User's Manual

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# RA4L1 Group

## Renesas Solution Starter Kit
## Capacitive Touch Evaluation System
## User's Manual

Renesas RA Family
RA4 Series

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Rev.1.10 Apr 2025

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(Rev.5.0-1 October 2020)

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

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

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

# How to Use This Manual

## 1. Purpose and Target Readers

This is a manual for users to understand the outline and hardware functions of the RA4L1 Group Capacitive Touch Evaluation System (RTK0EG0057S01001BJ). This manual is intended for users who use this CPU board. A basic knowledge of electric circuits, logical circuits, and MCUs is necessary in order to use this manual.

> 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.

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## Precautions

This Evaluation Kit 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 fulfill the regulatory standards for an end product.

## Safety Items

### Definitions of Symbols

A variety of symbols are used in this document and on the product itself to prevent in advance danger to you the user or any third parties and to prevent in advance damage to any physical property.
This section, Safety Items, presents these symbols and their meanings. It also presents safety notes to assure that this produce is used safely and correctly.
This product should only be used after fully understanding the material presented in this section.

**Warning** — Warning items indicate things that, if not avoided, could lead to death or serious injury.

**Caution** — Caution items indicate both latent dangers that can lead to minor or moderately severe injury and latent dangers that can lead to property damage if not avoided.

In addition to the above two markings, the following are displayed at the same time if appropriate.

**[Important]** Indicates a point that can lead to equipment failure or malfunction if incorrectly set when setting up this product.

A triangular mark △ indicates a warning or caution.

Example:




The ⃠ mark indicates something that is forbidden.

Example: :



Warning

| ⚠ Warning |
| --- |
| Handling related warnings:<br><br>Do not disassemble or modify this product. Renesas does not guarantee this product if it has been disassembled or modified.<br>The power supply for this product can be selected to be either the USB bus or a DC jack. A jumper is used to select the power supply.<br>If, during either use or storage of this product, any abnormality in the product itself (including abnormal odors, heating, color changes, or shape changes to the product itself) are observed, disconnect the USB cable and power supply cable immediately. |
| Installation:<br><br>Do not install this equipment in a location that has a high humidity or where water or other fluids could get on it. This equipment may be damaged if water or other fluids could get on it. |
| Ambient temperature:<br><br>The upper limit for the ambient temperature under which this product may be used is 35°C.<br>This maximum rated ambient temperature must not be exceeded. |

Caution

# ⚠Caution

Handling related cautions:

Use the antistatic band. Failure to do so could cause malfunction or unstable motion or be damaged Internal components.

This product must be handled carefully. Do not drop, knock over, or apply any strong mechanical shocks to this product.

When connecting or disconnecting cables from this product, hold the parts of the cable intended to be grasped (such as the plugs) and avoid putting stress on the cable. Do not pull on this product when it is connected to a communications cable or user system connection cable. Stress on the cable can result in internal disconnections in the cable. When connecting a cable to a connector, be careful not to insert the plug in the reverse orientation. Reverse insertion can result in damage to this product itself or to connected equipment.
The power supply for this product can be selected from two options (the DC jack or the USB cable). The jumper JP4 (on the top side of the circuit board) is used to select the power supply. Always check the jumper position before connecting a power source. An incorrect jumper position can result in damage to this product or the PC connected over the USB cable.
Do not handle this product with wet hands. This can lead to failure of the product.

Transport methods:

When transporting this product, use the product's packing box and cushioning materials and ship it with precision equipment handling. If the products packing is insufficient, it may be damaged during shipping.
If it must be transported by some other method, pack it carefully as precision equipment.
When packing this product, always use the antistatic pouch included with this product.
If some other pouch is used, damage to the product may be caused by electrostatic discharge.

Abnormal operation:

If operation of this product becomes abnormal due to interference from, for example, external noise, apply the following procedure.
1. Turn off the power.
2. Wait 10 seconds and then turn the power back on.

Disposal:

When disposing of this product, handle it as industrial waste according to all applicable laws.

European Union regulatory notices:

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 European Union only. 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 "http://www.renesas.eu/weee".

Electromagnetic Environment

| ⚠Electromagnetic Environment | |
|---|---|
| ⚠ | ・This product generates electromagnetic emissions in an industrial environment. Use in a residential environment may affect other equipment.<br>・This product requires special EMC precautions and should be used in accordance with the EMC information provided below. |

| EMI: Electro Magnetic Interference | | | |
|---|---|---|---|
| Standard | | Level | Guidance for EMC protection |
| Test Item | EN 55011 :2016/A1:2017/A2:2021 | Group1 Class A | This product has no intentional external emissions, but internal RF emissions may affect nearby electromagnetically sensitive electronic equipment. |
| Radiated Emissions | | | |
| Conducted Emissions | | | |

| EMS: Electro Magnetic Susceptibility | | | |
|---|---|---|---|
| Standard | | Level | Guidance for EMC protection |
| Radio Frequency Electromagnetic Field | EN IEC 61000-4-3:2020 | A*1 | This product is intended for use in electromagnetic environments in industrial settings. The user of the product should pay particular attention to the following electromagnetic immunity.<br>・Power supply quality<br>・Protection against static electricity<br>・Protection against external high-power radio waves<br>・Protection against external magnetic fields |
| Electrical Fast Transient / Burst | EN 61000-4-4:2012 | B*2 | |
| Surge | EN 61000-4-5 :2014/A1:2017 | B*3 | |
| Conducted Disturbance, Induced by Radio Frequency | EN 61000-4-6:2014 | A*4 | |
| Power Frequency Magnetic Field | EN 61000-4-8:2010 | A*5 | |
| Voltage Dips and Interruptions | EN IEC 61000-4-11:2020 | B or C*6 | |

*1 Test Condition of Radio Frequency Electromagnetic Field

| Test Level | Dwell Time | Modulation | Frequency Step | Antenna Polarization | Result |
|---|---|---|---|---|---|
| 3V/m (80MHz - 1.0GHz) | 1.0sec | 1kHz AM 80% | 1.0% | Horizontal / Vertical | Pass |
| 3V/m (1.4GHz – 6.0GHz) | | | | | Pass |

*2 Test Condition of Electrical Fast Transient / Burst

| Test Level | Wave Form | Repetition Frequency | Testing Duration | Result |
|---|---|---|---|---|
| ±1.0kV | Rise time: 5.0nsec Pulse Duration: 50nsec | 5kHz | 60sec | Pass |
| | | 100kHz | | Pass |

*3 Test Condition of Surge

| Test Level | Wave form Specification | Phase Angle | Result |
|---|---|---|---|
| ±0.5kV | Front time: 1.2 / 8.0 μsec Time to half value: 50 / 20 μsec | 0º, 90º,180º, 270º | Pass |
| | | | Pass |

*4 Test condition of Conducted Disturbance, Induced by Radio Frequency

| Test Level | Dwell Time | Modulation | Frequency Step | Result |
|---|---|---|---|---|
| 3V (0.15MHz – 80MHz) | 1.0 sec | 1kHz AM 80% | 1.0% | Pass |

*5 Test Condition of Power Frequency Magnetic Field

| Test Level | Applied Power Frequency | Test Duration | Result |
|---|---|---|---|
| 3A/m (rms) | 50Hz | 60sec | Pass |
| | 60Hz | | Pass |

*6 Test Condition of Voltage Dips and Interruptions

| Test Item | Test Level | Duration | Phase Angle | Result |
|---|---|---|---|---|
| Voltage Dips | 0% | 0.5 cycles | 0º, 180º | Pass |
| | | 1.0 cycles | | Pass |
| | 70% | 25 cycles | | Pass |
| Voltage Interruptions | 0% | 250 cycles | | Pass |

# Renesas RA Family

## RA4L1 Group Capacitive Touch Evaluation System User's Manual

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# 1. Overview

The RA4L1 Group Capacitive Touch Evaluation System (RTK0EG0057S01001BJ) is a kit created for evaluating the Renesas Electronics RA4L1 Group's Capacitive Touch Sensors (CTSU2).

