User's Manual

16

RL78/L23
Fast Prototyping Board

User's Manual

16-Bit Single-Chip Microcontrollers

RL78 Family

Renesas Electronics
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1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products
   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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Precautions

This Fast Prototyping Board is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area, or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:

• Ensure attached cables do not lie across the equipment.

• Reorient the receiving antenna.

• Increase the distance between the equipment and the receiver.

• Connect the equipment into an outlet on a circuit different from that which the receiver is connected.

• Power down the equipment when not in use.

• Consult the dealer or an experienced radio/TV technician for help.

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

The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken:

• The user is advised that mobile phones should not be used within 10 m of the product when in use.

• The user is advised to take ESD precautions when handling the equipment.

The Evaluation Kit does not represent an ideal reference design for an end product and does not fulfil the regulatory standards for an end product.

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How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the basic specifications and correct usage of this product.

The target users are those who will be using it in evaluating MCUs and debugging programs.

The target readers of this manual require basic knowledge regarding the facilities of MCUs and debuggers.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Handling Precautions section.

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

The following documents apply to the RL78/L23 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/L23 Fast Prototyping Board User's Manual	R20UT5544EJ (this manual)
Circuit schematics	Circuit schematics	RL78/L23 Fast Prototyping Board Circuit Schematics	R20UT0332EJ (D020662_04)
Parts list	Parts list	RL78/L23 Fast Prototyping Board BOM LIST	R12TU0331EJ (D020661_02)
User's manual for the hardware	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation	RL78/L23 User's Manual: Hardware	R01UH1082EJ
Application note	Usage of the RL78 debugging functions using the serial port	RL78 Debugging Functions Using the Serial Port	R20AN0632EJ

2. List of Abbreviations and Acronyms

Abbreviation	Full Form
BoM	Bill of Materials
COM	Communication Port
CPU	Central Processing Unit
DIP	Dual In-line Package
DNF	Do Not Fit
FPB	Fast Prototyping Board
GPIO	General Purpose Input Output
Grove	A connector that is compatible with Grove modules can be mounted on the fast prototyping board.
I^2C	Inter-Integrated Circuit
IDE	Integrated Development Environment
IRQ/INT	Interrupt Request
HOCO	High-Speed On-Chip Oscillator
LOCO	Low-Speed On-Chip Oscillator
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCU	Micro-controller Unit
MISO	SPI Master In Slave Out
MOSI	SPI Master Out Slave In
n/a (NA)	Not applicable
n/c (NC)	Not connected
PC	Personal Computer
PWM	Pulse Width Modulation
RAM	Random Access Memory
RFP	Renesas Flash Programmer
ROM	Read Only Memory
RXD	Serial Receive Data
SCK	SPI Serial Clock
SCL	I^2C Serial Clock line
SDA	I^2C Serial Data line
SMD	Surface Mount Device
SPI	Serial Peripheral Interface
TXD	Serial Transmit Data
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus

Table of Contents

1. Overview

This user's manual describes the RL78/L23 Fast Prototyping Board (RTK7RLL230S00001BJ) (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

- Programming of the Renesas MCU
- Debugging of user code
- User circuits for switches and LEDs
- Capacitive touch button x 2
- Pmod™ connector* x 2
- Arduino® connector*
- 8-digit 16-segment LCD panel
- Grove connector (not fitted)
- Debug connector for an E2 emulator or E2 emulator Lite (not fitted)

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

- Watch the video on "Getting Started with Fast Prototyping Board for RL78 Family".
  renesas.com/gs-fpb-rl78
- Install the integrated development environment (IDE) and required software on the host PC.
  https://www.renesas.com/development-tools
- Prepare a USB 2.0 Type-C™ cable for data transfer.
- Refer to the following Web page and prepare the E2 emulator if required.
  https://www.renesas.com/e2
- Refer to the following Web page and prepare the E2 emulator Lite if required.
  https://www.renesas.com/e2lite

1.3.1 Installing the e² studio IDE

For details on the procedure for installation, watch the video on “e² studio Quick Start Guide Video for RL78 Family - Installation”.

https://www.renesas.com/software-tool/rl78-software-tool-course

1. Download the installer for the latest version of the e² studio from the following Web page.
   https://www.renesas.com/software-tool/e-studio
2. Unzip the downloaded zip file and run the installer file.
3. Select “RL78” for [Device Families].
4. Confirm that the latest version has been selected as the compiler.
5. Select the [I accept the terms of the Software Agreements] checkbox and then click on the [Install] button.
6. When the software produces an installer window in the middle of installation, proceed with installation according to the instructions from the wizard.
7. After installation has finished, click on the [OK] button.

1.3.2 Installing the CS+ IDE

1. Download the installer for the latest version of CS+ for CC from the following Web page.
   https://www.renesas.com/software-tool/cs
2. Unzip the downloaded zip file and run the installer file.
3. Click on [Begin CS+ Startup].
4. Confirm that [Tools for RL78 family] has been selected.
5. After installation has finished, click on the [OK] button.

1.4 Board Specification Table

Table 1-1 shows the board specifications.

Table 1-1 Board Specification Table

Item	Specification
Evaluation MCU (RL78/L23)	Part No.: R7F100LPL3CFB
	Package: 100-pin LFQFP
	On-chip memory: 512-KB ROM (256 KB x 2 banks), 32-KB RAM, 8-KB data flash memory
Board size	66.04 mm x 119.38 mm
Power-supply voltage	VDD: 1.6 V to 5.5 V
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: 1.8 V to 5.0 V E2 emulator Lite: 3.3 V
Current drawn	Max. 300 mA
Main clock*1	X1: Crystal oscillator (surface-mount technology (SMT)) for the main system clock X3: Crystal oscillator or ceramic resonator (lead type) for the main system clock
Sub-clock	X2: Crystal oscillator (SMT) for the sub-clock
Push switches	Reset switch x 1
	User switch x 1
Capacitive touch buttons	2; a jumper block for switching the QE serial connection
LEDs	Power indicator: green x 1
	User: green x 2
LCD	8 digits x 16 segments
Pmod™	Right-angle type, 12 pins (6 x 2 columns) x 2
Arduino® connectors	Connectors: 6 pins x 1, 8 pins x 2, 10 pins x 1 The interfaces are compatible with the Arduino® UNO R3 board.
LCD header*1	Header: 60 pins (30 x 2 columns) x 1
MCU header*1	Header: 40 pins (20 x 2 columns) x 1
USB connector	Connector: USB Type-C™
USB-to-serial converter	Used as the interface with the RL78 COM port debug tool. FT232RNQ from FTDI x 1
USB-to-serial converter reset header	Header: 3 pins x 1 (open-circuit by default)
Current measurement header*1	Header: 2 pins x 1
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*1	Interface for Grove modules I^2C x 1

Notes: 1. This part is not mounted.

2. The intended source of power for the evaluation MCU on the board as shipped is a 3.3-V supply generated from USB 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. Use 3.3 V when the LCD panel is mounted on the board. If another voltage is to be used, remove the LCD panel.

1.5 Block Diagram

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

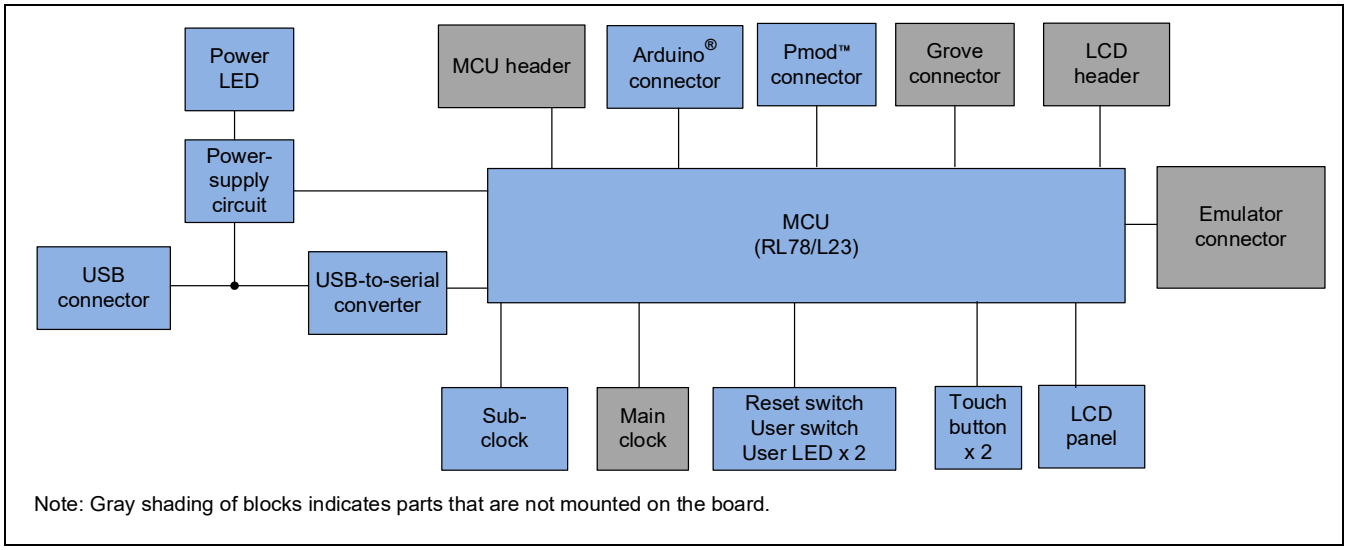


Figure 1-1 Block Diagram

2. Board Layout

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

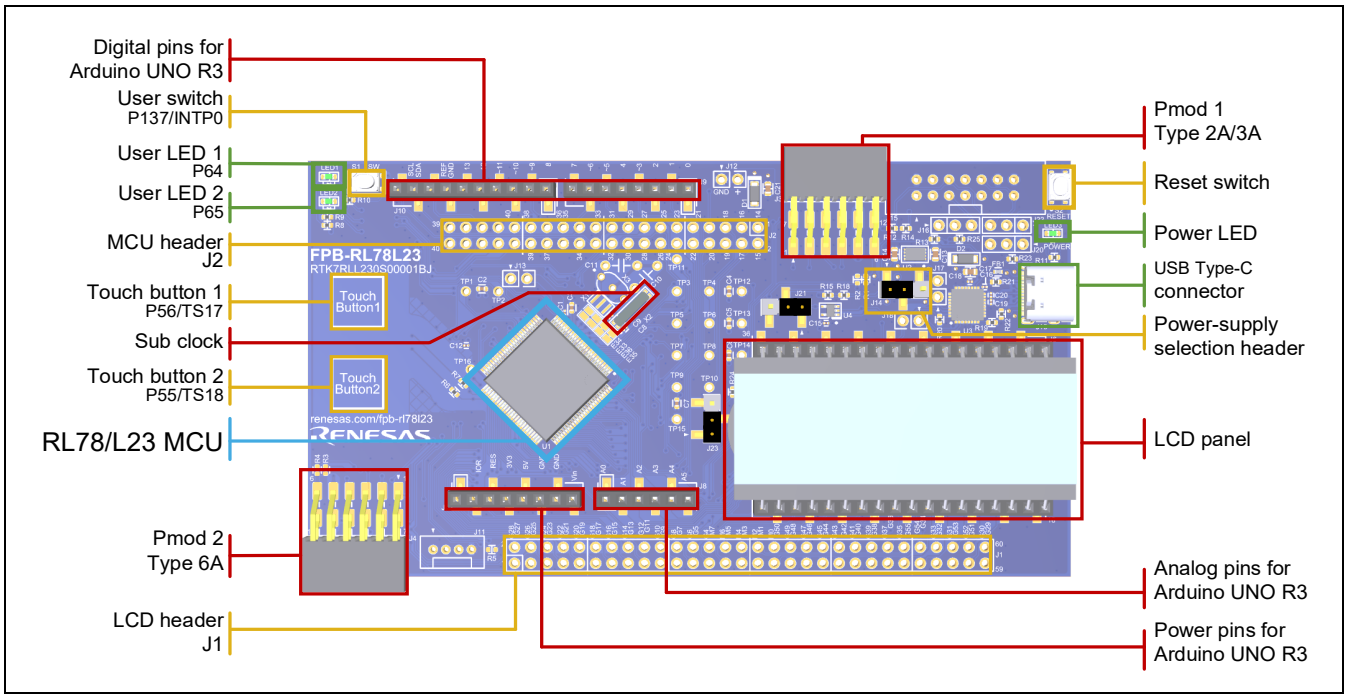


Figure 2-1 Board Layout (Top Side)

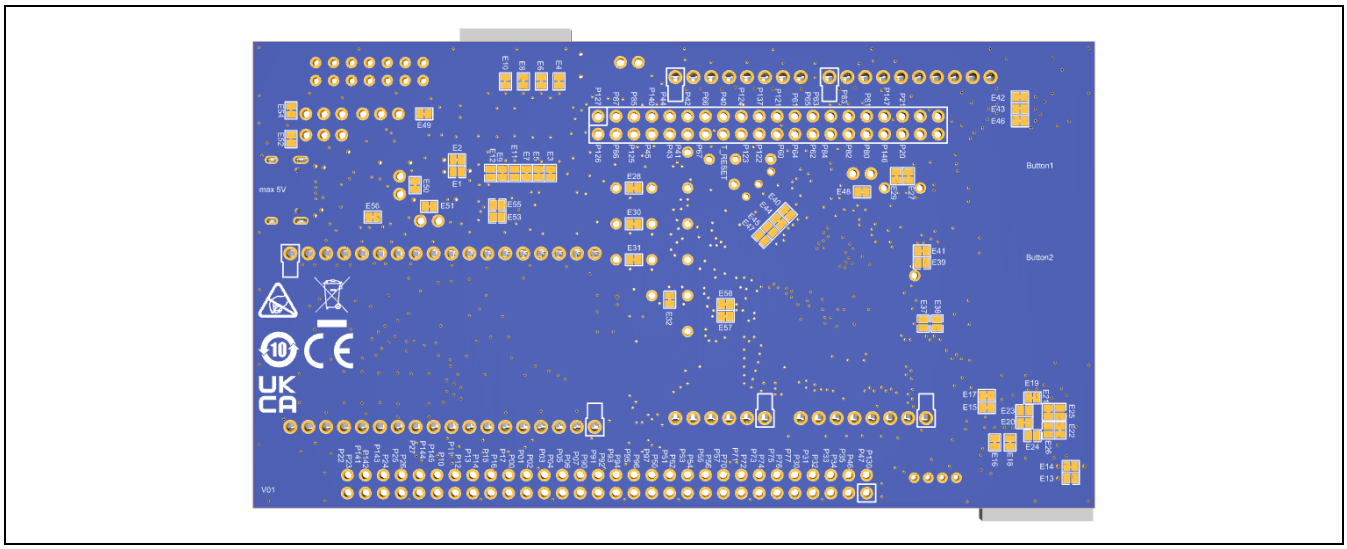


Figure 2-2 Board Layout (Soldered Side)

3. Parts Layout

Figure 3-1 and Figure 3-2 show the parts layout of this product.

