

RL78/G23-128p Fast Prototyping Board

16

User's Manual

16-Bit Single-Chip Microcontrollers
RL78 Family

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(Rev.5.0-1 October 2020)

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General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the 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 Usage Notes section.

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

The following documents apply to the RL78/G23-128p Fast Prototyping Board. Be sure to refer to the latest versions of these documents.

| Document Type | Description | Document Title | Document No. |
|------------------------------------|--|--|------------------------------|
| User's manual | Hardware specifications | RL78/G23-128p Fast Prototyping Board User's Manual | R20UT4870EJ (this manual) |
| Circuit schematics | Circuit schematics | RL78/G23-128p Fast Prototyping Board Circuit Schematics | R20UT4993EJ |
| Parts list | Parts list | RL78/G23-128p Fast Prototyping Board BOM LIST | R12TU0139EJ |
| User's manual for the hardware* | Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation | RL78/G23 User's Manual: Hardware | R01UH0896EJ |

2. List of Abbreviations and Acronyms

| Abbreviation | Full Form |
|---------------|--|
| Arduino™ MEGA | Connectors compatible with the Arduino™ MEGA board are mounted on the fast prototyping board. |
| 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. |
| CPU | Central Processing Unit |
| DIP | Dual In-line Package |
| DNF | Do Not Fit |
| Grove | A connector that is compatible with Grove modules can be mounted on the fast prototyping board. |
| 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 |
| RAM | Random Access Memory |
| RFP | Renesas Flash Programmer |
| ROM | Read Only Memory |
| SPI | Serial Peripheral Interface |
| TPU | Timer Pulse Unit |
| UART | Universal Asynchronous Receiver/Transmitter |
| USB | Universal Serial Bus |
| WDT | Watchdog timer |

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1. Overview

This user's manual describes the RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ) (hereinafter referred to as "this product").

1.1 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.

1.2 Features

This product can handle the following tasks.

- Programming of the Renesas MCU
- Debugging of user code
- User circuits for switches and LEDs
- Capacitive touch buttons (two buttons connectable)
- Pmod™ connector*
- Arduino™ connector*
- Grove connector*

Note: We do not guarantee connection to all types of these connectors. For details on the connector specifications, refer to the descriptions in this document.

1.3 Preparation

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

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

1.4 Board Specification Table

Table 1-1 shows the board specifications.

Table 1-1 Board Specification Table

| Item | Specification |
|---|---|
| Evaluation MCU (RL78/G23 with 128 pins) | Part No.: R7F100GSN2DFB |
| | Package: 128-pin LFQFP |
| | On-chip memory: 768-KB ROM, 48-KB RAM, 8-KB data flash memory |
| Board size | 53.34 mm x 99.06 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 (default) |
| | External power supply: 1.6 V to 5.5 V |
| | E2 emulator or E2 emulator Lite |
| Current drawn | Max. 200 mA |
| Main clock*1 | OSC1: Crystal oscillator (surface-mount technology (SMT)) for the main system clock |
| | OSC2: Crystal oscillator or ceramic resonator (lead type) for the main system clock |
| Sub-clock | OSC3: 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 |
| Capacitive touch button | 2 |
| USB connector | Connector: Micro USB Type-B |
| Arduino™ connectors | Connectors: 8 pins x 5, 10 pins x 1 The interfaces are compatible with the Arduino™ MEGA board. (Digital pins D22 to D53 on Arduino™ Mega are not supported.) |
| Pmod™ connectors | Connectors: Angle type, 12 pins x 2 |
| MCU headers*1 | Headers: 28 pins x 1, 14 pins x 2, 12 pins x 1 |
| USB-to-serial converter | Used as the interface with the RL78 COM port debug tool. FT232RQ from FTDI x 1 |
| USB-to-serial converter reset header*1 | Header: 2 pins x 1 (open-circuit by default) |
| Current measurement headers*1 | Headers: 2 pins x 2 |
| Power-supply selection header*2 | Header: 3 pins x 1 |
| Emulator connector*1 | 14-pin connector for connecting an E2 emulator or E2 emulator Lite |
| Grove connector | Interface for Grove modules I2C: 4; UART: 1 |

Notes: 1. This part is not mounted.

2. The intended source of power for the evaluation MCU on the board as shipped is VBUS (5 V). Setting a jumper is required if power is to be supplied from other sources. For details, refer to Chapter 5, User Circuits.

1.5 Block Diagram

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

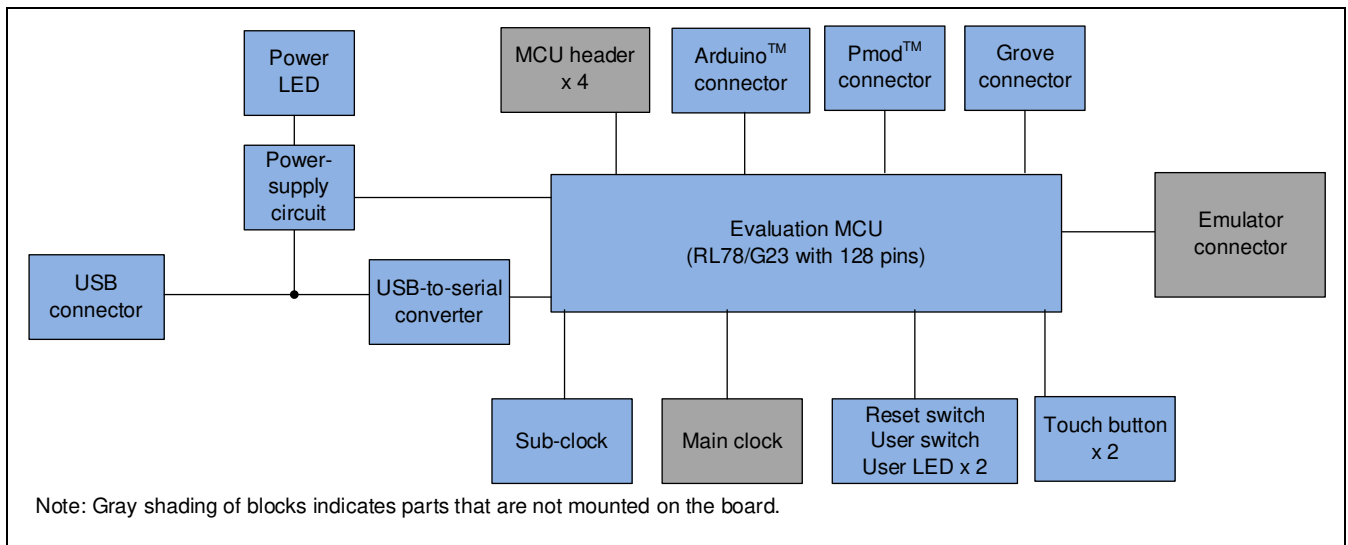


Figure 1-1 Block Diagram

2. Board Layout

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

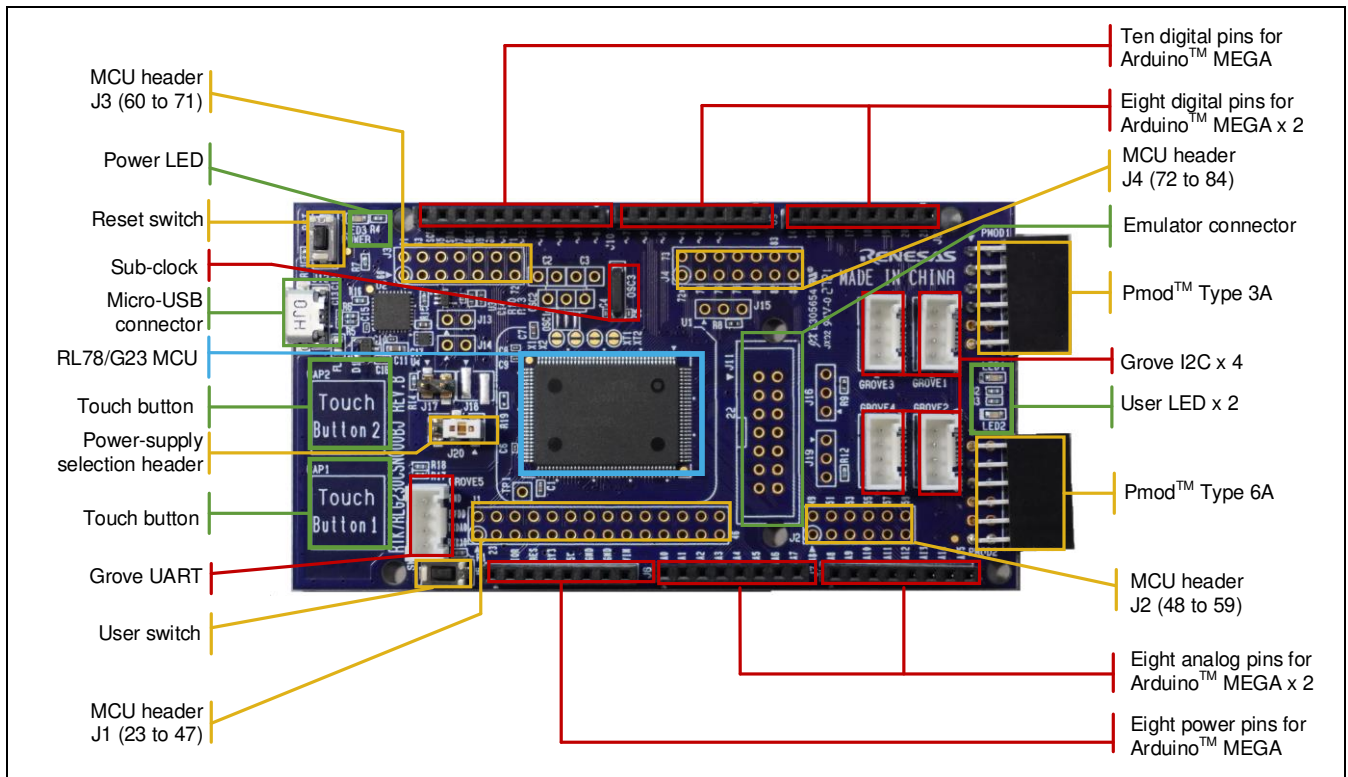


Figure 2-1 Board Layout (Top Side)

3. Parts Layout

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

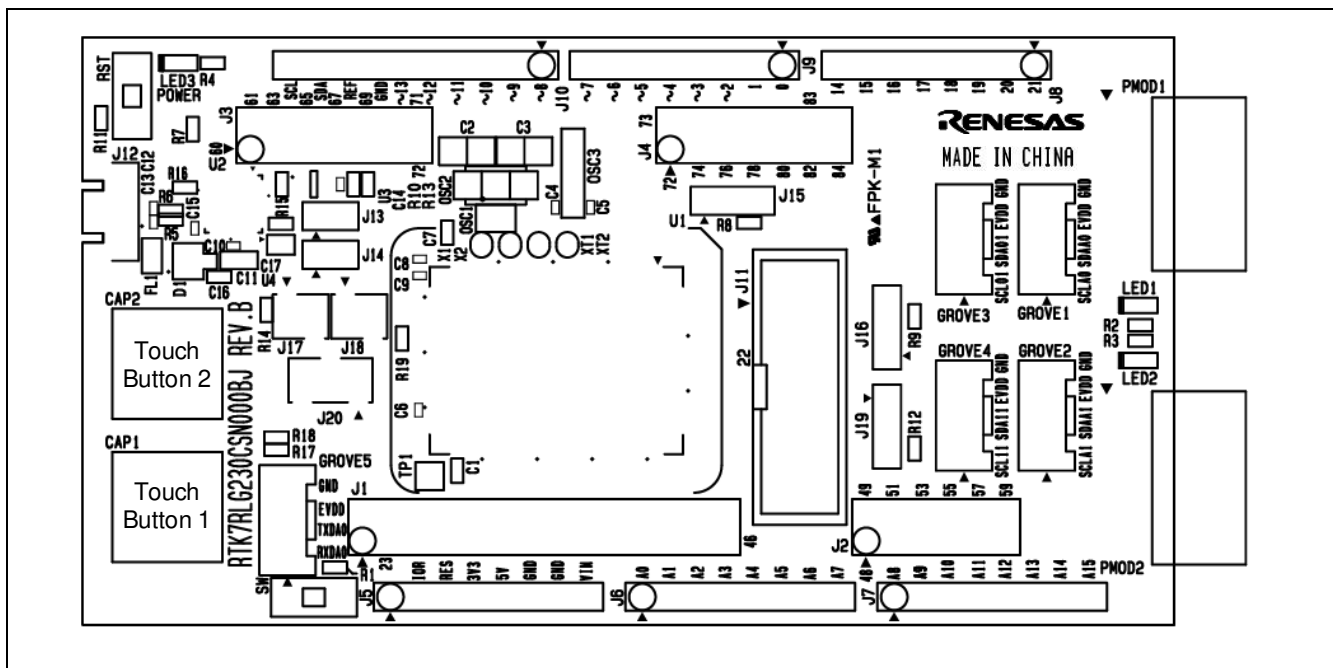


Figure 3-1 Parts Layout

Figure 3-2 shows the external dimensions of this product.