RTK0EG0057S01001BJ consists of two boards. The RA4L1 Cap Touch CPU board is equipped with the R4AL1 MCU which embeds the CTSU2. The Capacitive Touch Application Board is equipped with self-capacitance touch buttons, wheel and slider touch electrodes, and LEDs.

Note: The functional name of the RA4L1 Group capacitive touch sensor is "CTSU2," but is referred to as "CTSU" in this document.

Note: RA4L1 supports Secure Factory Programming function. However, Capacitive Touch Evaluation System for RA4L1 does not support it.

The main functions of the RA4L1 Cap Touch CPU board are as follows:

**Renesas RA4L1 Group**
- ---- R7FA4L1BD4CFP
- ---- 100-pin LQFP package
- ---- 80 MHz Cortex®-M33 core with built-in Arm® MPU (Armv8-M architecture)
- ---- 64KB SRAM, 512KB Code Flash, 8KB Data Flash
- ---- 12-channel capacitive touch sensor (CTSU) terminal

**Connectivity**
- ---- USB Type-C with J-Link OB (on-board debugging function)
- ---- 10-pin SWD interface for connecting external debugger or programmer
- ---- Pmod™ Type 2A/Type 3A/Type 6A: 1 pc. (Type 6A is default state)
- ---- Pmod™ Type 2A: 1 pc.
- ---- Connectors (sockets) for connecting application board
  GPIO interface: 2.54mm pitch, 2 rows, 16 pins x 1pc.
  CTSU interface: 2.54mm pitch, 2 rows, 40 pins x 1pc.

**Multi-clock sources**
- ----Main clock: on-chip oscillator / 16 MHz ceramic resonator (option)
- ---- Subclock: 32.768KHz crystal resonator (option)

**Board controller switches**
- ---- Board power supply source selection jumper
- ---- MCU reset push switch
- ---- MCU boot selection slide switch
- ---- J-Link OB reset slider switch

**Operating voltage**
- ---- 3.3V to 5.0V
- ---- Power supply connector (5.5 x 2.1mm center plus DC jack): 3.3V to 5.0V
- ---- USB bus power: 5V

**Other functions**
- ---- MCU current measurement jumper
- ---- User push switches: 2
- ---- User LEDs: 2

**Operating Temperature Range**
- ---- Operating: 10 to 35˚C
- ---- Storage: -10 to 50˚C (no condensation)

The main functions of the Capacitive Touch Application Board are as listed below:

- Self-capacitance detection touch electrodes
  ---- Buttons: 3
  ---- Wheels (4-electrode configuration): 1
  ---- Sliders (5-electrode configuration): 1
- LEDs: 16
- Connectors for connecting Renesas MCU Cap Touch CPU board (pin headers)
  ---- GPIO interface: 2.54mm pitch, 2 rows, 16 pins: 1
  ---- CTSU interface：2.54mm pitch, 2 rows, 40 pins: 1
- Overlay panel
  ---- 2mm-thick acrylic panel
- Operating Temperature Range
  ---- Operating: 10 to 35˚C
  ---- Storage: -10 to 50˚C (no condensation)

## 2. Product Configuration

This kit consists of the two following boards, CN1 and CN2, which are connected to each other as shown in Figure 3.