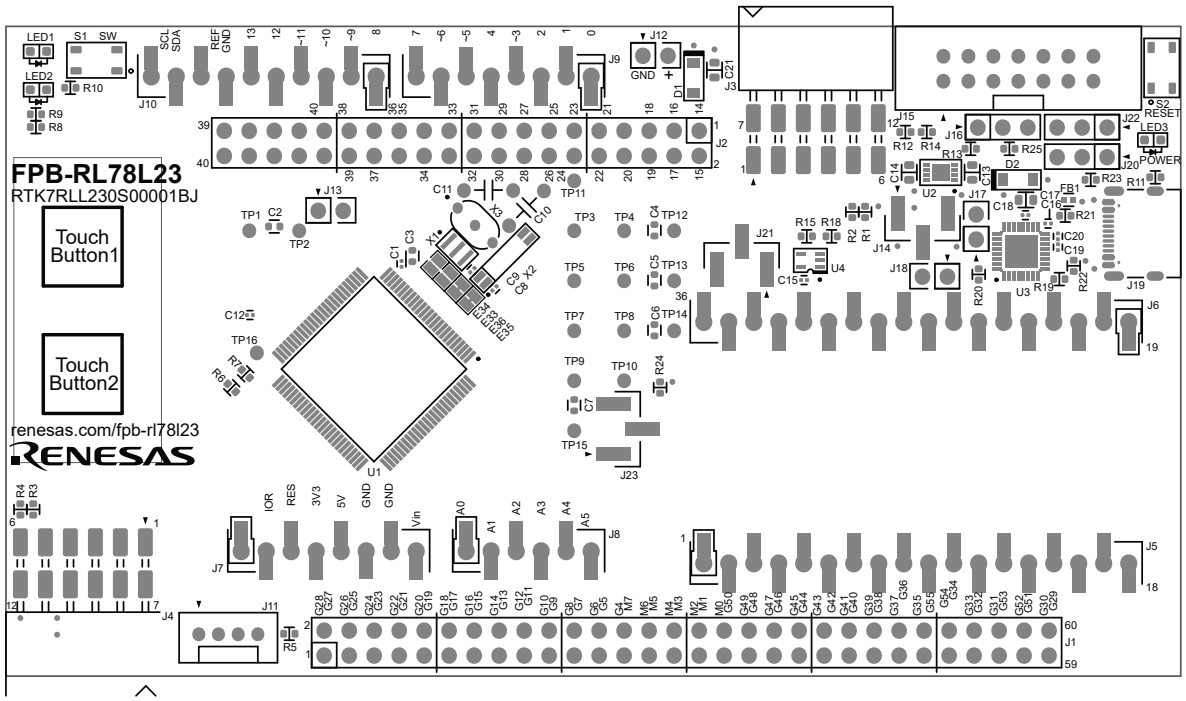


Figure 3-1 Parts Layout (Top Side)

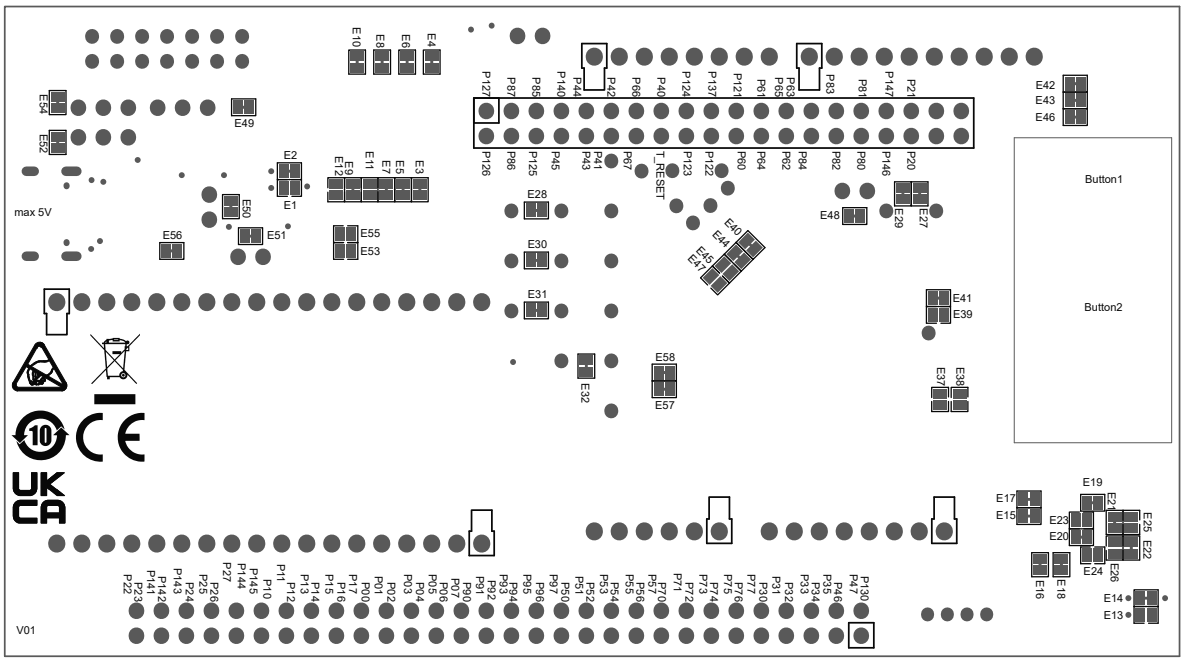


Figure 3-2 Parts Layout (Soldered Side)

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

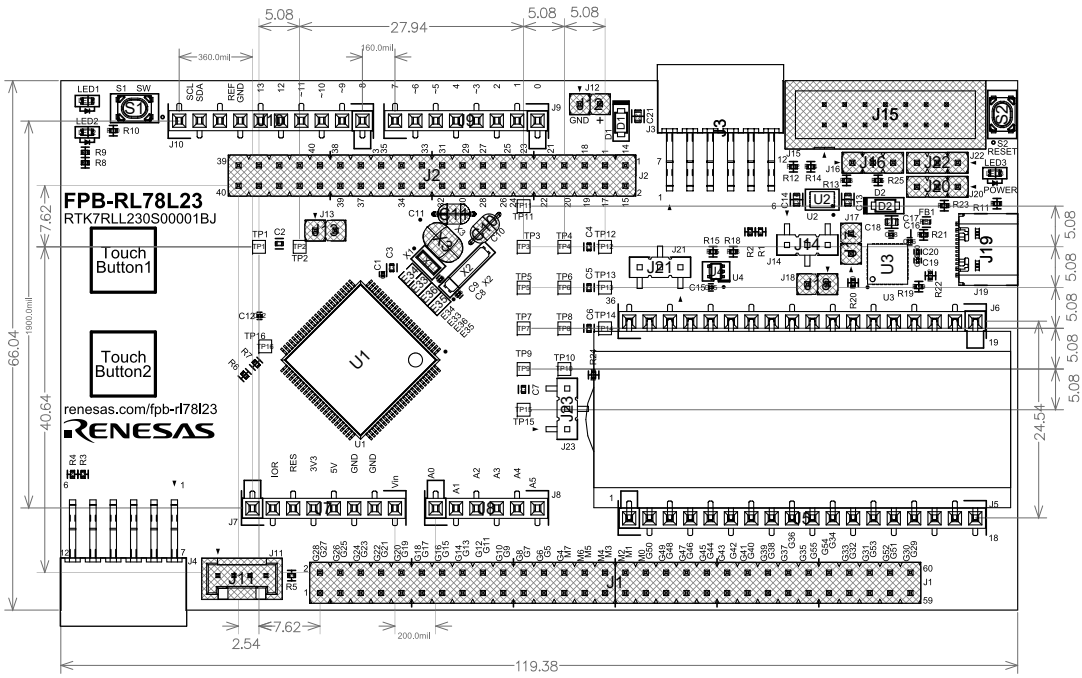


Figure 3-3 External Dimensions

4. Operating Environment

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

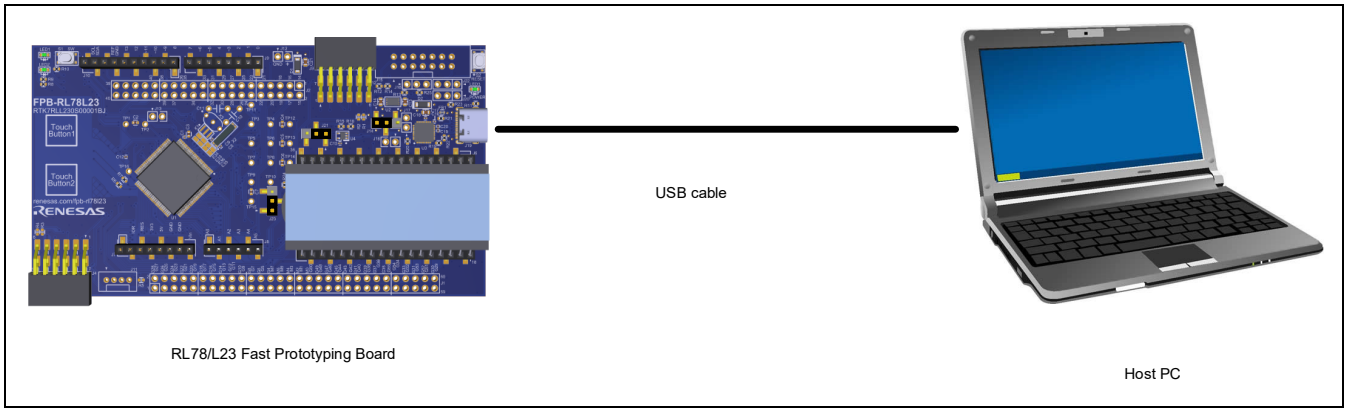


Figure 4-1 Operating Environment

5. User Circuits

5.1 Evaluation MCU

The specifications for the power supply, system clock, and reset of the evaluation MCU (RL78/L23) at the time of shipment are as follows.

- Power supply: 3.3 V generated from USB VBUS (5 V)
- System clock: Operation with an on-chip oscillator
- Reset: Directed by the reset switch or IDE

5.2 USB Connector

The connector shape is USB 2.0 Type-C™. 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.

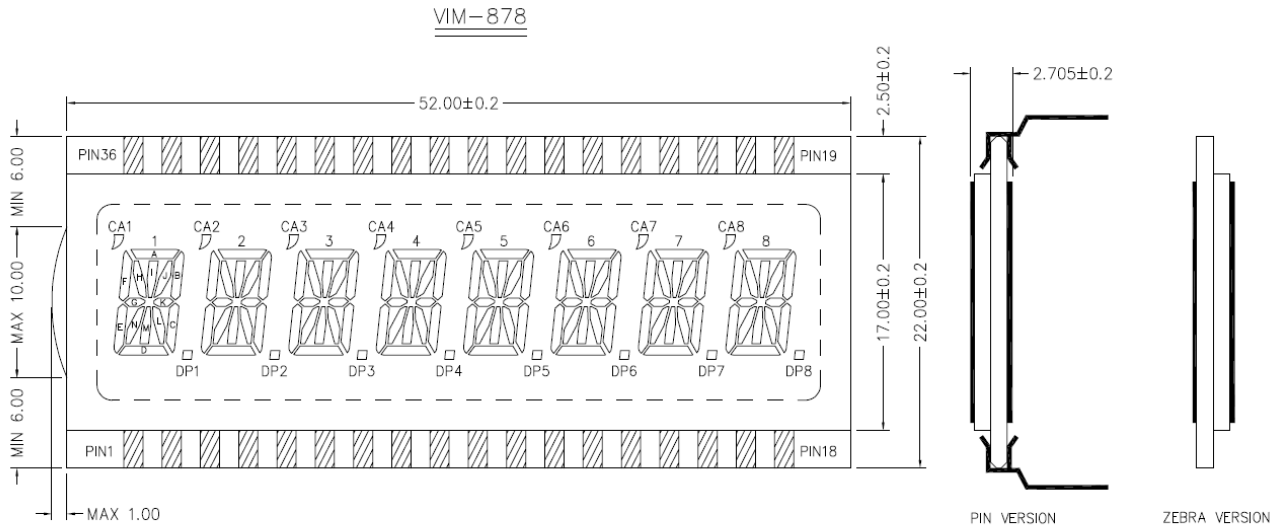
- LED1: Pin 24, connected to port P64
- LED2: Pin 25, connected to port P65

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

5.5 LCD

An LCD panel (8 digits x 16 segments) available for use by the user is mounted in a socket.

LCD panel: VIM-878-DP-FC-S-LV from Varitronix



PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
COM0	1D	1L	2D	2L	3D	3L	4D	4L	5D	5L	6D	6L	7D	7L	8D	8L	COM0	---	---	---	DP8	8M	DP7	7M	DP6	6M	DP5	5M	DP4	4M	DP3	3M	DP2	2M	DP1	1M
COM1	1E	1K	2E	2K	3E	3K	4E	4K	5E	5K	6E	6K	7E	7K	8E	8K	---	COM1	---	---	8C	8N	7C	7N	6C	6N	5C	5N	4C	4N	3C	3N	2C	2N	1C	1N
COM2	1F	1J	2F	2J	3F	3J	4F	4J	5F	5J	6F	6J	7F	7J	8F	8J	---	---	COM2	---	8B	8G	7B	7G	6B	6G	5B	5G	4B	4G	3B	3G	2B	2G	1B	1G
COM3	CA1	1I	CA2	2I	CA3	3I	CA4	4I	CA5	5I	CA6	6I	CA7	7I	CA8	8I	---	---	---	COM3	8A	8H	7A	7H	6A	6H	5A	5H	4A	4H	3A	3H	2A	2H	1A	1H

Figure 5-1 LCD Panel

Excerpt from: Datasheet for VIM-878-DP-FC-S-LV Varitronix Optoelectronics | Octopart

The operating condition for the LCD panel is 3.0 V to 4.6 V. If you will be using this product with an operating voltage other than 3.3 V, remove the LCD panel.

Note: Some Arduino® shields may interfere with the LCD panel. You may need to increase the height of the shield by using a two-tiered ARDUINO PROTO SHIELD.

Table 5-1 and Table 5-2 list the pin assignments of the LCD panel.

Table 5-1 Pin Assignments of the LCD Panel (J5)

Pin No. on Socket J5	Pin No. on LCD Panel	Signal Name	Port Name	Pin No.	LCD Header
1	LCD_1	SEG8	P54	54	J1_21
2	LCD_2	SEG7	P53	55	J1_22
3	LCD_3	SEG6	P52	56	J1_23
4	LCD_4	SEG5	P51	57	J1_24
5	LCD_5	SEG4	P50	58	J1_25
6	LCD_6	SEG3/COM7	P97	59	J1_26
7	LCD_7	SEG2/COM6	P96	60	J1_27
8	LCD_8	SEG1/COM5	P95	61	J1_28
9	LCD_9	SEG0/COM4	P94	62	J1_29
10	LCD_10	SEG50	P07	69	J1_34
11	LCD_11	SEG49	P06	70	J1_35
12	LCD_12	SEG48	P05	71	J1_36
13	LCD_13	SEG47	P04	72	J1_37
14	LCD_14	SEG39	P14	83	J1_45
15	LCD_15	SEG38	P13	84	J1_46
16	LCD_16	SEG37	P12	85	J1_47
17	LCD_17	COM0	P90	66	J1_33
18	LCD_18	COM1	P91	65	J1_32

Table 5-2 Pin Assignments of the LCD Panel (J6)

Pin No. on Socket J6	Pin No. on LCD Panel	Signal Name	Port Name	Pin No.	LCD Header
18	LCD_36	SEG12	P70	48	J1_17
17	LCD_35	SEG13	P71	47	J1_16
16	LCD_34	SEG14	P72	46	J1_15
15	LCD_33	SEG15	P73	45	J1_14
14	LCD_32	SEG16	P74	44	J1_13
13	LCD_31	SEG17	P75	43	J1_12
12	LCD_30	SEG20	P30	40	J1_9
11	LCD_29	SEG21	P31	39	J1_8
10	LCD_28	SEG28	P130	2	J1_1
9	LCD_27	SEG51	P141	96	J1_58
8	LCD_26	SEG52	P142	95	J1_57
7	LCD_25	SEG53	P143	94	J1_56
6	LCD_24	SEG54	P144	89	J1_51
5	LCD_23	SEG55	P145	88	J1_50
4	LCD_22	SEG35	P10	87	J1_49
3	LCD_21	SEG36	P11	86	J1_48
2	LCD_20	COM3	P93	63	J1_30
1	LCD_19	COM2	P92	64	J1_31

5.5.1 Setting the LCD-driving Power Supplies

The initial setting of the LCD drive power supply on this board supports either the internal voltage boosting method or the capacitor split method.

The internal voltage boosting method supports 1/3 bias method with V_{L1} reference and V_{L2} reference, and up to four-time-slice mode.

The capacitor split method supports 1/3 bias method with VDD reference and V_{L4} reference, and up to four-time-slice mode.

Additionally, by removing the capacitors on this board and installing resistors, it is possible to support the external resistance division method.

