User's Manual

32

RA4W1 Group

EK-RA4W1 User's Manual

32-bit MCU

Renesas Advanced (RA) Family

Renesas RA4 Series

Renesas Electronics
www.renesas.com

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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 are using this product to evaluate the RA4W1 microcontroller and debug programs. The readers of this manual must have basic knowledge about the features of microcontrollers 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 EK-RA4W1. Be sure to refer to the latest versions of these documents. The newest versions of the listed documents are available on the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
User's manual	EK-RA4W1 hardware specifications	EK-RA4W1 User's Manual	R20UT4683EJ (this manual)
Circuit schematics	EK-RA4W1 circuit schematics	EK-RA4W1 Circuit Schematics	R20UT4684EJ
Parts list	EK-RA4W1 parts list	EK-RA4W1 BOM LIST	R12TU0088EJ
Quick start guide	Procedure for checking the initial operation	EK-RA4W1 Quick Start Guide	R20QS0015EJ
Application note	Description of sample code for use with the EK-RA4W1	RA4W1 Group BLE Module Flexible Software Package Application Note	R01AN5383EJ
User's manual for the hardware*	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and descriptions of operation	RA4W1 Group User's Manual: Hardware	R01UH0883EU

Note: Download the documents for the RA4W1 from the product page for the RA4W1.

2. List of Abbreviations and Acronyms

Abbreviation	Full Form
Arduino™ UNO	Connectors compatible with the Arduino™ UNO R3 board are mounted on the fast prototyping board.
BLE	Bluetooth® Low Energy The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Renesas Electronics Corporation is under license.
CPU	Central Processing Unit
DIP	Dual In-line Package
DNF	Do Not Fit
IDE	Integrated Development Environment
IRQ	Interrupt Request
HOCO	High-Speed On-Chip Oscillator
LOCO	Low-Speed On-Chip Oscillator
LED	Light Emitting Diode
MCU	Micro-controller Unit
n/a (NA)	Not applicable
n/c (NC)	Not connected
PC	Personal Computer
Pmod™	Pmod™ is a trademark of Digilent Inc. The Pmod™ interface specification is the property of Digilent Inc. For the Pmod™ interface specification, refer to the Pmod™ License Agreement page at the Web site of Digilent Inc.
RAM	Random Access Memory
ROM	Read Only Memory
SPI	Serial Peripheral Interface
USB	Universal Serial Bus

Table of Contents

1. Overview

1.1 Package Components

Thank you for purchasing the EK-RA4W1 evaluation tool from Renesas (hereinafter referred to as “this product”). This product consists of the EK-RA4W1 (RTK7EKA4W1S00000BJ).

1.2 Purpose

This product is an evaluation tool for a Renesas MCU. This user’s manual describes the hardware specifications, the method of setting the switches on the board, and the basic procedures for setting this product up.

1.3 Features

- Programming of the Renesas MCU
- Debugging of user code
- Evaluation of Bluetooth® Low Energy (BLE) communications
- User circuits for switches and LEDs
- Sample applications*1
- Samples of peripheral-function initialization code*1

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

https://www.renesas.com/ra/ek-ra4w1

1.4 Preparation

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

https://www.renesas.com/ra/ek-ra4w1

1.5 EK-RA4W1: Table of Specifications

Table 1-1 shows the specifications of this product.

Table 1-1 EK-RA4W1 Specification Table

Item	Specification
Evaluation MCU	Part No.: R7FA4W1AD2CNG
	Package: 56-pin QFN
	On-chip memory: 512-KB ROM, 96-KB RAM, 8-KB data flash memory
Board size	Size: 54.0 mm x 90.0 mm
	Thickness: 1.6 mm
Power-supply voltage	USB connector: 5-V input
	Power-supply IC: 5-V input, 3.3-V output
	External power-supply header*1: 3.3-V input, 2 pins x 1
Current drawn	Max. 200 mA
Current measurement header*1	Header: 2 pins x 1
Main clock*1	Crystal oscillator (surface-mount technology (SMT)) for the main system clock
	Crystal oscillator or ceramic resonator (lead type) for the main system clock
Sub-clock*1	Crystal oscillator (SMT) for the sub-clock
Bluetooth® Low Energy	Bluetooth® Low Energy circuit x 1
	Range of frequency: 2402 to 2480 MHz
	Maximum transmission output power: 4 dBm (in 4-dBm output mode)
	Output variation: +2 dB
Push switches	Reset switch x 1
	User switch x 1
LEDs	Power indicator: green x 1
	User: green x 2
	ACT LED: green x 1
USB	Connector for an on-board emulator: USB Micro-B
	Connector for a USB serial-conversion interface: USB Micro-B
Pmod™ connector	Connector: Angle type, 12 pins
Arduino™ UNO connectors	A set of 2.54-mm pitch connectors for Arduino™ UNO
MCU headers*1	Headers: 28 pins x 2
Emulator reset switch	DIP switch x 1

Note: This part is not mounted.