1. RA4L1 Cap Touch CPU Board (RTK0EG0056C01001BJ): 1
2. Capacitive Touch Application Board (RTK0EG0019B01002BJ): 1

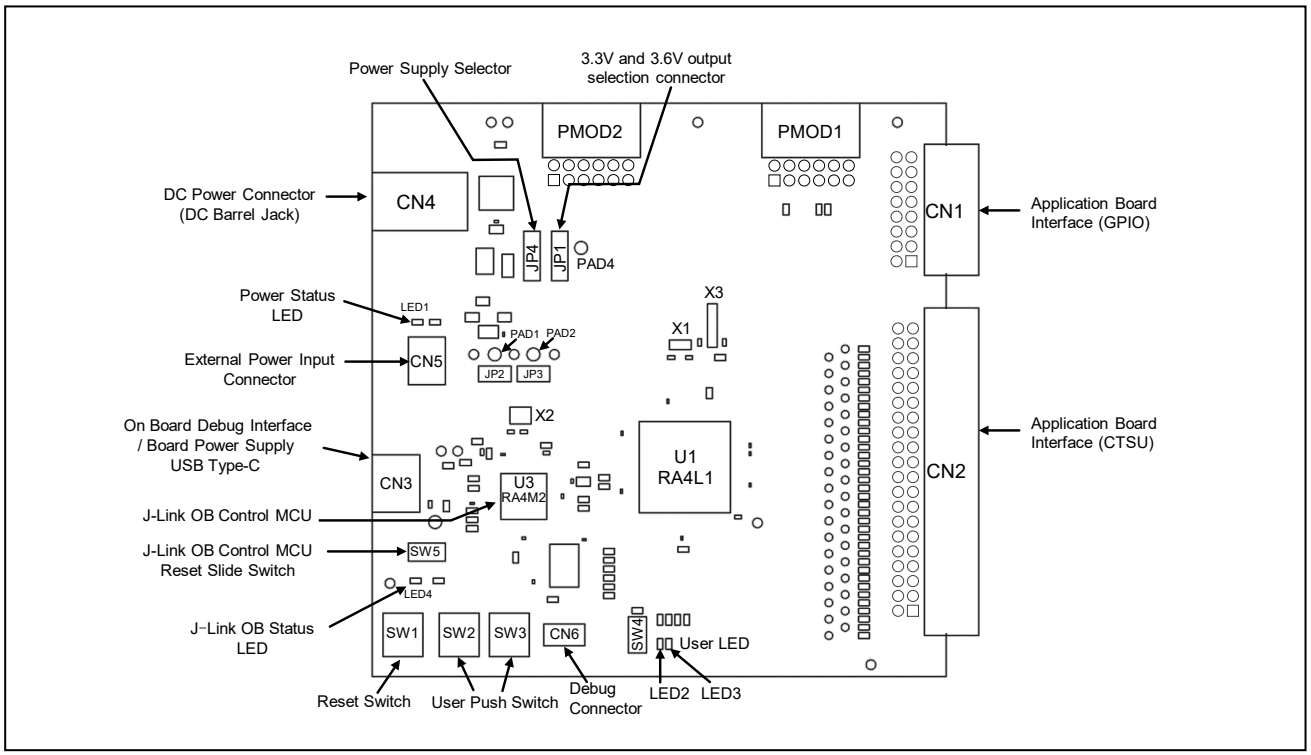



**Figure 1 RA4L1 Cap Touch CPU Board**

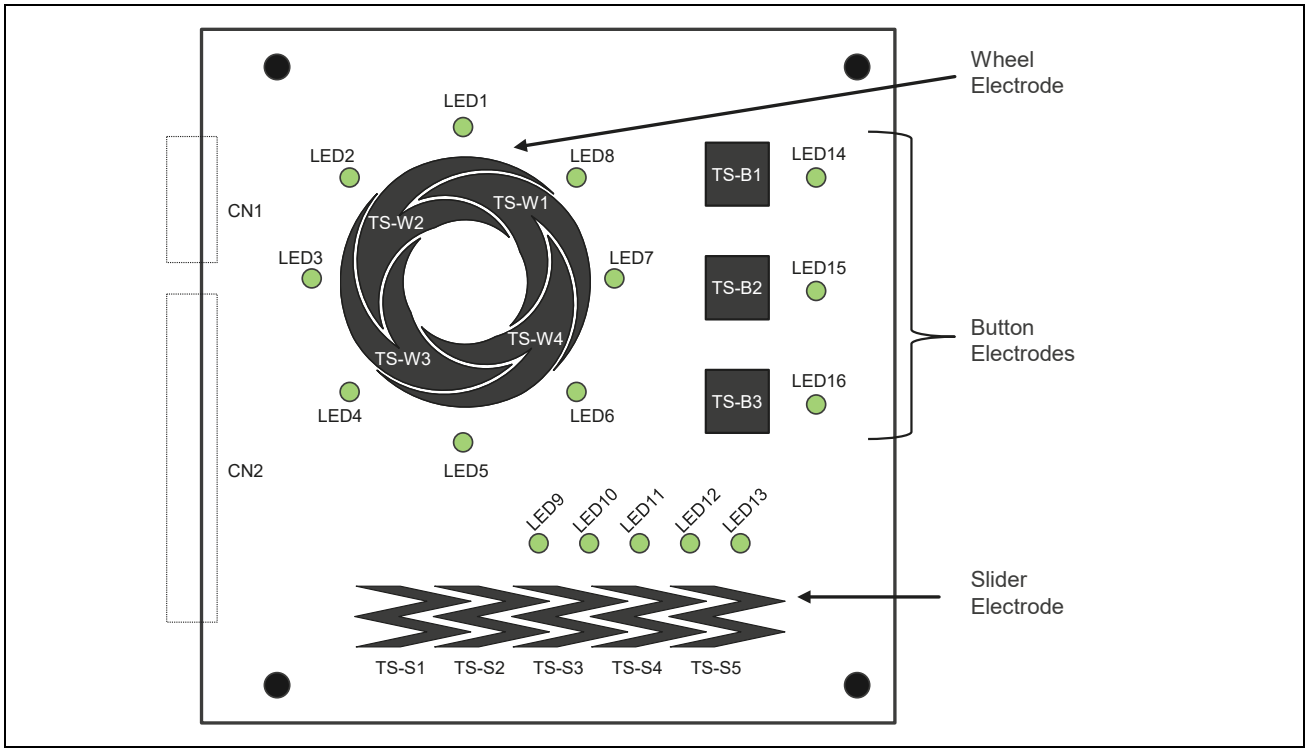



**Figure 2 Capacitive Touch Application Board**

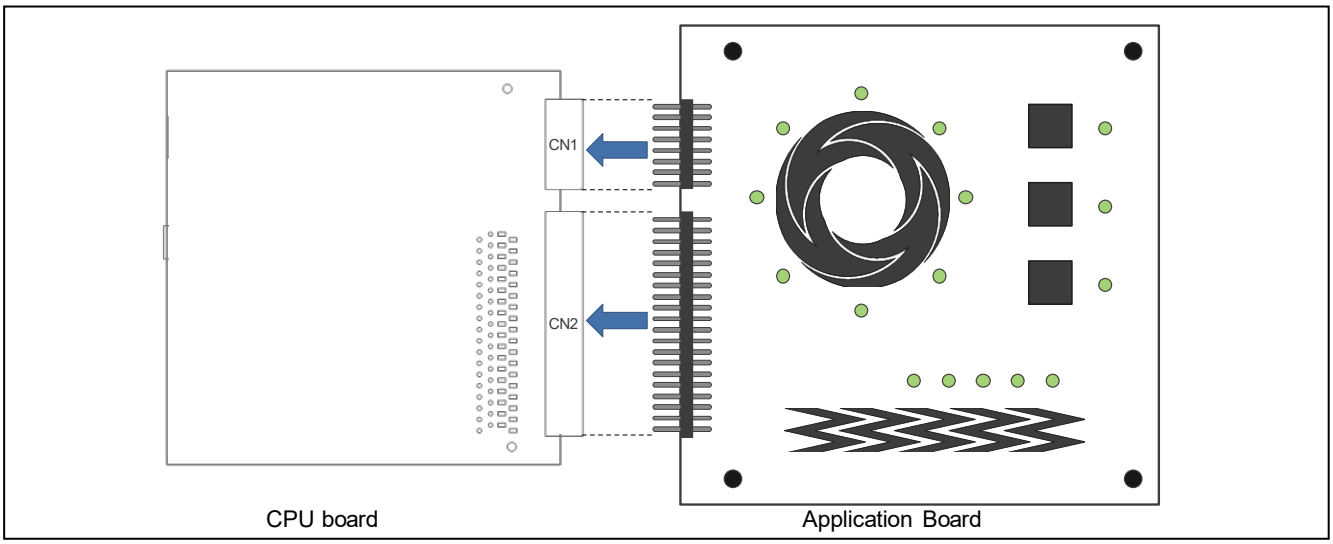



**Figure 3 CPU Board and Application Board Connection**

## 3. Product Ordering

- RA4L1 MCU Group Capacitive Touch Evaluation System part number for ordering:
  RTK0EG0057S01001BJ

  Note: The underlined character in the orderable part number indicates the kit version.

- RA4L1 Cap Touch CPU Board dimensions: 89 mm (width) × 89 mm (length)
- Application board dimensions: 110 mm (width) × 110 mm (length)

# 4. Hardware Default Settings

This product consists of two types of boards: the CPU board and the application board. For details regarding each board, refer to 5 Overview and 6 Capacitive Touch Application Board.

## 4.1 Switch and Jumper Default Settings

Only the CPU board needs to be initialized.

Table 1 Default Board Settings lists the initial values for the RA4L1 Cap Touch CPU board. Please initialize the settings as necessary.

When changing the hardware settings, such as switches and jumpers, make sure the board power is turned off.

**Table 1 Default Board Settings**

| Reference | Functional Overview | Default Setting | Detailed Description |
|---|---|---|---|
| JP4 | Selects Input power supply (USB or DC jack) | 1-2 pins: closed<br>USB power supply | 5.2 Power Supply |
| SW4 | Selects RA4L1 pin (MD/P201) setting (H or L) | 1-2 pins: closed<br>“H” state<br>MCU internal pull-up | 5.4 Reset Circuit / Debug Interface |
| SW5 | Selects RA4M2 (J-Link OB MCU) pin (RES) setting (H or L) | 1-2 pins: closed<br>“H” state<br>J-Link OB operation ON | |

