/KR2/(INTP2)/SEG18 | 47 | I/O | — |
| 41 | P83/SEG15 | 50 | I/O | — |
| 42 | P70/KR0/(INTP0)/SEG16 | 49 | I/O | — |
| 43 | P81/SEG13/(SI10)/(RxD1)/(SDA10) | 52 | I/O | — |
| 44 | P82/SEG14/(SO10)/(TxD1) | 51 | I/O | — |
| 45 | P17/SEG11/(SO00)/(TxD0) | 55 | I/O | — |
| 46 | P80/SEG12/(SCK10)/(SCL10) | 53 | I/O | — |
| 47 | VDD | — | — | — |
| 48 | GND | — | — | — |
| 49 | VDD | — | — | — |
| 50 | GND | — | — | — |

*1. This pin is for use with USB-serial conversion on the board as shipped and by default is not connected to the MCU header. If the MCU header is to be used, remove two short pads (RXD4 and TXD4) and short-circuit two open pads (P52 and P51) on the back of the board (refer to Figure 5-8 and Figure 5-9).

*2. This pin is for use in debugging or programming of the RL78/I1C with the TOOL0 function on the board as shipped and by default is not connected to the MCU header. If the MCU header is to be used, remove the short pad (TOOL0) and short-circuit the open pad (P40) on the back of the board (refer to Figure 5-10 and Figure 5-11).

*3. This pin is for use as the LCD drive voltage generator with the VL3 function on the board as shipped and by default is not connected to the MCU header. If the MCU header is to be used, remove the short pad (VL3) and short-circuit the open pad (P125) on the back of the board (refer to Figure 5-12 and Figure 5-13).