1.6 Block Diagram

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

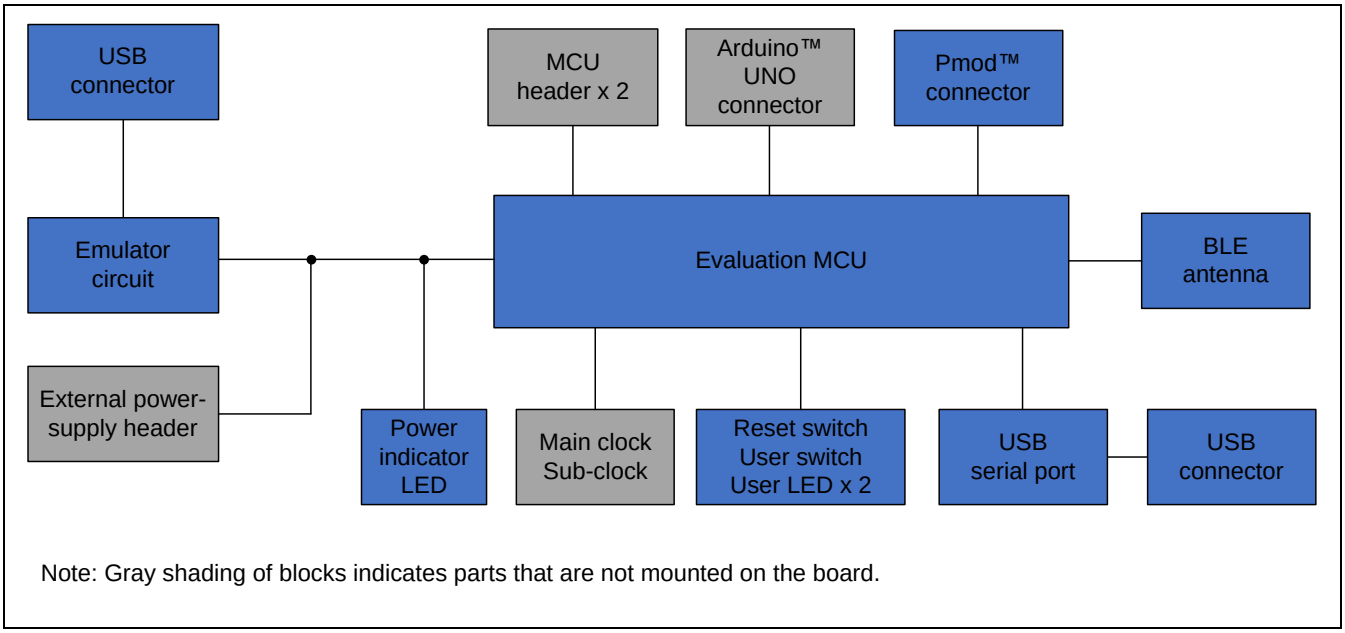

Figure 1-1 Block Diagram

2. Board Layout

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

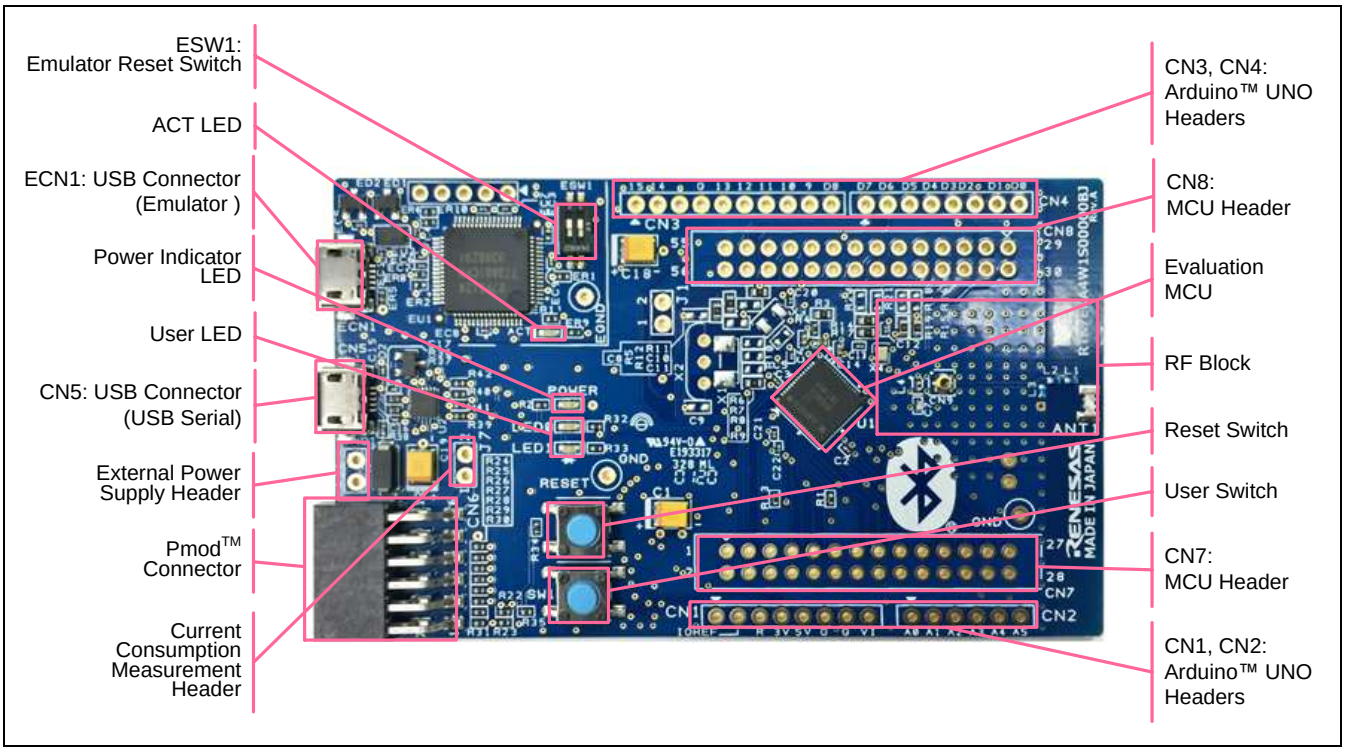

Figure 2-1 Board Layout (Top Side)