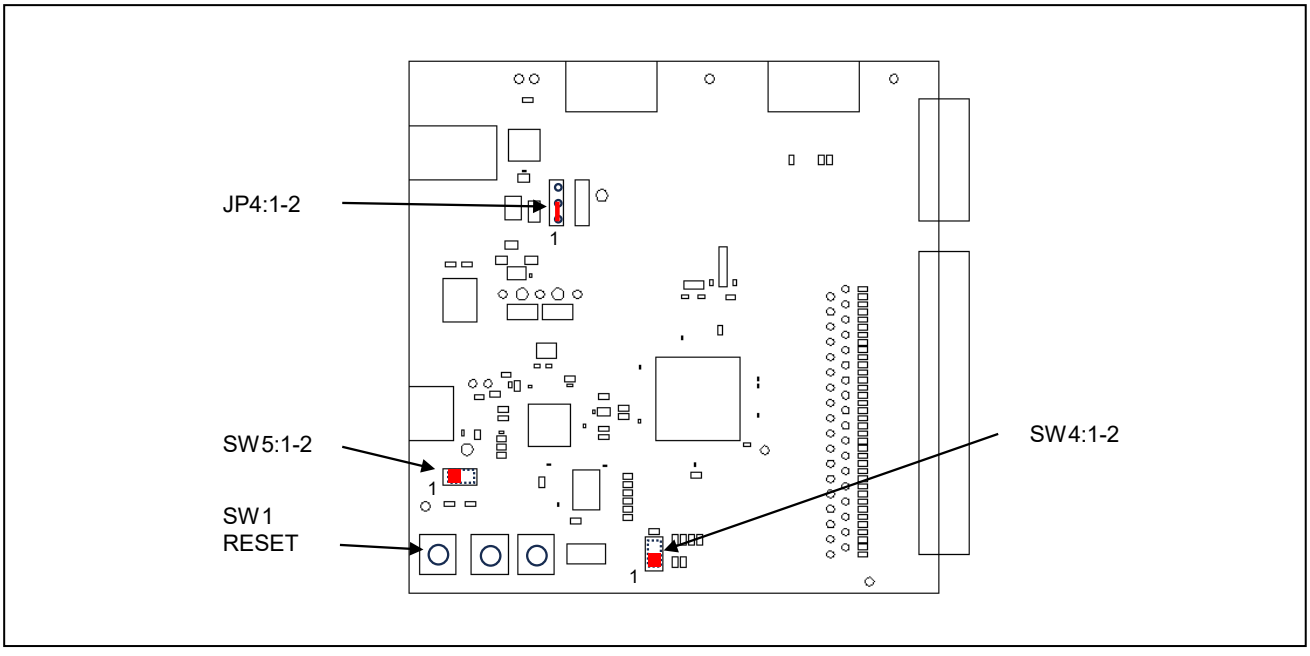



**Figure 4 Switch Layout**

# 5. CPU Board Layout

This section describes the RA4L1 Cap Touch CPU Board (RTK0EG0056C01001BJ).

## 5.1 Block Diagram

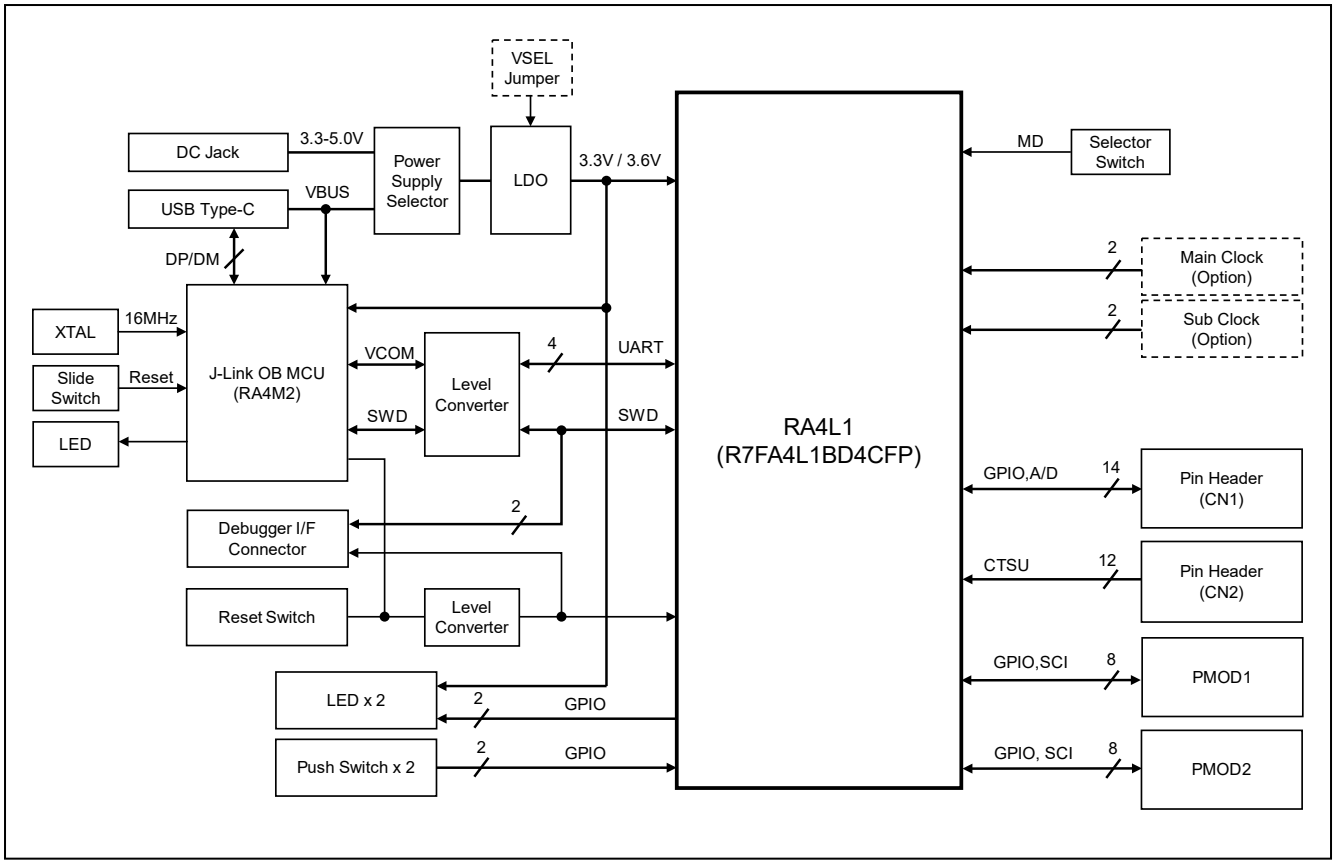



**Figure 5 CPU Board Block Diagram**

## 5.2 Power Supply

The user can select to have power supplied via USB or DC jack (2.1mm center plus).

**Table 2 Power Source Jumper Settings**

| Reference | Jumper Setting | Default Setting (X) | Description |
|---|---|---|---|
| JP4 | Shorted Pin 1-2 | X | Selects USB bus power |
| | Shorted Pin 2-3 | | Selects DC jack (CN4) |
| JP1 / PAD4 (Note 1) | Shorted Pin 1-2 | X | Supplies LDO output 3.3V |
| | Shorted Pin 2-3 | | Supplies LDO output 3.6V |
| JP2 / PAD1 (Note 1) | Shorted Pin 1-2 | X | Supplies LDO output to the MCU |
| | Open | | Cuts off LDO output<br>For power supply to MCU from external (CN5) |
| JP3 / PAD2 (Note 1) | Shorted Pin 1-2 | X | Supplies board power source to MCU |
| | Open | | For measuring MCU current consumption |

Note 1: Jumper (JP1, 2, 3) components are not installed, and the default state is realized by Short-PAD (PAD4, 1, 2).