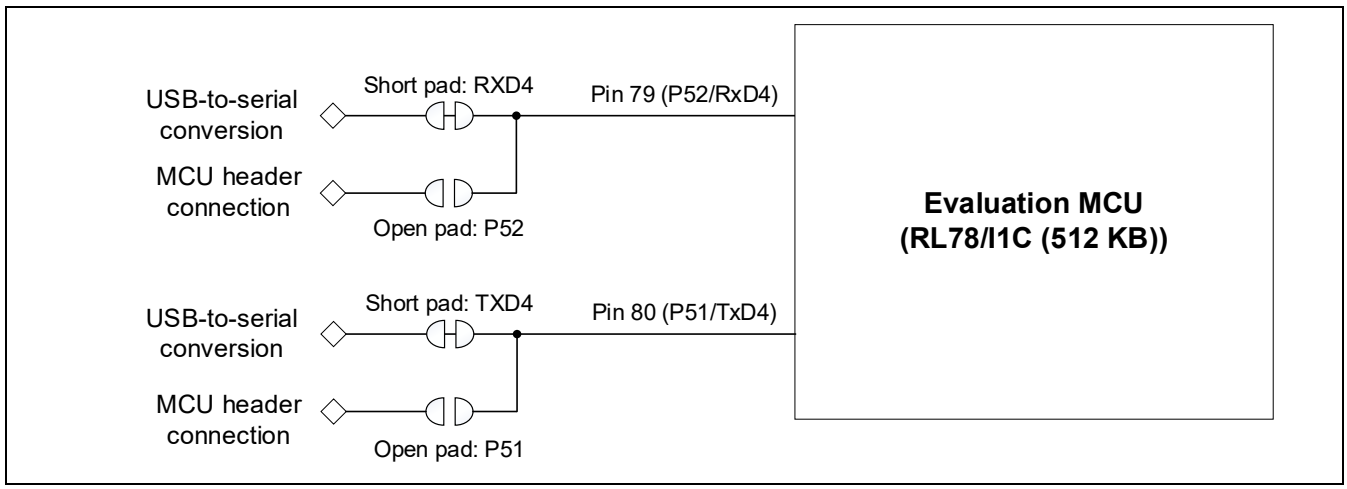


**Figure 5-8 Block Diagram of Switching between TxD4/RxD4 and P51/P52 (*1)**

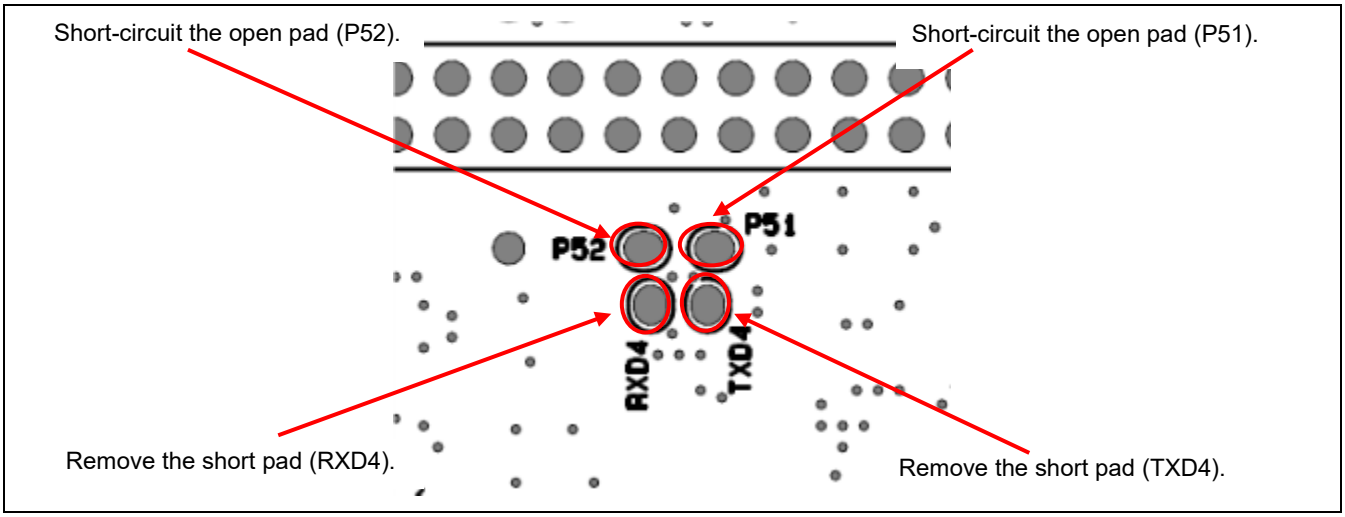


**Figure 5-9 Positions to be Modified when P51 and P52 are to be Connected to the MCU Headers (Soldered Side) (*1)**

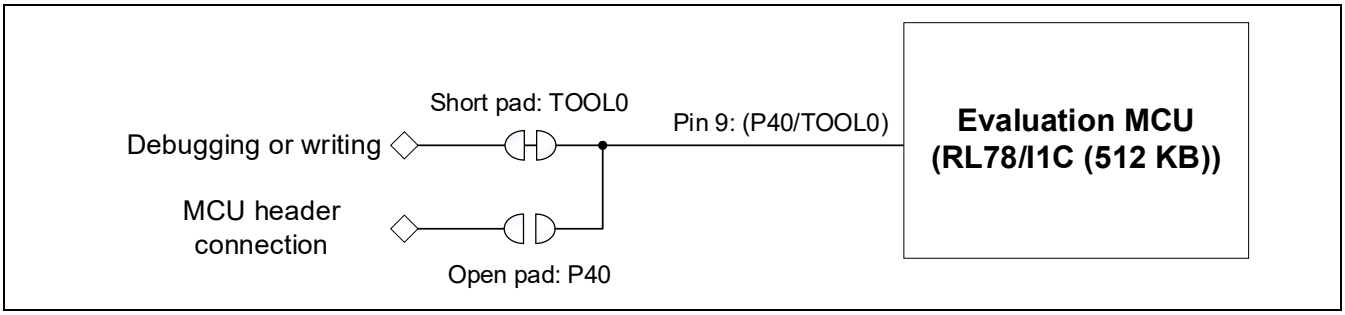


**Figure 5-10 Block Diagram of Switching between TOOL0 and P40 (*2)**

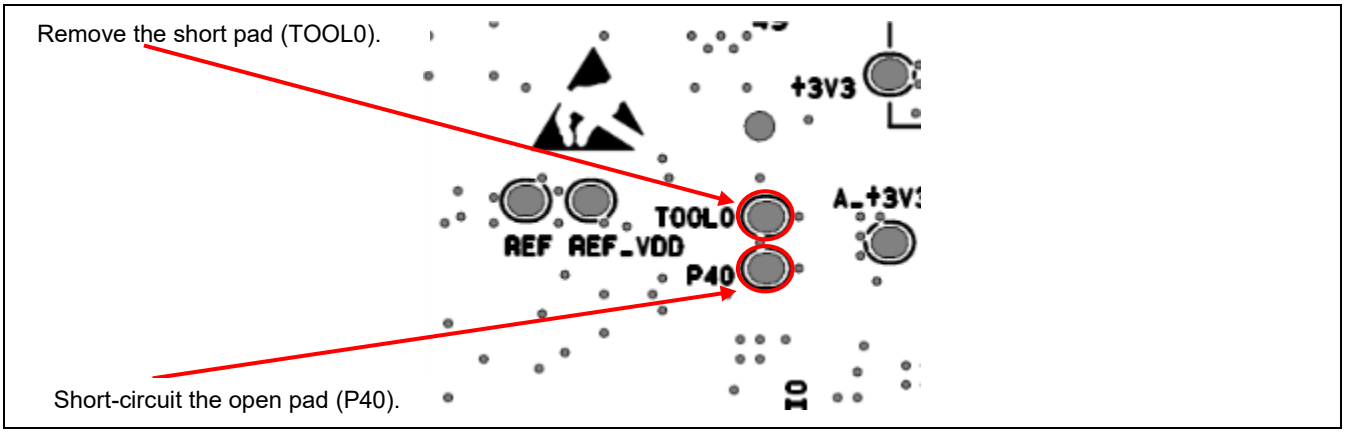


**Figure 5-11 Positions to be Modified when P40 is to be Connected to the MCU Headers (Soldered Side) (*2)**

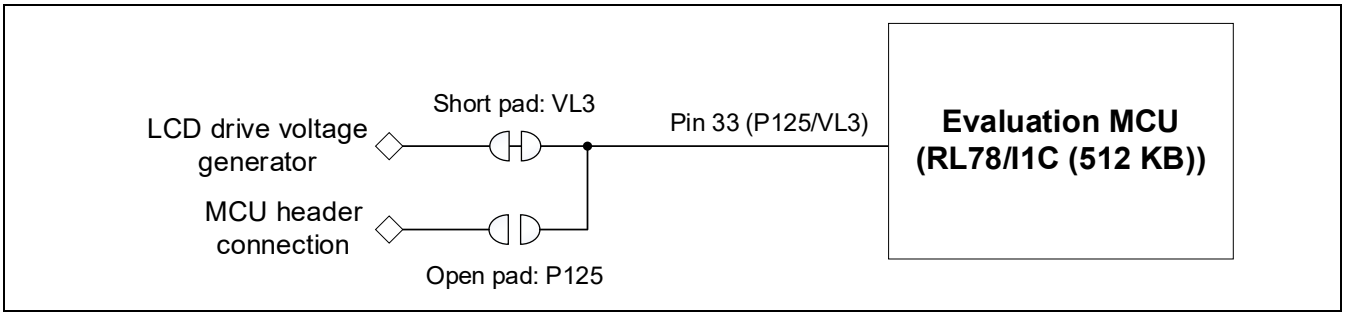


**Figure 5-12 Block Diagram of Switching between VL3 and P125 (*3)**

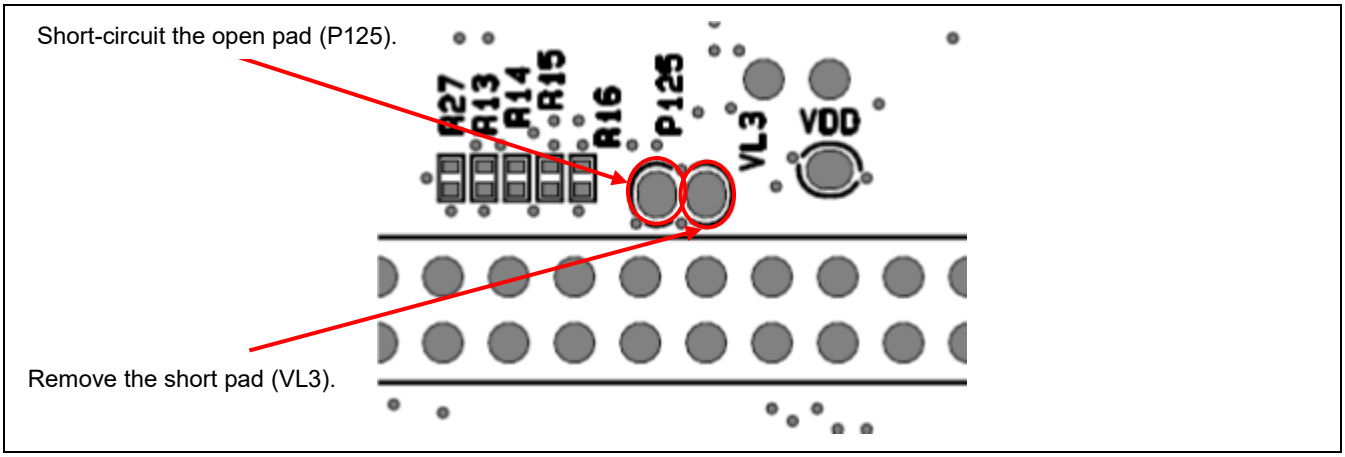


**Figure 5-13 Positions to be Modified when P125 is to be Connected to the MCU Headers (Soldered Side) (*3)**

**Table 5-5 Pin Assignments of the 50-Pin Connector for the MCU Headers (J6)**

| J6 | RL78/I1C | | Direction as Seen from the RL78/I1C | Note |
|---|---|---|---|---|
| | Name of Signal | Pin No. | | |
| 1 | +5.0V | — | — | — |
| 2 | GND | — | — | — |
| 3 | P16/SEG10/(SI00)/(RxD0)/(SDA00) | 56 | I/O | — |
| 4 | P15/SEG9/(SCK00)/(SCL00) | 57 | I/O | — |
| 5 | P14/SEG8 | 58 | I/O | — |
| 6 | P13/SEG7 | 59 | I/O | — |
| 7 | P12/SEG6 | 60 | I/O | - |
| 8 | P11/SEG5 | 61 | I/O | LED2 |
| 9 | P10/SEG4 | 62 | I/O | LED1 |
| 10 | P97/COM7/SEG3/(SEG24)/SMP5 | 64 | I/O | — |
| 11 | P96/COM6/SEG2/(SEG25)/SMP4 | 65 | I/O | — |
| 12 | P95/COM5/SEG1/(SEG26)/SMP3 | 66 | I/O | — |
| 13 | P94/COM4/SEG0/(SEG27)/SMO12 | 67 | I/O | — |
| 14 | P93/COM3/(SEG28)/SMO11 | 68 | I/O | — |
| 15 | P92/COM2/(SEG29)/SMO10 | 69 | I/O | — |
| 16 | P91/COM1/(SEG30)/SMP2 | 70 | I/O | — |
| 17 | P90/COM0/(SEG31)/SMP1 | 71 | I/O | — |
| 18 | P85/SEG41/SO30/TxD3/SMP0 | 72 | I/O | — |
| 19 | P84/SEG40/SI30/RxD3/SDA30/TRJIO1 | 73 | I/O | — |
| 20 | P57/SEG39/SCK30/SCL30/TRJIO0 | 74 | I/O | — |
| 21 | P50/SEG32/SMO00 | 81 | I/O | — |
| 22 | GND | — | — | — |
| 23 | AGND | — | — | — |
| 24 | AGND | — | — | — |
| 25 | ANIP3 | 82 | Input | — |
| 26 | ANIN3 | 83 | Input | — |
| 27 | AGND | — | — | — |
| 28 | AGND | — | — | — |
| 29 | ANIP2 | 84 | Input | — |
| 30 | ANIN2 | 85 | Input | — |
| 31 | AGND | — | — | — |
| 32 | AGND | — | — | — |
| 33 | ANIP1 | 90 | Input | — |
| 34 | ANIN1 | 91 | Input | — |
| 35 | AGND | — | — | — |
| 36 | AGND | — | — | — |
| 37 | ANIP0 | 92 | Input | — |
| 38 | ANIN0 | 93 | Input | — |
| 39 | AGND | — | — | — |
| 40 | AGND | — | — | — |

| | | | | |
|---|---|---|---|---|
| 41 | AGND | — | — | — |
| 42 | AVRT | 86 | — | — |
| 43 | P25/ANI2 | 94 | I/O / Input | — |
| 44 | AGND | — | — | — |
| 45 | P23/ANI0 | 96 | I/O / Input | — |
| 46 | P24/ANI1 | 95 | I/O / Input | — |
| 47 | P21/ANI4/AVREFM | 98 | I/O / Input | — |
| 48 | P22/ANI5/EXLVD | 97 | I/O / Input | — |
| 49 | AGND | — | — | — |
| 50 | P20/ANI3/AVREFP/VREFOUT | 99 | Output | *1 |

*1 This pin is write-only since a diode for preventing reverse current has been mounted between the RL78/I1C and the MCU header. Functions of the ANI3 and AVREFP pins for use as inputs and input through P20 are not available.