3. Parts Layout

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

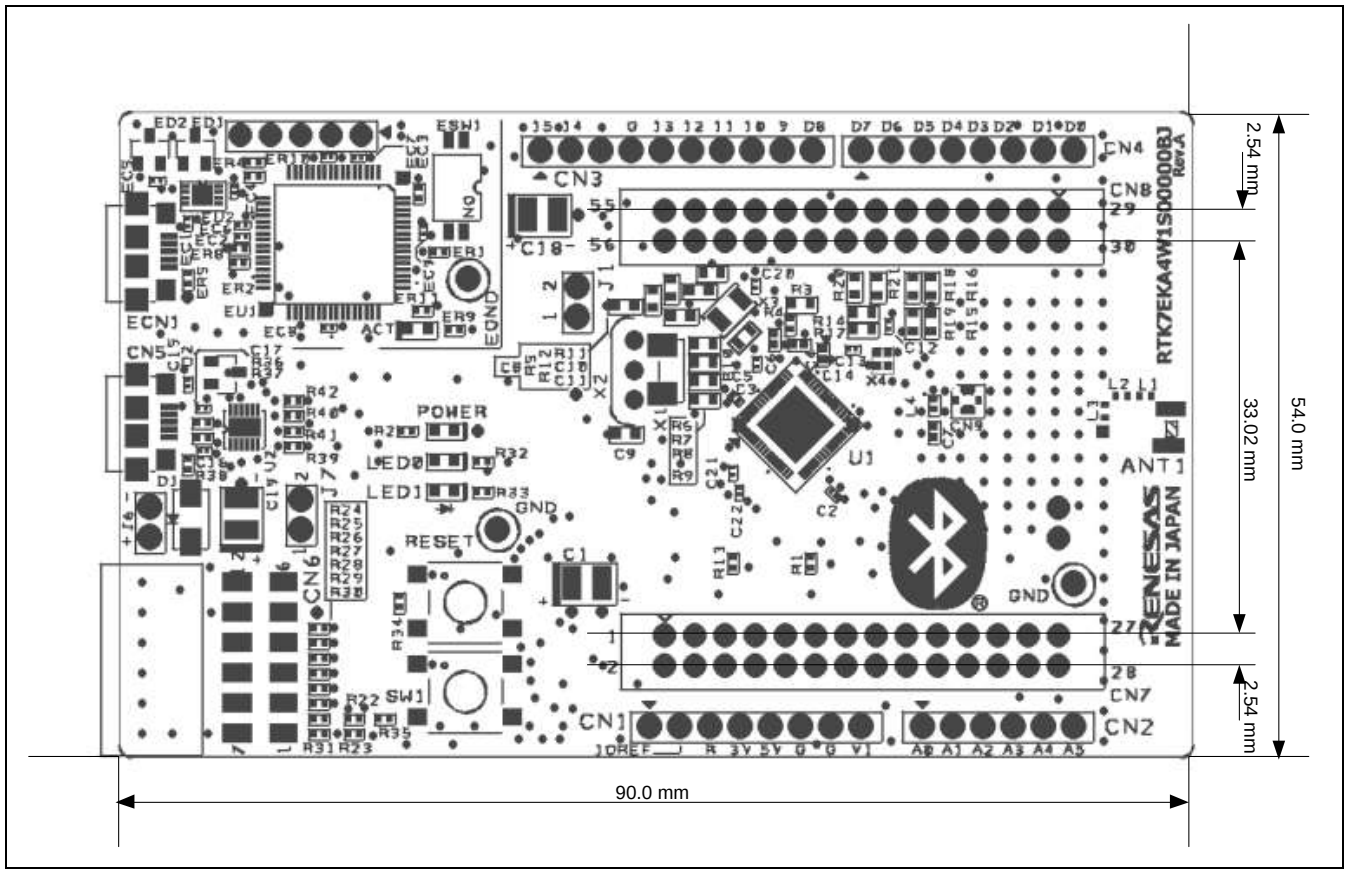

Figure 3-1 Parts Layout

4. Operating Environment

Figure 4-1 shows the operating environment of this product. Install the IDE from the following URL on the host PC. The installer automatically installs all required drivers along with the IDE.

https://www.renesas.com/ra/ek-ra4w1

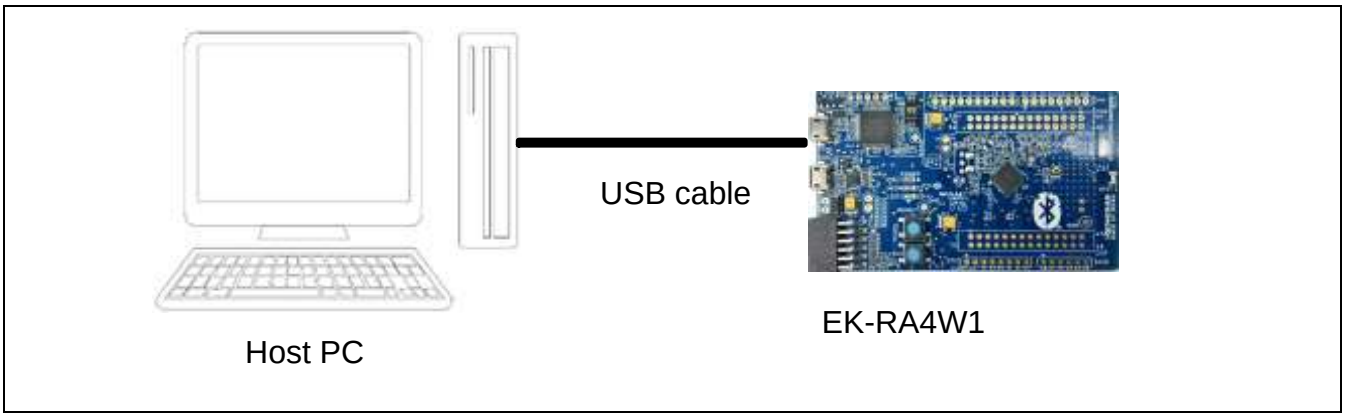

Figure 4-1 Operating Environment

5. User Circuits

5.1 Evaluation MCU

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

- Power supply: Fixed 3.3 V (including the analog power supply)
- System clock: Operation with an on-chip oscillator
- Reset: Directed by the reset switch or IDE

5.2 Bluetooth® Low Energy

A BLE communications circuit is mounted on this board.