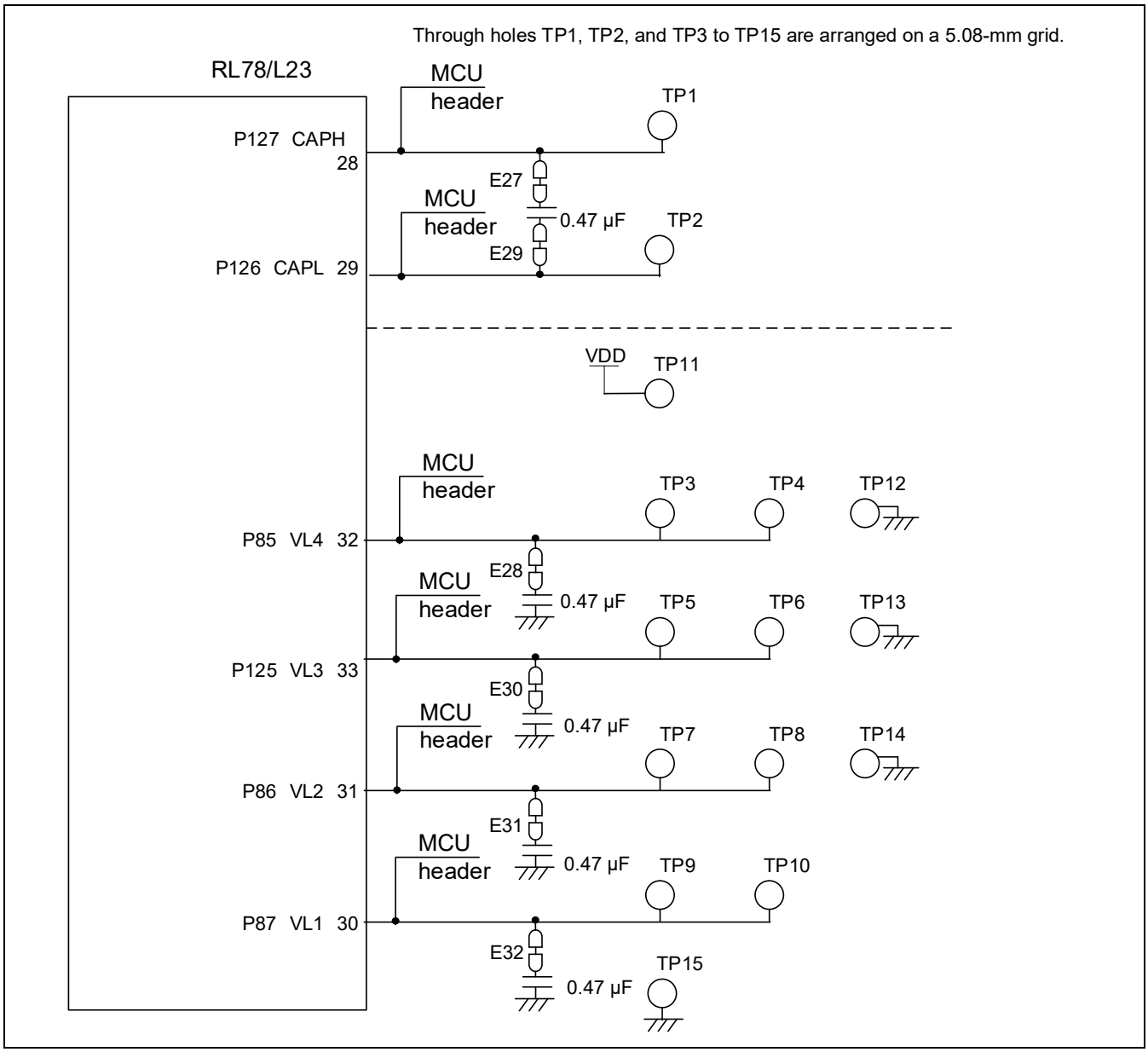


Figure 5-2 Initial Settings for the LCD-driving Power Supplies

Through holes are provided to evaluate the settings of the LCD-driving power supplies with the use of parts having leads.

To proceed with evaluation of the settings of the LCD-driving power supplies with the use of parts having leads, cut Jumper Trace Cuts E27 to E32 and mount resistors or capacitors having leads as shown in Figure 5-3.

P127 (pin 28) and P126 (pin 29) are respectively used as CAPH and CAPL by default. P87 (pin 30), P86 (pin 31), and P85 (pin 32) are respectively used as V_{L1}, V_{L2}, V_{L3}, and V_{L4} by default. When using the included LCD panel, P125/V_{L3} (pin 33) can be used as a general-purpose port (P125). 0.47-µF capacitors are connected to the pins, P127 (pin 28), P126 (pin 29) P87 (pin 30), P86 (pin 31), P125 (pin 33), and P85 (pin 32). Cut Jumper Trace Cuts E27 to E32 if these pins are to be used as port pins.

Note: The reference resistance “R” value for external resistance division is 10 kΩ to 1 MΩ. In addition, to stabilize the potential of the VL1 to VL4 pins, connect a capacitor between each of pins VL1 to VL4 and the GND pin as needed. When using the internal voltage boosting method or the capacitor split method, make the capacitor between CAPH to CAPL a nonpolar capacitor. The reference capacitance “C” is about 0.47 µF but it depends on the LCD panel used, the number of segment pins, the number of common pins, the frame frequency, and the operating environment. Thoroughly evaluate these values in accordance with your system and adjust and determine the capacitance.

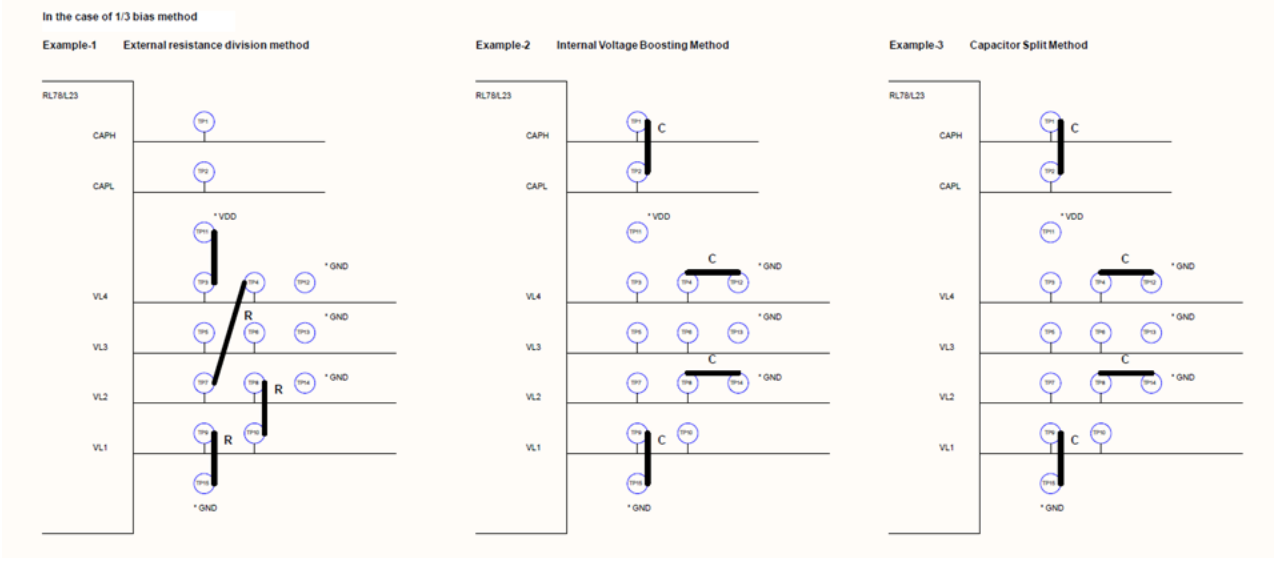


Figure 5-3 Settings for the LCD-driving Power Supplies, in the case of 1/3 bias method

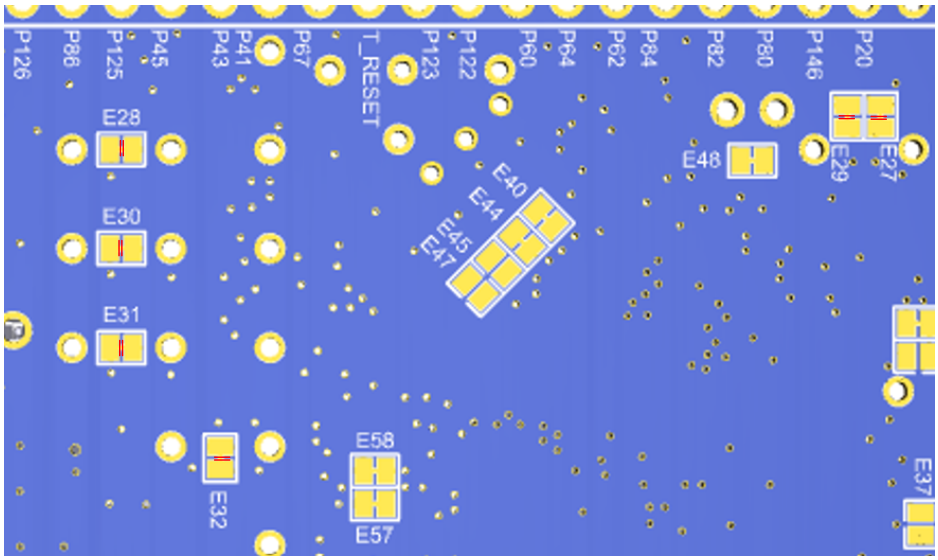


Figure 5-4 Positions of the Jumper Trace Cuts for Changing the Settings of the LCD-driving Power Supplies (Soldered Side)

5.6 Capacitive Touch Buttons

The capacitive touch buttons can be used for the user's desired 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 52, connected to ports P56 and TS17
- Touch button 2: Pin 53, connected to ports P55 and TS18

P57 (pin 51) is connected for the TSCAP pin function by default. A 0.01-μF capacitor is connected to P57. Cut Jumper Trace Cut E41 and apply solder to Jumper Solder Bridge E39 if this pin is to be used as a port pin.

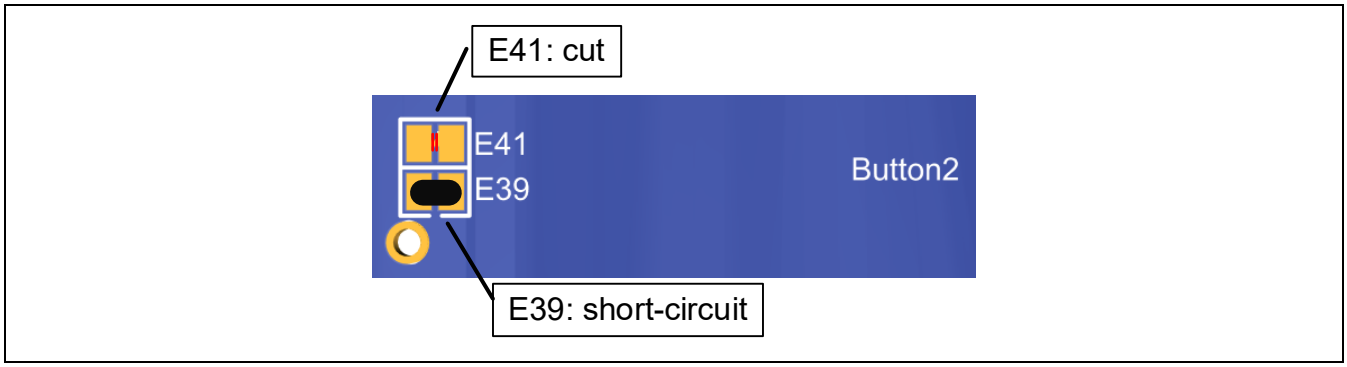


Figure 5-5 Settings for Using P57 as a Port Pin (Soldered Side)

Note: The condition for operating voltage of CTSU2La is VDD = 1.8 V to 5.5 V. Use capacitive touch buttons that produce voltages within the range VDD = 1.8 V to 5.5 V.

5.7 Pmod™ Connectors

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

Pmod 1 (J3) is assumed to be connected to the Pmod Interface Type 2A or 3A module*.

Pmod 2 (J4) 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 5-6, Table 5-3 and Table 5-4 show the pin assignments of the Pmod connectors.

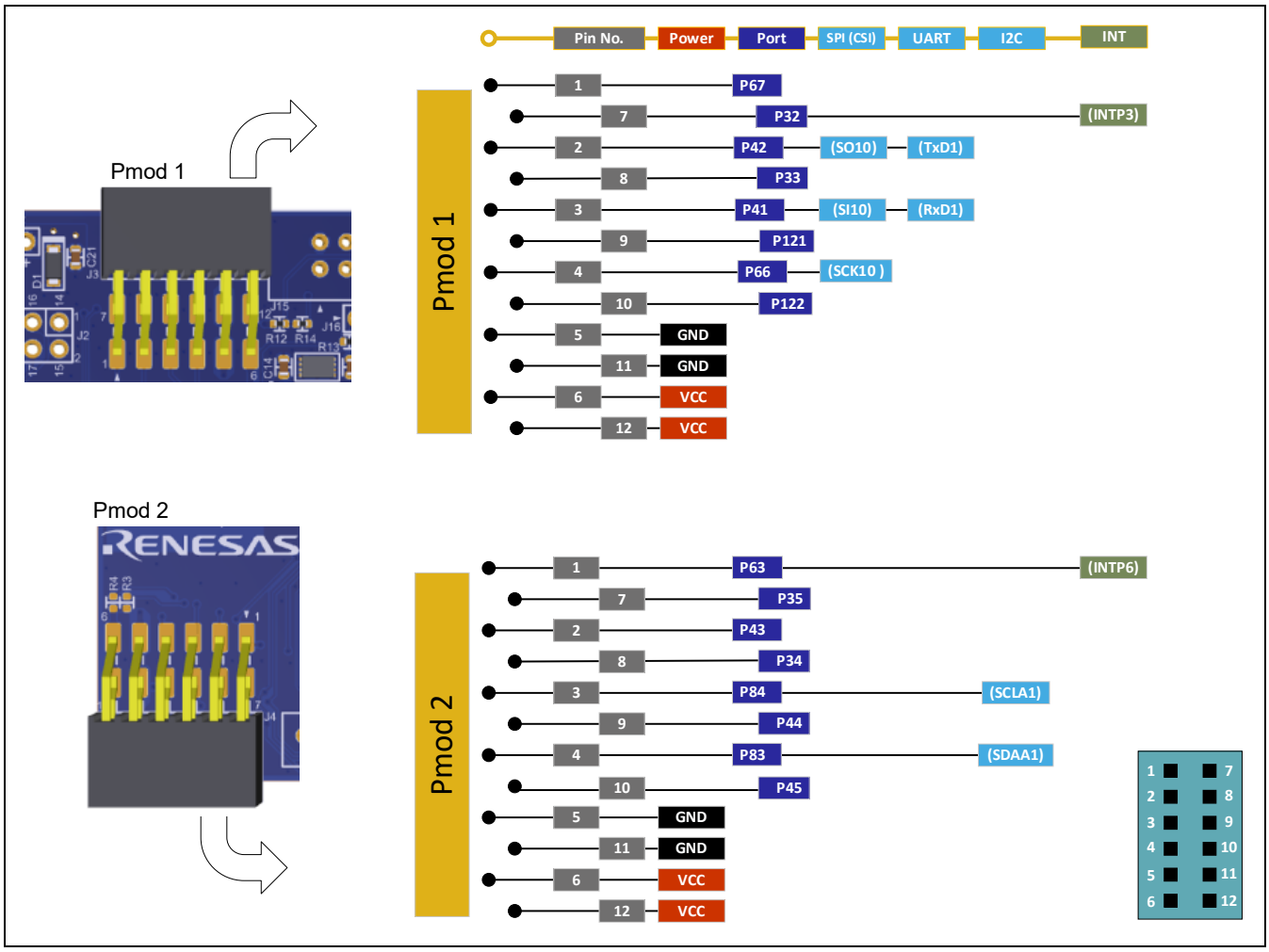


Figure 5-6 Pin Assignments of the Pmod Connectors

Table 5-3 Pin Assignments of Pmod 1 (J3)

Pmod 1			RL78/L23	Pmod 1 Configuration	
Pin	Type 2A/3A (default)	Option Type 6A	Signal/Bus	Short	Open
J3-1	CS/CTS	INT	P67/(INTP2)	E3	-
J3-2	MOSI/TXD	RESET	P42/(SO10)/(TxD1)	E5	-
J3-3	MISO/RXD	-	P41/(SI10)/(RxD1)	E7	E11
	-	SCL	P66/(SCL10)	E11	E7
J3-4	SCK/RTS	-	P66/(SCK10)	E9	E12
	-	SDA	P41/(SDA10)	E12	E9
J3-5	GND		GND	-	-
J3-6	VCC		VDD	E2	-
J3-7	INT/GPIO	GPIO	P32/(INTP3)	E4	-
J3-8	RESET/GPIO	GPIO	P33	E6	-
J3-9	CS2/GPIO	GPIO	P121	E8	-
J3-10	CS3/GPIO	GPIO	P122	E10	-
J3-11	GND		GND	-	-
J3-12	VCC		VDD	E2	-

Table 5-4 Pin Assignments of Pmod 2 (J4)

Pmod 2			RL78/L23	Pmod 2 Configuration	
Pin	Option Type 2A/3A	Type 6A (default)	Signal/Bus	Short	Open
J4-1	CS/CTS	INT	P63/(INTP6)	E15	
J4-2	MOSI/TXD	RESET	P43/SO30/TxD3	E17	
J4-3	-	SCL	P84/(SCLA1)	E19	E23
	MISO/RXD	-	P44/SI30/RxD3	E23	E19
J4-4	-	SDA	P83/(SDAA1)	E21	E25
	SCK/RTS	-	P45/SCK30	E25	E21
J4-5	GND		GND	-	-
J4-6	VCC		VDD	E14	-
J4-7	INT/GPIO	GPIO	P35/(INTP4)	E16	-
J4-8	RESET/GPIO	GPIO	P34	E18	-
J4-9	CS2/GPIO	-	P44	E20	E24
	-	GPIO	P84	E24	E20
J4-10	CS3/GPIO	-	P45	E22	E26
	-	GPIO	P83	E26	E22
J4-11	GND		GND	-	-
J4-12	VCC		VDD	E14	-