## 5.9 Clock

Clock circuits are provided to handle the clock sources for the RL78/I1C. For details on the specifications of the RL78/I1C clocks, refer to the RL78/I1C (512 KB) User's Manual: Hardware. For details on the clock circuit of this product, refer to the circuit schematics of the RL78/I1C (512 KB) Fast Prototyping Board.

When you are using the crystal oscillator (OSC2) for the sub clock, mount a CR2032 coin-cell battery on BT1. For details, refer to section 5.16, Coin-Cell Battery Circuit.

Table 5-6 lists details of the clocks on the RL78/I1C Fast Prototyping Board.

**Table 5-6 Details of Clocks**

| Clock | Function and Usage | State as Shipped | Frequency | Package for the Oscillator |
|---|---|---|---|---|
| OSC1 | Crystal oscillator for the high-speed system clock | Not mounted | n/a | SMT |
| OSC2 | Crystal oscillator for the sub clock | Mounted | 32.768 kHz | SMT |

## 5.10 Reset Switch

Pressing the reset switch (RST) applies a hardware reset to the RL78/I1C.

## 5.11 User Switch

An optional user switch (SW) is mounted. It is connected to pin 12 of the RL78/I1C, which operates as pin function P150. The INTP14 interrupt is multiplexed on the same pin.

## 5.12 Debug/Serial Select Switch

A switch (SW3) is mounted on the board for switching the connection of the USB connector and changing between the debug mode and serial mode.

The debug mode is selected on the board as shipped, enabling debugging and programming of the RL78/I1C.

For serial mode, using the TxD4 and RxD4 functions of the P51 and P52 pins of the RL78/I1C enables UART communications between the host PC and the RL78/I1C. The user needs to prepare the terminal software, such as TeraTerm.

To change the switch setting, the power supply must be turned off.

Figure 5-14 shows the position of the switch and Table 5-7 lists details of the switch settings.

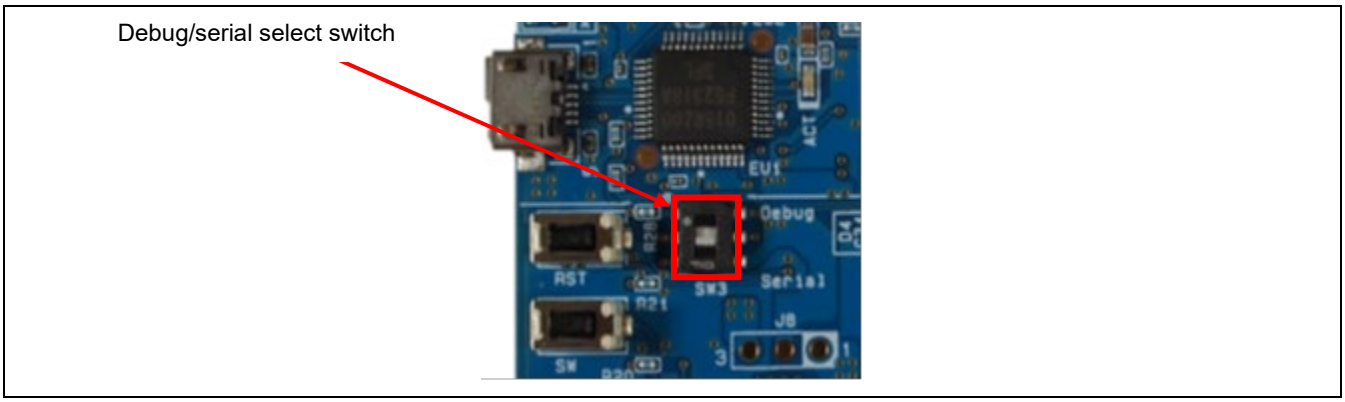


**Figure 5-14 Position of the Debug/Serial Select Switch (Top Side)**

**Table 5-7 Details of the Switch Settings**

| Position of the Switch | Function and Usage | RL78/I1C | |
|---|---|---|---|
| | | Pin | Function |
| Debug | Debugging or programming of the RL78/I1C (setting as shipped) | 9 | TOOL0 |
| Serial | Connected to the host PC via USB-to-serial conversion*1 | 80 | TxD4 |
| | | 79 | RxD4 |
| | | 11 | P151/INTP13*2 |

*1. Set the bit rate no higher than 57600 bps when USB-to-serial conversion is to be used.

*2. When entering serial mode, driving is fixed to the low level after the output of a high pulse.

## 5.13 Emulator Reset Header

The emulator is placed in the forced reset state by short-circuiting the emulator reset header (EJ2). This allows stand-alone operation of the RL78/I1C independently of control by the IDE while the IDE is applying a forcible reset. Figure 5-15 shows the position of the emulator reset header.

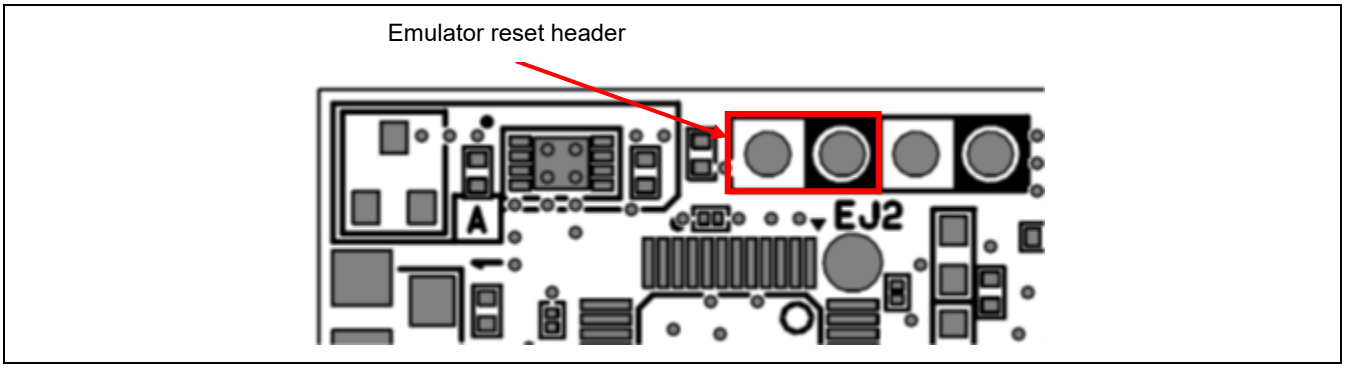


**Figure 5-15 Position of the Emulator Reset Header (Top Side)**

## 5.14 Power-Supply Selection Header

The operating power (VDD) of the RL78/I1C can be changed to VBUS (+5 V) or +3.3 V with the use of this header (J8). Only change the jumper setting of J8 while power is not being supplied (actual header components are not mounted).

- J8 being open-circuit and the short pad (E_+3V3) being short-circuit select +3.3 V. This is the default setting as shipped (Figure 5-16).
- 1-2 of J8 being short-circuit and the short pad (E_+3V3) being removed select +3.3 V (Figure 5-17).
- 2-3 of J8 being short-circuit and the short pad (E_+3V3) being removed select VBUS (+5 V) (Figure 5-18).