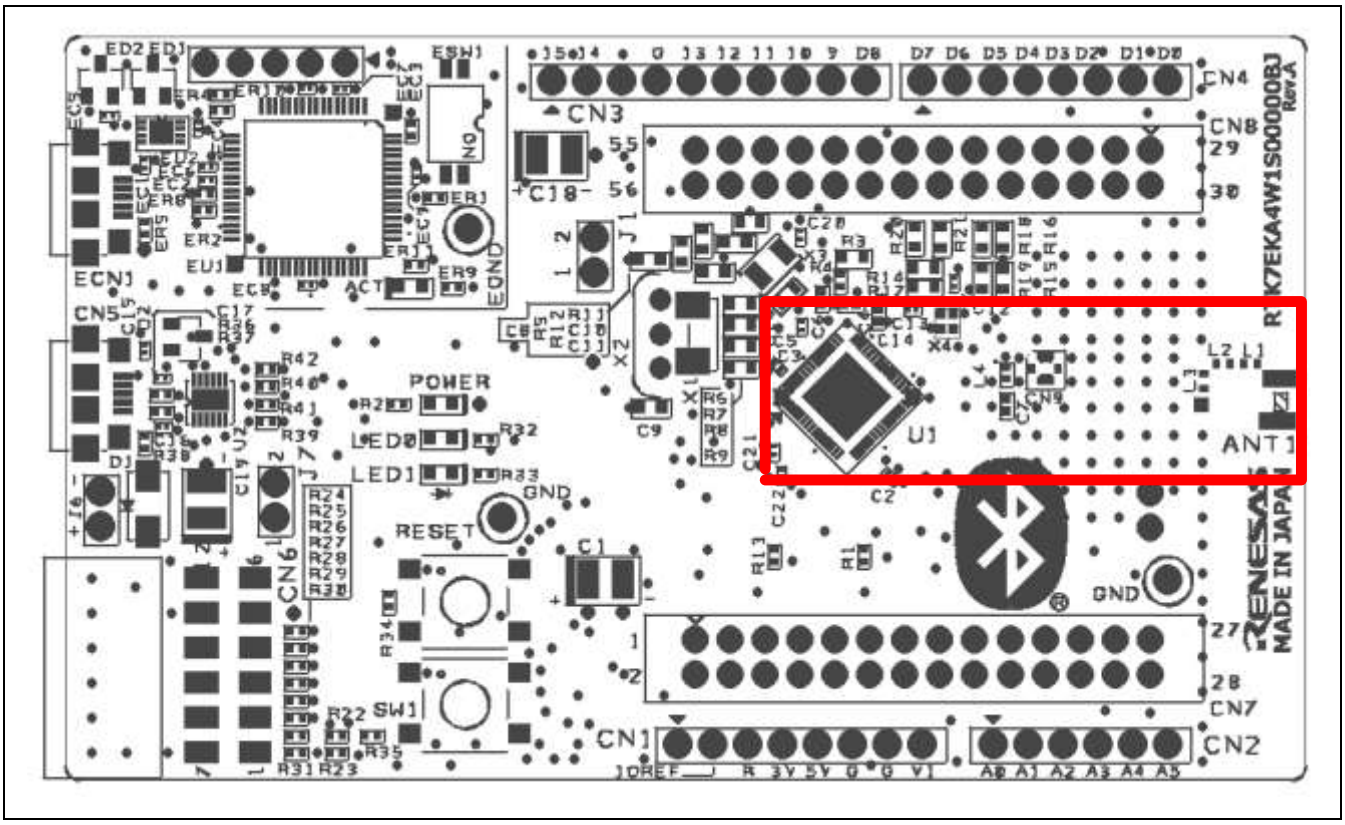

Figure 5-1 BLE Circuit

Note: Never remodel the BLE circuit, as doing so will violate radio-related laws.

5.3 Emulator

An emulator (J-LINK® OB) is mounted on the board. With the settings as shipped, the switches shown in Figure 5-2 are turned off and the emulator is in reset state. To use the emulator, make the corresponding switch setting in Table 5-1.

The shape of the emulator connector (ECN1) is USB micro-B for the IDE. Connect the emulator connector to the computer by a USB cable. If the power supply on the host side is on, the power is supplied to this product at the same time as connection of the cable.

Note: The package does not include a USB cable.

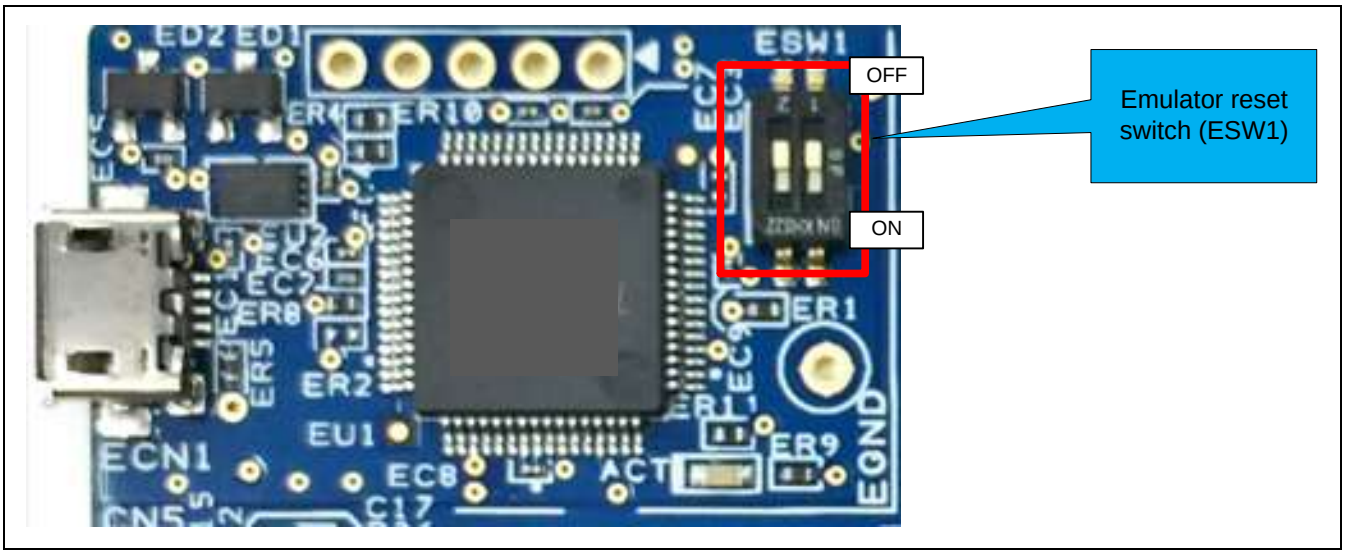

Figure 5-2 Emulator Reset Switch (ESW1)