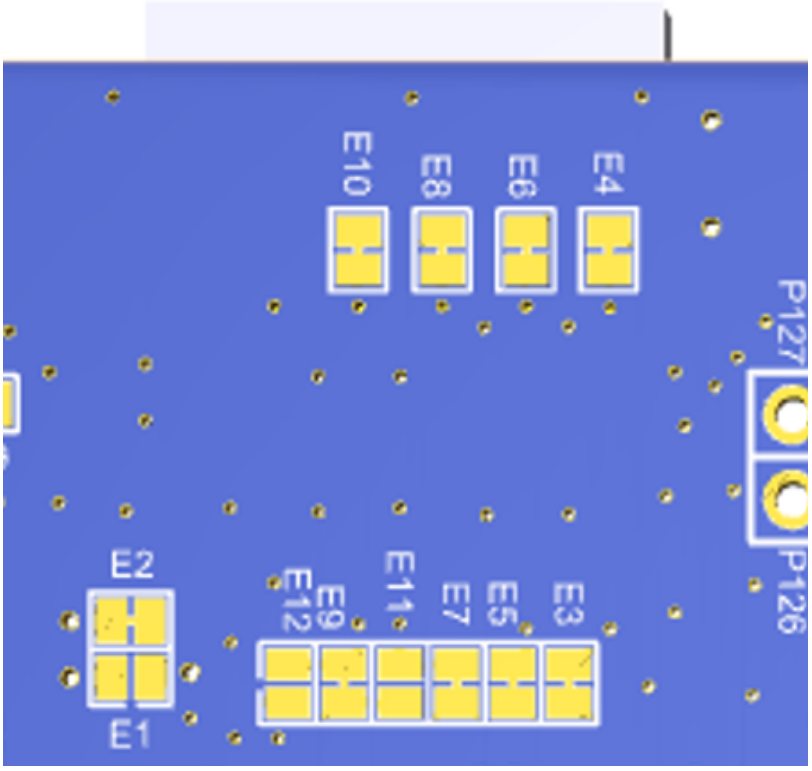


Figure 5-7 Assignments of Jumper Trace Cuts and Jumper Solder Bridges for Pmod 1 (Soldered Side)

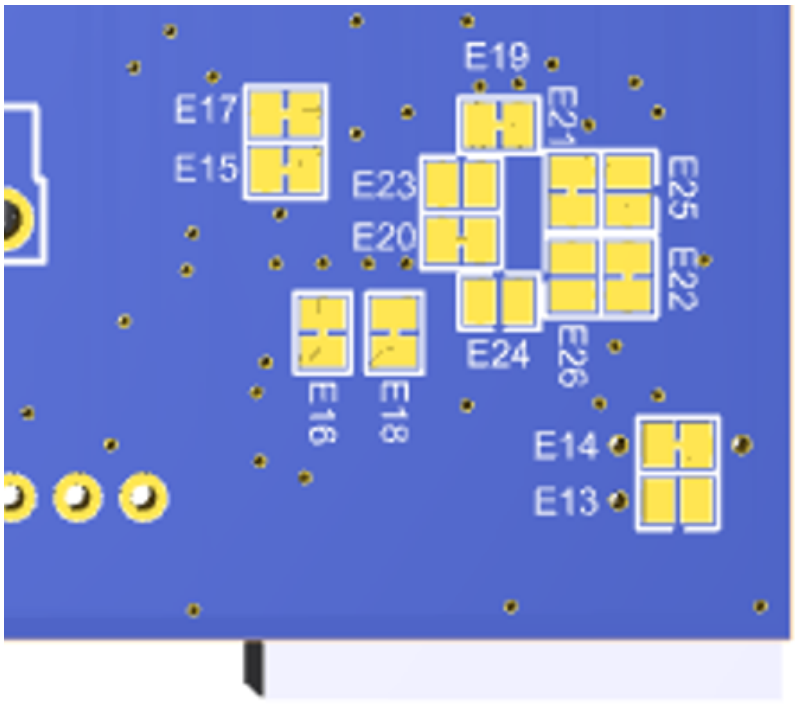


Figure 5-8 Assignments of Jumper Trace Cuts and Jumper Solder Bridges for Pmod 2 (Soldered Side)

5.8 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 5-9 and Table 5-5 show the pin assignments of the Arduino connectors.

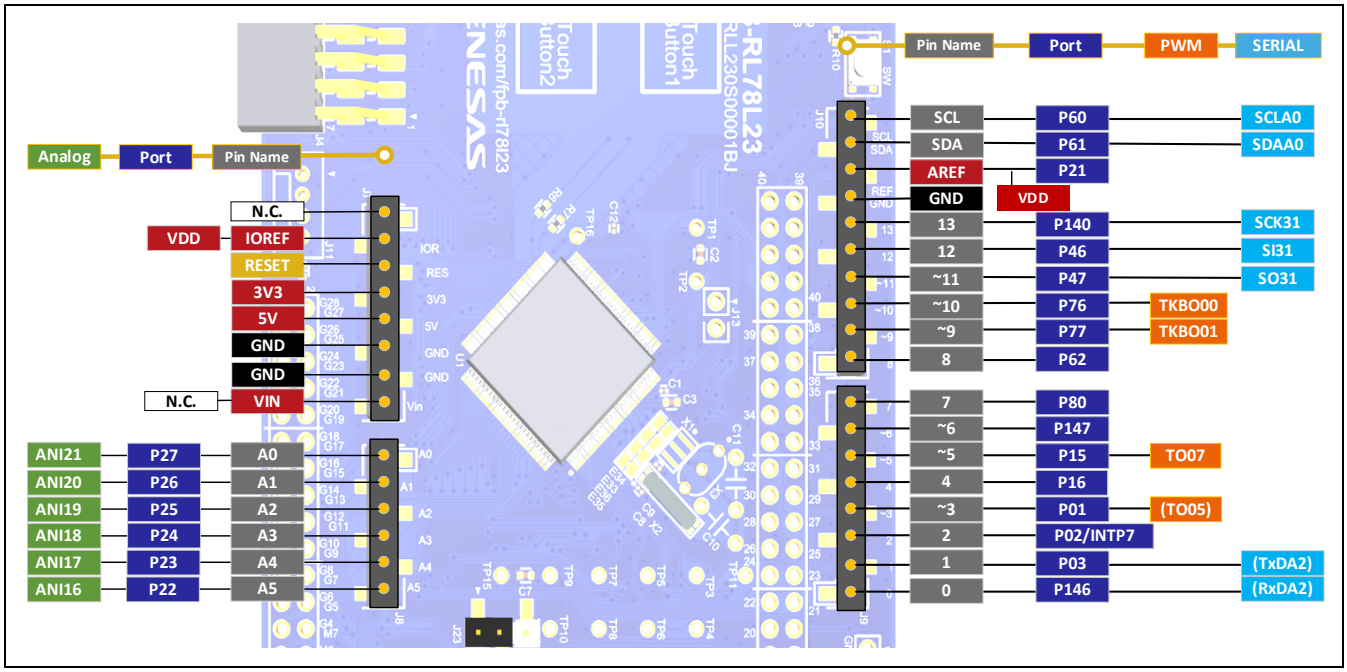


Figure 5-9 Pin Assignments of the Arduino Connectors

Table 5-5 Pin Assignments of the Arduino Connectors

Part No. in the Circuit Schematics	Name of Arduino Signal	RL78/L23						
		Pin	Power Supply	Port	Analog	PWM	Serial	Others
J7-1	n/c	-	-	-	-	-	-	-
J7-2	IOREF	21	VDD	-	-	-	-	-
J7-3	RESET	13	-	-	-	-	-	RESET
J7-4	3V3	-	-	-	-	-	-	-
J7-5	5V	-	-	-	-	-	-	-
J7-6	GND	20/38	VSS/ EVSS	-	-	-	-	-
J7-7	GND	20/38	VSS/ EVSS	-	-	-	-	-
J7-8	VIN	-	-	-	-	-	-	-
J8-1	A0	90	-	P27	ANI21	-	-	ANO1
J8-2	A1	91	-	P26	ANI20	-	-	-
J8-3	A2	92	-	P25	ANI19	-	-	-
J8-4	A3	93	-	P24	ANI18	-	-	-
J8-5	A4	97	-	P23	ANI17	-	-	-
J8-6	A5	98	-	P22	ANI16	-	-	-
J10-10	SCL	22	-	P60	-	-	SCLA0	-
J10-9	SDA	23	-	P61	-	-	SDAA0	-
J10-8	AREF*1	99	-	[P21]	[AVREFP /ANI0]	-	-	-
J10-7	GND	20/38	VSS/ EVSS		-	-	-	-
J10-6	SCK/13	1	-	P140	-	-	SCK31	-
J10-5	MISO/12	4	-	P46	-	-	SI31	-
J10-4	MOSI/~11	3	-	P47	-	-	SO31	-
J10-3	~10	42	-	P76	-	TKBO00	-	-
J10-2	~9	41	-	P77	-	TKBO01	-	-
J10-1	8	26	-	P62*2	-	-	-	-

J9-8	7	73		P80	-	-	-	-
J9-7	~6	74		P147	-	-	-	PWM not assigned
J9-6	~5	82		P15	-	TO07	-	-
J9-5	4	81		P16	-	-	-	-
J9-4	~3	78		P01	-	(TO05)	-	(INTP5)
J9-3	2	77		P02	-	-	-	INTP7
J9-2	TX/1	76		P03	-	-	(TxDA2)	-
J9-1	RX/0	75		P146	-	-	(RxDA2)	-

Note 1: P21 is connected to VDD by default. When P21 is disconnected from VDD, cut Jumper Trace Cut E57.
Note 2: P62 is N-ch open drain output.

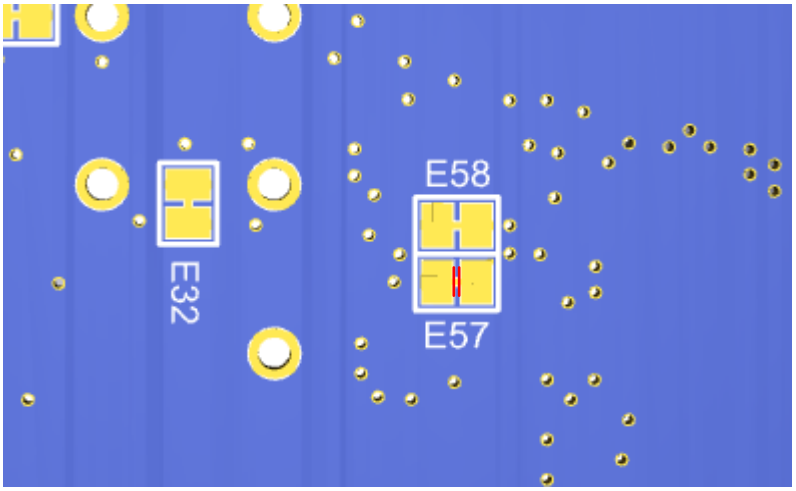


Figure 5-10 Assignment of E57 (Soldered Side)

5.9 LCD Headers

In this product, all SEG and COM signals are assigned to through hole J1 for the 60-pin headers to evaluate the LCD panel. The pin headers have a pitch of 2.54 mm and the evaluation MCU is connected to the through holes for the headers.

Table 5-6 shows the pin assignments of the LCD headers.

SEGxx and COMxx are respectively abbreviated on the board as silkscreened marks Gxx and Mxx.

Table 5-6 Pin Assignments of the LCD Headers (J1)

J1	Evaluation MCU				Other Assignments						
Pin No.	Signal Name	Pin No.	Port Name	Pin Name	LCD Panel	Debug	Touch	Pmod1	Pmod2	Arduino	*1
1	SEG28	2	P130	P130/SEG28/TRJO1/(TxDA0)/(SO21)/(SO01)	LCD_28	-	-	-	-	-	41
2	SEG27	3	P47	P47/SEG27/(RxDA0)/SO31/(SI21)/(SDA21)/(SDA01)/(SI01)/(INTP1)	-	-	-	-	-	"SO31 11	
3	SEG26	4	P46	P46/SEG26/SI31/SDA31/(SCK21)/(SCL21)/(SCL01)/(SCK01)	-	-	-	-	-	SI31 12	-
4	SEG25	34	P35	P35/SEG25/TS03/(VCOUT0)/(INTP4)/(SO30)/(TxD3)	-	-	-	-	7	-	42
5	SEG24	35	P34	P34/SEG24/TS04/(TI01)/(TO01)/(INTP0)/(SI30)/(RxD3)/(SDA30)	-	-	[10-kΩ pull down]	-	8	-	43
6	SEG23	36	P33	P33/INTP4/SEG23/TS05/(TI01)/(TO01)/(RTC1HZ)/(SCK30)/(SCL30)	-	-	-	8	-	-	44
7	SEG22	37	P32	P32/TI01/TO01/SEG22/TS06/(TI03)/(TO03)/(REMOOUT)/(INTP3)/(RTC1HZ)	-	-	-	(INTP3) 7	-	-	45
8	SEG21	39	P31	P31/INTP3/RTC1HZ/SEG21/TS07/(TI01)/(TO01)	LCD_29	-	-	-	-	-	46
9	SEG20	40	P30	P30/TI03/TO03/SEG20/REMOOUT/TS08/(INTP3)/(RTC1HZ)	LCD_30	-	-	-	-	-	47
10	SEG19	41	P77	P77/KR7/SEG19/TS09/CCD00/TKBO01/SO20/TxD2/EI77/EO77/(TKBO21)/(TI07)/(TO07)/(INTP1)/(EXSDO0)	-	-	-	-	-	TKBO01 ~9	-
11	SEG18	42	P76	P76/KR6/SEG18/TS10/CCD01/TKBO00/SI20/SDA20/RxD2/EI76/EO76/(INTP2)/(RTC1HZ)/(EXSDO1)	-	-	-	-	-	TKBO00 ~10	-
12	SEG17	43	P75	P75/KR5/SEG17/TS11/CCD02/SCK20/SCL20/(TKBO11)/(TKBO01)/(TI03)/(TO03)/(REMOOUT)/(INTP0)	LCD_31	-	-	-	-	-	48
13	SEG16	44	P74	P74/KR4/SEG16/TS12/CCD03/TKBO11/(TKBO01)	LCD_32	-	-	-	-	-	49
14	SEG15	45	P73	P73/KR3/SEG15/TS13/TKBO10	LCD_33	-	-	-	-	-	50
15	SEG14	46	P72	P72/KR2/SEG14/TS14/TKBO21	LCD_34	-	-	-	-	-	51
16	SEG13	47	P71	P71/KR1/SEG13/TS15	LCD_35	-	-	-	-	-	52
17	SEG12	48	P70	P70/KR0/SEG12/TS16/TKBO20	LCD_36	-	-	-	-	-	53
18[*2]	SEG11	51	P57	P57/INTP6/SEG11/TSCAP/(TI03)/(TO03)/(REMOOUT)	-	-	TSCAP	-	-	-	54

J1	Evaluation MCU				Other Assignments						
Pin No.	Signal Name	Pin No.	Port Name	Pin Name	LCD Panel	Debug	Touch	Pmod1	Pmod2	Arduino	*1
19	SEG10	52	P56	P56/TI06/TO06/SEG10/TS17	-	-	Button 1: TS17	-	-	-	55
20	SEG9	53	P55	P55/INTP5/SEG9/TS18/(TI02)/(TO02)	-	-	Button 2: TS18	-	-	-	56
21	SEG8	54	P54	P54/TI02/TO02/SEG8/TS19/SCK01/SCL01/(INTP0)/(PCLBUZ0)	LCD_1	-	-	-	-	-	57
22	SEG7	55	P53	P53/INTP2/SEG7/TS20/SI01/SDA01/(TI07)/(TO07)/(PCLBUZ0)	LCD_2	-	-	-	-	-	58
23	SEG6	56	P52	P52/TI00/TO00/INTP1/SEG6/TS21/SO01/(PCLBUZ1)	LCD_3	-	-	-	-	-	59
24	SEG5	57	P51	P51/SEG5/TS22/RxDA3/(INTP6)	LCD_4	-	-	-	-	-	60
25	SEG4	58	P50	P50/SEG4/TS23/TxDA3	LCD_5	-	-	-	-	-	61
26	SEG3/ COM7	59	P97	P97/COM7/SEG3/TS24/(TI05)/(TO05)/(SCK01)/(SCL01)/(SCLA1)	LCD_6	-	-	-	-	-	62
27	SEG2/ COM6	60	P96	P96/COM6/SEG2/TS25/(INTP5)/(SI01)/(SDA01)/(SDAA1)/(PCLBUZ0)	LCD_7	-	-	-	-	-	63
28	SEG1/ COM5	61	P95	P95/COM5/SEG1/TS26/(TI02)/(TO02)/(INTP1)/(SO01)	LCD_8	-	-	-	-	-	64
29	SEG0/ COM4	62	P94	P94/COM4/SEG0/TS27/(INTP2)/(SI01)/(SDA01)/(TI06)/(TO06)	LCD_9	-	-	-	-	-	65
30	COM3	63	P93	P93/COM3/TS28/(INTP3)/(SCK01)/(SCL01)	LCD_20	-	-	-	-	-	66
31	COM2	64	P92	P92/COM2/TS29/(TI01)/(TO01)	LCD_19	-	-	-	-	-	67
32	COM1	65	P91	P91/COM1/TS30/(INTP2)	LCD_18	-	-	-	-	-	68
33	COM0	66	P90	P90/COM0/TS31/(TI00)/(TO00)/(INTP1)	LCD_17	-	-	-	-	-	69
34	SEG50	69	P07	P07/SO10/TxD1/SEG50/TS32/EI07/(PCLBUZ0)	LCD_10	-	-	-	-	-	70
35	SEG49	70	P06	P06/SI10/RxD1/SDA10/SEG49/TS33/EI06/(PCLBUZ1)	LCD_11	-	-	-	-	-	71
36	SEG48	71	P05	P05/SCK10/SCL10/SEG48/TS34/EO05	LCD_12	-	-	-	-	-	72
37	SEG47	72	P04	P04/SEG47/VCOUT1/TS35/(INTP6)/(SO20)/(TxD2)/(PCLBUZ0)	LCD_13	-	-	-	-	-	73
38	SEG46	76	P03	P03/SEG46/VCOUT0/TRJIO0/(TxDA2)/(RxD2)/(SI20)/(SDA20)/(SI31)/(SDA31)	-	-	-	-	-	(TxDA2) TX/1	-
39	SEG45	77	P02	P02/INTP7/PCLBUZ0/SEG45/(TKBO21)/(SCK20)/(SCL20)/(SCK31)/(SCL31)	-	-	-	-	-	INTP7 2	-