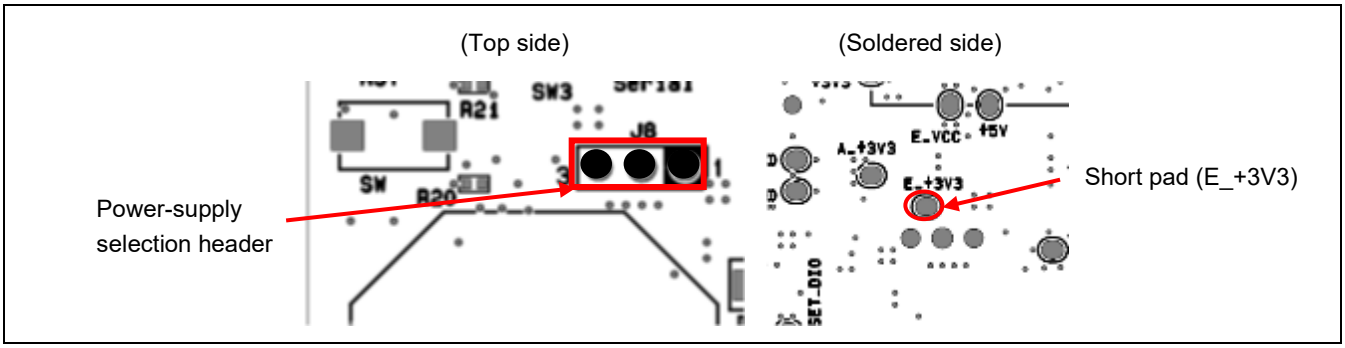


**Figure 5-16 Settings to Select the Use of +3.3 V (Short Pad (E_+3V3))**

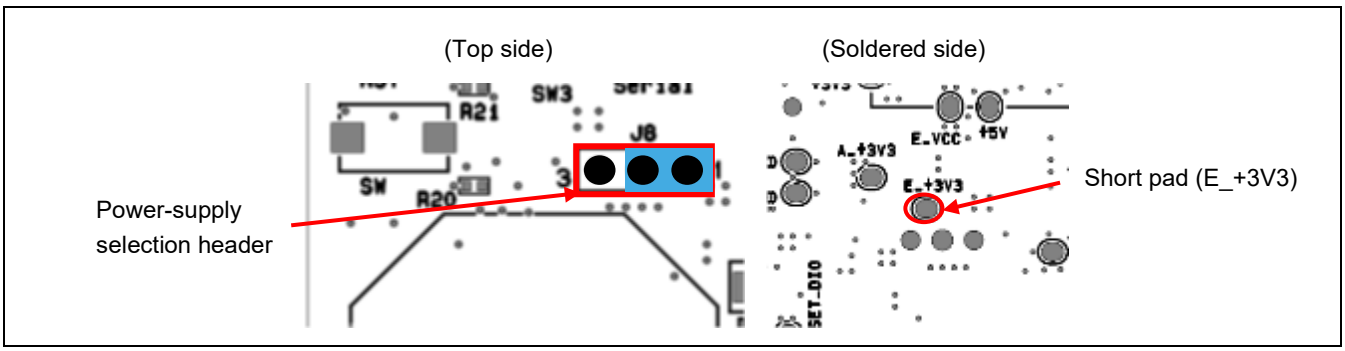


**Figure 5-17 Settings to Select the Use of +3.3 V (J8)**

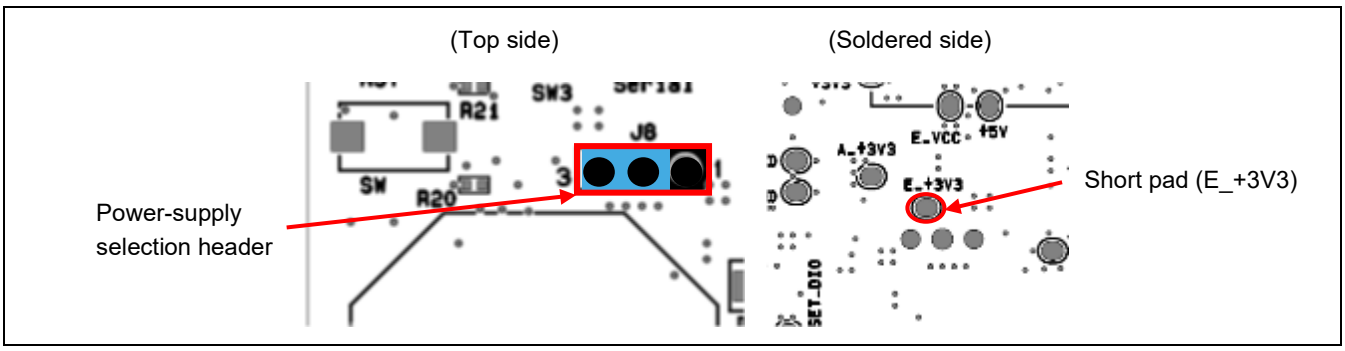


**Figure 5-18 Settings to Select the Use of VBUS (+5 V) (J8)**

## 5.15 External Power-Supply Header

When the RL78/I1C 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 (J9) to supply power. The usable voltages depend on the RL78/I1C.

Destinations for the connection of an external power supply:

- VDD side: pin J9-1
- GND side: pin J9-2

When using this header, remove the short pad (E_+3V3) on the soldered side (refer to section 5.14, Power-Supply Selection Header). In addition, short-circuit the emulator reset header (EJ2) as described in section 5.13, Emulator Reset Header, to place the emulator in the forced reset state.
Figure 5-19 shows the positions of the external power-supply header (actual header components are not mounted).

When an external power supply is used, confirm that the I/O voltages for Arduino™ shields or Pmod™ modules are correct.

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

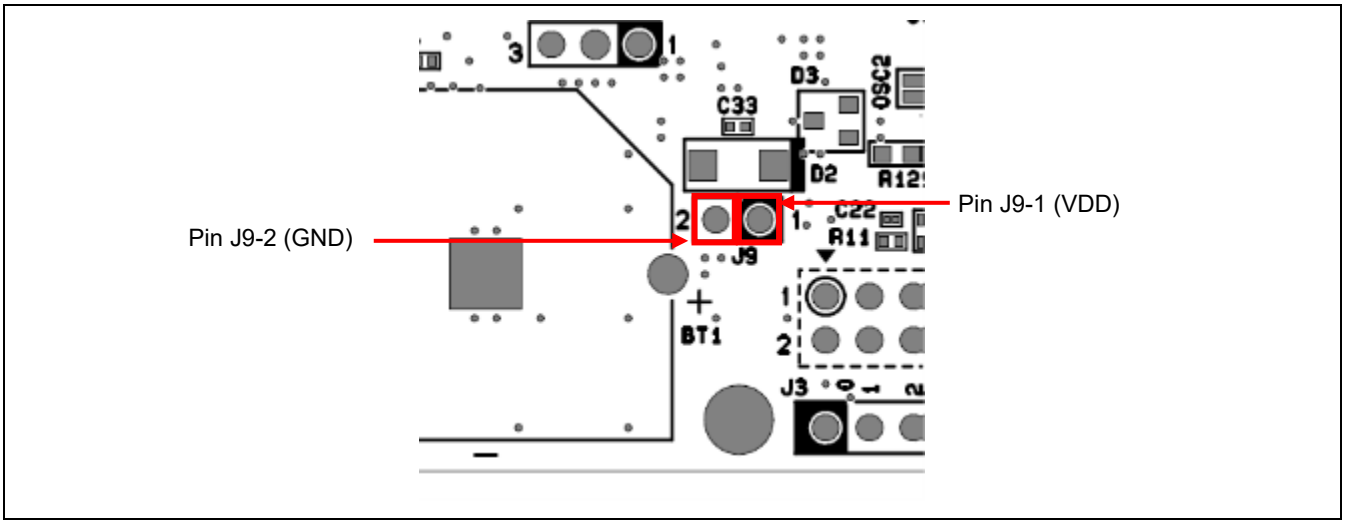


**Figure 5-19 Positions of the External Power-Supply Header (Top Side)**

## 5.16 Coin-Cell Battery Circuit

Mounting a CR2032 coin-cell battery on BT1 operates the crystal oscillator (OSC2) for the sub clock of the RL78/I1C, P123, P124, and RTCIC0 to RTCIC2.

Note: A CR2032 coin-cell battery is not included with this product.

Figure 5-20 shows the position of BT1.