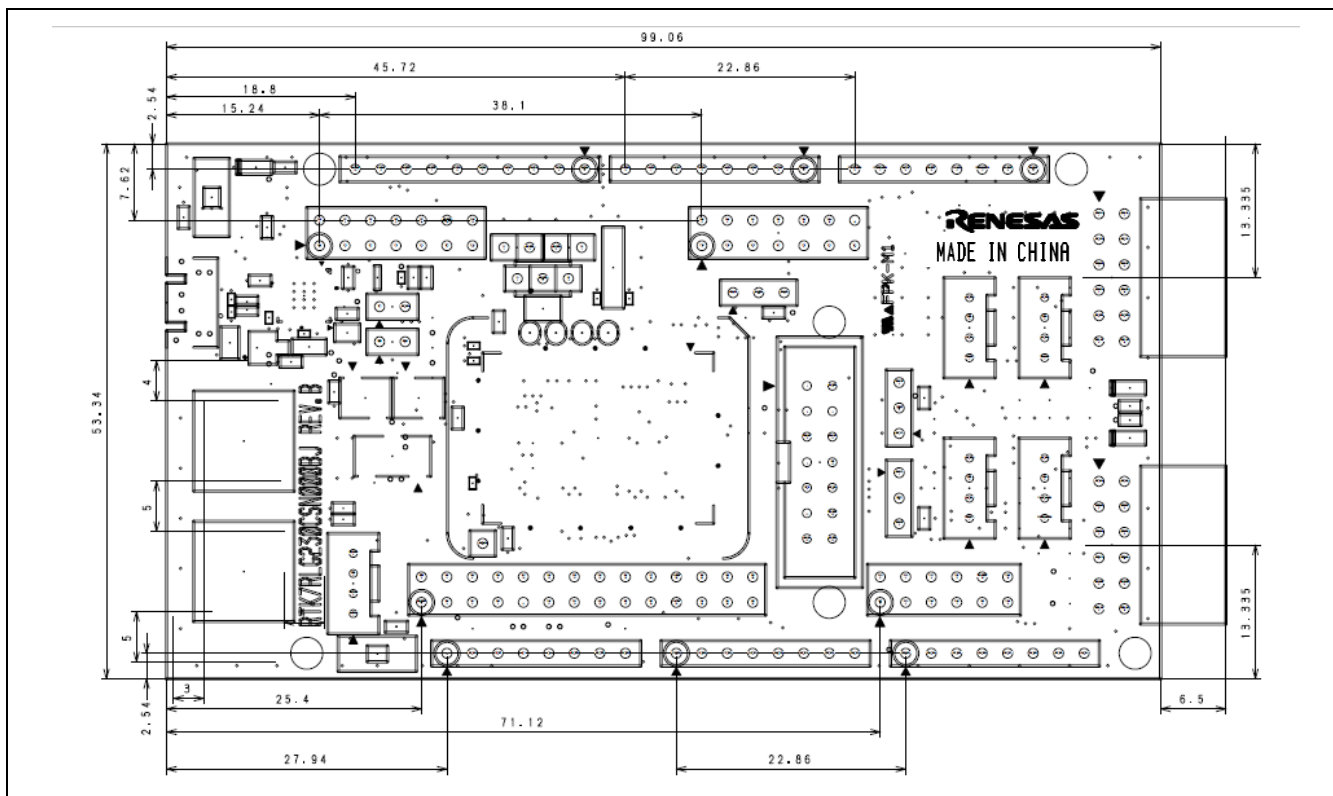


Figure 3-2 External Dimensions

4. Operating Environment

Figure 4-1 shows the operating environment of this product. Install the IDE on the host PC.

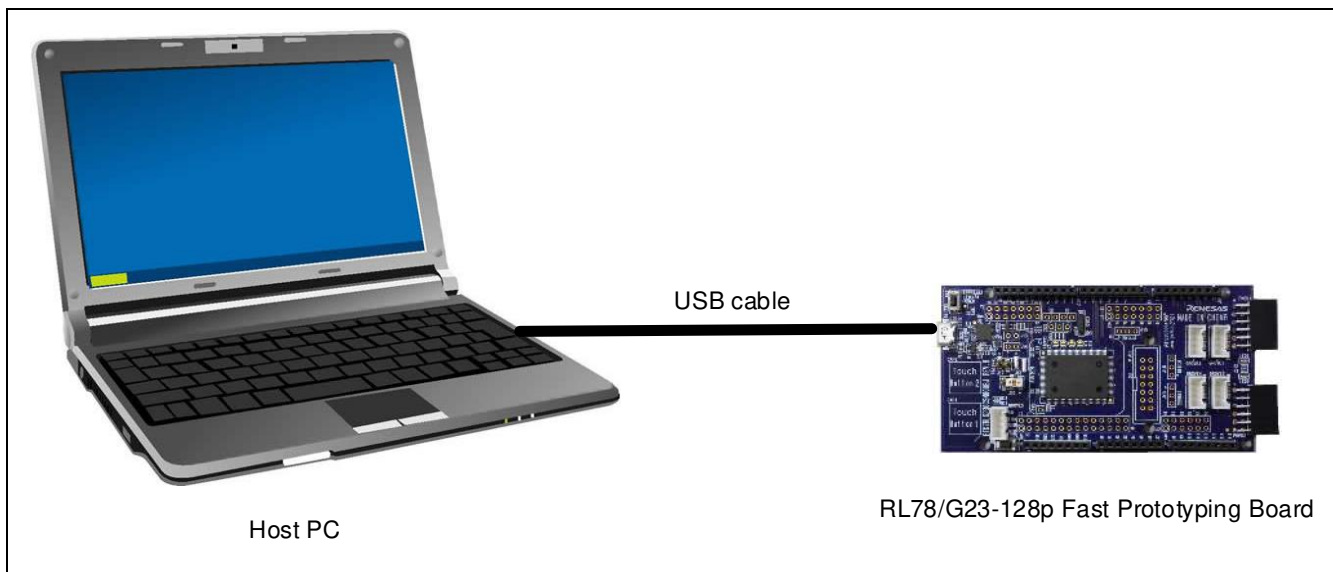


Figure 4-1 Operating Environment

5. User Circuits

5.1 Evaluation MCU

The specifications for the power supply, system clock, and reset of the evaluation MCU (RL78/G23 with 128 pins) at the time of shipment are as follows.

- Power supply: 5 V (VBUS) supplied from the USB (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. It serves as a power-supply input and an interface for communications with the RL78 COM port debug tool (through USB-to-serial conversion). Connect the USB connector to the host PC 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. Do not connect a USB cable while the emulator is supplying power.

5.3 Power LED

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

Note: The LED may not be illuminated when the power supply voltage is 2.2 V or lower.

5.4 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.

- LED1: Pin 67, connected to port P50
- LED2: Pin 68, connected to port P51

Note: The LED may not be illuminated when the power supply voltage is 2.2 V or lower.

5.5 Capacitive Touch Buttons

The capacitive touch buttons can be used for any purpose. Two electrodes (touch button 1 and touch button 2) are mounted on the board and are respectively connected to the following ports.

- Touch button 1: Pin 55, connected to ports P05 and TS10
- Touch button 2: Pin 54, connected to ports P06 and TS11

P30 (pin 66) is connected for the TSCAP pin function by default.

Note: The condition for operating voltage of CTSU2L is $VDD = 1.8\text{ V}$ to 5.5 V . Use capacitive touch buttons that produce voltages within the range $VDD = 1.8\text{ V}$ to 5.5 V .

5.6 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 5-1, Table 5-1, and Table 5-2 show the pin assignments of the Arduino™ connectors.

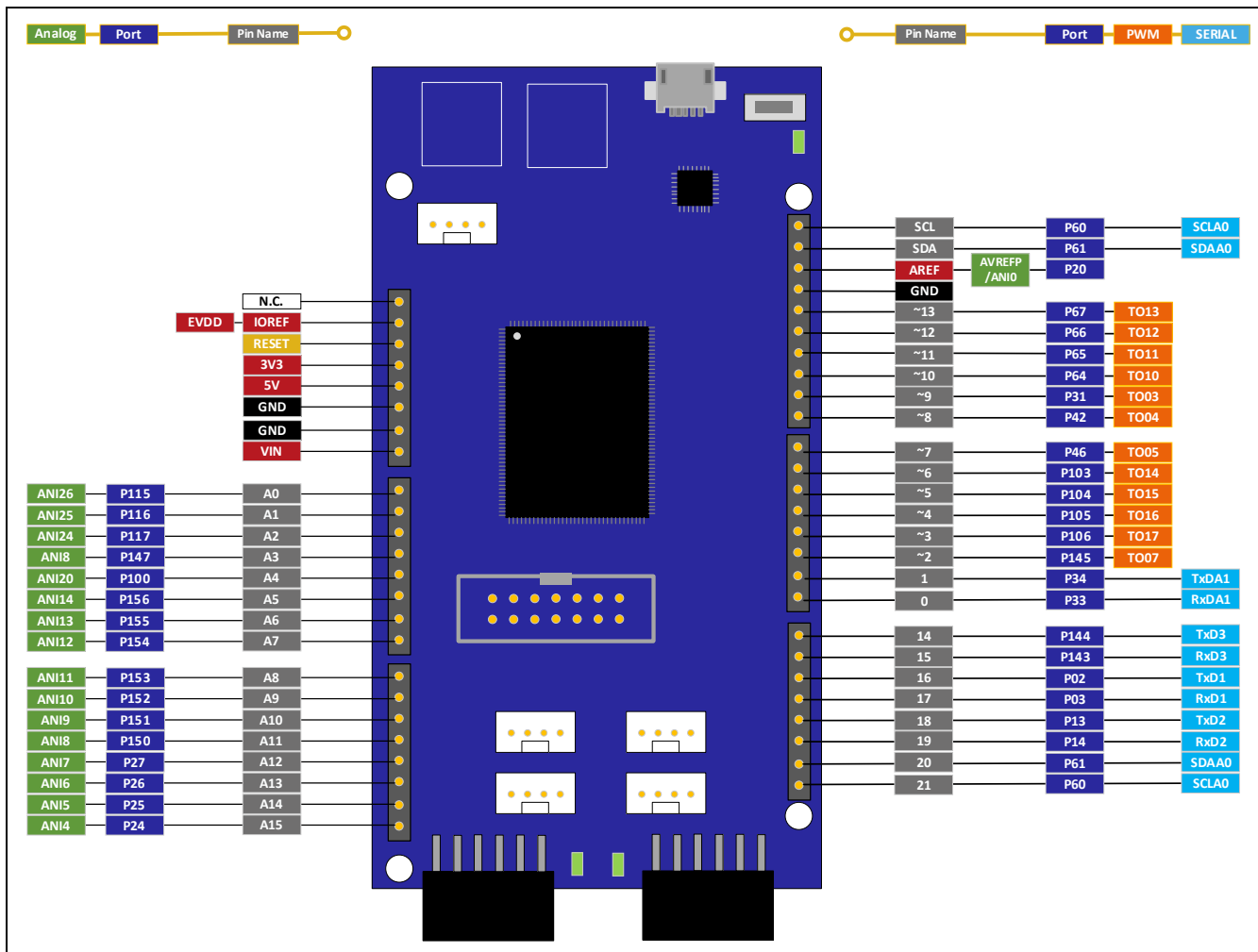


Figure 5-1 Pin Assignments of the Arduino™ Connectors

Table 5-1 Pin Assignments of the Arduino™ Connectors (1/2)

| Part No. in the Circuit Schematics | Name of Arduino™ Signal* | RL78/G23 (128 Pins) | | | | | |
|------------------------------------|--------------------------|---------------------|--------------|------|--------|-----|--------|
| | | Pin | Power Supply | Port | Analog | PWM | Serial |
| J5-1 | N.C. | - | - | - | - | - | - |
| J5-2 | IOREF | 36 | EVDD | - | - | - | - |
| J5-3 | RESET | 26 | - | - | - | - | - |
| J5-4 | 3V3 | - | - | - | - | - | - |
| J5-5 | 5V | - | - | - | - | - | - |
| J5-6 | GND | 33 | VSS | - | - | - | - |
| J5-7 | GND | 33 | VSS | - | - | - | - |
| J5-8 | VIN | - | - | - | - | - | - |
| J6-1 | A0 | 94 | - | P115 | ANI26 | - | - |
| J6-2 | A1 | 95 | - | P116 | ANI25 | - | - |
| J6-3 | A2 | 96 | - | P117 | ANI24 | - | - |
| J6-4 | A3 | 101 | - | P147 | ANI18 | - | - |
| J6-5 | A4 | 102 | - | P100 | ANI20 | - | - |
| J6-8 | A5 | 103 | - | P156 | ANI14 | - | - |
| J6-7 | A6 | 104 | - | P155 | ANI13 | - | - |
| J6-9 | A7 | 105 | - | P154 | ANI12 | - | - |
| J7-1 | A8 | 106 | - | P153 | ANI11 | - | - |
| J7-2 | A9 | 107 | - | P152 | ANI10 | - | - |
| J7-3 | A10 | 108 | - | P151 | ANI9 | - | - |
| J7-4 | A11 | 109 | - | P150 | ANI8 | - | - |
| J7-5 | A12 | 110 | - | P27 | ANI7 | - | - |
| J7-6 | A13 | 111 | - | P26 | ANI6 | - | - |
| J7-7 | A14 | 112 | - | P25 | ANI5 | - | - |
| J7-8 | A15 | 113 | - | P24 | ANI4 | - | - |

Note: The names of the signals correspond to the pin numbers for the Arduino™ IDE. The Arduino™ IDE will be supported in the future.