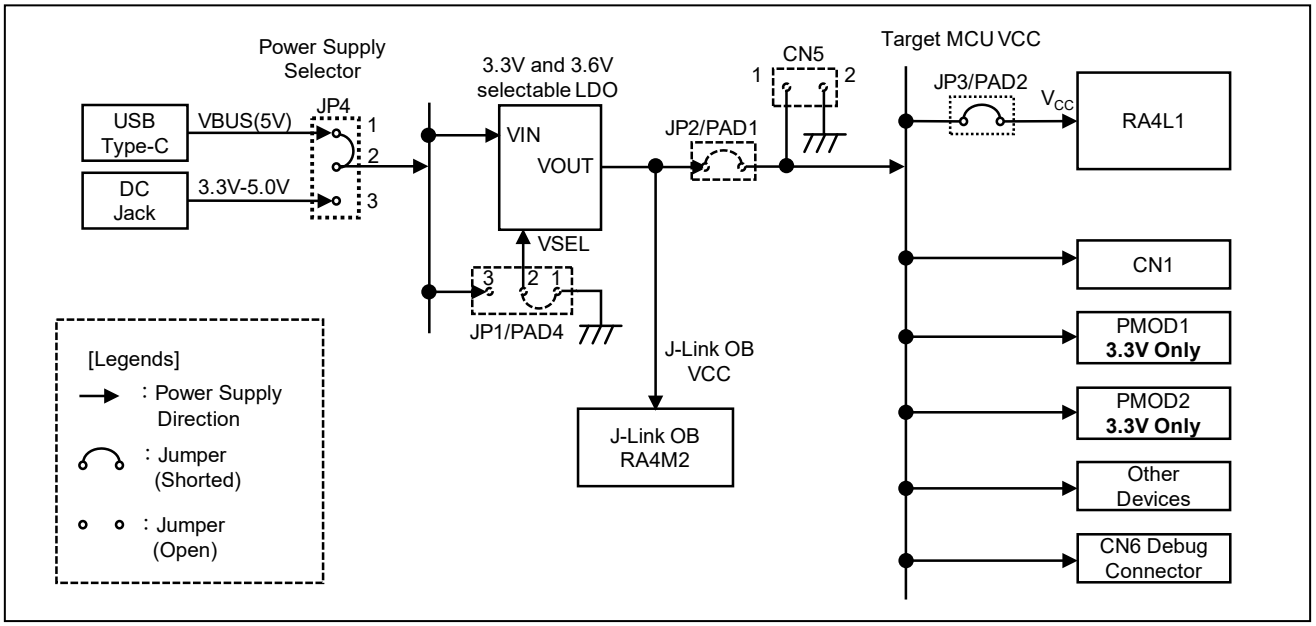


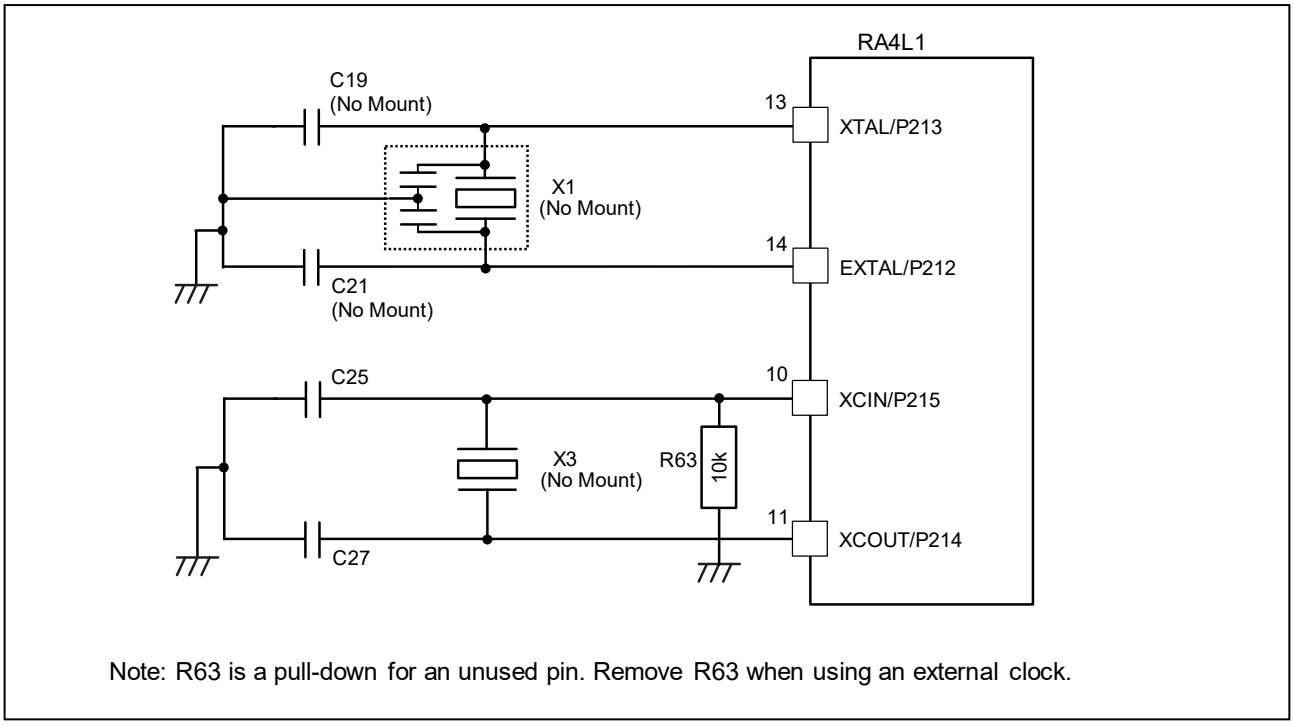

**Figure 6 Power Supply System Block Diagram**

## 5.3 Clock Circuit

The CPU board is not equipped with an external clock by default. The software programmed to the board when shipped operates on the RA4L1 high speed on-chip oscillator (HOCO).

**Table 3 Clock Specifications**

| Reference | Function | Default State | Frequency | Package |
|---|---|---|---|---|
| X1 | Main clock (CSTNE16M0V530000R0) | Not mounted | 16MHz | 3.20mm x 1.30mm SMD |
| X2 | Sub clock (SSP-T7-F-7p) | Not mounted | 32.768kHz | 6.70mm x 1.50mm SMD |




Note: R63 is a pull-down for an unused pin. Remove R63 when using an external clock.

**Figure 7 Clock Circuit**

## 5.4 Reset Circuit / Debug Interface

This CPU board can reset the RA4L1 with the push switch (SW1).

The RA4L1 can be debugged with an emulator via J-Link OB or the debug connector (CN6).

When the MD pin is set to high (“H”), the RA4L1 operates in single-chip mode and SWD boot mode, and when the MD pin is set to low (“L”), the RA4L1 operates in SCI boot and USB boot modes. All boot modes, other than USB boot, can be used on this board.

When using an emulator connected to the debug connector (CN6), stop the J-Link OB with SW5.

**Table 4 Function Selection Switch Specifications (SW4/SW5)**

| Reference | Position | Default Setting (X) | Function |
|---|---|---|---|
| SW4 | 1-2 Shorted | X | RA4L1: MD/P201 “H” (RA4L1 internal pull-up) |
| | 2-3 Shorted | | RA4L1: MD/P201 “L” (pull-down via board) |
| SW5 | 1-2 Shorted | X | RA4M2: RES “H” (when using J-Link OB) |
| | 2-3 Shorted | | RA4M2: RES “L” (when J-Link OB is stopped) |