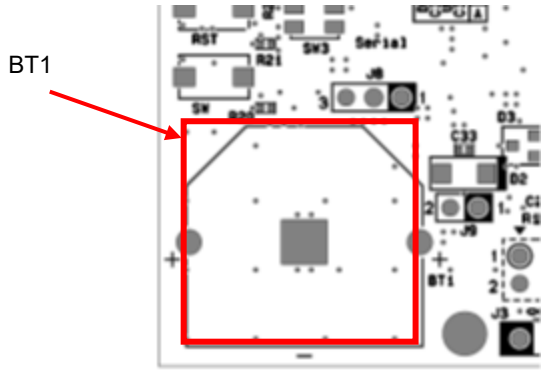


**Figure 5-20 Position of BT1 (Top Side)**

## 5.17 MCU Current Measurement Header

This header (J7) is used to measure the current drawn by the RL78/I1C (J7 header components are not mounted). Connecting an ammeter to this product enables measurement of the current being drawn by the evaluation MCU. Take care to remove the given short pad (VDD) if this header is to be used. Figure 5-21 shows the position of the current measurement header and Figure 5-22 shows the position of the short pad (VDD).

Destinations for the connection of an ammeter:

- VDD side: pin J7-1
- GND side: pin J7-2

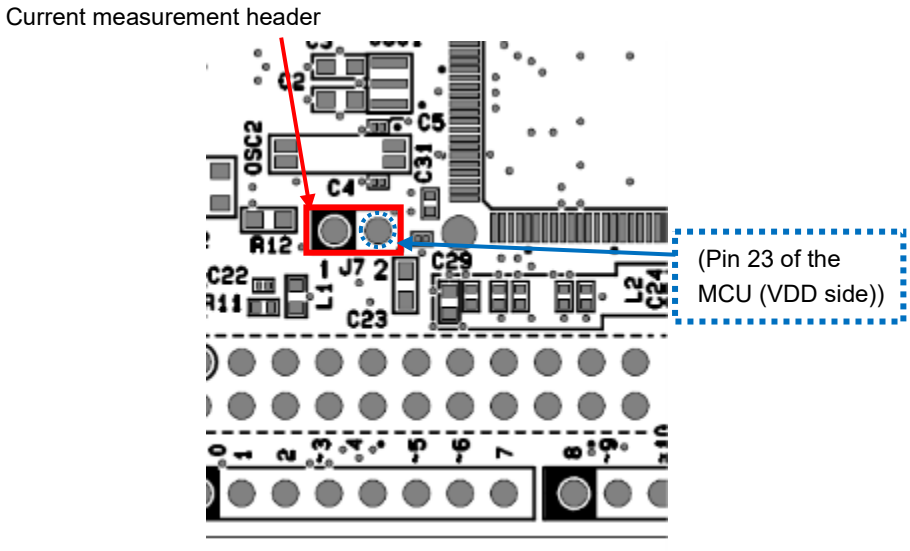


**Figure 5-21 Position of the Current Measurement Header (Top Side)**

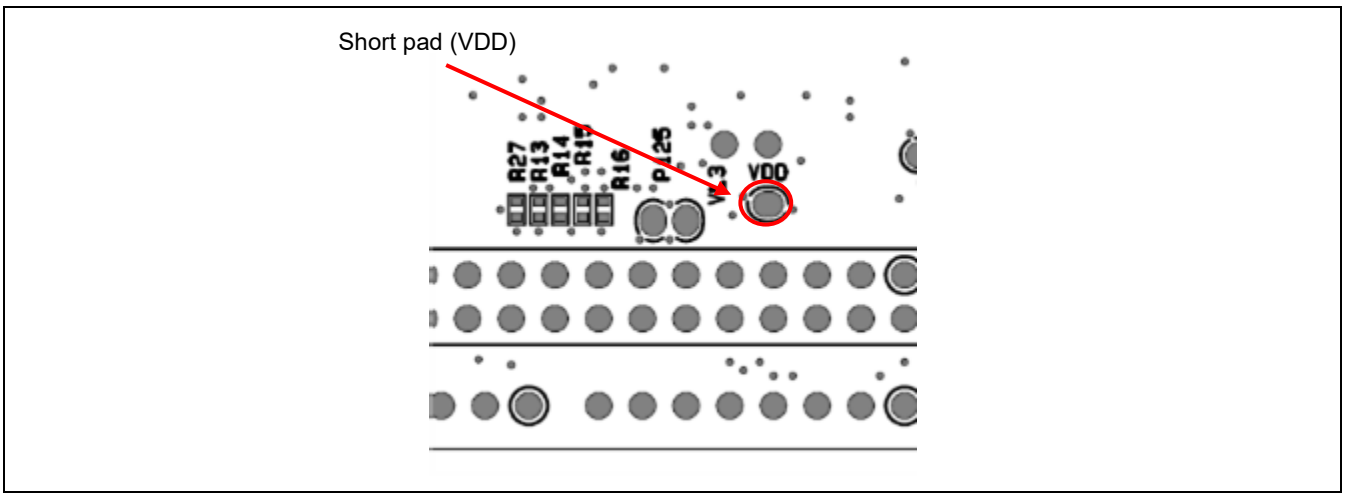


**Figure 5-22 Position of the Short Pad (VDD) (Soldered Side)**

When the current is to be measured, turn down the LED to reduce the current drawn with the RL78/I1C or remove the short pads (P10 and P11).

Figure 5-23 is a block diagram of the power-supply lines related to the measurement of current drawn. For a block diagram of the power-supply circuit as a whole, refer to Figure 6-1.

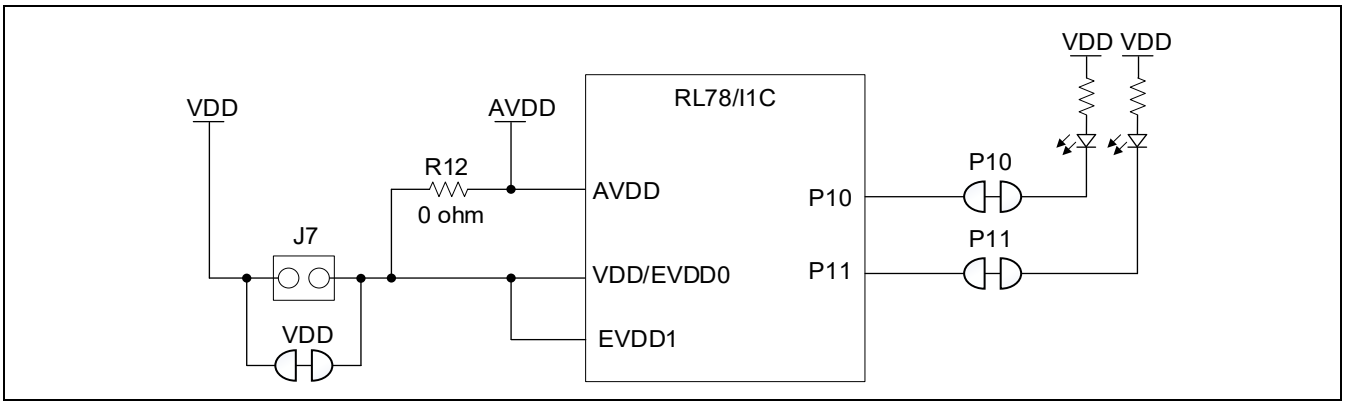


**Figure 5-23 Block Diagram of the Headers Related to MCU Current Measurement**

## 5.18 Analog Circuits

- An anti-aliasing circuit is mounted on the input line of DSAD.
- A voltage-follower circuit is mounted on the AVRT signal line.
- For VREFOUT (J6-50), switching open pads between open-circuit and short-circuit can select VREFOUT (pin 99 of the RL78/I1C), REF for Arduino™, or VDD.
  VREFOUT for the RL78/I1C is selected by default on the board as shipped (refer to Figure 5-25).
  To select REF for Arduino™, short-circuit an open pad (REF) (refer to Figure 5-26).
  To select VDD, short-circuit an open pad (REF_VDD) (refer to Figure 5-27).
  Do not short-circuit both open pads (REF_VDD and REF).
  Figure 5-24 shows the positions of the open pads (REF_VDD and REF).