Table 5-1 Setting of the Emulator Reset Switch (ESW1)

ESW1	Function	MCU	
Channel 1	Not used.	—	—
Channel 2	Resets the emulator.	Off	The emulator is reset. The emulator cannot be used.
		On	The emulator can be used.

5.4 USB-to-Serial Conversion

USB connector CN5 is connected to the USB-to-serial conversion module from FTDI and can be used as a virtual COM port. Table 5-2 shows the connection relationship of USB-to-serial signals.

Table 5-2 Names of the USB-to-Serial Signals

Signal Name	Function and Usage	MCU	
		Port	Pin
TXD	Signal for transmitting data	P205	8
RXD	Signal for receiving data	P206	7
CTS	Input signal for controlling the start of transmission and reception of data	*1	
RTS	Output signal for controlling the start of transmission and reception of data	*1	

Note: This port is not connected on the board as shipped.

The first time the CPU board is connected to the USB port of a PC, the monitor of the PC shows the message stating that installation of the driver is in progress as shown in Figure 5-3. After that, a message indicating completion of the driver installation is displayed. The content of the message will differ with the OS version on the host PC.

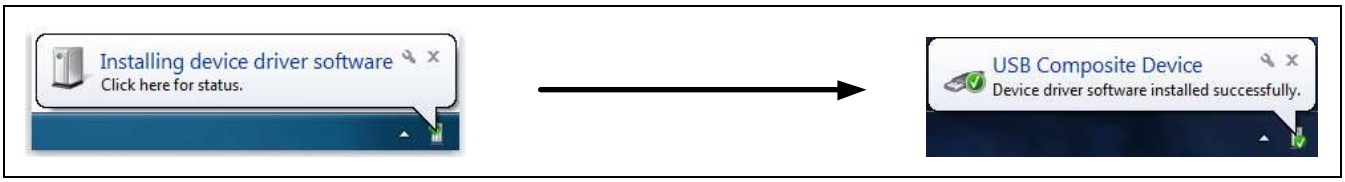

Figure 5-3 Displays Indicating Installation of the USB Driver

If you do not have a driver, download the installer for the driver from the Web site of FTDI.

5.5 ACT LED

The ACT LED displays the state of operation of the emulator control software. The illumination conditions are listed below. The LED is green.

- Illuminated: Indicates that the host machine (PC) has recognized the emulator.
- Not illuminated: Indicates that the emulator cannot be used for some reason (including its power being off).

5.6 Power LED

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

5.7 User LEDs

The optional user LEDs can be used for any purpose. LED0 and LED1 are mounted on the board and are respectively connected to the following ports. The LEDs are green.

- LED0: Pin 21, connected to port P106
- LED1: Pin 46, connected to port P404

5.8 External Power-Supply Header

When more current is required than the USB is capable of supplying, use the external power-supply header (J6) to supply power. The usable voltage is 3.3 V. When this header is to be used, remove the pattern for cutting (SS19) on the soldered side, electrically separating the emulator from the target. Figure 5-4 shows the position of the pattern for cutting. Figure 5-5 shows the position of the external power-supply header (the actual header component is not mounted on the board as shipped).