J1	Evaluation MCU				Other Assignments						
Pin No.	Signal Name	Pin No.	Port Name	Pin Name	LCD Panel	Debug	Touch	Pmod1	Pmod2	Arduino	*1
40	SEG44	78	P01	P01/PCLBUZ1/SEG44/(TI05)/(TO05)/(TKBO11)/(INTP5)/(SO31)	-	-	-	-	-	(TO05) /(INTP5) ~3	-
41	SEG43	79	P00	P00/SEG43/SO00/TxD0/TOOLTxD/EI00/EO00/EXSDI0/(TKBO01)/(TRJO0)	-	TOOLTxD	-	-	-	-	74
42	SEG42	80	P17	P17/SEG42/SI00/RxD0/TOOLRxD/SDA00/EI17/EO17/EXSDI1/(TKBO01)/(TRJIO0)	-	TOOLRxD	-	-	-	-	75
43	SEG41	81	P16	P16/SEG41/SCK00/SCL00/EI16/(VCOUT0)/(TKBO01)/(RTC1HZ)	-	-	-	-	-	4	
44	SEG40	82	P15	P15/TI07/TO07/SEG40	-	-	-	-	-	TO07 ~5	
45	SEG39	83	P14	P14/TI04/TO04/SEG39/ANI26	LCD_14	-	-	-	-	-	76
46	SEG38	84	P13	P13/ANI25/SEG38	LCD_15	-	-	-	-	-	77
47	SEG37	85	P12	P12/ANI24/SEG37/EI12/CLKA0/SO11/(VCOUT1)/(TKBO00)/(TRJO1)/(PCLBUZ1)	LCD_16	-	-	-	-	-	78
48	SEG36	86	P11	P11/ANI23/SEG36/RxDA0/SI11/SDA11/(TKBO11)/(TRJIO1)/(INTP1)	LCD_21	-	-	-	-	-	79
49	SEG35	87	P10	P10/ANI22/SEG35/TxDA0/SCK11/SCL11/(TKBO10)/(INTP0)	LCD_22	-	-	-	-	-	80
50	SEG55	88	P145	P145/SEG55/(INTP3)/(TxDA1)/(SDAA0)	LCD_23	-	-	-	-	-	81
51	SEG54	89	P144	P144/SEG54/(INTP4)/(RxDA1)/(SCLA0)	LCD_24	-	-	-	-	-	82
52	SEG34	90	P27	P27/ANI21/SEG34/ANO1/EI27/RxDA1/SO21/(TKBO21)/(INTP4)/(TxD0)/(SO00)/(EXSDI1)	-	-	-	-	-	ANI21/ANO1 A0	-
53	SEG33	91	P26	P26/ANI20/SEG33/ANO0/EI26/TxDA1/SI21/SDA21/(TKBO20)/(INTP5)/(RxD0)/(SI00)/(SDA00)/(EXSDI0)	-	-	-	-	-	ANI20 A1	-
54	SEG32	92	P25	P25/ANI19/SEG32/CLKA1	-	-	-	-	-	ANI19 A2	-
55	SEG31	93	P24	P24/ANI18/SEG31	-	-	-	-	-	ANI18 A3	-
56	SEG53	94	P143	P143/SEG53/(INTP5)/(TxDA2)	LCD_25	-	-	-	-	-	83
57	SEG52	95	P142	P142/SEG52/(INTP7)/(RxDA2)	LCD_26	-	-	-	-	-	84
58	SEG51	96	P141	P141/SEG51/(INTP6)/(RxDA3)	LCD_27	-	-	-	-	-	85
59	SEG30	97	P23	P23/ANI17/SEG30/TRJIO1	-	-	-	-	-	ANI17 A4	-
60	SEG29	98	P22	P22/ANI16/SEG29/SCK21/SCL21/(SCK00)/(SCL00)/(INTP7)	-	-	-	-	-	ANI16 A5	-

Notes: 1. Arduino I/O; the names of Arduino signals correspond to the pin numbers for the Arduino IDE. For details on the Arduino IDE, refer to the Web site at https://github.com/renesas/Arduino/wiki/.

2. P57 (pin 51) is connected for the TSCAP pin function by default. A 0.01-μF capacitor is connected to P57. Cut Jumper Trace Cut E41 and apply solder to Jumper Solder Bridge E39 if this pin is to be used as a port pin. See Figure 5-5.

5.10 MCU Headers

The MCU headers are provided as through hole J2 for 40 pins. The pin headers have a pitch of 2.54 mm and the evaluation MCU is connected to the through hole for the headers.

Table 5-7 shows the pin assignments of the MCU headers.

Table 5-7 Pin Assignments of the MCU Headers (J2)

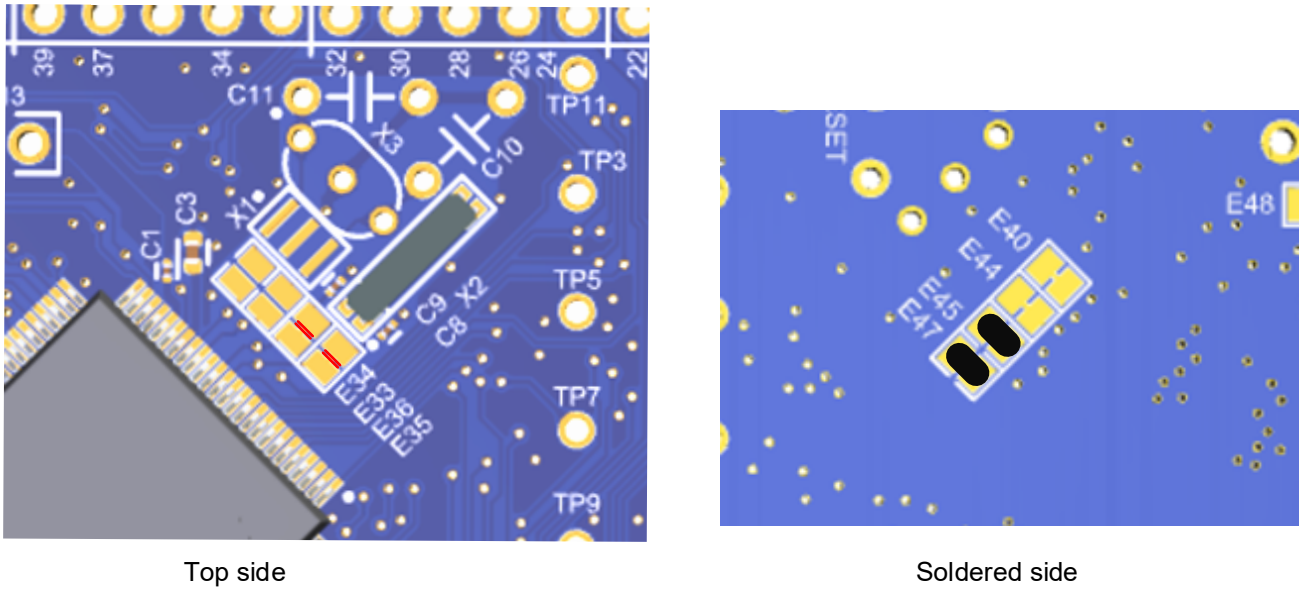
J2	Evaluation MCU		Other Assignments								
Pin No.	Pin No.	Pin Name	Port Name	LCD Pattern		Power, Clock, Debug, LED, SW	Pmod1	Pmod2	Grove	Arduino	*1
1*6	28	P127/CAPH/(TI03)/(TO03)/(REMOOUT)/TS00	P127	CAPH	TP1	-	-	-	-	-	14
2*6	29	P126/CAPL/(TI04)/(TO04)/TS01/(INTP4)	P126	CAPL	TP2	-	-	-	-	-	15
3*6	30	P87/VL1/(TxD1)/(SO10)	P87	VL1	TP9 TP10	-	-	-	-	-	16
4*6	31	P86/VL2/(TI06)/(TO06)/(INTP3)/(RxD1)/(SI10)/(SDA10)/(PCLBUZ1)	P86	VL2	TP7 TP8	-	-	-	-	-	17
5*6	32	P85/VL4/(VCOUT0)/(INTP4)/(SCK10)/(SCL10)/(SCK30)/(SCL30)	P85	VL4	TP3 TP4	-	-	-	-	-	18
6*6	33	P125/VL3/(TI06)/(TO06)/TS02/(VCOUT1)/(INTP7)/(RxD3)/(SI30)/(SDA30)/(PCLBUZ1)	P125	VL3	TP5 TP6	-	-	-	-	-	19
7	1	P140/SCK31/SCL31	P140	-	-	-	-	-	-	SCK31 13	-
8	5	P45/IVREF0/TxDA2/SCK30/SCL30/EXSDO0	P45	-	-	-	-	10 / [SCK30 4]	-	-	20
9	6	P44/IVCMP0/RxDA2/SI30/SDA30/RxD3/EXSDO1/(TI04)/(TO04)/(INTP7)/(SCK11)/(SCL11)	P44	-	-	-	-	9 / [SI30/RxD3 3]	-	-	21
10	7	P43/IVCMP1/SO30/TxD3/(TI05)/(TO05)/(INTP4)/(RxDA1)/(SI11)/(SDA11)	P43	-	-	-	-	SO30/TxD3 2	-	-	22
11	8	P42/TI05/TO05/IVREF1/TRJO0/(INTP7)/(TxDA1)/(SCLA0)/(RxD0)/(TxD1)/(SI00)/(SDA00)/(SO10)/(SO11)/(PCLBUZ1)	P42	-	-	-	(TxD1) / (SO10) 2	-	-	-	23
12	9	P41/(TI07)/(TO07)/(INTP6)/(TxD0)/(RxDA3)/(SDAA0)/(SO00)/(SI10)/(SDA10)/(RxD1)	P41	-	-	-	(SI10) / (RxD1) 3 / [(SDA10) 4]	-	-	-	24
13	10	P66/(TI05)/(TO05)/(INTP1)/(SCK10)/(SCL10)/(TxDA3)	P66	-	-	-	(SCK10) 4 /	-	-	-	25

J2	Evaluation MCU		Other Assignments								
Pin No.	Pin No.	Pin Name	Port Name	LCD Pattern		Power, Clock, Debug, LED, SW	Pmod1	Pmod2	Grove	Arduino	*1
							[(SCL10) 3]				
14	11	P67/(INTP2)/(TI01)/(TO01)	P67	-	-	-	(INTP2) 1	-	-	-	26
15	12	P40/TOOL0/(TI00)/(TO00)/(SCK00)/(SCL00)	P40	-	-	TOOL0	-	-	-	-	27
16	13	RESET	RESET	-	-	RESET	-	-	-	-	28
17[*2]	14	P124/XT2/EXCLKS	[P124]	-	-	Sub-clock	-	-	-	-	29
18[*3]	15	P123/XT1	[P123]	-	-	Sub-clock	-	-	-	-	30
19	16	P137/INTP0/EI137	P137	-	-	SW	-	-	-	-	31
20	17	P122/X2/EXCLK/EI122	P122	-	-	[Main clock]	10	-	-	-	32
21	18	P121/X1/VBAT0/EI121	P121	-	-	[Main clock]	9	-	-	-	33
22	22	P60/SCLA0/CCD04/EO60/(TI01)/(TO01)/(INTP3)	P60	-	-	-	-	-	-	SCLA0 SCL	-
23	23	P61/SDAA0/CCD05/EO61/(TI02)/(TO02)/(INTP4)	P61	-	-	-	-	-	-	SDAA0 SDA	-
24	24	P64/(INTP5)/(SDAA1)/(TI03)/(TO03)/(REMOOUT)	P64	-	-	LED1	-	-	-	-	34
25	25	P65/(INTP0)/(SCLA1)/(TI05)/(TO05)	P65	-	-	LED2	-	-	-	-	35
26	26	P62/SCLA1/CCD06/(TI03)/(TO03)/(REMOOUT)/(INTP5)	P62	-	-	-	-		-	8	-
27	27	P63/SDAA1/CCD07/(TI04)/(TO04)/(INTP6)	P63	-	-	-	-	(INTP6) 1	-	-	36
28	49	P84/(INTP0)/(TxDA0)/(SCLA1)	P84	-	-	-	-	(SCLA1) 3 / [9]	-	-	37
29	50	P83/(INTP1)/(RxDA0)/(SDAA1)	P83	-	-	-	-	(SDAA1) 4 / [10]	-	-	38
30	67	P82/(SCK10)/(SCL10)/(PCLBUZ0)	P82	-	-	-	-	-	(SCL10) 1	-	39

J2	Evaluation MCU		Other Assignments								
Pin No.	Pin No.	Pin Name	Port Name	LCD Pattern		Power, Clock, Debug, LED, SW	Pmod1	Pmod2	Grove	Arduino	*1
31	68	P81/(RxD1)/(SI10)/(SDA10)	P81	-	-	-	-	-	(SDA10) 2	-	40
32	73	P80/(INTP2)/(SCK20)/(SCL20)	P80	-	-	-	-	-	-	7	-
33	74	P147/(INTP2)/(TxDA3)/(RxD2)/(SI20)/(SDA20)	P147	-	-	-	-	-	-	~6 w/o PWM	-
34	75	P146/(VCOUT1)/(TxD2)/(SO20)/(SO31)/(RxDA2)/(INTP7)	P146	-	-	-	-	-	-	(RxDA2) RX/0	-
35[*4]	99	P21/ANI0/AVREFP/VBAT1/EI21/(TO00)/(INTP6)/(PCLBUZ0)	[P21]	-	-	VDD	-	-	-	AREF	-
36[*5]	100	P20/ANI1/AVREFM/EI20/(TI00)/(INTP7)/(PCLBUZ1)	[P20]	-	-	GND	-	-	-	-	-
37	19	REGC	-	-	-	-	-	-	-	-	-
38	20	VSS	-	-	-	GND	-	-	-	-	-
39	21	VDD	-	-	-	VDD	-	-	-	-	-
40	38	EVSS	-	-	-	GND	-	-	-	-	-

Notes: 1. Arduino I/O; the names of Arduino signals correspond to the pin numbers for the Arduino IDE. For details on the Arduino IDE, refer to the Web site at https://github.com/renesas/Arduino/wiki/.

2. P124 is connected to a sub-clock by default. Cut Jumper Trace Cut E35 and apply solder to Jumper Solder Bridge E47 if this pin is to be used as a port pin.
3. P123 is connected to a sub-clock by default. Cut Jumper Trace Cut E36 and apply solder to Jumper Solder Bridge E45 if this pin is to be used as a port pin.
4. P21 is connected to VDD by default. When P21 is to be disconnected from VDD, cut Jumper Trace Cut E57.
5. P20 is connected to GND by default. When P20 is to be disconnected from GND, cut Jumper Trace Cut E58.
6. P127 (pin 28) and P126 (pin 29) are respectively used as CAPH and CAPL by default. P87 (pin 30), P86 (pin 31), P125 (pin 33), and P85 (pin 32) are respectively used as V_{L1}, V_{L2}, V_{L3}, and V_{L4} by default. 0.47-µF capacitors are connected to the pins. Cut Jumper Trace Cuts E27 to E32 if these pins are to be used as port pins (see Figure 5-4).