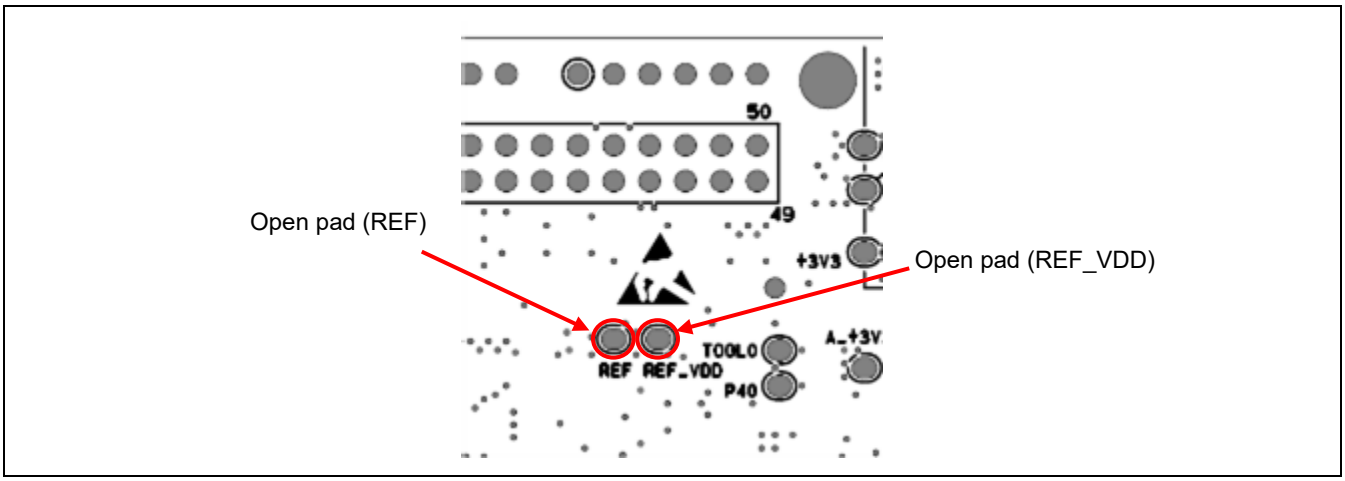


**Figure 5-24 Positions of the Open Pads (REF_VDD and REF) (Soldered Side)**

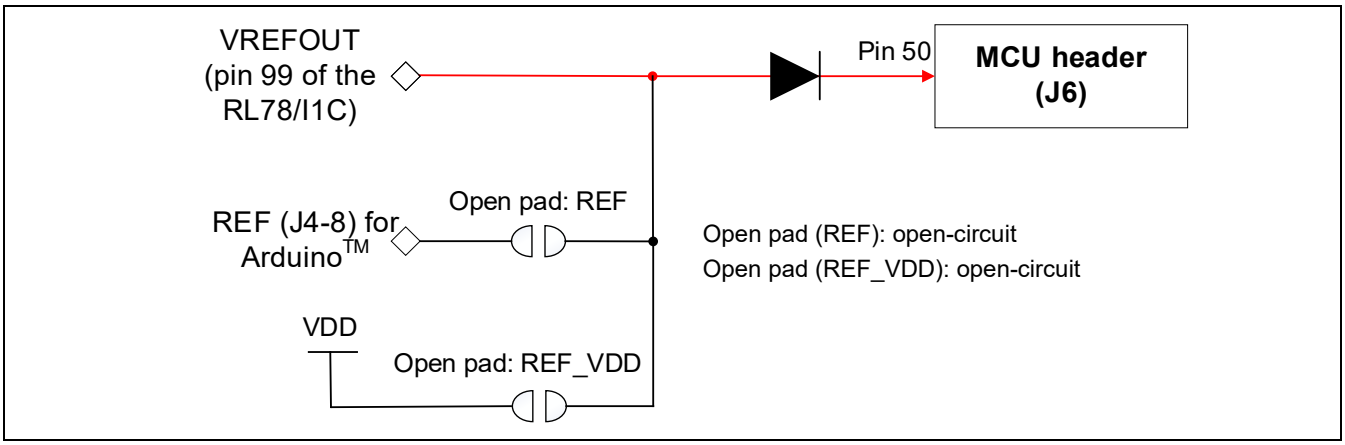


**Figure 5-25 Circuit Schematic when VREFOUT for the RL78/I1C is Selected (Setting as Shipped)**

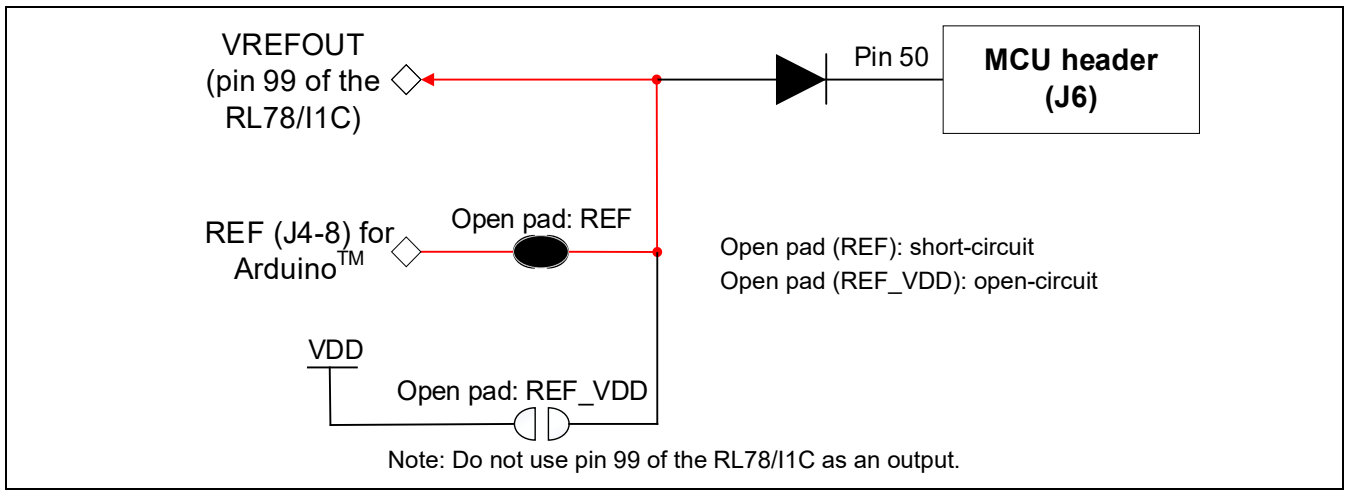


**Figure 5-26 Circuit Schematic when REF for Arduino™ is Selected**

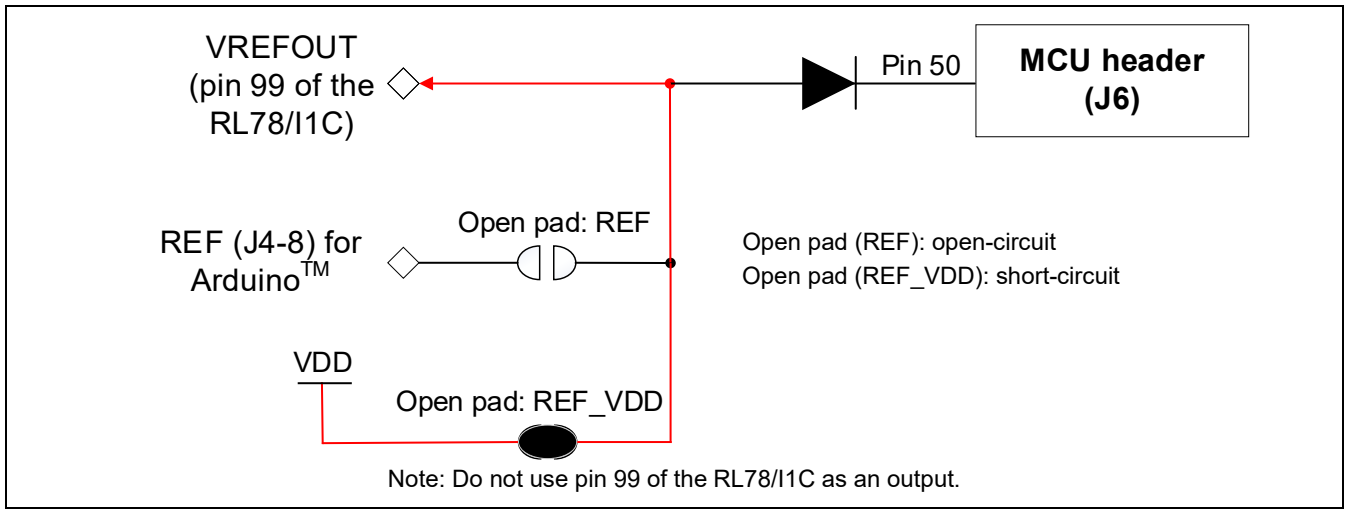


**Figure 5-27 Circuit Schematic when VDD is Selected**

## 5.19 LCD Drive Voltage Generator

By mounting resistors or capacitors on this product, the internal voltage boosting method, capacitor split method, or external resistance division method can be selected as the LCD drive power generating method of the RL78/I1C.