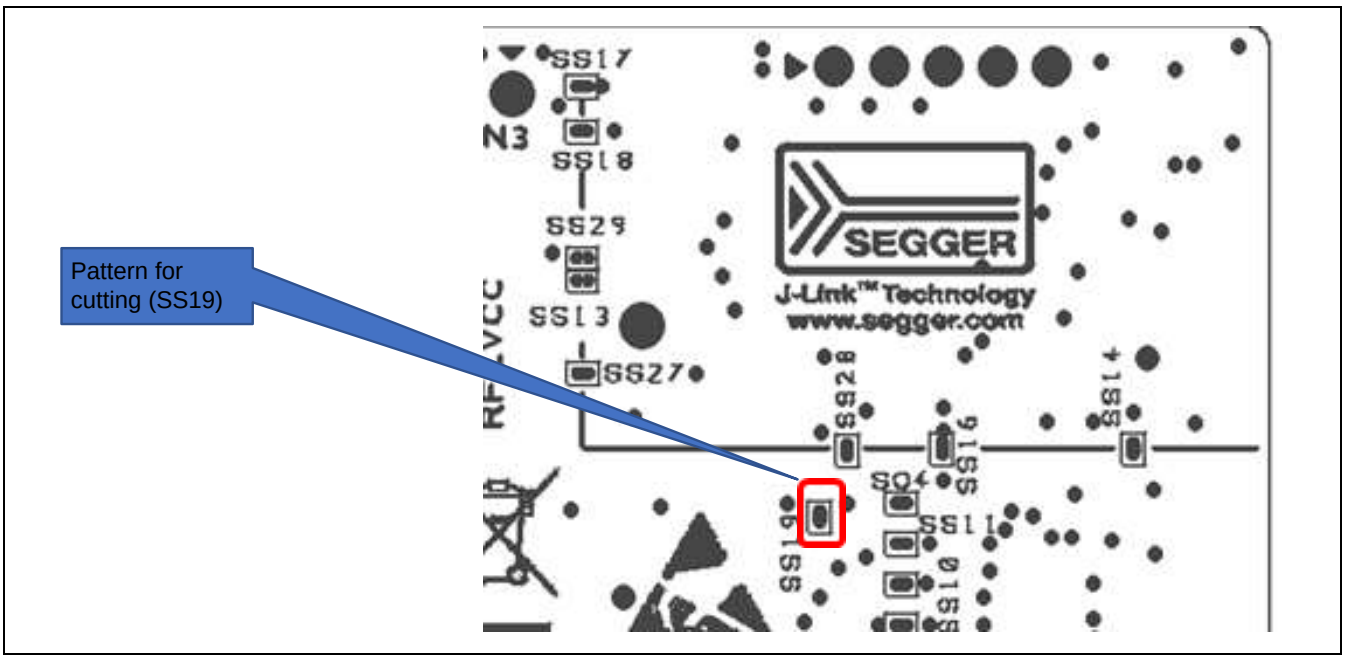

Figure 5-4 Position of the Pattern for Cutting (SS19) (Soldered Side)

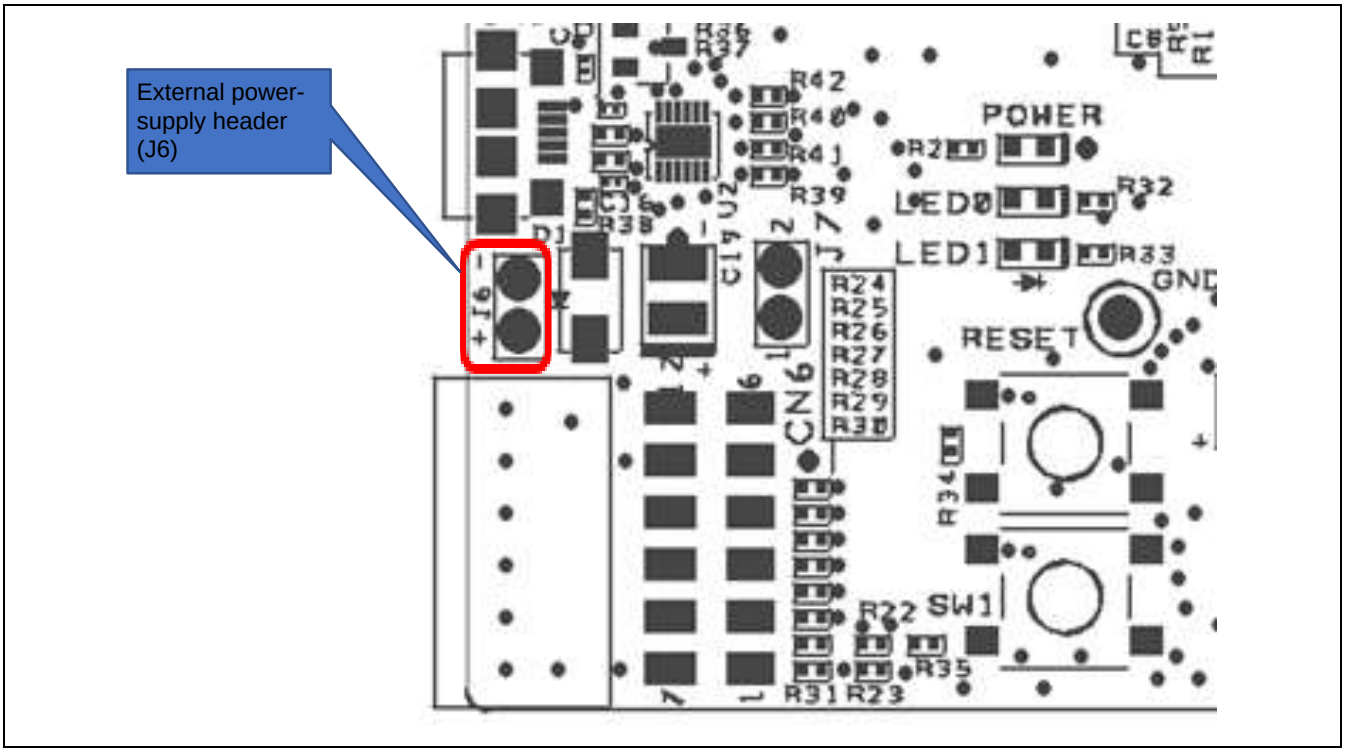

Figure 5-5 Position of the External Power-Supply Header (J6) (Top Side)

5.9 Pmod™ Connector

A Pmod™ connector (CN6) is connectable to the evaluation MCU via a type 2A Pmod™ interface. Note that the pin assignments of the Pmod™ connector differ from those of other headers.

Figure 5-6 and Table 5-3 show the pin assignments of the Pmod™ connector and the specifications of signals on the Pmod™ connector, respectively. The IRQ1 interrupt is multiplexed on the same pin.

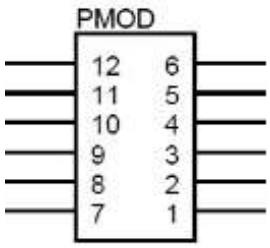

Figure 5-6 Pin Assignments of the Pmod™ Connector (Top View)

Table 5-3 Pin Assignments of the Pmod™ Connector

Pin No.	Signal Name	Evaluation MCU		Pin No.	Signal Name	Evaluation MCU	
		Port	Pin			Port	Pin
1	PMOD1-CS	P103	24	7	PMOD1-IRQ	P104	23
2	PMOD1-MOSI	P101	26	8	PMOD1-RST	P107	20
3	PMOD1-MISO	P100	27	9	PMOD1-IO0	P204	9
4	PMOD1-SCK	P102	25	10	PMOD1-IO1	P407	1
5	GROUND	—	—	11	GROUND	—	—
6	TARGET_VCC	—	—	12	TARGET_VCC	—	—

5.10 Arduino™ UNO Headers

For the CN1, CN2, CN3, and CN4 headers, through holes are assigned with a pitch of 2.54 mm and these headers are connected to the evaluation MCU according to the Arduino™ UNO R3 specification. Table 5-4, Table 5-5, Table 5-6, and Table 5-7 show the signal specifications of the Arduino™ UNO connectors (the actual connector components are not mounted on the board as shipped).