Top side Soldered side

Figure 5-11 Assignments of E35, E36, E45, and E47

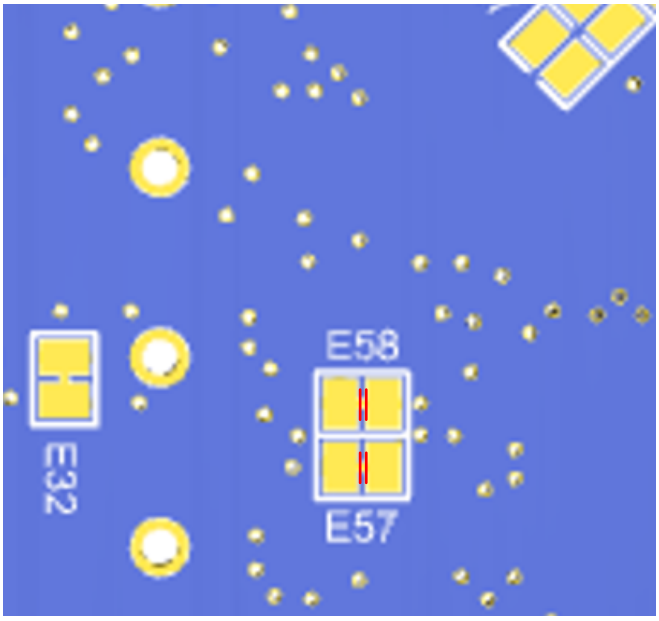


Figure 5-12 Assignments of E57 and E58 (Soldered Side)

5.11 Grove Connector

The specification of the grove connector (J11) is on the assumption that Grove modules are to be connectable through I^2C. If a connector is mounted, however, connection to all Grove modules (through I^2C) is not guaranteed. Use this connector after having confirmed the specifications of this product and Grove modules (through I^2C) you intend to use.

Figure 5-13 and Table 5-8 show the pin assignments of the Grove connector (the connector is not mounted).

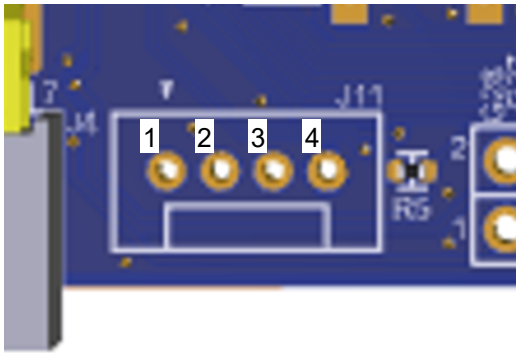


Figure 5-13 Pin Assignments of the Grove Connector

Table 5-8 Pin Assignments of the Grove Connector

Part No. in the Circuit Schematics	RL78/L23			
	Pin	Power Supply	Port	I^2C
J11-1	67	-	P82	(SCL10)
J11-2	68	-	P81	(SDA10)
J11-3	-	VDD	-	-
J11-4	-	GND	-	-

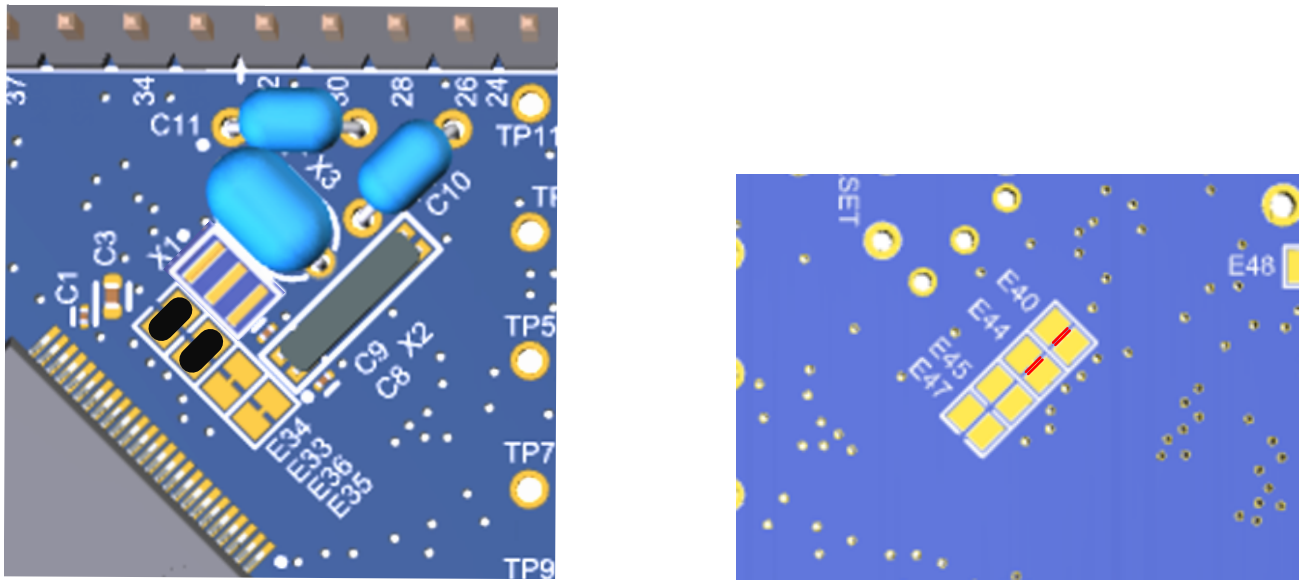
5.12 Clock

Clock circuits are provided to handle the clock sources for the evaluation MCU. For details on the specifications of the evaluation MCU, refer to the RL78/L23 User's Manual: Hardware. For details on the clock circuit of this product, refer to the circuit schematics of the RL78/L23 Fast Prototyping Board. Table 5-9 shows the details of the clocks on the RL78/L23 Fast Prototyping Board.

Table 5-9 Details of Clocks

Clock	Function and Usage	State as Shipped	Frequency	Package for the Oscillator
X1*	Crystal oscillator for the main system clock (e.g. CSTNE20M0V5 from Murata Manufacturing Co., Ltd.)	Not mounted	n/a	SMT
X3*	Crystal oscillator or ceramic resonator for the main system clock	Not mounted	n/a	Lead type
X2	Crystal oscillator for the sub-clock SSP-T7-FL 4.4pF*2	Mounted	32.768 kHz	SMT

Note: Use the main system clock by cutting Jumper Trace Cuts E40 and E44 and short-circuiting Jumper Solder Bridges E33 and E34.



Top side Soldered side

Figure 5-14 Assignments of E33, E34, E40, and E44

5.13 Reset Switch

Pressing the reset switch (S2: RESET) applies a hardware reset to the evaluation MCU.

5.14 User Switch

An optional user switch (S1: SW) is mounted. It is connected to pin 16 of the evaluation MCU, which operates as pin function P137. The INTP0 interrupt is multiplexed on the same pin.

5.15 USB-to-Serial Converter

A USB-to-serial converter (FT232RNQ) 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.

https://www.ftdichip.com DRIVERS -> VCP Drivers

Pins 1-2 of the USB-to-serial converter reset header (J23) are short-circuited; the port 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, P17, and P00 pins of the evaluation MCU are respectively occupied as the TOOL0, TOOLRxD, and TOOLTxD functions.

For the method of COM port debugging, refer to the application note, RL78 Debugging Functions Using the Serial Port (R20AN0632).

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 P17 and P00 pins enables UART communications between the host PC and the evaluation MCU. The user needs to prepare the terminal software, such as TeraTerm.

5.16 USB-to-Serial Converter Reset Header

The USB-to-serial converter is placed in the forced reset state by short-circuiting its reset header (2-3 of J23). 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 P17 (RxD0) and P00 (TxD0) as facilities other than for a UART, such as port pins, while a reset is being applied to the USB-to-serial converter. To place the USB-to-serial converter in the reset state, the board must be connected to the host PC via a USB cable to supply power to the USB-to-serial converter. Figure 5-15 shows the position of the USB-to-serial converter reset header.

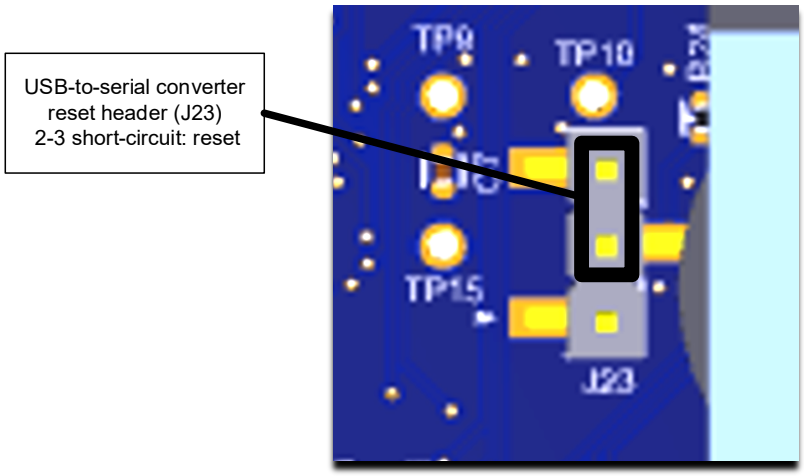


Figure 5-15 Position of the USB-to-Serial Converter Reset Header

When power is to be supplied other than through the USB cable, the evaluation MCU alone is to operate, and P17 and P00 are to be used other than as COM ports, cut Jumper Trace Cuts E50 and E51 that would otherwise connect the USB-to-serial converter.

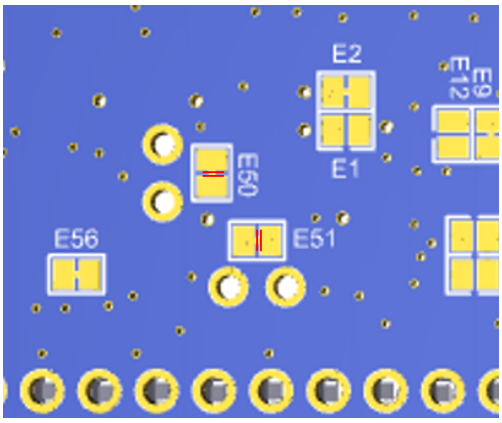


Figure 5-16 Positions for Disconnecting the Host PC from the USB-to-Serial Converter (Soldered Side)

To restore availability of the COM ports after having cut E50 and E51, short-circuit J17 and J18 (the components are not mounted).

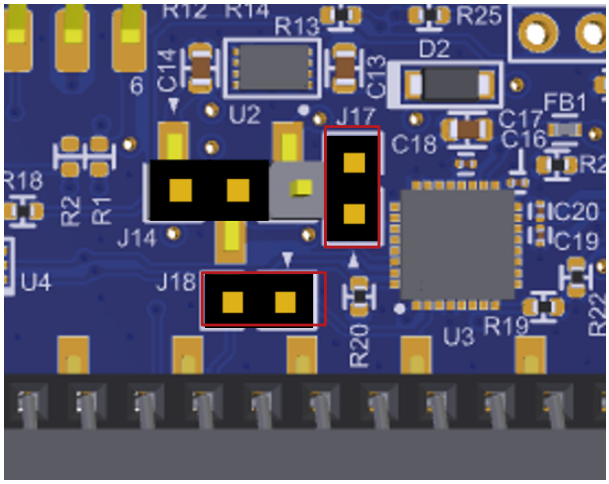


Figure 5-17 When the COM Port is to be Used after Having Cut E50 and E51

5.17 Power-Supply Selection Header

The operating power (VDD) of the evaluation MCU can be changed to 3.3 V or 5 V or to supply from the emulator or external power with the use of a header (J14). Only change the jumper setting of J14 while power is not being supplied.

- 1-2 of J14 being short-circuit selects a 3.3-V power supply. This is the default setting as shipped (Figure 5-18).
- 2-3 of J14 being short-circuit selects a 5-V power supply (Figure 5-19).
- J14 being open-circuit selects supply from the emulator or external power. (Figure 5-20).

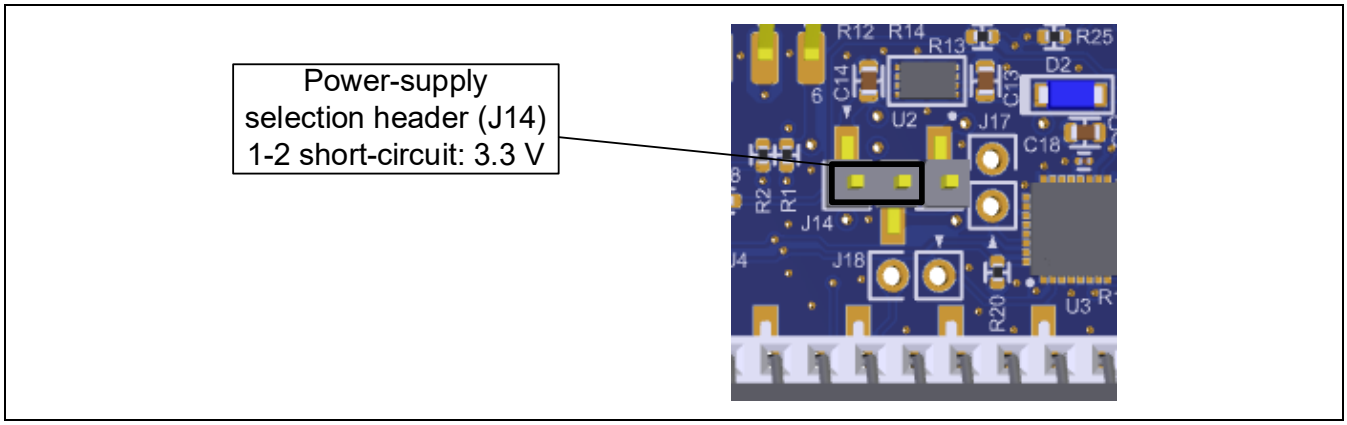


Figure 5-18 Setting of the Header to Select a 3.3-V Power Supply

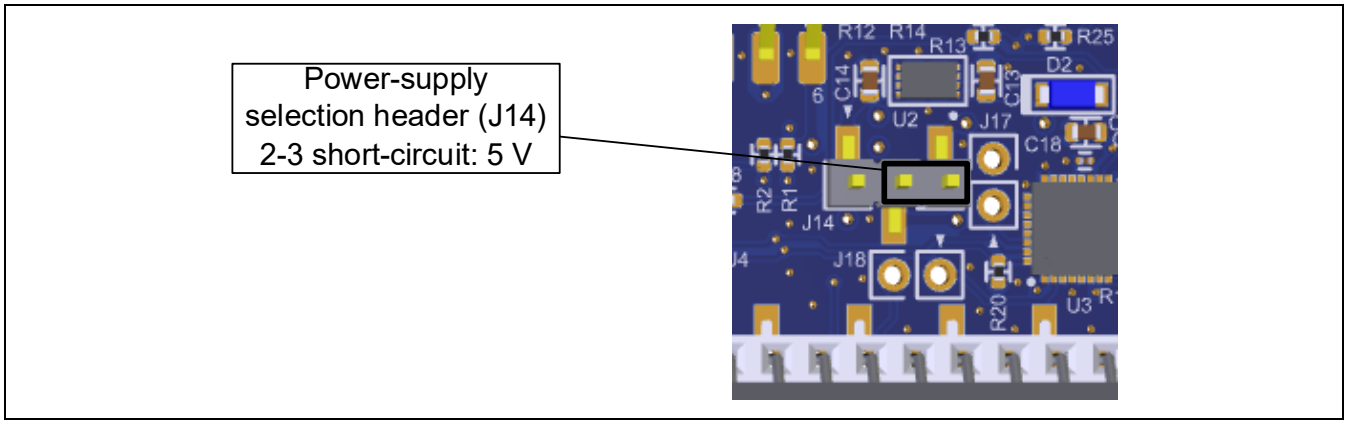


Figure 5-19 Setting of the Header to Select a 5-V Power Supply

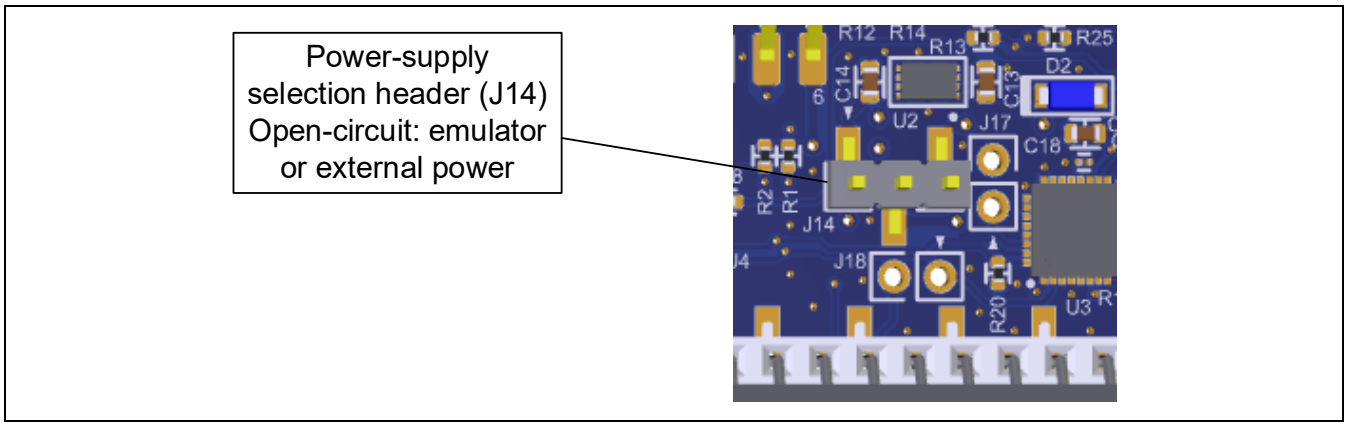


Figure 5-20 Setting of the Header to Select Supply from the Emulator or External Power

5.18 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:

- VDD: Pin J12-2 or pin J2-39 on the MCU header
- GND: Pin J12-1 or pin J2-40 on the MCU header

Figure 5-21 shows the positions of the external power supply.