Table 5-2 Pin Assignments of the Arduino™ Connectors (2/2)

| Part No. in the Circuit Schematics | Name of Arduino™ Signal*1 | RL78/G23 (128 Pins) | | | | | |
|------------------------------------|---------------------------|---------------------|--------------|-------|-----------------|------|--------|
| | | Pin | Power Supply | Port | Analog | PWM | Serial |
| J8-1 | 21 | 37 | - | P60 | - | - | SCLA0 |
| J8-2 | 20 | 38 | - | P61 | - | - | SDAA0 |
| J8-3 | 19 | 78 | - | P14 | - | - | RxD2 |
| J8-4 | 18 | 79 | - | P13 | - | - | TxD2 |
| J8-5 | 17 | 122 | - | P03 | - | - | RxD1 |
| J8-6 | 16 | 123 | - | P02 | - | - | TxD1 |
| J8-7 | 15 | 128 | - | P143 | - | - | RxD3 |
| J8-8 | 14 | 127 | - | P144 | - | - | TxD3 |
| J9-1 | 0 | 9 | - | P33 | - | - | RxDA1 |
| J9-2 | 1 | 8 | - | P34 | - | - | TxDA1 |
| J9-3 | ~2 | 126 | - | P145 | - | TO07 | - |
| J9-4 | ~3 | 11 | - | P106 | - | TO17 | - |
| J9-5 | ~4 | 12 | - | P105 | - | TO16 | - |
| J9-6 | ~5 | 13 | - | P104 | - | TO15 | - |
| J9-7 | ~6 | 14 | - | P103 | - | TO14 | - |
| J9-8 | ~7 | 16 | - | P46 | - | TO05 | - |
| J4-1 | ~8 | 20 | - | P42 | - | TO04 | - |
| J4-2 | ~9 | 41 | - | P31 | - | TO03 | - |
| J4-3 | ~10 | 42 | - | P64 | - | TO10 | - |
| J4-4 | ~11 | 43 | - | P65 | - | TO11 | - |
| J4-5 | ~12 | 44 | - | P66 | - | TO12 | - |
| J4-6 | ~13 | 45 | - | P67 | - | TO13 | - |
| J4-7 | GND | 34 | VSS | GND | - | - | - |
| J4-8 | ADREF | 117 | - | P20*2 | AVREFP /ANI0 | - | - |
| J4-9 | SDA | 38 | - | P61 | - | - | - |
| J4-10 | SCL | 37 | - | P60 | - | - | - |

Notes: 1. The names of the signals correspond to the pin numbers for the Arduino™ IDE. The Arduino™ IDE will be supported in the future.

2. P20 is connected to VDD by default. When P20 is disconnected from VDD, remove the given pattern for cutting (AVREFP).

5.7 Pmod™ Connectors

The specification of the Pmod™ connectors is on the assumption that Pmod™ modules are to be connectable.

Pmod1 is assumed to be connected to Pmod™ Interface Type 2A or 3A and [Wi-Fi Pmod Expansion Board](#) (RTK00WFMX0B00000BE).

Pmod2 is assumed to be connected to the Pmod™ Interface Type 6A module*.

Note: For details on the Pmod module from Renesas, refer to the Web site at: <https://www.renesas.com/quickconnect>.

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.

Figure 5-2, Table 5-3, and Table 5-4 show the pin assignments of the Pmod™ connectors.

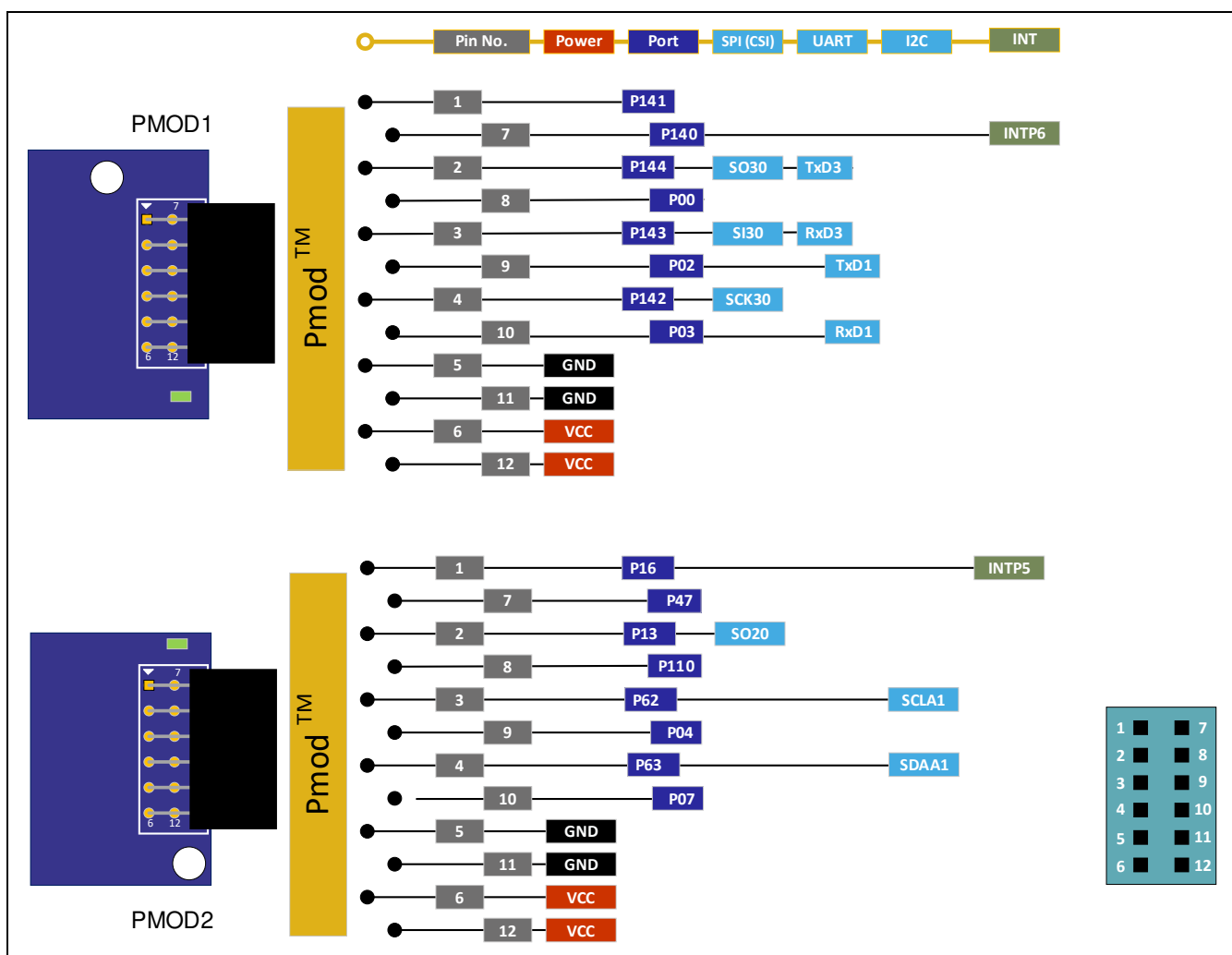


Figure 5-2 Pin Assignments of the Pmod™ Connectors

Table 5-3 Pin Assignments of Pmod™ (Pmod1)

| Pin No. of Pmod™ | Name of Pmod™ Signal | RL78/G23 (128 Pins) | | | | | |
|------------------|----------------------|---------------------|--------------|------------|-----------|------|--------------|
| | | Pin | Power Supply | Port | SPI (CSI) | UART | I2C |
| 1 | CTS | 2 | - | P141 | - | - | - |
| 2 | TXD | 127 | - | P144 | SO30 | TxD3 | - |
| 3 | RXD | 128 | - | P143 | SI30 | RxD3 | (P60/SCLA0)* |
| 4 | RTS | 1 | - | P142 | SCK30 | - | (P61/SDAA0)* |
| 5 | GND | - | VSS | - | - | - | - |
| 6 | VCC | - | EVDD | - | - | - | - |
| 7 | INT | 3 | - | P140/INTP6 | - | - | - |
| 8 | RESET | 125 | - | P00 | - | - | - |
| 9 | GPIO | 123 | - | P02 | - | TxD1 | |
| 10 | GPIO | 122 | - | P03 | - | RxD1 | |
| 11 | GND | - | VSS | - | - | - | - |
| 12 | VCC | - | EVDD | - | - | - | - |

Note: These signals can be used as Type 6A (I2C) by removing the patterns for cutting to disconnect P142 and P143 and short-circuiting the pads P60 and P61.

Table 5-4 Pin Assignments of Pmod™ (Pmod2)

| Pin No. of Pmod™ | Name of Pmod™ Signal | RL78/G23 (128 Pins) | | | | | |
|------------------|----------------------|---------------------|--------------|-----------|--------------|-------------|-------|
| | | Pin | Power Supply | Port | SPI (CSI) | UART | I2C |
| 1 | INT | 76 | - | P16/INTP5 | - | - | - |
| 2 | RESET | 79 | - | P13 | SO20 | TxD2 | - |
| 3 | SCL | 39 | - | P62 | (P14/SI20)* | (P14/RxD2)* | SCLA1 |
| 4 | SDA | 40 | - | P63 | (P15/SCK20)* | - | SDAA1 |
| 5 | GND | - | VSS | - | - | - | - |
| 6 | VCC | - | EVDD | - | - | - | - |
| 7 | IO1 | 15 | - | P47 | - | - | - |
| 8 | IO2 | 98 | - | P110 | - | - | - |
| 9 | IO3 | 121 | - | P04 | - | - | - |
| 10 | IO4 | 120 | - | P07 | - | - | - |
| 11 | GND | - | EVSS | - | - | - | - |
| 12 | VCC | - | VDD | - | - | - | - |

Note: These signals can be used as Type 2A or 3A (CSI or UART) by removing the patterns for cutting to disconnect P62 and P63 and short-circuiting the pads P14 and P15.

5.8 MCU Headers

The MCU headers are provided as through holes; J1 includes the headers for a total of 28 pins, J2 includes the headers for a total of 12 pins, and J3 and J4 include the headers for a total of 14 pins. The pin headers have a pitch of 2.54 mm and the evaluation MCU is connected to the through holes for the headers.

Note that a multiplexed pin function of Arduino™ signal 22 is for use as pin 5 of the emulator connector (J11). Table 5-5 to Table 5-8 show the pin assignments of the MCU headers.

Table 5-5 Pin Assignments of the MCU Headers (J11 and J1)

| Part No. in the Circuit Schematics | Name of Arduino™ Signal*1 | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------------|---------------------|--------------|---|----------------|
| | | Pin | Power Supply | Port and Peripheral Modules | Others |
| J11-5 | 22 | 22 | - | P40 | TOOL0 |
| J1-1 | - | 56 | EVSS1 | - | - |
| J1-2 | - | 57 | EVDD1 | - | - |
| J1-3 | 23 | 58 | - | P80/(SCK10)/(SCL10) | - |
| J1-4 | 24 | 55 | - | P05/TS10*2 | Touch button 1 |
| J1-5 | 25 | 59 | - | P81/(SI10)/(RxD1)/(SDA10) | - |
| J1-6 | 26 | 60 | - | P82/(SO10)/(TxD1) | - |
| J1-7 | 27 | 63 | - | P85/(INTP7)/CLKA0 | - |
| J1-8 | 28 | 64 | - | P86/(INTP8) | - |
| J1-9 | - | - | - | - | - |
| J1-10 | 29 | 65 | - | P87/(INTP9) | - |
| J1-11 | 30 | 66 | - | P30/INTP3/TSCAP/RTC1HZ/EI30/VCOUT0*3 | TSCAP |
| J1-12 | 31 | 67 | - | P50/CCD03/TS00/EI50/EO50 | LED1 |
| J1-13 | 32 | 68 | - | P51/CCD02/EI51/EO51 | LED2 |
| J1-14 | 33 | 69 | - | P52/SO31 | - |
| J1-15 | 34 | 70 | - | P53/SI31/SDA31 | - |
| J1-16 | 35 | 71 | - | P54/SCK31/SCL31 | - |
| J1-17 | 36 | 72 | - | P55/(PCLBUZ1)/(SCK00) | - |
| J1-18 | 37 | 73 | - | P56/(INTP1) | - |
| J1-19 | 38 | 74 | - | P57/(INTP3) | - |
| J1-20 | 39 | 75 | - | P17/CCD01/TI02/TO02/EO17/(SO00)/(TxD0) | - |
| J1-21 | 40 | 80 | - | P12/SO00/TxD0/TOOLTxD/EI12/EO12/(INTP5)/(TI05)/(TO05) | TOOLTxD |
| J1-22 | 41 | 81 | - | P11/SI00/RxD0/TOOLRxD/SDA00/EI11/EO11/(TI06)/(TO06) | TOOLRxD |
| J1-23 | 42 | 82 | - | P10/SCK00/SCL00/EI10/EO10/(TI07)/(TO07) | - |
| J1-24 | 43 | 83 | - | P90 | - |
| J1-25 | 44 | 84 | - | P91 | - |
| J1-26 | 45 | 85 | - | P92 | - |
| J1-27 | 46 | 86 | - | P93 | - |
| J1-28 | 47 | 87 | - | P94 | - |

- Notes:
1. The names of the Arduino™ signals correspond to the pin numbers for the Arduino™ IDE. The Arduino™ IDE will be supported in the future.
 2. P05 is connected to touch button 1 (CAP1) by default. When P05 is to be used as a port pin, short-circuit the pad [P05].
 3. P30 is connected to TSCAP (C1) by default. When P30 is to be used as a port pin, short-circuit the pad [P30].