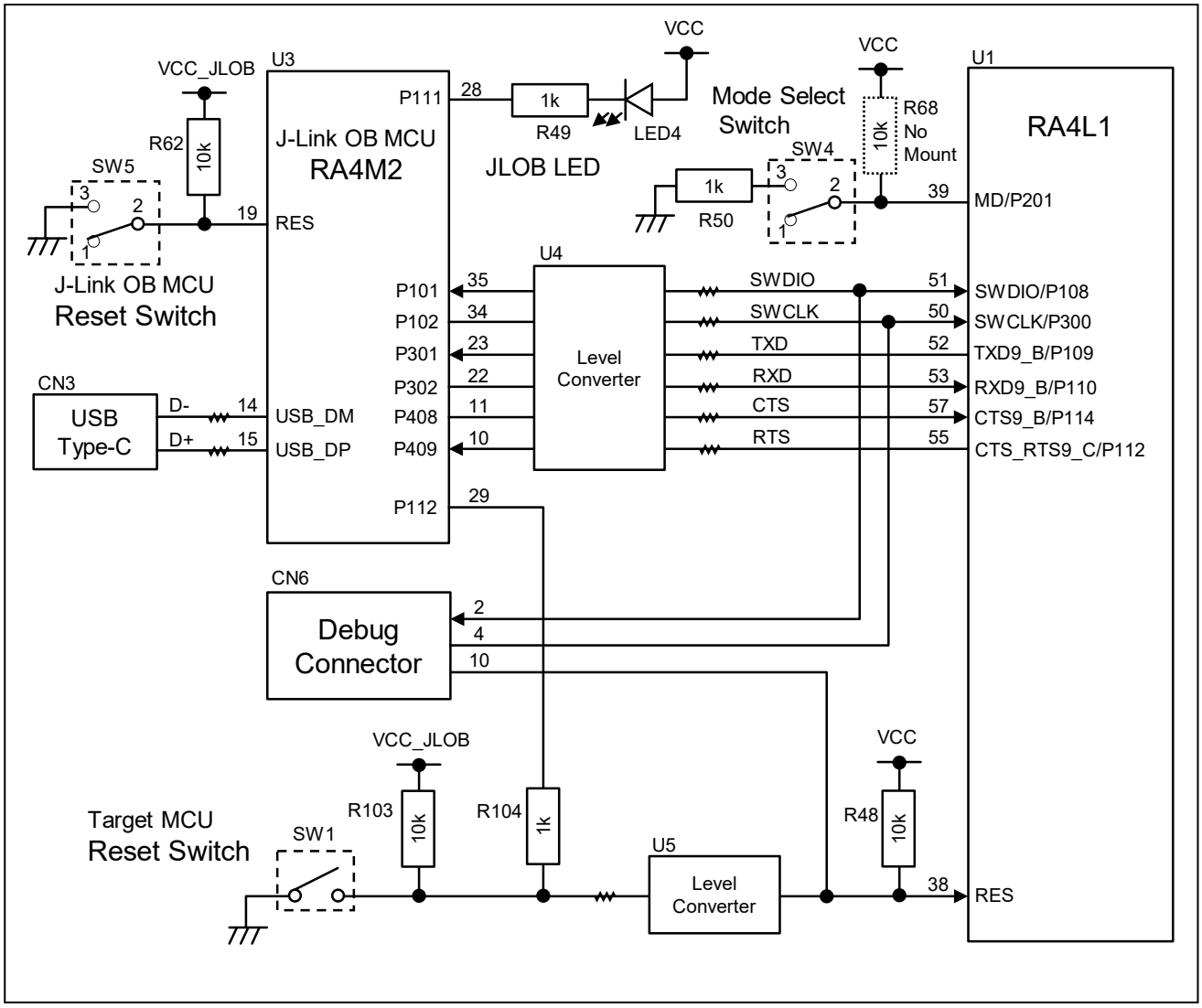



**Figure 8 Reset Circuit / Debug Interface**

## 5.5 Push Switches / LEDs

**Table 5 Push Switch Specifications**

| Reference | Connection | Function |
|---|---|---|
| SW1（Reset） | RES# | Resets microcontroller RA4L1 |
| SW2 | P107 | User controllable switch |
| SW3 | P106 | User controllable switch |

**Table 6 LED Specifications**

| Reference | Connection | Function | Color |
|---|---|---|---|
| LED1 (Power) | VCC | Power supply status | Red |
| LED2 | P601 | User controllable LED | Green |
| LED3 | P600 | User controllable LED | Yellow |

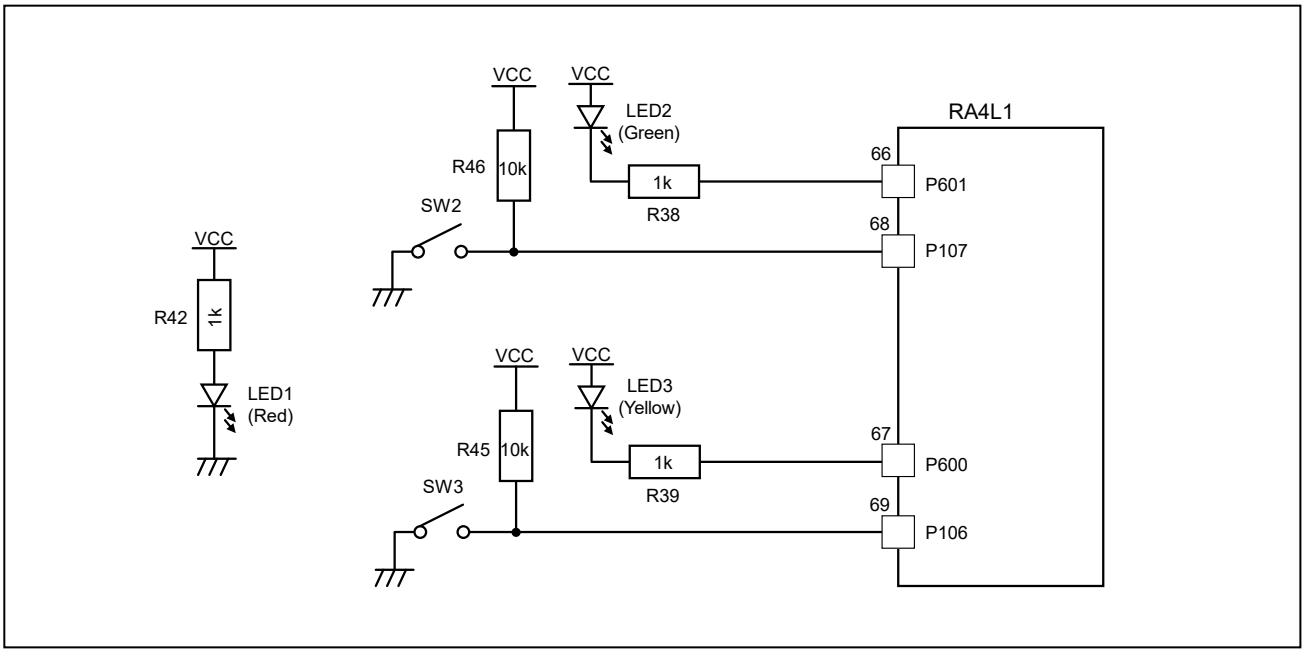



**Figure 9 Push Switch and LED Circuits**

## 5.6 Pmod Interface

This CPU board is equipped with two Pmod interface connectors (PMOD1 and PMOD2).

PMOD1 can be used as Pmod Type 2A, Type 3A, or Type 6A. The selection can be changed by mounting a 0Ω resistor (Figure 10). The default setting is Type 6A.

PMOD2 can be used as Pmod Type 2A.

When connecting the Pmod module, check the pin positions to make sure they are not misaligned or inserted backwards. Such issues can cause damage to the device.

**Table 7 PMOD1 Pin Assignments (Default Type 6A)**

| Pin | Function (Type) | | | MCU Port |
|---|---|---|---|---|
| | 2A | 3A | 6A | |
| 1 | CS | CTS | NC | **[2A,3A]** P402/CTS_RTS1_A/SS1_A **[6A]** (Unrelated) |
| 2 | MOSI | TXD | NC | **[2A,3A]** P400/TXD1_A/SDA1_A/MOSI1_A **[6A]** (Unrelated) |
| 3 | MISO | RXD | SCL | **[2A,3A,6A]** P401/RXD1_A/SCL1_A/MISO1_A |
| 4 | SCK | RTS | SDA | **[2A,3A]** P403/SCK1_A **[6A]** P400/TXD1_A/SDA1_A/MOSI1_A |
| 5 | GND | | | – |
| 6 | VCC | | | – |
| 7 | GPIO | | | P404 |
| 8 | GPIO | | | P405 |
| 9 | GPIO | | | P406 |
| 10 | GPIO | | | P700 |
| 11 | GND | | | – |
| 12 | VCC | | | – |

**Table 8 PMOD2 Pin Assignments**

| Pin | Function (Type) | | | MCU Port |
|---|---|---|---|---|
| | 2A | 3A | 6A | |
| 1 | CS | Not supported | | **[2A]** P204/SSLA0_A |
| 2 | MOSI | | | **[2A]** P211/MOSIA_A |
| 3 | MISO | | | **[2A]** P210/MISOA_A |
| 4 | SCK | | | **[2A]** P209/RSPCKA_A |
| 5 | GND | | | – |
| 6 | VCC | | | – |
| 7 | GPIO | | | P205 |
| 8 | GPIO | | | P206 |
| 9 | GPIO | | | P207 |
| 10 | GPIO | | | P208 |
| 11 | GND | | | – |
| 12 | VCC | | | – |