The internal voltage boosting method (1/4 bias method) is set up for use by default on the board as shipped.

To use either of the other methods, change the mounting of capacitors (C25 to C28) or resistors (R13 to R16 and R27). Figure 5-28 shows the positions of the capacitors and a circuit schematic. Figure 5-29 shows the positions of the resistors and a circuit schematic.

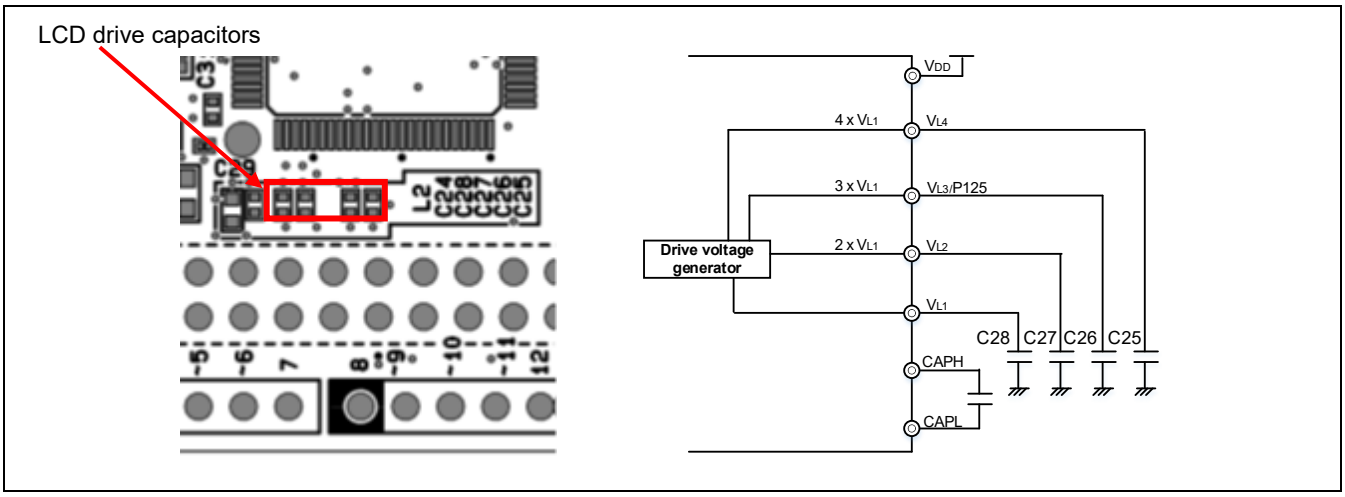


**Figure 5-28 Positions of Capacitors (C25 to C28) (Top Side) and Circuit Schematic**

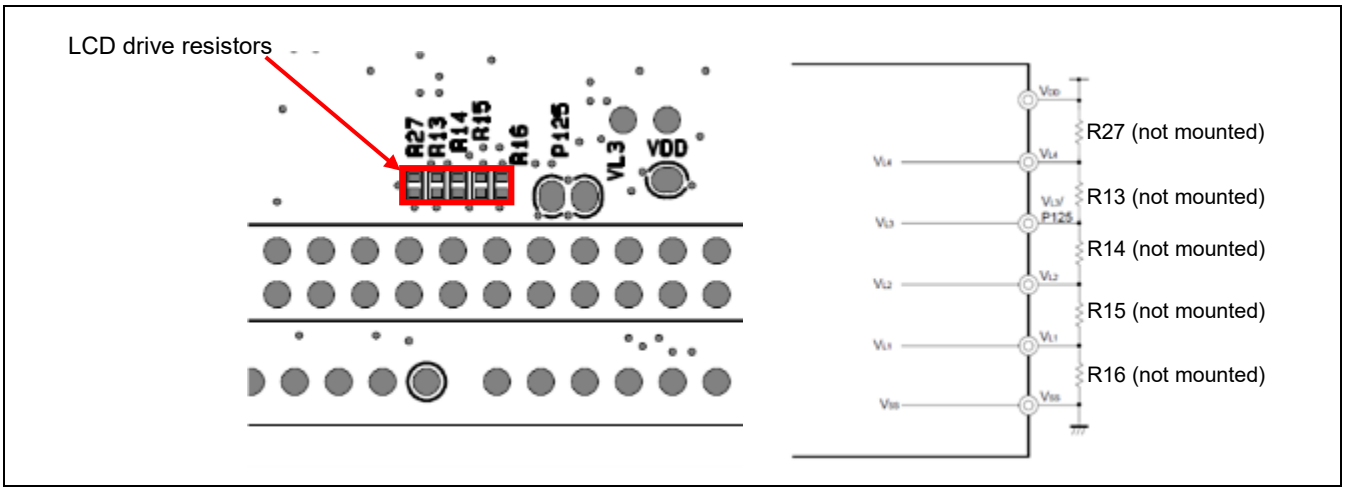


**Figure 5-29 Positions of Resistors (R13 to R16 and R27) (Soldered Side) and Circuit Schematic**

# 6. Handling Precautions

## 6.1 Power to be Supplied

When power is supplied to this product through the USB, note that the current drawn by the whole system should not exceed the maximum of 200 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/I1C (512 KB) Fast Prototyping Boards

Connecting the same host PC to multiple RL78/I1C (512 KB) 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. Figure 6-1 shows the block diagram of the power-supply circuit.

**Table 6-1 Power-Supply Circuits and Usage Conditions**

| Power-supply circuit | Usage Condition | | | | |
|---|---|---|---|---|---|
| | Power supplied to the RL78/I1C | Use of Arduino™ shields*1 | Use of boards supported by Pmod™ *1 | Use of an emulator and IDE | Remodeling the board*2 |
| As shipped | 3.3 V | Possible | Possible | Possible | Not required |
| Power-supply selection header | VBUS (5 V) | Possible | Possible | Possible | Required<br>J8: mounted; J8: 2-3 short-circuit; E_+3V3: removed<br>+3V3: short-circuit; A_+3V3: removed |
| | 3.3 V | Possible | Possible | Possible | Required<br>J8: mounted; J8: 1-2 short-circuit; E_+3V3: removed<br>+3V3: short-circuit |
| External power-supply header | 1.6 V to 5.5 V | Only possible with 3.3 V | Possible | Not possible<br>(The emulator circuit is in the reset state.) | Required<br>J9: mounted; E_+3V3: removed<br>EJ2: mounted; EJ2: short-circuit |

*1. Connecting the RL78/I1C (512 KB) 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.