Table 5-6 Pin Assignments of the MCU Headers (J2)

| Part No. in the Circuit Schematics | Name of Arduino™ Signal*1 | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------------|---------------------|--------------|--------------------------------|--------|
| | | Pin | Power Supply | Port and Peripheral Modules | Others |
| J2-1 | 48 | 90 | - | P97/SO11 | - |
| J2-2 | 49 | 91 | - | P112 | - |
| J2-3 | 50 | 92 | - | P113 | - |
| J2-4 | 51 | 93 | - | P114 | |
| J2-5 | 52 | 97 | - | P101 | - |
| J2-6 | 53 | 99 | - | P111/(INTP11) | - |
| J2-7 | 54 | 100 | - | P146/(INTP4) | - |
| J2-8 | 55 | 114 | - | P23/ANI3/ANO1/IVREF0/EI23/TS21 | - |
| J2-9 | 56 | 115 | - | P22/ANI2/ANO0/EI22/TS20 | - |
| J2-10 | 57 | 116 | - | P21/ANI1/AVREFM/EI21*2 | GND |
| J2-11 | 58 | 118 | - | P130 | - |
| J2-12 | 59 | 119 | - | P102/TI06/TO06 | - |

Notes: 1. The names of the Arduino™ signals correspond to the pin numbers for the Arduino™ IDE. The Arduino™ IDE will be supported in the future.

2. P21 is connected to GND by default. When P21 is to be disconnected from GND, remove the given pattern for cutting (AVREFM).

Table 5-7 Pin Assignments of the MCU Headers (J3)

| Part No. in the Circuit Schematics | Name of Arduino™ Signal*1 | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------------|---------------------|--------------|-------------------------------|----------------|
| | | Pin | Power Supply | Port and Peripheral Modules | Others |
| J3-1 | 62 | 54 | - | P06/TS11*2 | Touch button 2 |
| J3-2 | 63 | 29 | - | P137/INTP0/EI137 | SW1 |
| J3-3 | 64 | 53 | - | P70/KR0/TS02/RIN0/SCK21/SCL21 | - |
| J3-4 | 65 | 52 | - | P71/KR1/TS03/SI21/SDA21 | |
| J3-5 | 66 | 51 | - | P72/KR2/TS04/SO21 | - |
| J3-6 | 67 | 50 | - | P73/KR3/TS05 | - |
| J3-7 | 68 | 49 | - | P74/KR4/TS06/INTP8 | - |
| J3-8 | 69 | 48 | - | P75/KR5/TS07/INTP9 | - |
| J3-9 | 70 | 47 | - | P76/KR6/TS08/INTP10/(RxD2) | - |
| J3-10 | 71 | 46 | - | P77/KR7/TS09/INTP11/(TxD2) | - |
| J3-11 | - | 35 | VDD | - | - |
| J3-12 | - | 33 | VSS | - | - |
| J3-13 | 72 | 31 | - | P121/X1/EI121/VBAT | |
| J3-14 | 73 | 30 | - | P122/X2/EXCLK/EI122 | |

- Notes: 1. The names of the Arduino™ signals correspond to the pin numbers for the Arduino™ IDE. The Arduino™ IDE will be supported in the future.
2. P06 is connected to touch button 2 (CAP2) by default. When P06 is to be used as a port pin, short-circuit the pad [P06].

Table 5-8 Pin Assignments of the MCU Headers (J4)

| Part No. in the Circuit Schematics | Name of Arduino™ Signal*1 | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------------|---------------------|--------------|-----------------------------|-----------|
| | | Pin | Power Supply | Port and Peripheral Modules | Others |
| J4-1 | 74 | 28 | - | P123/XT1*2 | Sub-clock |
| J4-2 | 75 | 27 | - | P124/XT2/EXCLKS*3 | Sub-clock |
| J4-3 | 76 | 25 | - | P125 | - |
| J4-4 | 77 | 24 | - | P126 | |
| J4-5 | 78 | 23 | - | P127 | - |
| J4-6 | 79 | 21 | - | P41 | - |
| J4-7 | 80 | 17 | - | P45/SO01 | - |
| J4-8 | 81 | 10 | - | P32/CLKA1 | - |
| J4-9 | 82 | 7 | - | P35/ANI23 | - |
| J4-10 | 83 | 6 | - | P36/ANI22 | - |
| J4-11 | 84 | 5 | - | P37/ANI21 | - |
| J4-12 | 85 | 4 | - | P120/ANI19/IVCMP1/EI120 | - |
| J4-13 | 86 | 124 | - | P01/TS27/EI01/EO01/TO00 | - |
| J4-14 | - | - | - | - | - |

- Notes:
1. The names of the Arduino™ signals correspond to the pin numbers for the Arduino™ IDE. The Arduino™ IDE will be supported in the future.
 2. P123 is connected to the XT1 sub-clock by default. When P123 is to be used as a port pin, remove the pattern for cutting [XT1] and short-circuit the pad [P123].
 3. P124 is connected to the XT2 sub-clock by default. When P124 is to be used as a port pin, remove the pattern for cutting [XT2] and short-circuit the pad [P124].

5.9 Grove Connector

The specification of the grove connector is on the assumption that Grove modules are to be connectable; GROVE1 to GROVE4 are for connection through I2C and GROVE5 is for connection through a UART. If a connector is mounted, however, connection to all Grove modules (through I2C or UART) is not guaranteed. Use this connector after having confirmed the specifications of this product and Grove modules (through I2C or UART) you intend to use.

Figure 5-3 and Table 5-9 to Table 5-13 show the pin assignments of the Grove connector.

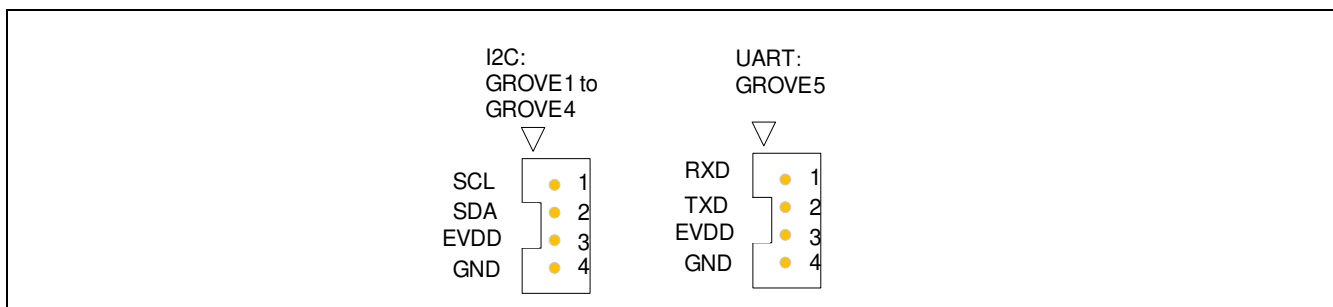


Figure 5-3 Pin Assignments of the Grove Connector

Table 5-9 Pin Assignments of the GROVE1 Connector

| Part No. in the Circuit Schematics | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------|--------------|------|-------|
| | Pin | Power Supply | Port | I2C |
| GROVE1-1 | 37 | - | P60 | SCLA0 |
| GROVE1-2 | 38 | - | P61 | SDAA0 |
| GROVE1-3 | - | EVDD | - | - |
| GROVE1-4 | - | GND | - | - |

Table 5-10 Pin Assignments of the GROVE2 Connector

| Part No. in the Circuit Schematics | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------|--------------|------|-------|
| | Pin | Power Supply | Port | I2C |
| GROVE2-1 | 77 | - | P15 | SCL20 |
| GROVE2-2 | 78 | - | P14 | SDA20 |
| GROVE2-3 | - | EVDD | - | - |
| GROVE2-4 | - | GND | - | - |

Table 5-11 Pin Assignments of the GROVE3 Connector

| Part No. in the Circuit Schematics | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------|--------------|------|-------|
| | Pin | Power Supply | Port | I2C |
| GROVE3-1 | 19 | - | P43 | SCL01 |
| GROVE3-2 | 18 | - | P44 | SDA01 |
| GROVE3-3 | - | EVDD | - | - |
| GROVE3-4 | - | GND | - | - |

Table 5-12 Pin Assignments of the GROVE4 Connector

| Part No. in the Circuit Schematics | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------|--------------|------|-------|
| | Pin | Power Supply | Port | I2C |
| GROVE4-1 | 88 | - | P95 | SCL11 |
| GROVE4-2 | 89 | - | P96 | SDA11 |
| GROVE4-3 | - | EVDD | - | - |
| GROVE4-4 | - | GND | - | - |

Table 5-13 Pin Assignments of the GROVE5 Connector

| Part No. in the Circuit Schematics | RL78/G23 (128 Pins) | | | |
|------------------------------------|---------------------|--------------|------|-------|
| | Pin | Power Supply | Port | I2C |
| GROVE5-1 | 62 | - | P84 | RXDA0 |
| GROVE5-2 | 61 | - | P83 | TXDA0 |
| GROVE5-3 | - | EVDD | - | - |
| GROVE5-4 | - | GND | - | - |

5.10 Clock

Clock circuits are provided to handle the clock sources for the evaluation MCU. For details on the specifications of the evaluation MCU clocks, refer to the RL78/G23 User's Manual: Hardware. For details on the clock circuit of this product, refer to the circuit schematics of the RL78/G23-128p Fast Prototyping Board. Table 5-14 shows the details of the clocks on the RL78/G23-128p Fast Prototyping Board.

Table 5-14 Details of Clocks

| Clock | Function and Usage | State as Shipped | Frequency | Package for the Oscillator |
|-------|--|------------------|------------|----------------------------|
| OSC1 | Crystal oscillator for the main system clock (e.g. CSTNE20M0V5 from Murata Manufacturing Co., Ltd.) | Not mounted | n/a | SMT |
| OSC2 | Crystal oscillator or ceramic resonator for the main system clock | Not mounted | n/a | Lead type |
| OSC3 | Crystal oscillator for the sub-clock | Mounted | 32.768 kHz | SMT |

5.11 Reset Switch

Pressing the reset switch (RST) applies a hardware reset to the evaluation MCU.

5.12 User Switch

An optional user switch (SW) is mounted. It is connected to pin 29 of the evaluation MCU, which operates as pin function P137. The INTP0 interrupt is multiplexed on the same pin.

5.13 USB-to-Serial Converter

A USB-to-serial converter (FT232RQ) from FTDI is mounted on the board and is usable with the standard driver of Windows 10. For other operating systems, install the driver by downloading from the following Web site of FTDI.

<http://www.ftdichip.com/Drivers> -> VCP Drivers

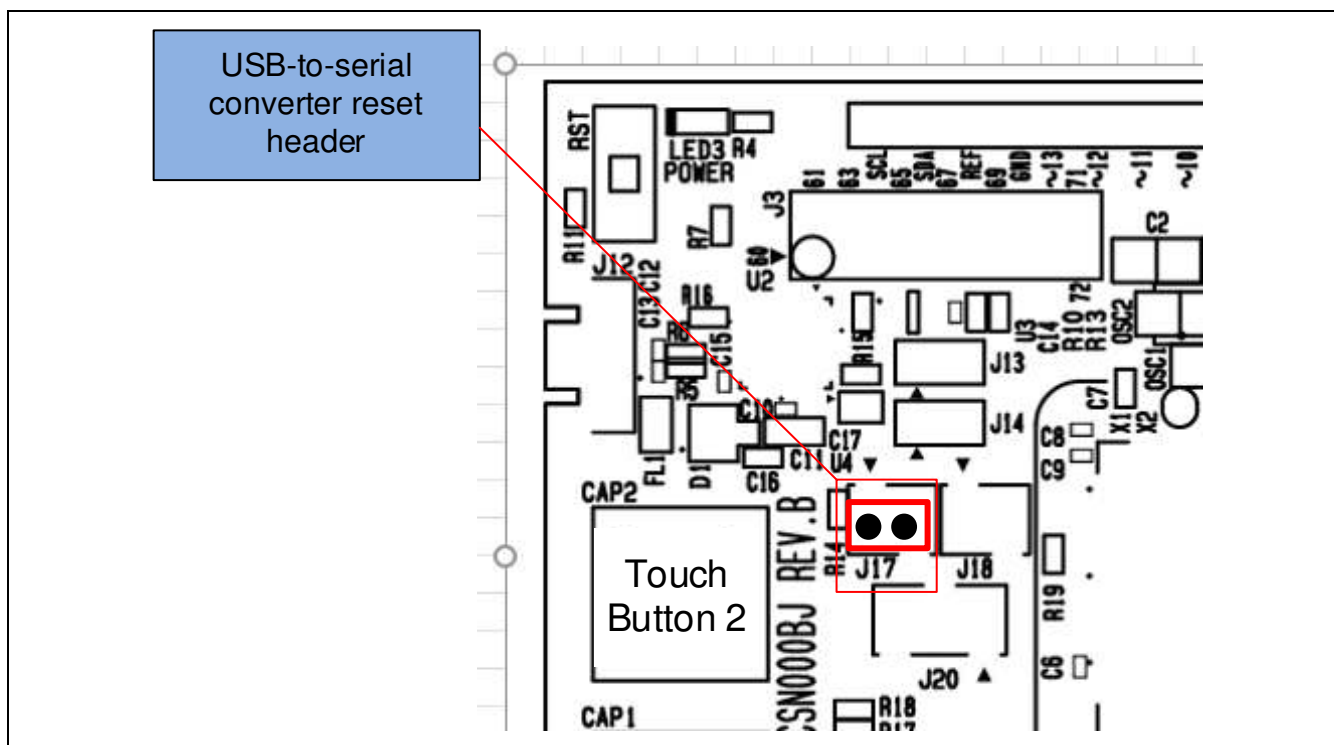
The USB-to-serial converter reset header (J17) is open-circuit; it is recognized as a COM port when the host PC is connected to this board via a USB cable.