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

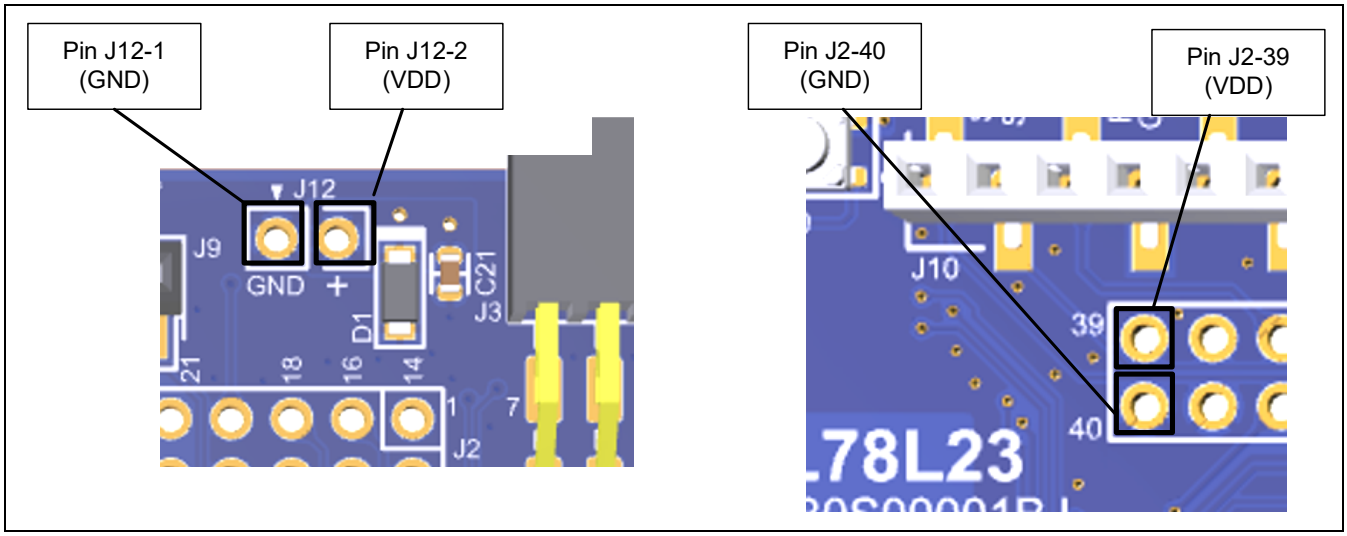


Figure 5-21 Positions of the Destinations for Connection of an External Power Supply

5.19 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 cut Jumper Trace Cut E48 if this header is to be used. Figure 5-22 shows the positions of the current measurement header and Jumper Trace Cut.

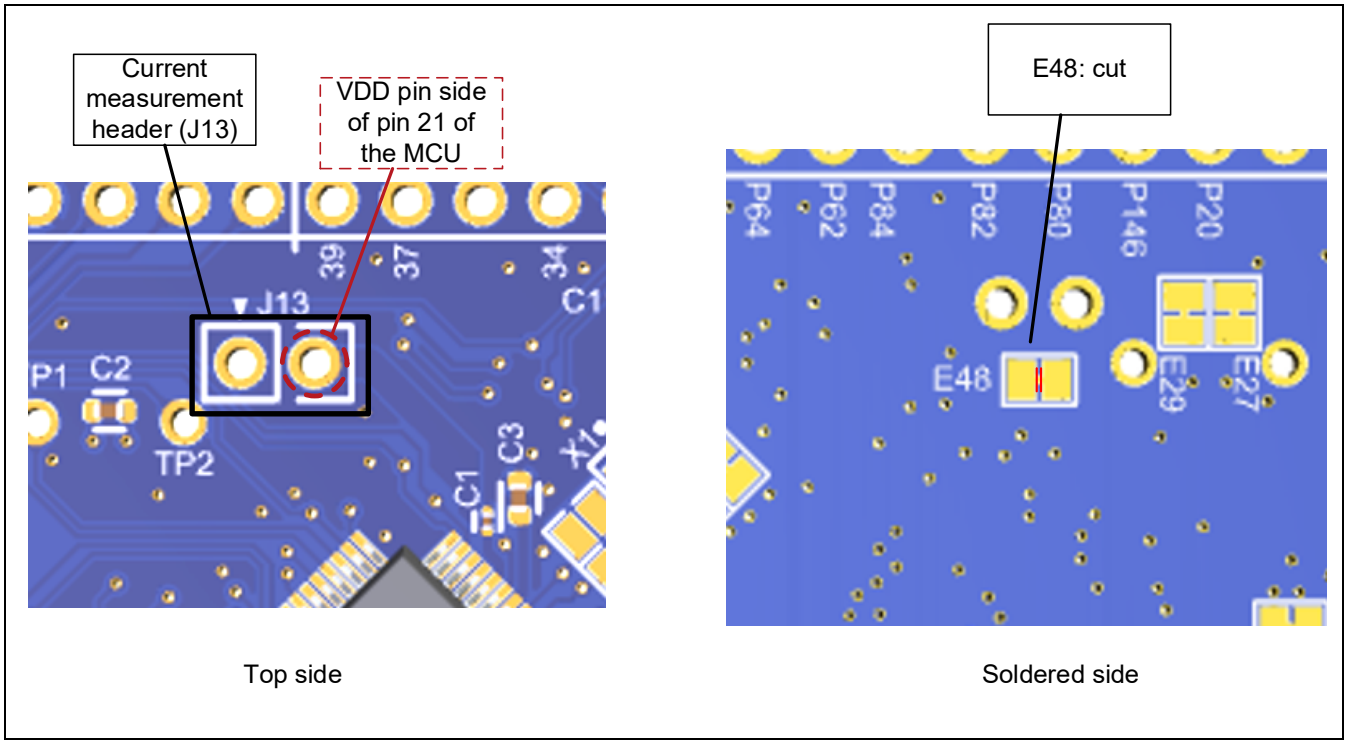


Figure 5-22 Positions of the Current Measurement Header (J13) and Jumper Trace Cut E48

Insert an ammeter between the sockets of the current measurement header (J13) to measure the current. Cut Jumper Trace Cut E56 (Figure 5-24) and turn down the LED to reduce the current drawn with an MCU other than the evaluation MCU.

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 6-2.

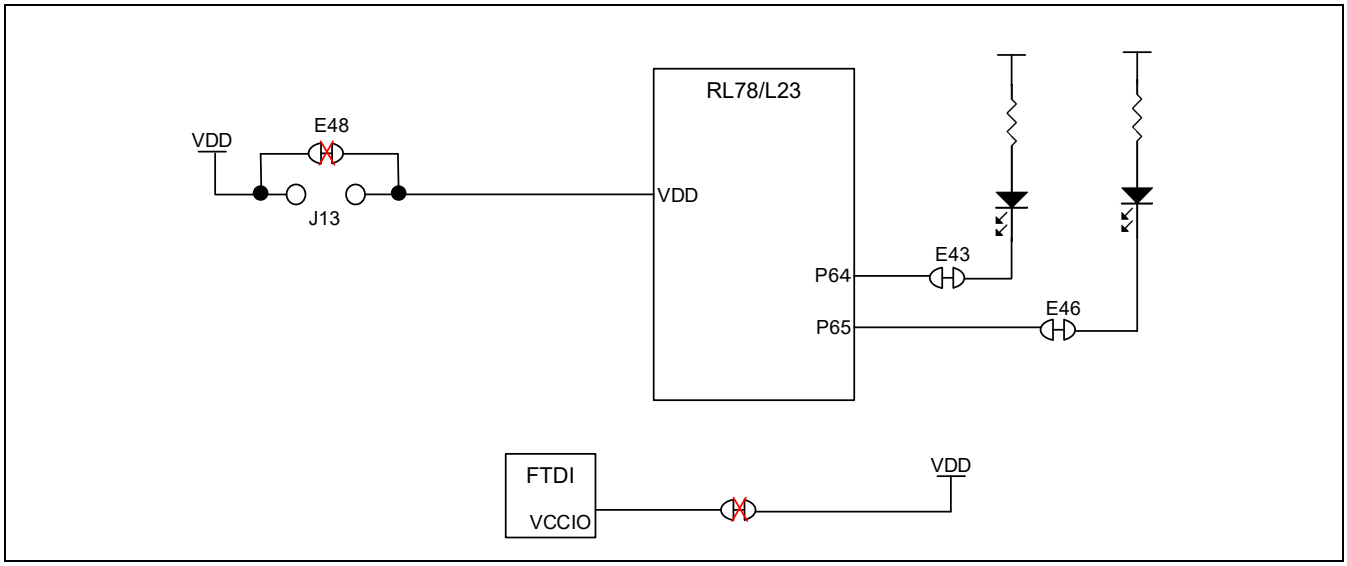


Figure 5-23 Block Diagram of the Headers Related to Current Measurement

5.20 I/O Power Supply for the USB-to-Serial Converter

If you intend to use this board without connecting a USB connector, cut Jumper Trace Cut E56. Figure 5-24 shows the position of the Jumper Trace Cut.

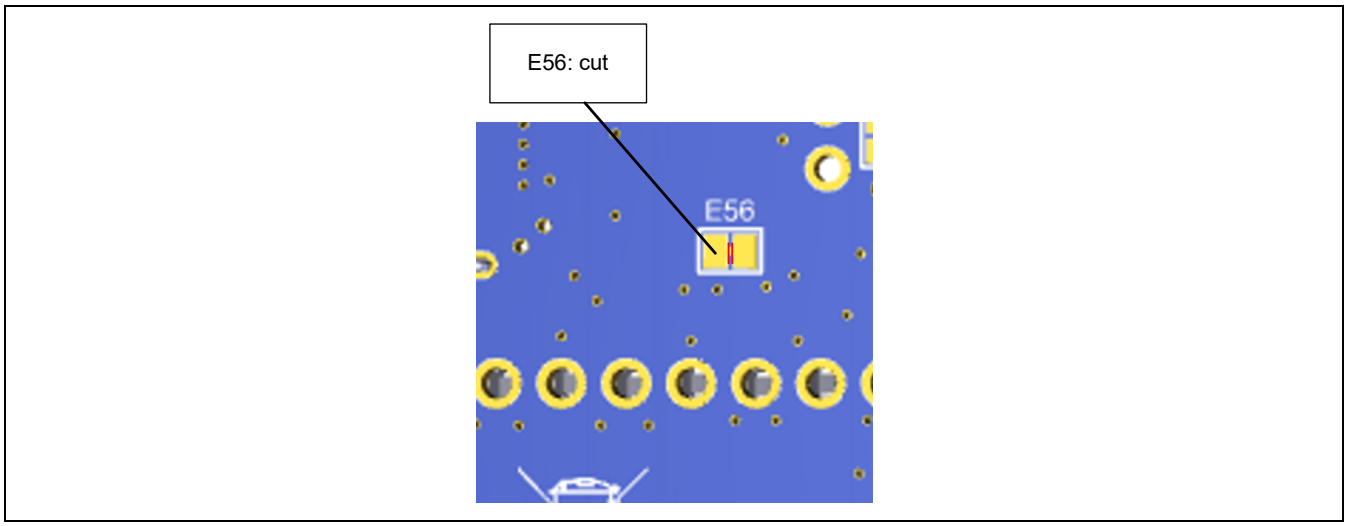


Figure 5-24 Position of Jumper Trace Cut E56 (Soldered Side)

5.21 Emulator Connector

This 14-pin connector (J15) 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.

- J15: 14-pin connector must be mounted
- J16, J20, and J22: pins 2-3 are short-circuit
- Jumper Trace Cut E49: cut
- Jumper Trace Cut E52: cut
- Jumper Trace Cut E54: cut

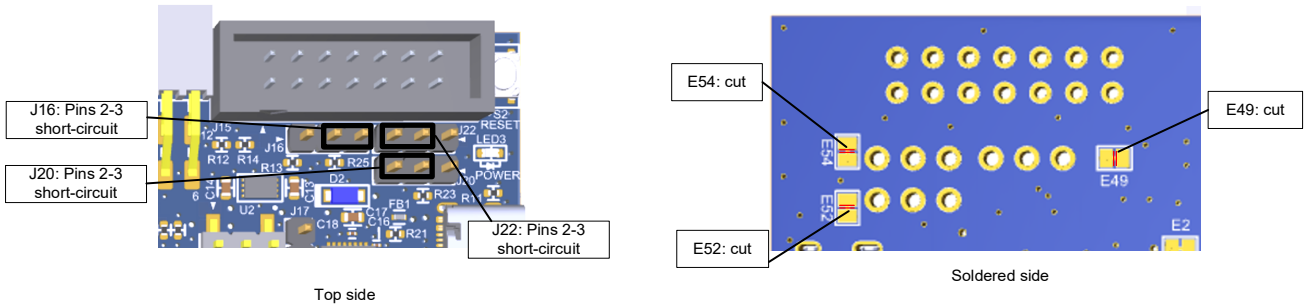


Figure 5-25 Settings for Use with the Emulator Connector

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.

- J16, J20, and J22: pins 1-2 are short-circuit

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

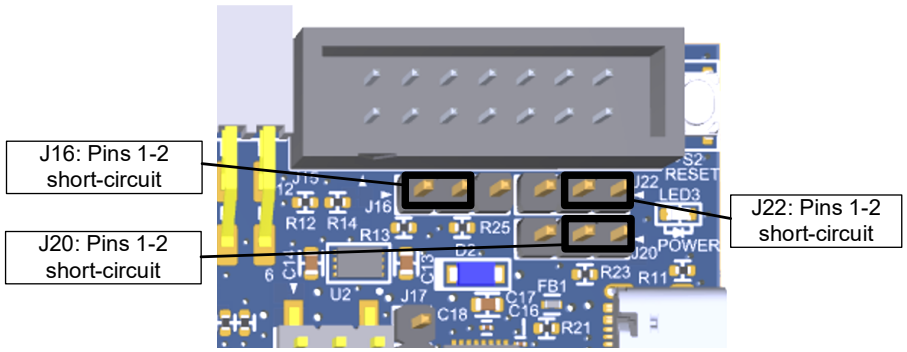


Figure 5-26 Settings for Use with COM Port Debugging

6. Handling Precautions

6.1 Power to be Supplied

When power is to be supplied to this product through the USB or the DC jack, or from an emulator, note that the total current of VDD, 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 cutting the Jumper Trace Cut and short-circuiting the Jumper Solder Bridge) shall be conducted at the user's own responsibility.

The following shows the settings of jumpers as shipped.

- J14: pins 1-2 are short-circuit (VDD: 3.3 V)
- J21: pins 1-2 are short-circuit (using a reset from the COM port)
- J23: pins 1-2 are short-circuit (release from resetting of the USB-to-serial converter)

6.3 Copper Jumpers

Copper jumpers are of two types, designated **Jumper Trace Cut (closed)** and **Jumper Solder Bridge (open)**.

A **Jumper Trace Cut (closed)** is provided with a narrow copper trace connecting its pads. The silk screen overlay printing around a Jumper Trace Cut (closed) is a solid box. To isolate the pads, cut the trace between pads adjacent to each pad, then remove the connecting copper foil either mechanically or with the assistance of heat. Once the etched copper trace is removed, the Jumper Trace Cut (closed) is turned into a Jumper Solder Bridge (open) for any later changes.

A **Jumper Solder Bridge (open)** is provided with two isolated pads that may be joined together by one of three methods:

- Solder may be applied to both pads to develop a bulge on each and the bulges joined by touching a soldering iron across the two pads.
- A small wire may be placed across the two pads and soldered in place.
- A SMD zero-ohm resistor, inch size 0805, 0603, or 0402, may be placed across the two pads and soldered in place. A zero-ohm resistor shorts the pads together.