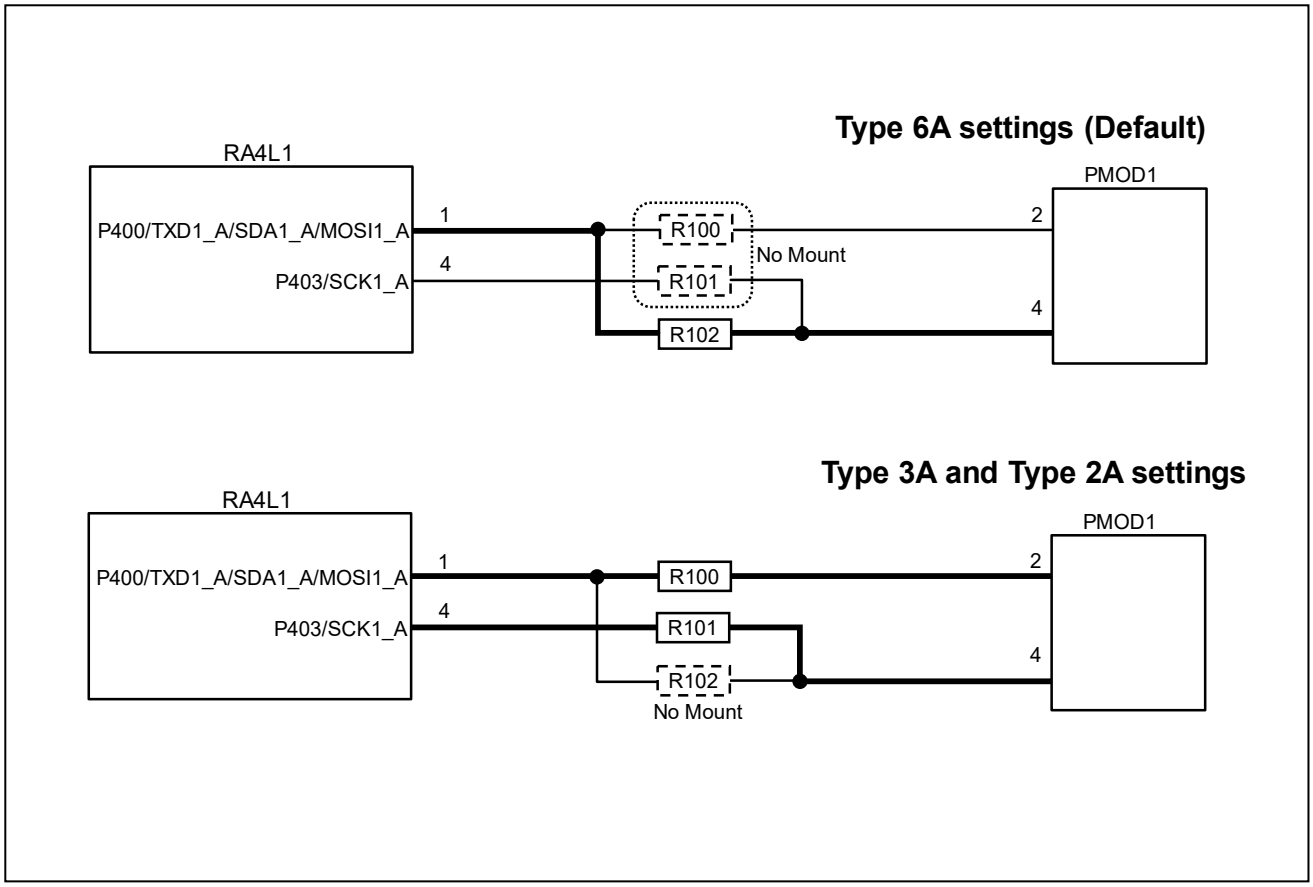



**Figure 10 PMOD1 Interface Switching Circuit**

## 5.7 Application Board Interface

Application board headers CN1 and CN2 are interfaces for user board connections.

CN1 is for GPIO pins. Refer to the MCU user's hardware manual for details on peripheral functions not listed here.

CN2 is mainly used for CTSU pins. GPIO pins should be used fixed to low level by software.

**Table 9 Application Board Connector (CN1)**

| CN1 | MCU | | CN1 | MCU | |
|---|---|---|---|---|---|
| Pin | Port | Peripheral | Pin | Port | Peripheral |
| 16 | VSS (GND) | — | 15 | VCC | — |
| 14 | P407 | — | 13 | P408 | — |
| 12 | P409 | — | 11 | P410 | — |
| 10 | P411 | — | 9 | P000 | — |
| 8 | P001 | — | 7 | P002 | — |
| 6 | P003 | — | 5 | P004 | — |
| 4 | P513 | — | 3 | P512 | — |
| 2 | P511 | — | 1 | P510 | — |

**Table 10 Application Board Connector (CN2)**

| CN2 | MCU | | CN2 | MCU | |
|---|---|---|---|---|---|
| Pin | Port | CTSU | Pin | Port | CTSU |
| 40 | — | — | 39 | — | — |
| 38 | — | — | 37 | — | — |
| 36 | P509 | TS11 | 35 | — (GND) | — |
| 34 | P508 | TS10 | 33 | — (GND) | — |
| 32 | — (GND) | — | 31 | P507 | TS9 |
| 30 | — (GND) | — | 29 | — (GND) | — |
| 28 | P506 | TS8 | 27 | — (GND) | — |
| 26 | — (GND) | — | 25 | — (GND) | — |
| 24 | — (GND) | — | 23 | — (GND) | — |
| 22 | P504 | TS7 | 21 | — (GND) | — |
| 20 | — (GND) | — | 19 | — (GND) | — |
| 18 | — (GND) | — | 17 | — (GND) | — |
| 16 | — (GND) | — | 15 | — (GND) | — |
| 14 | — (GND) | — | 13 | — (GND) | — |
| 12 | — (GND) | — | 11 | — (GND) | — |
| 10 | — (GND) | — | 9 | P503 | TS6 |
| 8 | P502 | TS5 | 7 | P501 | TS4 |
| 6 | P100 | TS3 | 5 | P101 | TS2 |
| 4 | P102 | TS1 | 3 | P103 | TS0 |
| 2 | — (GND) | — | 1 | — (GND) | — |

— : Not Applicable

# 6. Capacitive Touch Application Board

The Capacitive Touch Application Board (RTK0EG0019B01002BJ) features self-capacitance method touch buttons, wheel and slider electrodes, and LEDs.

## 6.1 Signal Assignments

The following shows the signal assignments when the RA4L1 Cap Touch CPU board is connected.