As the interface with the RL78 COM port debug tool, the USB-to-serial converter enables debugging and programming of the evaluation MCU. Refer to Chapter 7, Developing Code. Note that the P40, P11, and P12 pins of the evaluation MCU are respectively occupied as the TOOL0, TOOLRxD, and TOOLTxD functions.

When the USB-to-serial converter is not used as the interface with the RL78 COM port debug tool, using the RxD0 and TxD0 functions of the P11 and P12 pins enables UART communications between the host PC and the evaluation MCU. The user needs to prepare the terminal software, such as TeraTerm.

5.14 USB-to-Serial Converter Reset Header

The USB-to-serial converter is placed in the forced reset state by short-circuiting its reset header (J17). If the evaluation MCU alone is to operate without the use of the RL78 COM port debug tool, place the USB-to-serial converter in the reset state. This allows the use of P11 (RxD0) and P12 (TxD0) as facilities other than for a UART, such as port pins, while a reset is being applied to the USB-to-serial converter. Even if P11 and P12 are used as facilities other than for a UART, such as port pins, the board must be connected to the host PC by using the USB cable. Figure 5-4 shows the position of the USB-to-serial converter reset header.



5.15 Power-Supply Selection Header

The operating power (VDD) of the evaluation MCU can be changed to supply from the emulator or external power, and to 5 V or 3.3 V with the use of a header (J20). Only change the jumper setting of J20 while power is not being supplied.

- 1-2 of J20 being short-circuit selects a 5-V power supply. This is the default setting as shipped (Figure 5-5).
- 2-3 of J20 being short-circuit selects a 3.3-V power supply (Figure 5-6).
- J20 being open-circuit selects supply from the emulator or external power. (Figure 5-7).

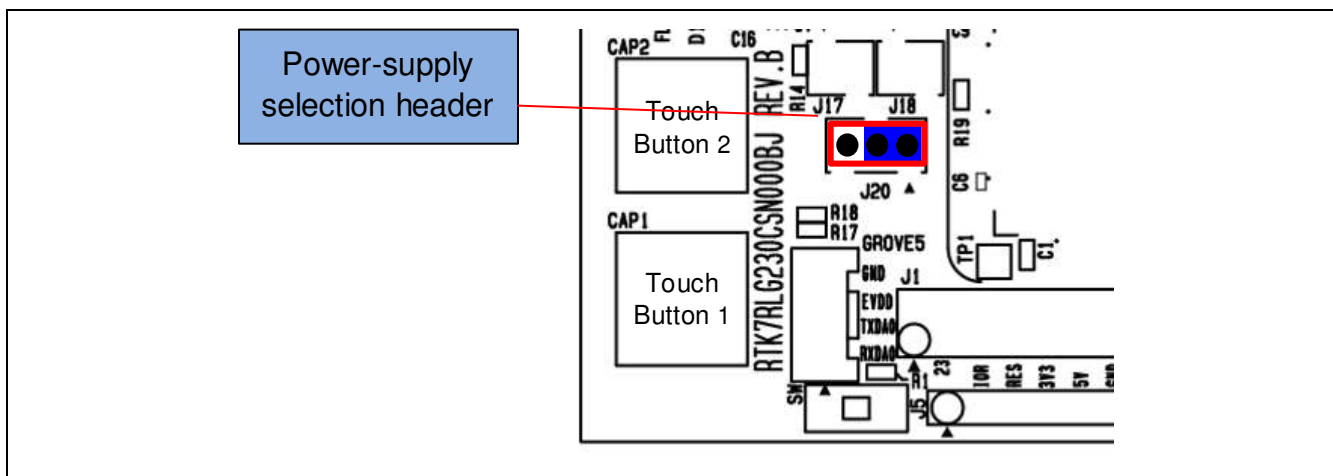


Figure 5-5 Setting of the Header to Select a 5-V Power Supply (Top Side)

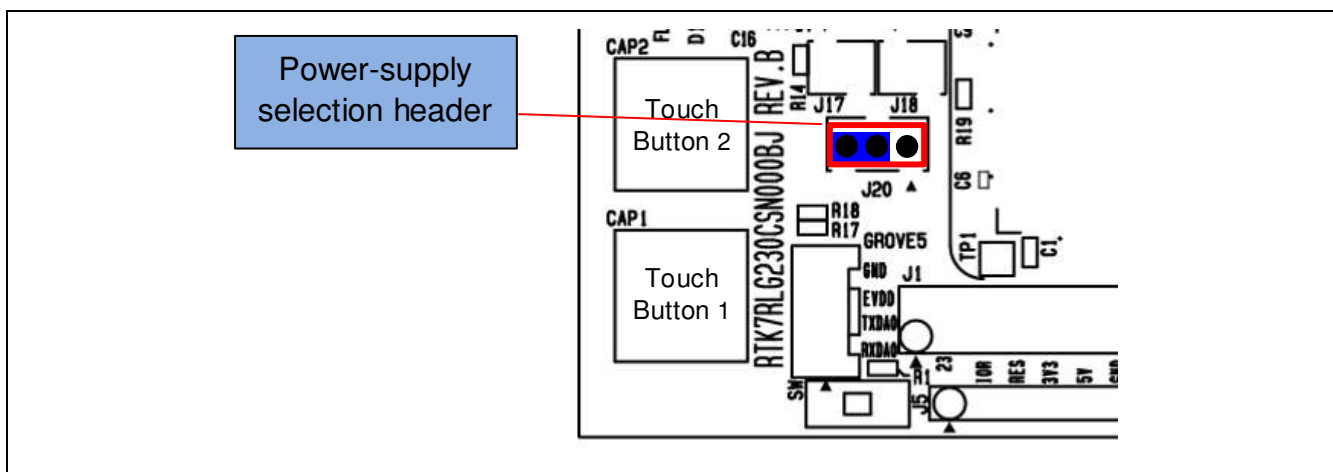


Figure 5-6 Setting of the Header to Select a 3.3-V Power Supply (Top Side)

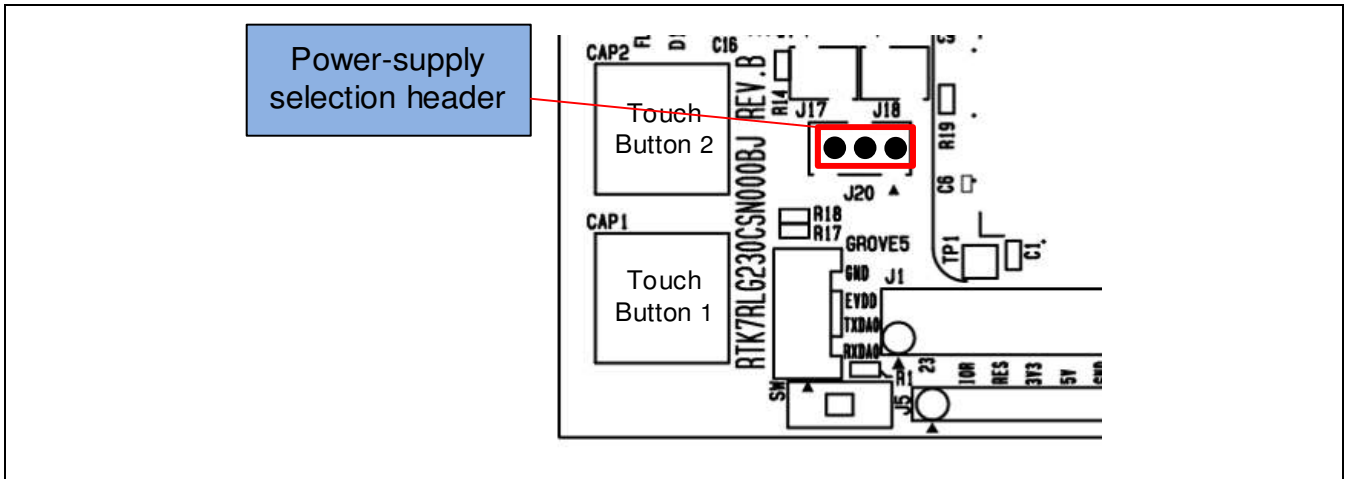


Figure 5-7 Setting of the Header to Select Supply from the Emulator or External Power (Top Side)

5.16 External Power Supply

When the evaluation MCU is to have a desired power-supply voltage, or when more current is required, use an external power supply. The usable voltages depend on the evaluation MCU.

Destinations for the connection of an external power supply:

- EVDD1: pin J1-2 on the MCU header; or VDD: pin J3-11 on the MCU header
- EVSS1: pin J1-1 on the MCU header; or VSS: pin J3-12 on the MCU header

Figure 5-8 shows the positions of the external power supply.

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

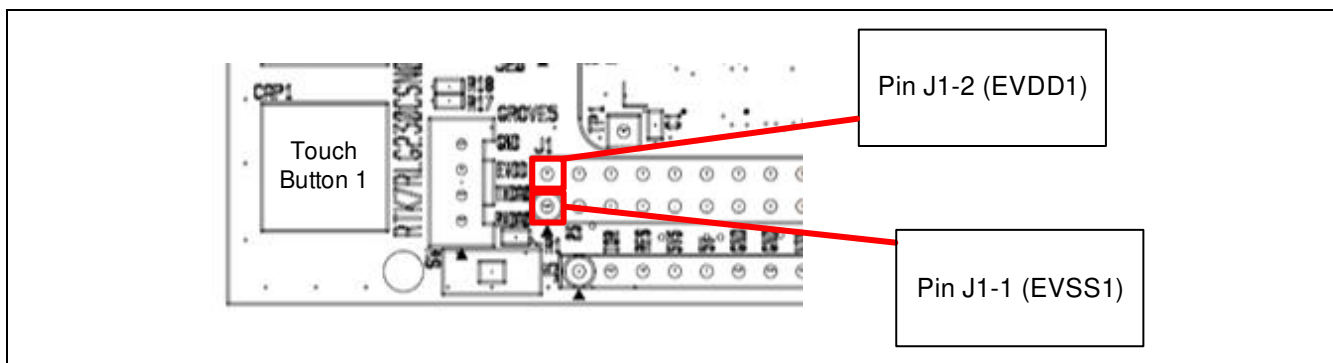


Figure 5-8 Positions of the Destinations for Connection of an External Power Supply (Top Side)

5.17 Current Measurement Header

This header (J13) is used to measure the current drawn by the evaluation MCU (J13 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 pattern for cutting (VDD) if this header is to be used. Figure 5-9 shows the positions of the current measurement header and pattern for cutting.

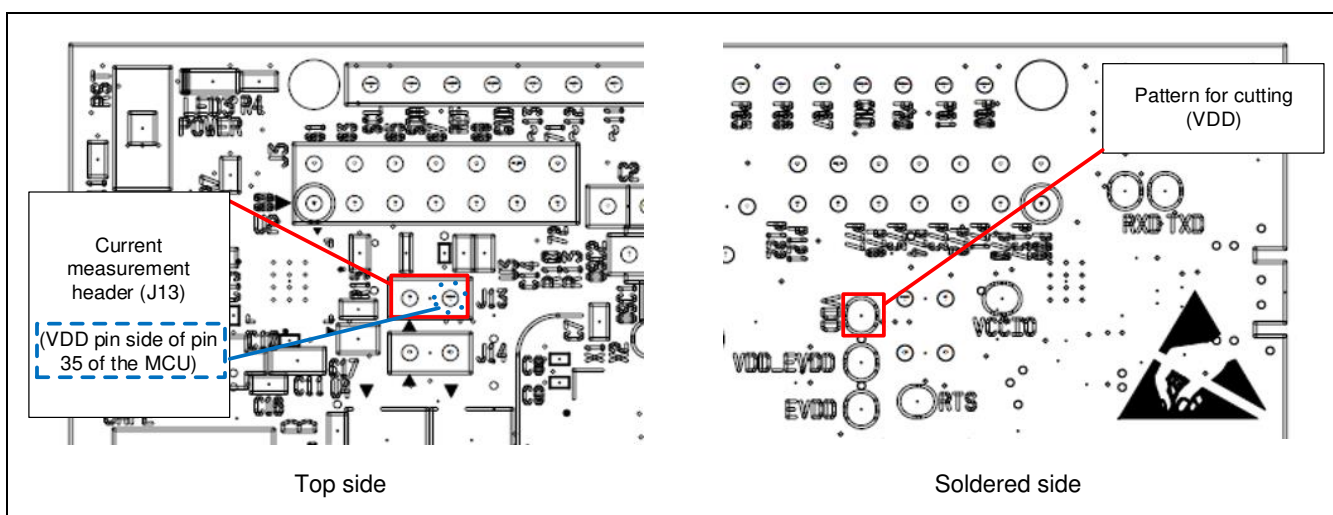


Figure 5-9 Positions of the Current Measurement Header (J13) and Pattern for Cutting (VDD)

Insert an ammeter between the sockets of the current measurement header (J13) to measure the current. Remove the pattern for cutting (VCCIO) (Figure 5-12) and turn down the LED to reduce the current drawn with an MCU other than the evaluation MCU.