Table 5-4 Pin Assignments of CN1 (8-Pin Power Connector)

Pin No.	Signal Name	Specification	MCU	
			Signal Name	Pin No.
1	NC	Reserved	—	—
2	IOR	IOREF	VCC	—
3	RES	RESET	RES	10
4	3V3	Power supply	VCC	—
5	5V		—	—
6	GND		GND	—
7	GND		GND	—
8	VIN		VCC	—

Table 5-5 Pin Assignments of CN2 (6-Pin Analog Connector)

Pin No.	Signal Name	Specification	MCU	
			Signal Name	Pin No.
1	A0	AD input	AN004	40
2	A1		AN009	32
3	A2		AN010	31
4	A3		AN017	29
5	A4		AN021/SDA1	26
6	A5		AN022/SCL1	27

Table 5-6 Pin Assignments of CN3 (10-Pin Digital Connector)

Pin No.	Signal Name	Specification	MCU	
			Signal Name	Pin No.
1	SCK	GPIO/SCK	P204/SCL0	9
2	SDA	GPIO/SDA	P407/SDA0	1
3	ADREF	Reserved	—	—
4	GND	GND	GND	—
5	D13	GPIO/SCK/PWM	P102/RSPCKA/GTIOC2B	25
6	D12	GPIO/MISO/PWM/IRQ	P100/MISOA/GTIOC5B/IRQ2	27
7	D11	GPIO/MOSI/PWM/IRQ	P101/MOSIA/GTIOC5A/IRQ1	26
8	D10	GPIO/SS/PWM	P103/SSLA0/GTIOC2A	24
9	D9	GPIO/PWM/IRQ	P104/GTIOC1B/IRQ1	23
10	D8	GPIO/PWM	P106/GTIOC8B	21

Table 5-7 Pin Assignments of CN4 (8-Pin Digital Connector)

Pin No.	Signal Name	Specification	MCU	
			Signal Name	Pin No.
1	D7	GPIO/RXD/PWM/IRQ	P212/RXD1/GTIOC0B/IRQ3	53
2	D6	GPIO/TXD/PWM/IRQ	P213/TXD1/GTIOC0A/IRQ2	52
3	D5	GPIO/PWM/IRQ	P414/GTIOC0B/IRQ9	55
4	D4	GPIO/PWM/IRQ	P409/GTIOC5A/IRQ6	56
5	D3	GPIO/PWM/IRQ	P105/GTIOC1A/IRQ0	22
6	D2	GPIO/PWM/IRQ	P111/GTIOC3A/IRQ4	17
7	D1	GPIO/TxD/PWM	P109/TXD9/GTIOC1A/SWO*[1]	15
8	D0	GPIO/RxD/PWM/IRQ	P110/RXD9/GTIOC1B/IRQ3	16

Note: A serial wire output (SWO) provides trace output. When this pin is in use for the SWO, the other functions are not available.

5.11 Current Measurement Header

The current measurement header (J7) is used to measure the current drawn by the evaluation MCU (an actual header component is not mounted on the board as shipped). The current drawn can be measured by connecting an ammeter to the evaluation MCU. When this header is to be used, remove the relevant pattern for cutting (SS20) on the soldered side. Figure 5-7 shows the positions of the header and pattern for cutting.

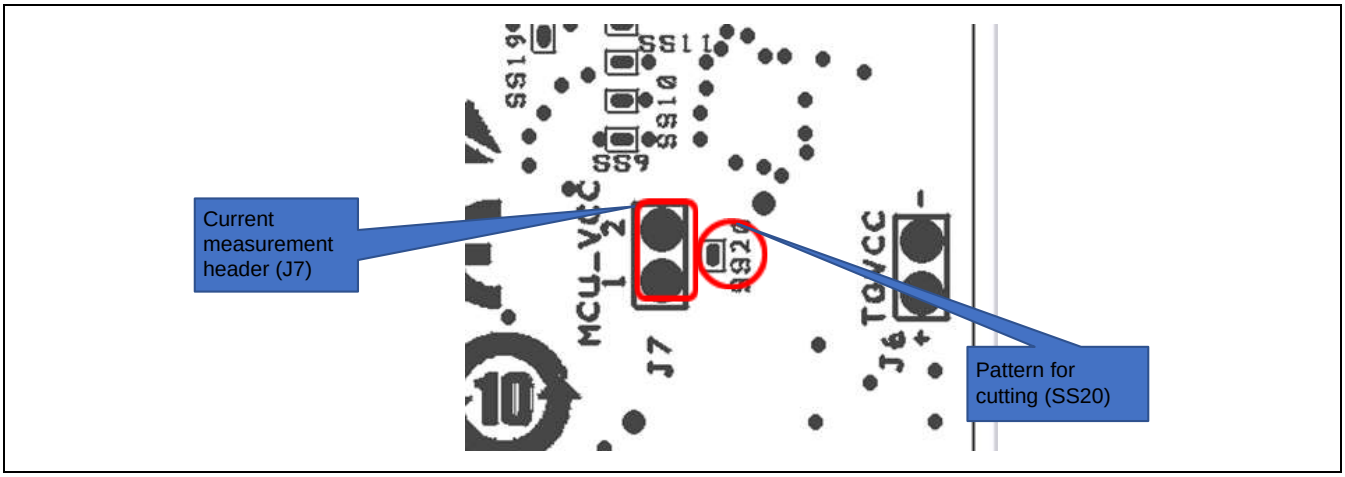

Figure 5-7 Positions of the Current Measurement Header (J7) and Pattern for Cutting (SS20) (Soldered Side)

5.12 MCU Headers

MCU headers are provided for by two sets of through holes (CN7 and CN8) for 28-pin headers (actual header components are not mounted on the board as shipped). The pin headers have a pitch of 2.54 mm and are connected to the evaluation MCU. Pin numbers of the MCU headers correspond to those of the evaluation MCU, and most pins are connected (with pins 2, 5, 6, 11, 28, 30, 33, 34, 39, 41, 42, 43, 45, and 48 as the exceptions).