For any copper jumper, the connection is considered **closed** if there is an electrical connection between the pads (default for Jumper Trace Cut (closed)). The connection is considered **open** if there is no electrical connection between the pads (default for Jumper Solder Bridge (open)).

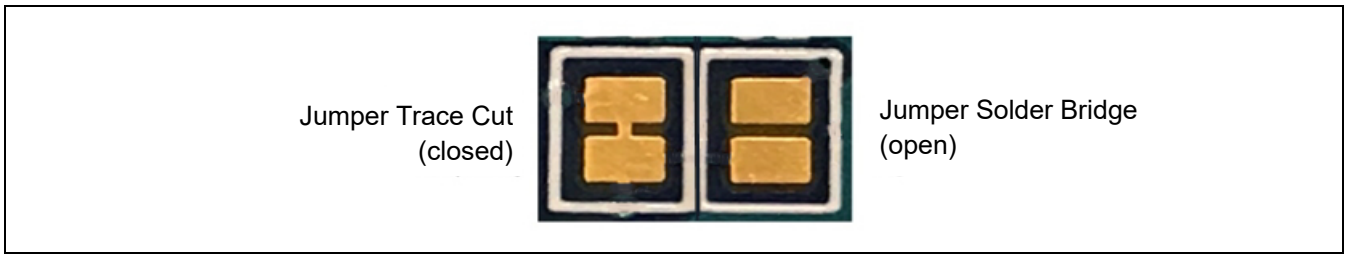


Figure 6-1 Copper Jumpers

6.4 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 6-2 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 • J14: 1-2 short-circuit: 3.3 V (default) Required • J14: 2-3 short-circuit: 5 V
External power supply	1.6 V to 5.5 V	Possible	Possible	Possible*3	Required • J14: open-circuit
Emulator	E2 Lite: 3.3 V E2: 1.8 V to 5.0 V	Not possible	Possible	Possible	Required • J14: open-circuit

Notes: 1. Connecting the RL78/L23 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. The power-supply voltage must be at least 1.8 V.
4. If power to be supplied to this product other than via the USB, cut Jumper Trace Cut E56 (see Figure 5-24).

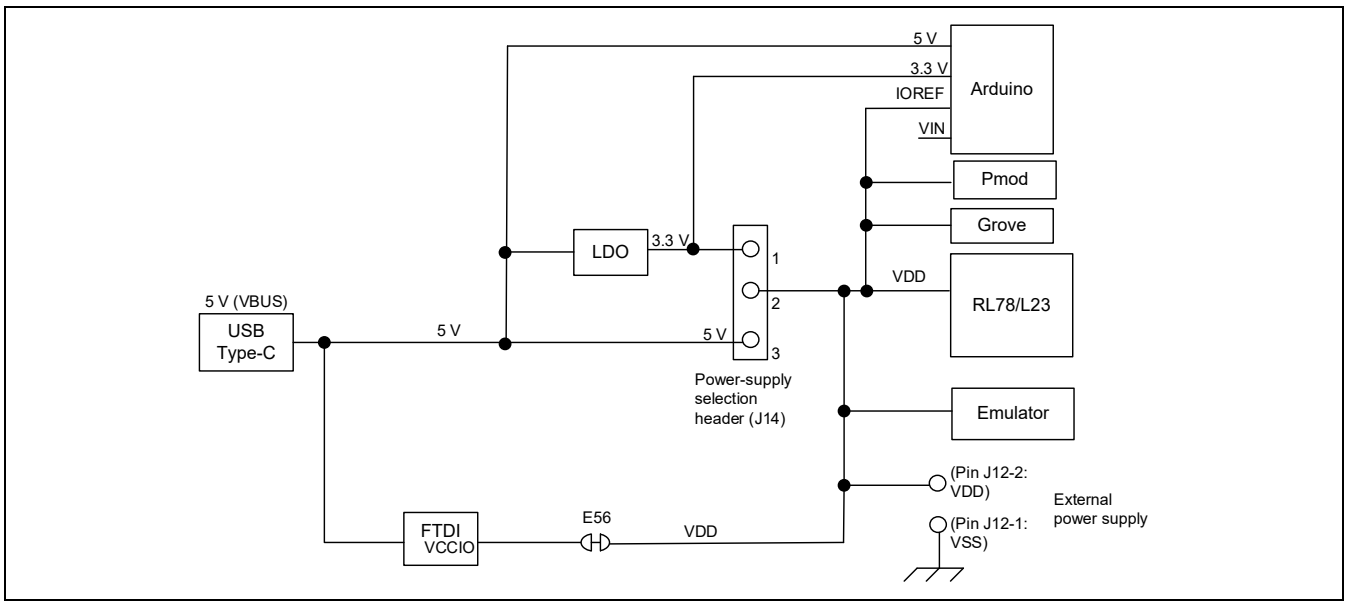


Figure 6-2 Block Diagram of the Power-Supply Circuit

6.5 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 (standalone ver.) to Develop Touch Applications for FPB board” (R01AN6741).

(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 J21 jumper block for switching the QE serial connection as follows.

- J21: pins 2-3 are short-circuit

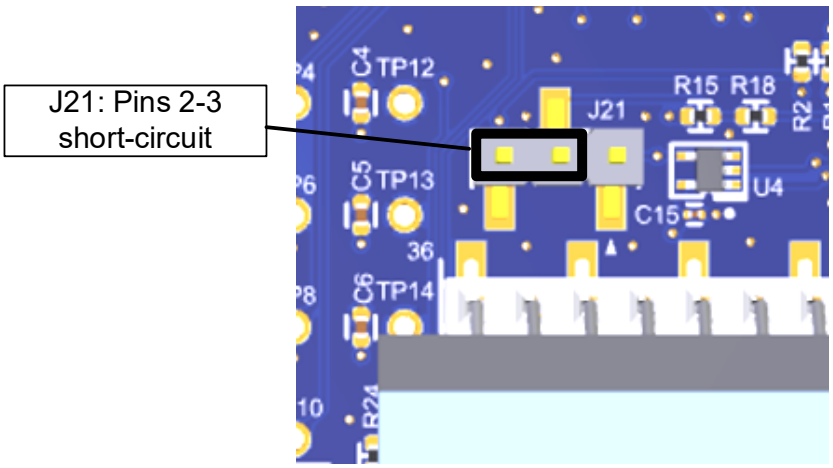


Figure 6-3 Settings for Use with the Serial Connection Function of QE (Top Side)

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
- Tuning the capacitive touch sensor via COM port debugging with the use of QE

(2) Not using the serial connection function of QE

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 (including the case of the usage described under note above), make the following change of setting as follows.

- J21: pins 1-2 are short-circuit

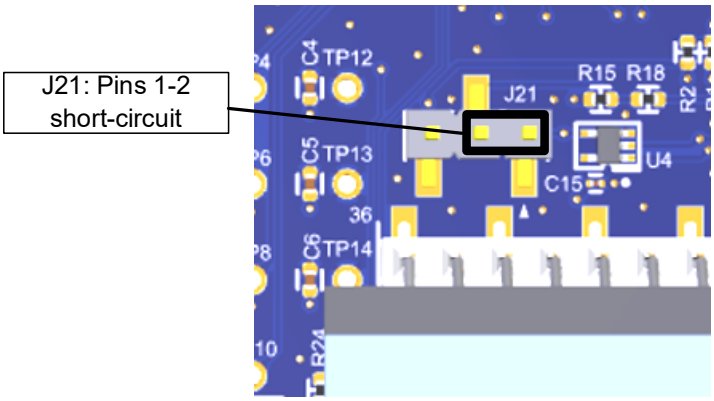


Figure 6-4 Settings for Use with COM Port Debugging (Top Side)

6.6 Note on Using P00/TxD0

When the power is turned on or immediately after release from resetting of the USB-to-serial converter of this product, if a user program which starts the output of the UART transmission to the P00/TxD0 line is written to the evaluation MCU before the host PC recognizes the USB-to-serial converter as the COM port, the operation of the USB-to-serial converter may be unstable and prevent connection to the Renesas Flash Programmer or terminal software.

In such cases, turn on the power (connect the USB cable) while pressing the reset switch, wait about 3 seconds until the host PC recognizes the USB-to-serial converter as the COM port, and release the reset switch. Otherwise, reset the USB-to-serial converter (by briefly short-circuiting pins 2-3 on J23 and then restoring the short-circuit to pins 1-2) while pressing the reset switch, wait about 3 seconds until the host PC recognizes the USB-to-serial converter as the COM port, and release the reset switch.

Finally, erase the user program by using the Renesas Flash Programmer.

7. Developing Code

Use the e^2 studio or CS+, both of which support the evaluation MCU (RL78/L23).

For the usage of the E2 emulator and E2 emulator Lite, refer to the help system or user's manual of the e^2 studio or CS+.

7.1 Using COM Port Debugging with the e^2 studio

Figure 7-1 shows the settings of the e^2 studio when it is to be connected to the RL78/L23 Fast Prototyping Board.

- [Debug hardware]: Select [COM port (RL78)].
- [Target Device]: Select [R7F100LPL].
- [Connection with Target Board]:
  [COM Port]: Select the COM port number for assignment to the RL78/L23 Fast Prototyping Board from the pull-down list.
  [Reset control pin]: Select [DTR].

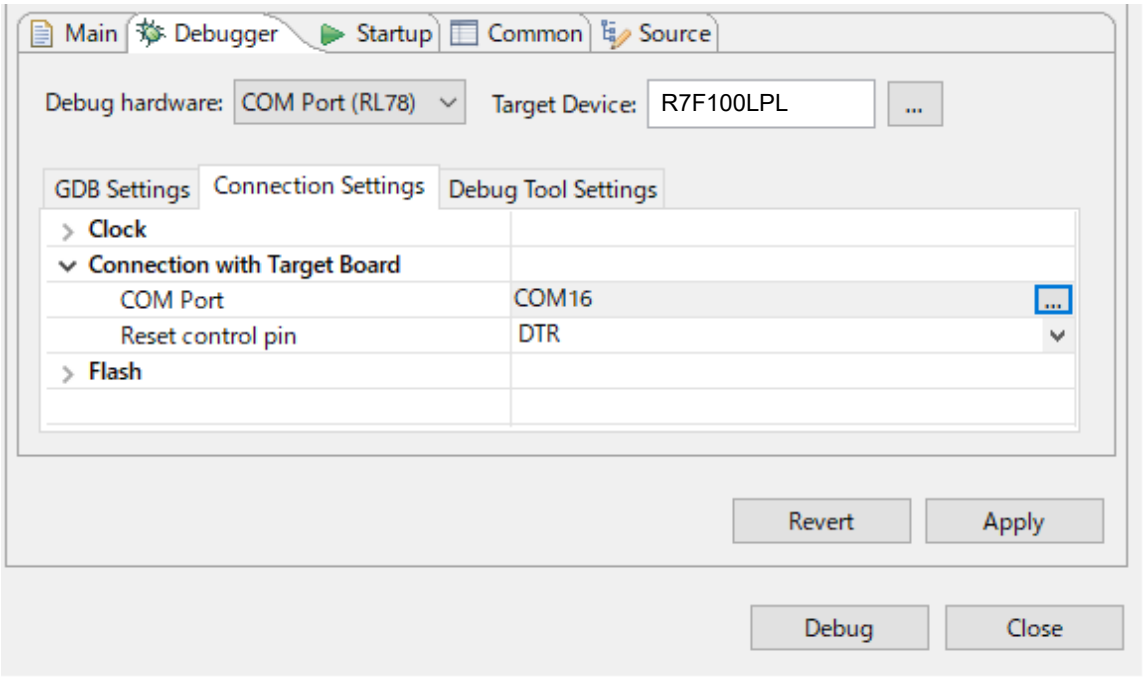


Figure 7-1 Settings of the e^2 studio

7.2 Using COM Port Debugging with CS+

Figure 7-2 and Figure 7-3 show the settings of CS+ when it is to be connected to the RL78/L23 Fast Prototyping Board.

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

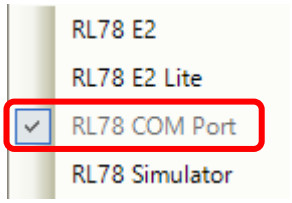


Figure 7-2 Panel for Selecting the Debug Tool

- [Connection with Target Board]:
  [Communication port]: Select the COM port number for assignment to the RL78/L23 Fast Prototyping Board from the pull-down list.
  [Reset control pin]: Select [DTR].

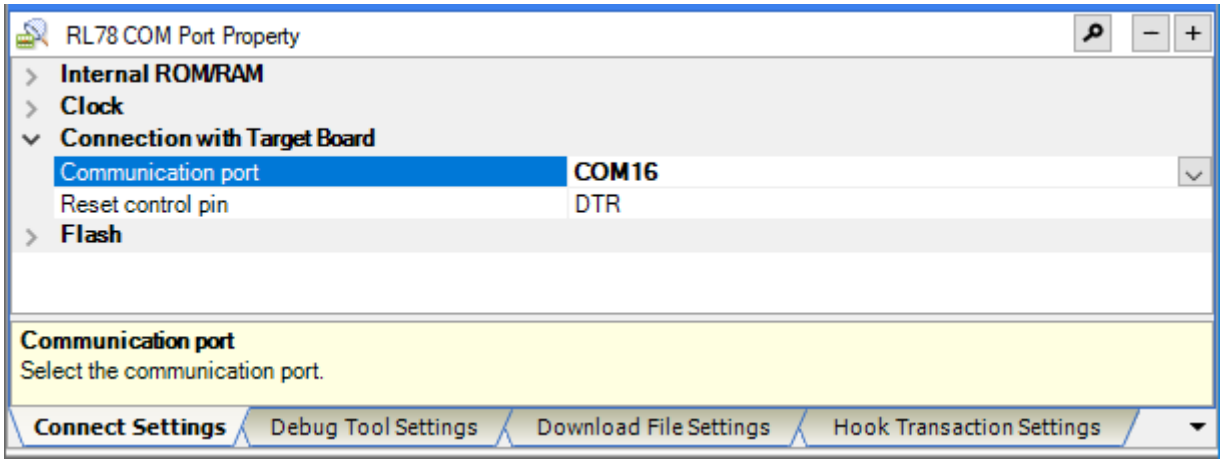


Figure 7-3 [Connect Settings] Tabbed Page of CS+

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. Certifications

The RL78/L23 Fast Prototyping Board meets the following certifications/standards. See page 4 of this user's manual for the disclaimer and precautions.

8.1 EMC/EMI Standards

- CE Class A (EMC)

  This product is herewith confirmed to comply with the requirements set out in the Council Directives on the Approximation of the laws of the Member States relating to Electromagnetic Compatibility Directive 2014/30/EU.

  Warning – This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures to correct this interference.
- UKCA Class A (EMC)

  This product is in conformity with the following relevant UK Statutory Instrument(s) (and its amendments): 2016 No. 1091 Electromagnetic Compatibility Regulations 2016.

  Warning – This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures to correct this interference.
- Taiwan: Chinese National Standard 13438, C6357 compliance, Class A limits
- Australia/New Zealand AS/NZS CISPR 32:2015, Class A

8.2 Material Selection, Waste, Recycling and Disposal Standards

- EU RoHS
- China SJ/T 113642014, 10-year environmental protection use period.
- WEEE Directive (2012/19/EU) & The Waste Electrical and Electronic Equipment Regulations 2013

The WEEE (Waste Electrical and Electronic Equipment) regulations put responsibilities on producers for the collection and recycling or disposal of electrical and electronic waste. Return of WEEE under these regulations is applicable in the UK and European Union.

This equipment (including all accessories) is not intended for household use. After use the equipment cannot be disposed of as household waste, and the WEEE must be treated, recycled and disposed of in an environmentally sound manner.

Renesas Electronics Europe GmbH can take back end of life equipment. Register for this service at;
https://www.renesas.com/eu/en/support/regional-customer-support/weee

8.3 Safety Standards

- UL 94V-0

9. Design and Manufacturing Information

The design and manufacturing information on the RL78/L23 Fast Prototyping Board is available on https://www.renesas.com/fpb-rl78l23.

Table 9-1 Design and Manufacturing Information on the RL78/L23 Fast Prototyping Board

File Type	Content	Title
File (PDF)	Schematics	RL78/L23 Fast Prototyping Board Schematics
File (PDF)	BoM	RL78/L23 Fast Prototyping Board BoM List
File (Zip)	Design and manufacturing files	RL78/L23 Fast Prototyping Board Design Package

10. Website and Support

Visit the following URLs to learn about the kit and the RL78 family of microcontrollers, download tools and documentation, and get support.

RL78 Fast Prototyping Board resources	https://www.renesas.com/fpb-rl78l23
RL78 Product Information	renesas.com/rl78
RL78 Product Support Forum	https://community.renesas.com/mcu-mpu/rl78/
Renesas Support	renesas.com/support

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