When the current is to be measured with EVDD turned off and the MCU in a low-power state, remove the pattern for cutting (VDD_EVDD) (Figure 5-11) to separate VDD from EVDD.

Figure 5-10 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.

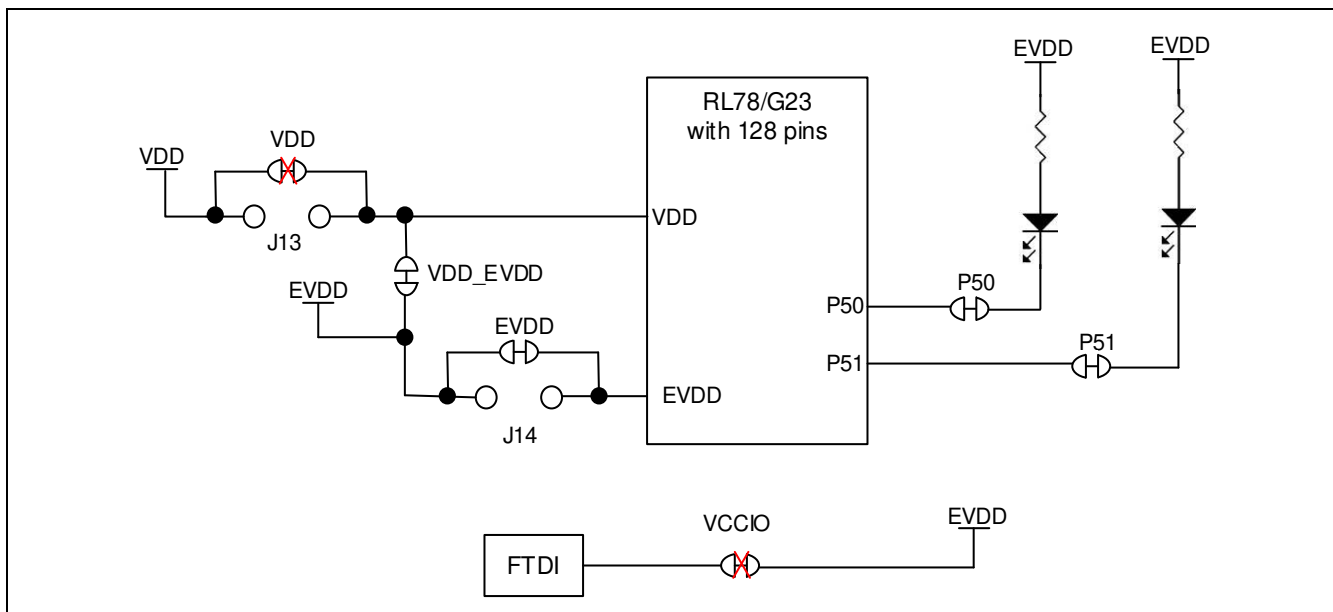


Figure 5-10 Block Diagram of the Headers Related to Current Measurement

5.18 Separate Pattern for VDD and EVDD

When VDD and EVDD are to be used with different potentials, remove the given pattern for cutting (VDD_EVDD). Figure 5-11 shows the position of the pattern for cutting.

Destination for the connection of an external power supply of EVDD to the source with a different potential:

- EVDD1 side: pin J1-2 on the MCU header

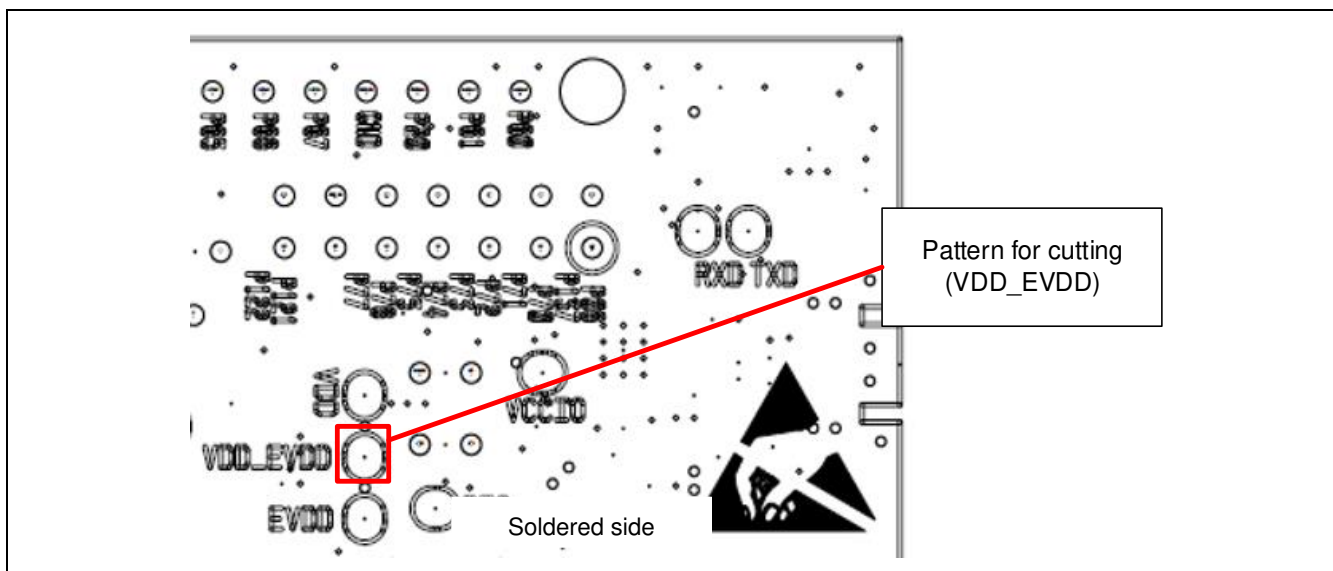


Figure 5-11 Position of the Pattern for Cutting (VDD_EVDD)

5.19 Pattern for Cutting the I/O Power Supply for the USB-to-Serial Converter

If you intend to use this board without connecting a USB connector, remove the given pattern for cutting (VCCIO). Figure 5-12 shows the position of the pattern for cutting.

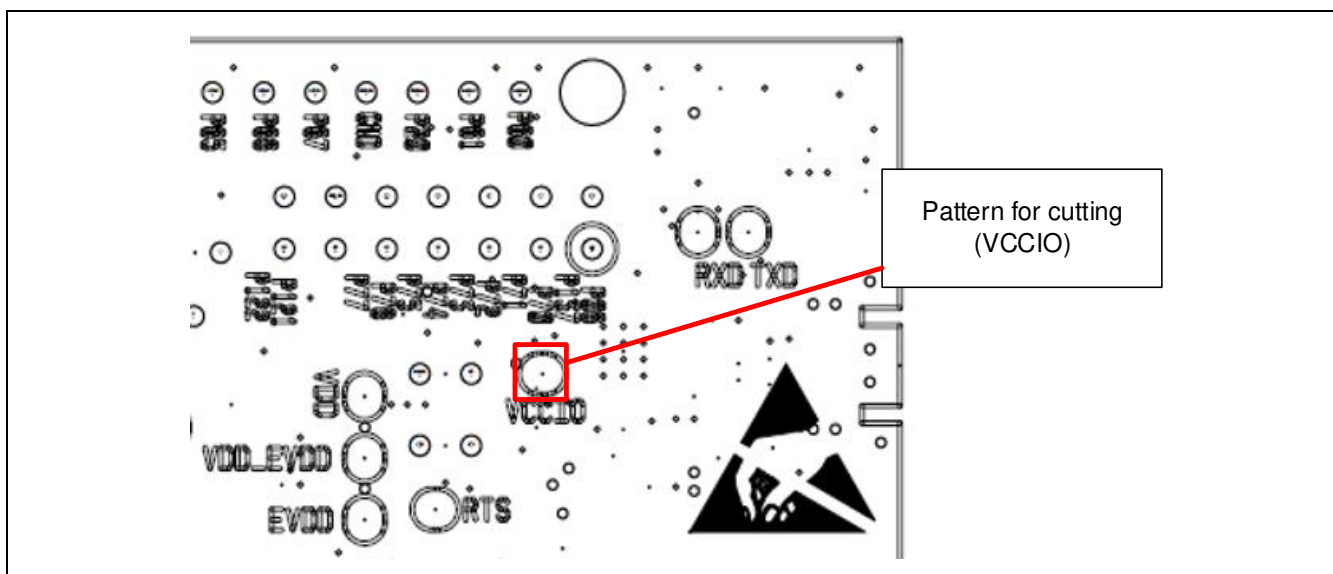


Figure 5-12 Position of the Pattern for Cutting (VCCIO)

5.20 Emulator Connector

This 14-pin connector (J11) is used to connect this product to an on-chip debugging E2 emulator or E2 emulator Lite, from Renesas Electronics, incorporating programming facilities (the connector is not mounted). The emulator is used for programming or debugging the evaluation MCU.

To connect the emulator, change the circuit as follows.

- J11: 14-pin connector must be mounted.
- J15, J16, and J19: pins 2-3 are short-circuit
- Pattern for cutting [TOOL0_USB]: removed
- Pattern for cutting [RESET]: removed
- Pattern for cutting [T_RESET]: removed

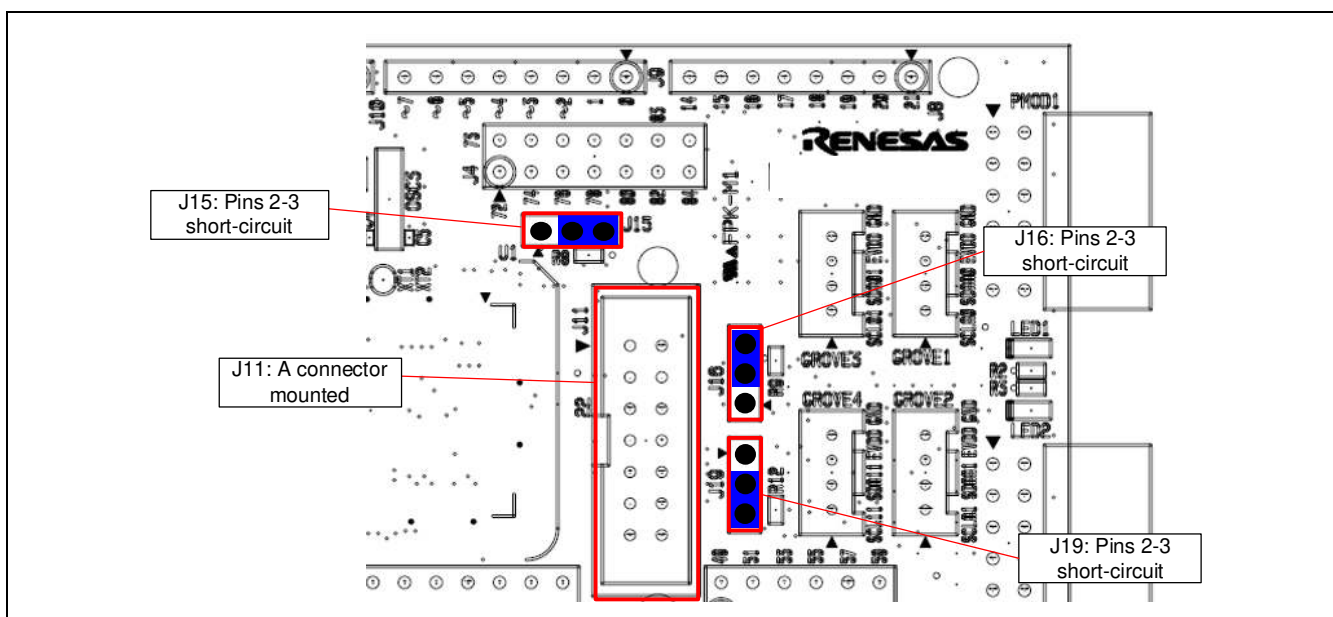


Figure 5-13 Settings for Use with the Emulator Connector (Top Side)