5.13 Reset Switch

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

5.14 User Switch

An optional user switch (SW1) is mounted. It is connected to pin 44 of the evaluation MCU, which operates as pin function P402. The IRQ4 interrupt is multiplexed on the same pin.

5.15 Patterns for Cutting

Patterns must be cut or repaired by soldering if necessary. Figure 5-8 shows examples of the states of patterns for cutting.

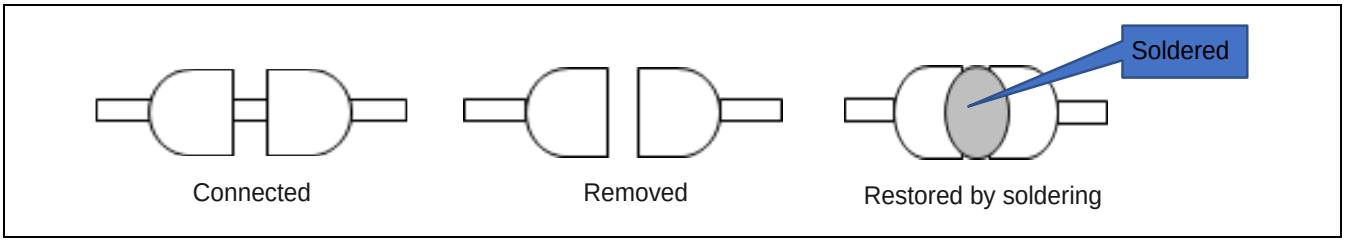

Figure 5-8 Examples of States of Patterns for Cutting

6. Configurations

6.1 Modifying the EK-RA4W1

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

An option-link resistor is a 0-Ω surface-mount resistor, which is used to short-circuit or isolate a part of circuits. The subsequent sections contain lists of option-link resistors for individual functions. Fit or remove option-link resistors to switch functions with reference to the list. **Resistor numbers in bold blue type** indicate the initial state of the configuration on the EK-RA4W1 as shipped. For the positions of the option links, refer to chapter 3, Parts Layout.

When removing soldered components, do not apply a soldering iron to the EK-RA4W1 for more than 5 seconds. This time restriction is to avoid any damage components mounted nearby on the board.

6.2 Analog Power Supply

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

Table 6-1 Option-Link Resistors for the Analog Power Supply of the 14-Bit A/D and 12-Bit D/A Converters

Analog Power-Supply Source of the 14-Bit A/D and 12-Bit D/A Converters	Mounted	Not Mounted	Remark
3.3 V on the board	**R15, R19**	**R16, R18**	—
MCU headers	R16, R18	R15, R19	A bypass capacitor (C13) becomes ineffective.

Table 6-2 Option-Link Resistors for the Reference Power Supply of the 14-Bit A/D Converter

Reference Power-Supply Source of the 14-Bit A/D Converter	Mounted	Not Mounted	Remark
3.3 V on the board	**R14, R17**	**R20, R21**	—
MCU headers	R20, R21	R14, R17	A bypass capacitor (C12) becomes ineffective.

6.3 On-Chip Oscillator

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

Table 6-3 Option-Link Resistors for the HOCO

Setting of the HOCO	Mounted	Not Mounted	Remark
Oscillating	**R5, R9**	**R6, R8**	—
Halted	R6, R8	R5, R9	Mount a crystal oscillator on X1 or X2 and the load capacitance as C8 or C9.

Table 6-4 Option-Link Resistors for the LOCO

Setting of the LOCO	Mounted	Not Mounted	Remark
Oscillating	**R11, R12**	**—**	—
Halted	—	R11, R12	Mount a crystal oscillator on X3 and the load capacitance as C10 or C11.

7. Handling Precautions

7.1 Adding Load

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

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

7.2 Remodeling the Board

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

8. Additional Information

Technical Support

For details on the RA4W1-group microcontrollers, refer to the RA4W1 Group User's Manual: Hardware.

The latest information is available from this Web page: https://www.renesas.com/ra/ek-ra4w1.

Technical Contact Details

America: techsupport.america@renesas.com

Europe: https://www.renesas.com/eu/en/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 EK-RA4W1 or sample code into your product.

The operation of sample code is not guaranteed. Confirm the operation on your own responsibility.

Trademarks

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9. Certification of Compliance

The EK-RA4W1 has obtained certificates of compliance with the laws and regulations stated below.

Since the use of this product in countries and regions that require compliance with other regulations may lead to the violation of the laws; confirm the regulations of such countries in which the product is to be used.

The use of this product in a Faraday-shielded chamber or box may be required.

9.1 Radio-Related Laws

Japan: Type certification (authentication number: 006-000839)

Europe: CE (RE)

North America: FCC (FCC ID: 2AEMXEKRA4W1Q56)

RE Directive

Hereby, Renesas Electronics Corporation declares that the radio equipment type RTK7EKA4W1S00000BJ is in compliance with Directive 2014/53/EU.

FCC Regulatory

FCC ID: 2AEMXEKRA4W1Q56

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

[for FCC]

FCC CAUTION

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This equipment has very low levels of RF energy that it deemed to comply without maximum permissive exposure evaluation (MPE). But it is desirable that it should be installed and operated keeping the radiator at least 20cm or more away from person's body.

This device complies with FCC Part **15.203** because the antenna is not removable from this device.

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Rev.	Date	Description	
		Page	Summary
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