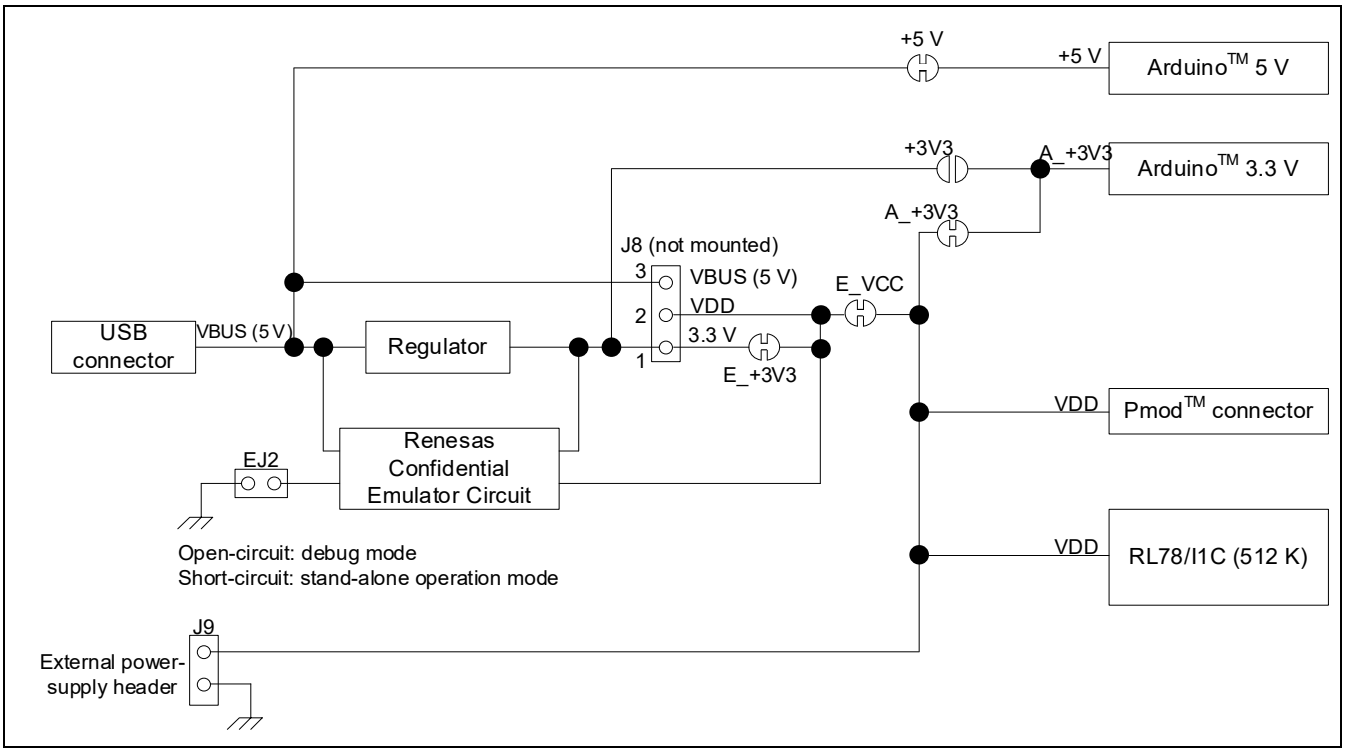


**Figure 6-1 Block Diagram of the Power-Supply Circuit**

# 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/I1C (512 KB) Fast Prototyping Board.

- [Debug hardware]: Select [E2 Lite (RL78)].
- [Power Target From The Emulator]: Select [No].
- [Target Device]: Select [R5F10NPL].

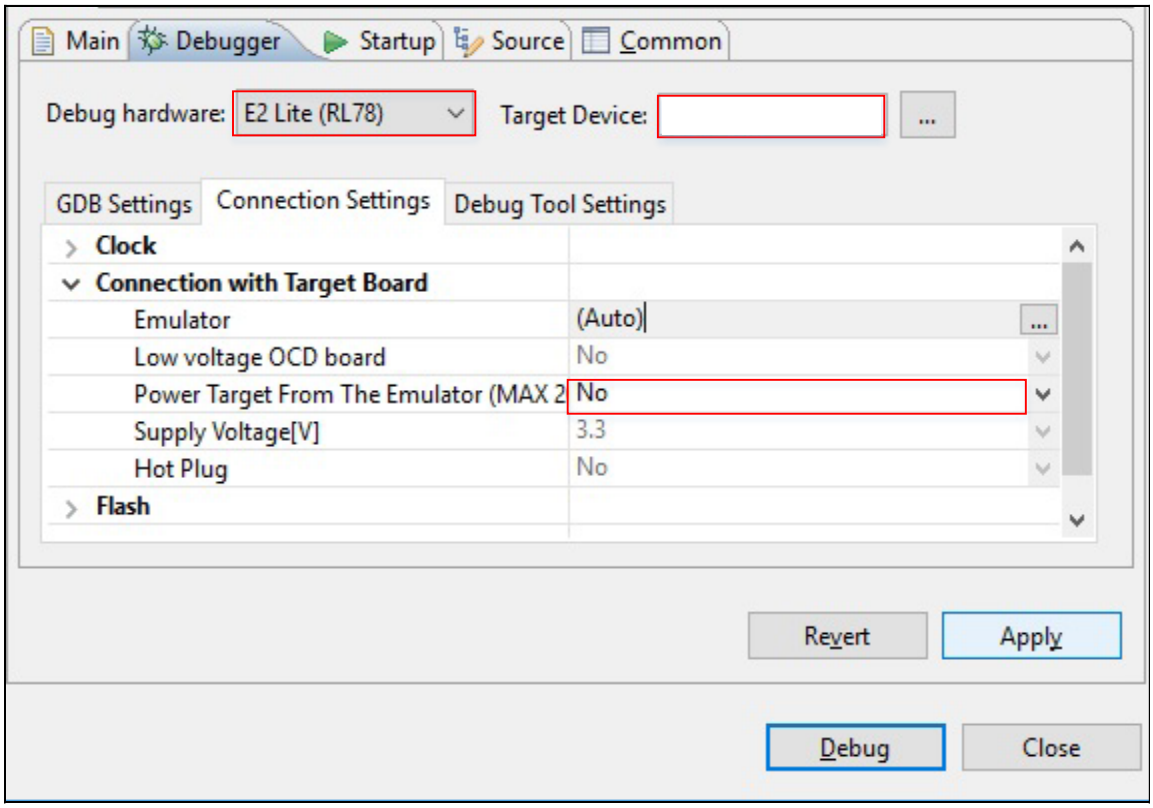


**Figure 7-1 Settings of the e² studio**

## 7.2 Using CS+

Figure 7-2 and Figure 7-3 show the settings of CS+ when creating a new project for the RL78/I1C (512 KB) Fast Prototyping Board.

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

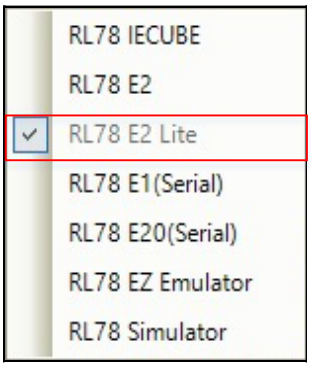


**Figure 7-2 Panel for Selecting the Debug Tool**

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

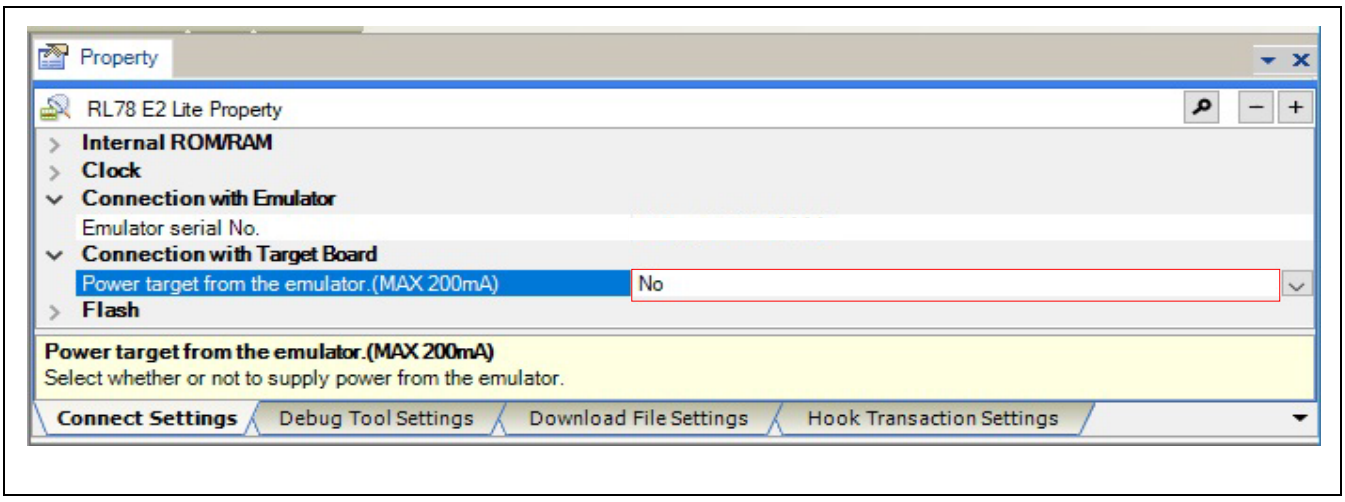


**Figure 7-3 [Connect Settings] Tabbed Page of CS+**

# 8. Additional Information

### Technical Support

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

For details on the RL78/I1C, refer to the RL78/I1C (512 KB) 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/I1C (512 KB) 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/I1C (512 KB) Fast Prototyping Board User's Manual |
|---|---|

| Rev. | Date | Description | |
|---|---|---|---|
| | | Page | Summary |
| 1.00 | Apr.01.21 | — | First Edition issued |
| 1.10 | Jan.06.23 | 5 | Figure 3-1 Corrected the dimension between J5 and J6. |

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