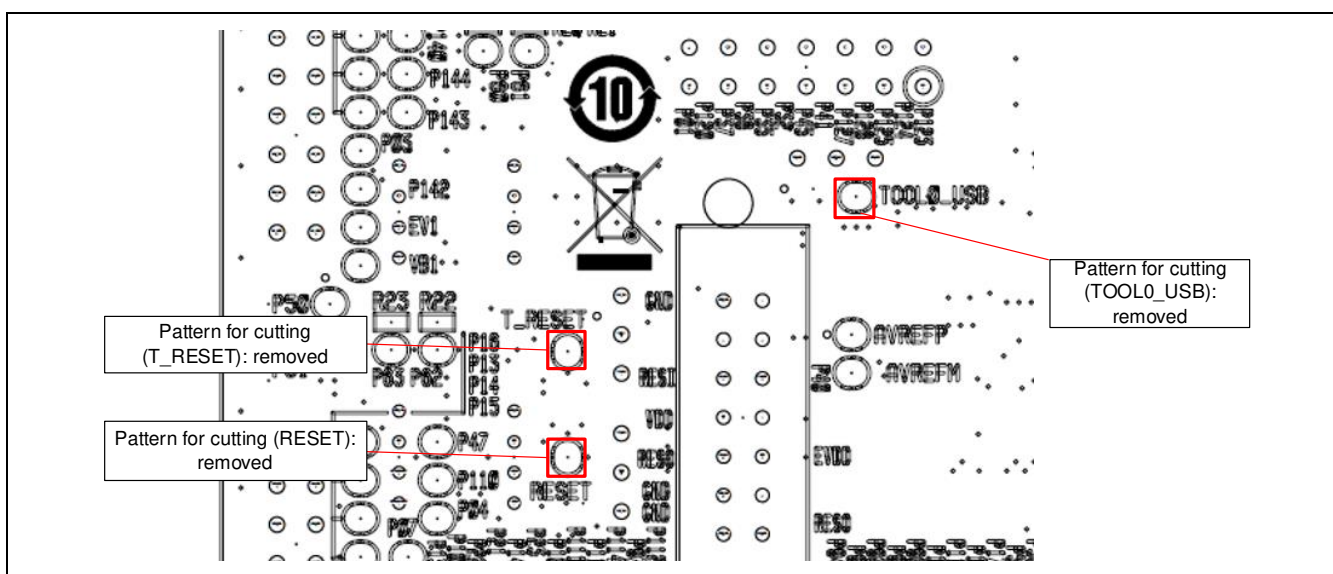


Figure 5-14 Settings for Use with the Emulator Connector (Soldered Side)

For the usage of the emulator, refer to the E1/E20/E2 Emulator, E2 emulator Lite Additional Document for User's Manual (Notes on Connection of RL78) (R20UT1994).

After the changes to the circuit have been made to connect the emulator as described in the previous page, if you want to restore the settings to those for COM port debugging with the use of the USB-to-serial converter, make the following change of setting as follows.

- J15, J16, and J19: pins 1-2 are short-circuit

For the patterns for cutting that were removed on the previous page, solder need not to be applied.

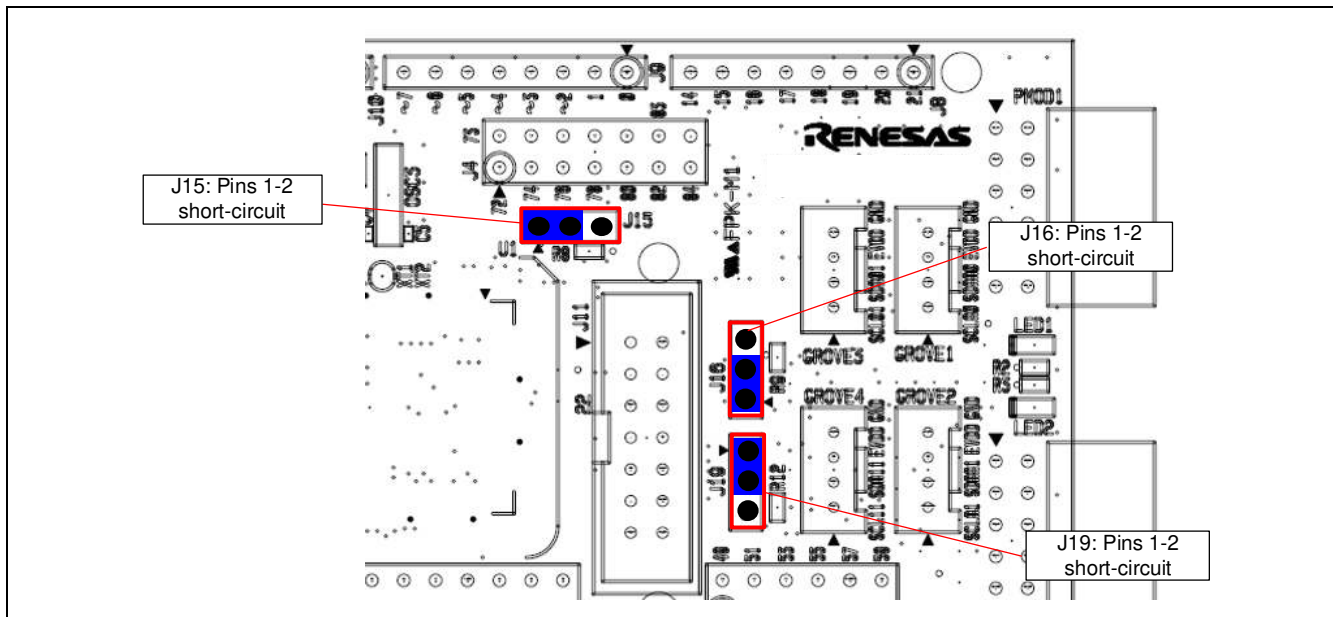


Figure 5-15 Settings for Use with COM Port Debugging (Top Side)

6. Handling Precautions

6.1 Power to be Supplied

When power is supplied to this product from an emulator or through the USB, note that the total current of VDD, EVDD, 5 V, and 3.3 V should not exceed the maximum current 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.

The following shows the settings of jumpers as shipped.

- J17: open-circuit
- J20: pins 1-2 are short-circuit

6.3 Power Supplies and Usage Conditions

Different power supplies can be selected. Table 6-1 shows the relationship between power-supply sources and usage conditions.

Figure 6-1 shows the block diagram of the power-supply circuit.

Table 6-1 Power-Supply Sources and Usage Conditions

| Power-Supply Source | Usage Condition | | | | |
|--------------------------------|--------------------------------------|---------------------------------------|--|----------------------------|---|
| | Power supplied to the evaluation MCU | Use of Arduino™ shields* ¹ | Use of Pmod or Grove modules* ¹ | Use of an emulator and IDE | Jumper setting* ² |
| USB* ⁴ (default) | 5 V or 3.3 V | Possible | Possible | Possible* ³ | Not required <ul style="list-style-type: none"> • J20: 1-2 short-circuit: 5 V (default) Required <ul style="list-style-type: none"> • J20: 2-3 short-circuit: 3.3 V |
| External power supply | 1.6 V to 5.5 V | Possible | Possible | Possible* ³ | Not required <ul style="list-style-type: none"> • J20: open-circuit |
| Emulator | E2 Lite: 3.3 V E2: 1.8 V to 5.0 V | Not possible | Possible | Possible | Not required <ul style="list-style-type: none"> • J20: open-circuit |

- Notes: 1. Connecting the RL78/G23-128p Fast Prototyping Board to an Arduino™ shield, a Pmod module, or a Grove module shall be conducted at the user's own responsibility and should only proceed after confirming the specifications of the power supply and interfaces. When an Arduino™ shield requires the supply of 5-V or 3.3-V power, connect the host PC to this board via the USB cable.
2. Requirements for modifications after shipment are stated in this column.
3. Use the IDE in a state where power is being supplied from a source other than the emulator.
4. If power to be supplied to this product other than via the USB, remove the pattern for cutting (VCCIO).

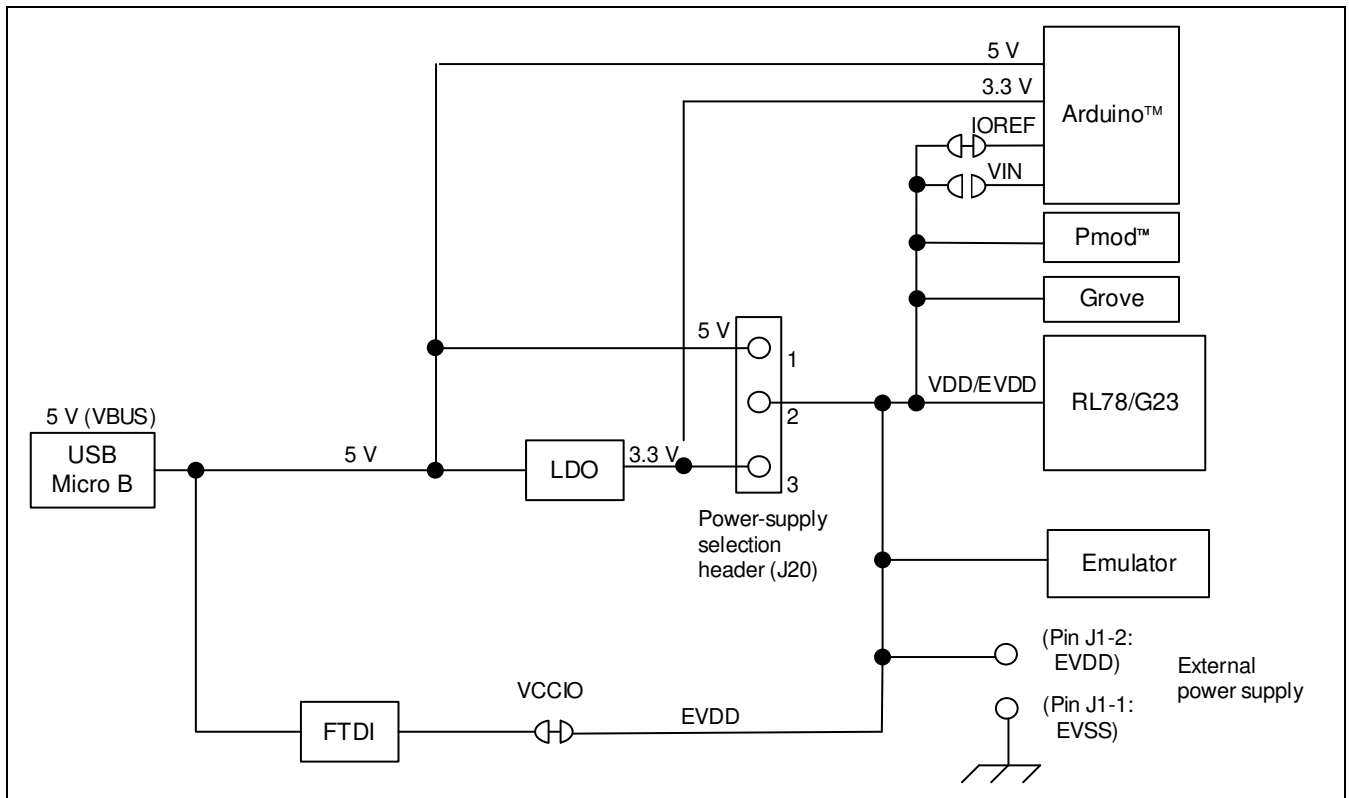


Figure 6-1 Block Diagram of the Power-Supply Circuit

6.4 Note on Using QE for Capacitive Touch

When you are using QE for Capacitive Touch (QE) with this product, change the circuits in the following cases (1) and (2).

For the methods for developing touch applications with the use of QE, refer to the application note “RL78 Family Using QE and SIS to Develop Capacitive Touch Applications” (R01AN5512).

(1) Usage with the serial connection function of QE

When the serial connection function of QE is to be used (serial communications via QE between the host PC and the USB connector on the board of this product), modify the board as follows.

- Pattern for cutting [RESET]: removed
- J19: pins 2-3 are short-circuit

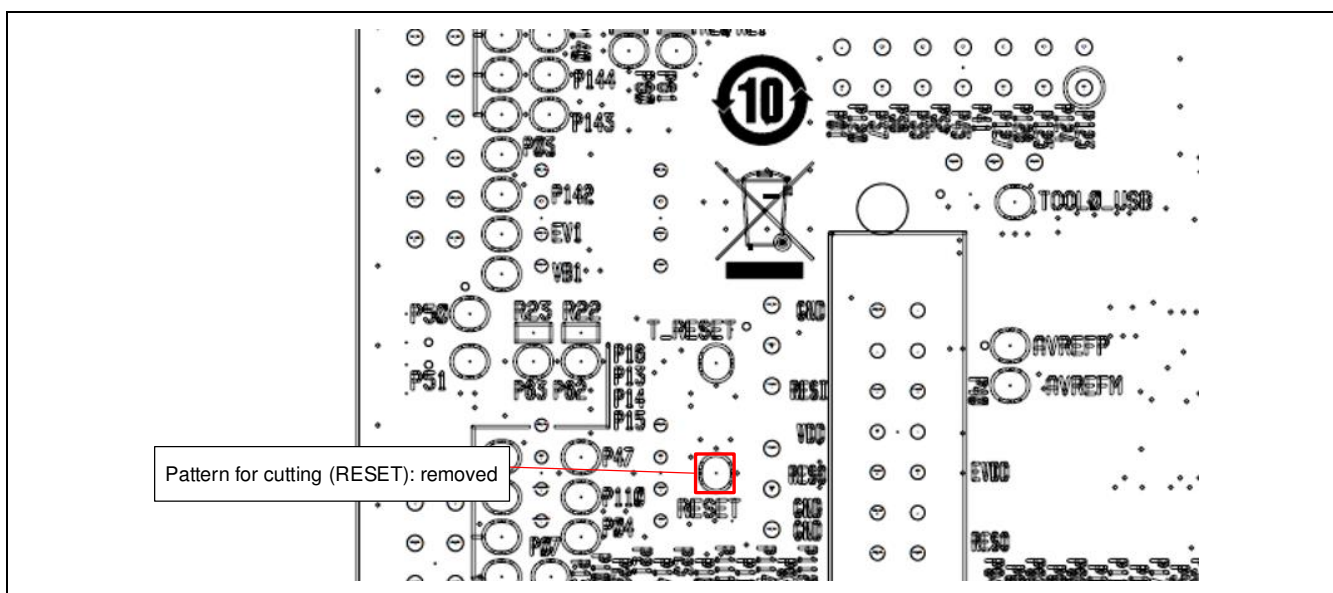


Figure 6-2 Settings for Use with the Serial Connection Function of QE (Soldered Side)

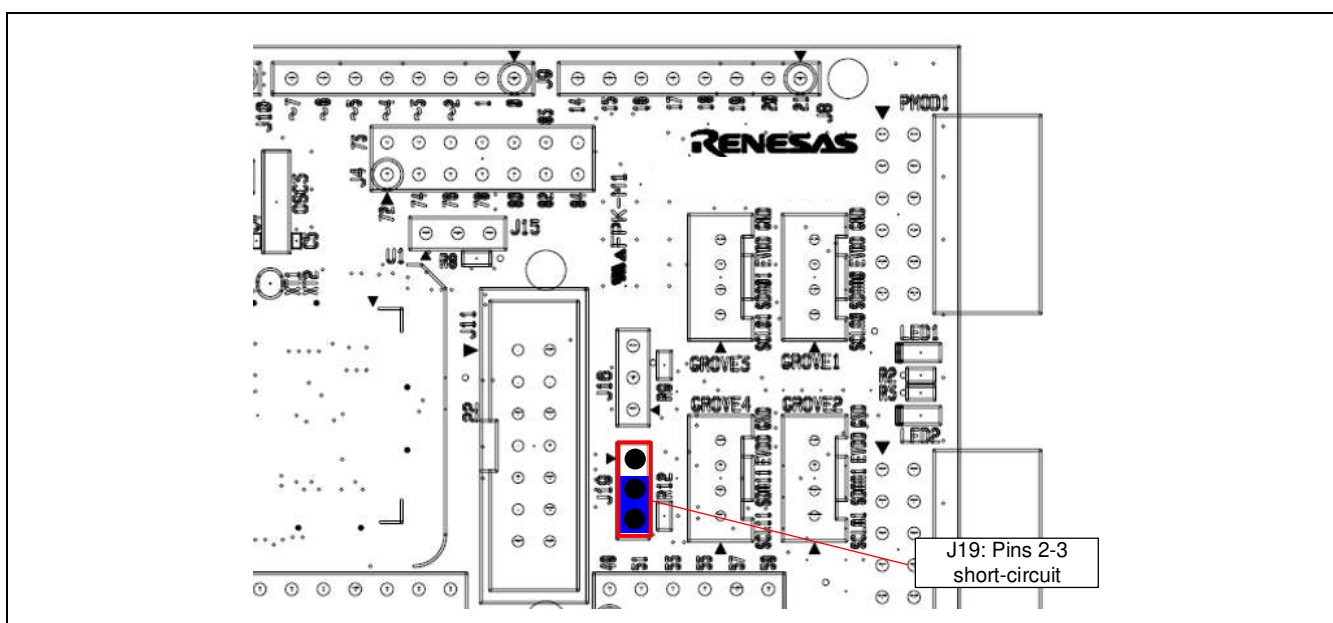


Figure 6-3 Settings for Use with the Serial Connection Function of QE (Top Side)

Note: When the circuit is configured for the case “(1) Usage with the serial connection function of QE” above, the following forms of usage are not available with QE.

- Debugging or programming through COM port debugging
- Reset by the reset switch
- Tuning the capacitive touch sensor via COM port debugging with the use of QE

(2) Not using the serial connection function of QE

As shown in Figure 5-5, Setting of the Header to Select a 5-V Power Supply (Top Side), use QE with the circuit retaining its default connections.

After the changes to the circuit have been made as described under “(1) Usage with the serial connection function of QE”, if you want to restore the settings to those for COM port debugging (the usage described under note in the previous page), make the following change of setting as follows.

- J19: pins 1-2 are short-circuit

For the patterns for cutting that were removed, solder need not to be applied.

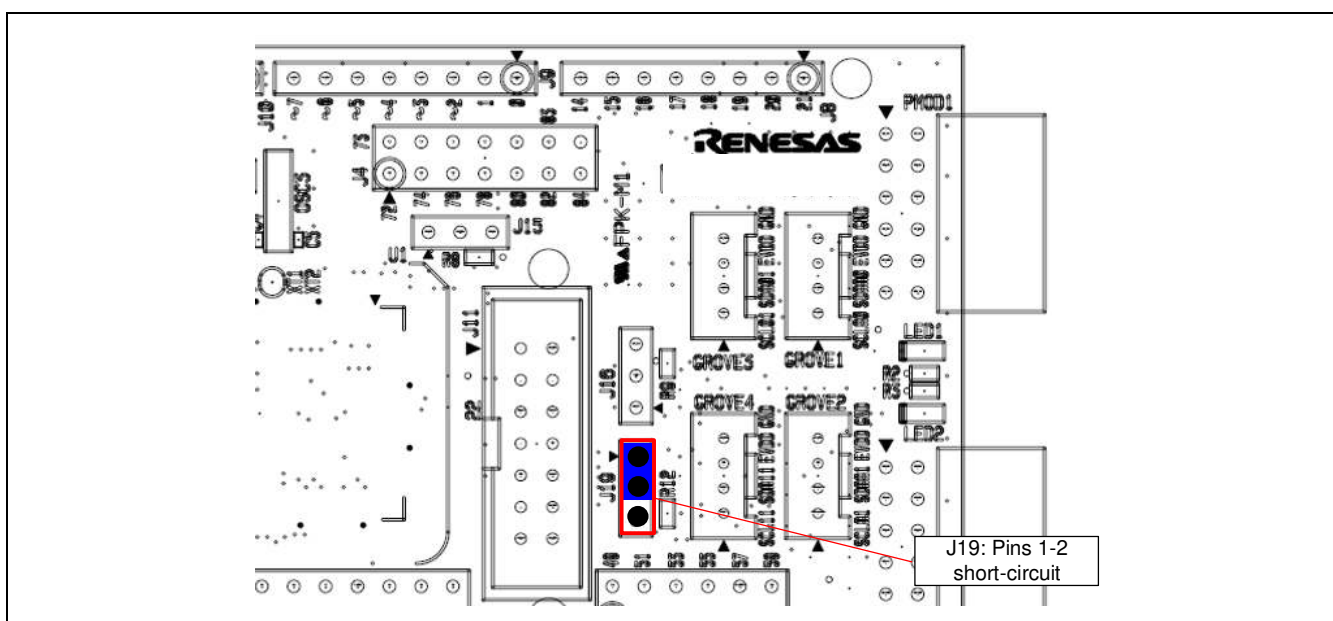


Figure 6-4 Settings for Use with COM Port Debugging (Top Side)

7. Developing Code

Use the e² studio or CS+, both of which support the evaluation MCU (RL78/G23 with 128 pins).

7.1 Using the e² studio

Figure 7-1 shows the settings of the e² studio when it is to be connected to the RL78/G23-128p Fast Prototyping Board.

- [Debug hardware]: Select [COM port (RL78)].
- [Target Device]: Select [R7F100GSN].
- [Connection with Target Board]:
 - [COM Port]: Select the COM port number for assignment to the RL78/G23-128p FPB from the pull-down list.
 - [Reset control pin]: Select [DTR].

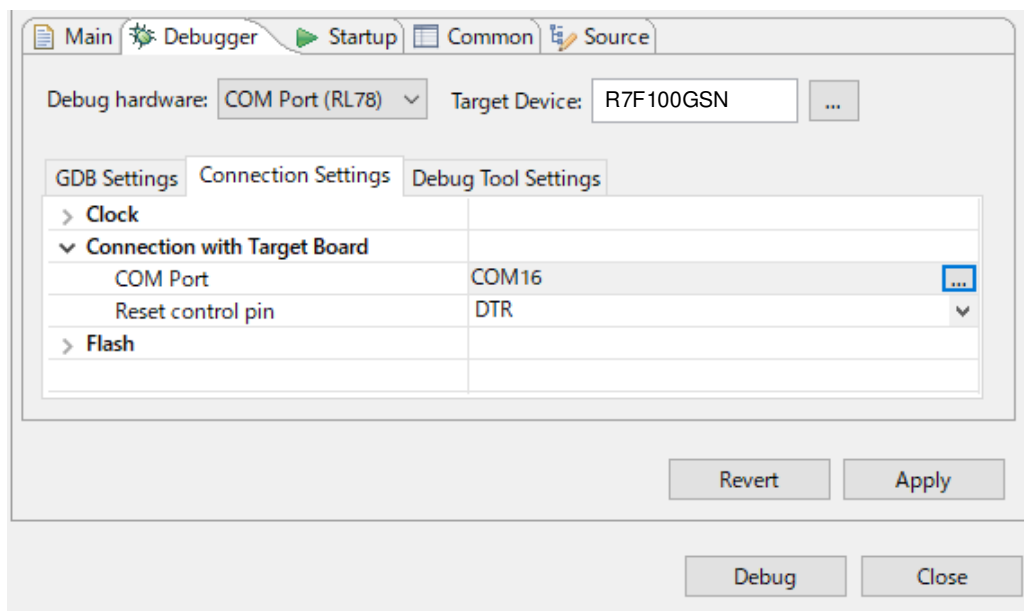


Figure 7-1 Settings of the e² studio

7.2 Using CS+

Figure 7-2 and Figure 7-3 show the settings of CS+ when it is to be connected to the RL78/G23-128p Fast Prototyping Board.

- [Using Debug Tool]:
Select [RL78 COM Port] from [Using Debug Tool] in the [Debug] menu.

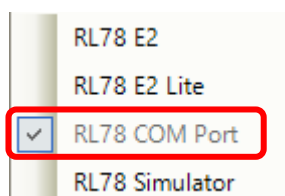


Figure 7-2 Panel for Selecting the Debug Tool

- [Connection with Target Board]:
[Communication port]: Select the COM port number for assignment to the RL78/G23-128p FPB from the pull-down list.
[Reset control pin]: Select [DTR].

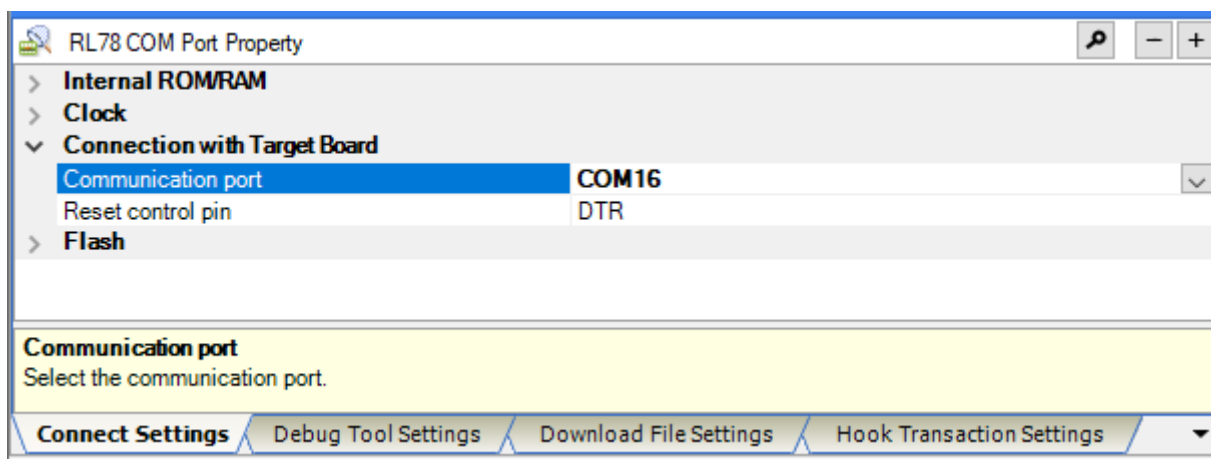


Figure 7-3 [Connect Settings] Tabbed Page of CS+

For details and points for caution, refer to the following application note for the RL78 COM port debug tool.

- RL78 Debugging Functions Using the Serial Port (R20AN0632)

8. Additional Information

Technical Support

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

For details on the evaluation MCU (R78/G23 with 128 pins), refer to the RL78/G23 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/G23-128p 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/G23-128p Fast Prototyping Board User's Manual |
|------------------|--|

| Rev. | Date | Description | |
|------|-----------|-------------|----------------------|
| | | Page | Summary |
| 1.00 | Sep.16.21 | — | First Edition issued |

RL78/G23-128p Fast Prototyping Board User's Manual

Publication Date: Rev.1.00 Sep.16.21

Published by: Renesas Electronics Corporation

RL78/G23



Renesas Electronics Corporation

R20UT4870EJ0100