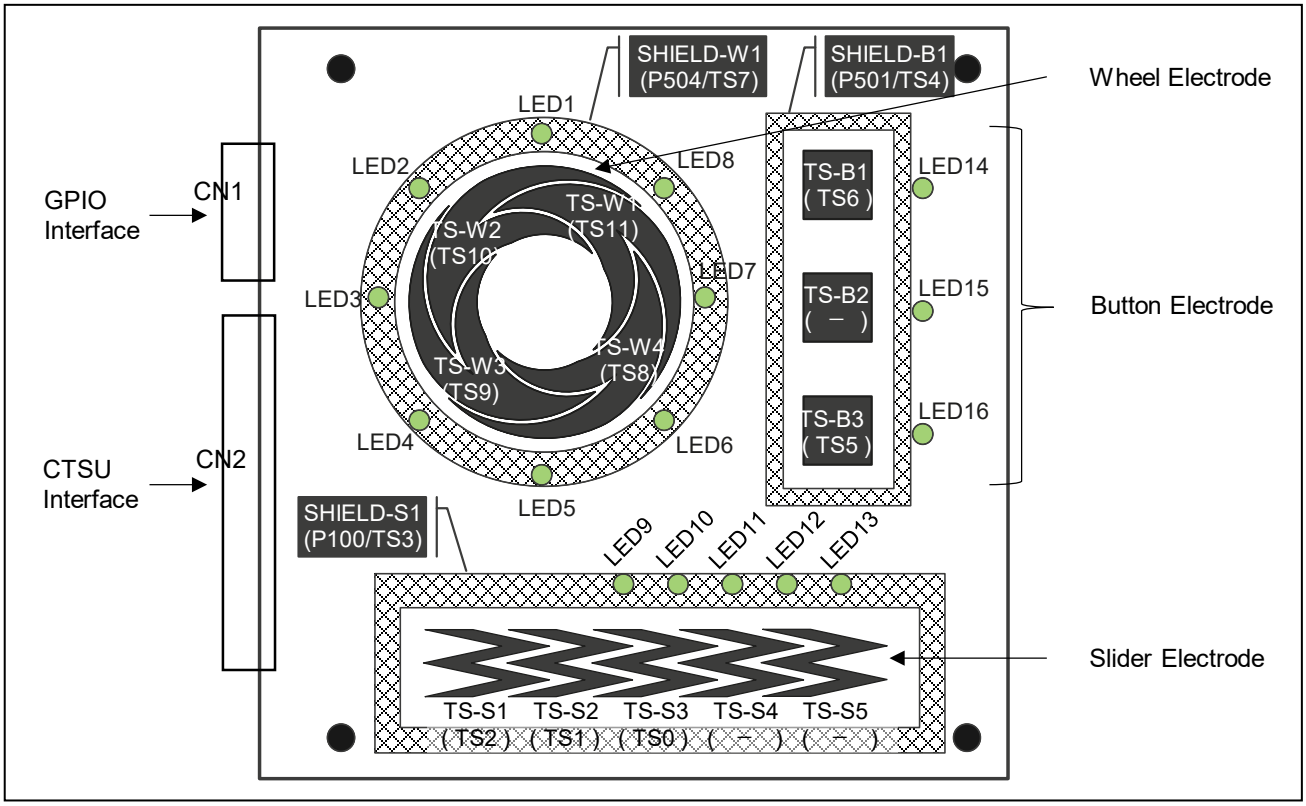



**Figure 11 Capacitive Touch Application Board (connected to RA4L1 Cap Touch CPU board)**

**Table 11 Application Header (CN1)**

| Pin | Function | RA4L1 | Pin | Function | RA4L1 |
|---|---|---|---|---|---|
| 15 | LED_VCC | VCC | 16 | LED_VSS (GND) | VSS (GND) |
| 13 | LED_ROW0 | P408 | 14 | LED_ROW1 | P407 |
| 11 | LED_ROW2 | P410 | 12 | LED_ROW3 | P409 |
| 9 | – | P000 | 10 | – | P411 |
| 7 | LED_COL3 | P002 | 8 | – | P001 |
| 5 | LED_COL1 | P004 | 6 | LED_COL2 | P003 |
| 3 | – | P512 | 4 | LED_COL0 | P513 |
| 1 | – | P510 | 2 | – | P511 |

– : Not Applicable

**Table 12 Application Header (CN2)**

| Pin | Touch Electrode | CTSU (RA4L1) **(Note1)** | Pin | Touch Electrode | CTSU (RA4L1) **(Note1)** |
|---|---|---|---|---|---|
| 39 | — | — | 40 | — | — |
| 37 | — | — | 38 | — | — |
| 35 | — | — | 36 | TS-W1 | TS11 |
| 33 | — | — | 34 | TS-W2 | TS10 |
| 31 | TS-W3 | TS9 | 32 | — | — |
| 29 | — | — | 30 | — | — |
| 27 | — | — | 28 | TS-W4 | TS8 |
| 25 | — | — | 26 | — | — |
| 23 | — | — | 24 | — | — |
| 21 | — | — | 22 | SHIELD-W1 | TS7 (Note2) |
| 19 | — | — | 20 | — | — |
| 17 | — | — | 18 | — | — |
| 15 | — | — | 16 | — | — |
| 13 | — | — | 14 | — | — |
| 11 | — | — | 12 | — | — |
| 9 | TS-B1 | TS6 | 10 | TS-B2 | — |
| 7 | SHIELD-B1 | TS4 (Note2) | 8 | TS-B3 | TS5 |
| 5 | TS-S1 | TS2 | 6 | SHIELD-S1 | TS3 (Note2) |
| 3 | TS-S3 | TS0 | 4 | TS-S2 | TS1 |
| 1 | TS-S5 | — | 2 | TS-S4 | — |

— : Not Applicable

Note 1: This shows the TS pins of the RA4L1 when the RA4L1 Cap Touch CPU board is connected.
"—" does not always indicate a free pin. Refer to the CPU board connectors (Table 10) for details.

Note 2: SHIELD-S1, SHIELD-W1, and SHIELD-B1 are shield electrodes. Set these to Low output via software.

**Table 13 LED Matrix Table**

| | LED_COL0 | LED_COL1 | LED_COL2 | LED_COL3 |
|---|---|---|---|---|
| LED_ROW0 | LED1 | LED5 | LED13 | LED9 |
| LED_ROW1 | LED2 | LED6 | LED14 | LED10 |
| LED_ROW2 | LED3 | LED7 | LED15 | LED11 |
| LED_ROW3 | LED4 | LED8 | LED16 | LED12 |

**Table 14 LED Status and Pin Output Settings**

| **LED** | **LED_ROWn Connection Pin** | **LED_COLn Connection Pin** |
|---|---|---|
| On | Low | High |
| Off | High | Low |

Note : n=0~3

# 7. Certifications

## 7.1 European Union regulatory notices

This product complies with the following EU Directives. (These directives are only valid in the European Union.)

CE Certifications:

- Electromagnetic Compatibility (EMC) Directive 2014/30/EU
  EN IEC 61326-1: 2021 Group1 Class A

| | |
|---|---|
| **WARNING:** | This is a Class A product. This equipment can cause radio frequency noise when used in the residential area. In such cases, the user/operator of the equipment may be required to take appropriate countermeasures under his responsibility. |

- ・Information for traceability
  - Authorised representative
    Name: Renesas Electronics Corporation
    Address: Toyosu Foresia, 3-2-24, Toyosu, Koto-ku, Tokyo 135-0061, Japan
  - Manufacturer
    Name: Renesas Electronics Corporation
    Address: Toyosu Foresia, 3-2-24, Toyosu, Koto-ku, Tokyo 135-0061, Japan
  - Person responsible for placing on the market
    Name: Renesas Electronics Europe GmbH
    Address: Arcadiastrasse 10, 40472 Dusseldorf, Germany
  - Trademark and Type name
    Trademark: Renesas
    Product name: RA4L1 Group Capacitive Touch Evaluation System
    Type name: RTK0EG0057S01001BJ

Environmental Compliance and Certifications:

Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU

## 8. Website and Support

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

- RTK0EG0057S01001BJ Resources renesas.com/rssk-touch-ra4l1
- Renesas Capacitive Touch Sensor Solutions renesas.com/solutions/touch-key
- RA Product Information renesas.com/ra
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## Revision History

| Rev. | Date | Description | |
|---|---|---|---|
| | | Page | Summary |
| 1.00 | Oct.31.24 | - | First edition issued |
| 1.10 | Apr.05.25 | 3 | Added a note on the RA4L1 Secure Factory Programming function.<br>Added RA4L1 Cap Touch CPU board operating temperature range. |
| | | 4 | Added capacitive touch application board operating temperature range. |

RA4L1 Group Renesas Solution Starter Kit
Capacitive Touch Evaluation System User's Manual

Publication Date: Rev.1.00 Oct.31.24
Rev.1.10 Apr.05.25

Published by: Renesas Electronics Corporation

# Renesas RA4L1 Group

# Renesas Solution Starter Kit
# Capacitive Touch Evaluation System
# User's Manual

Renesas Electronics Corporation

R12UZ0162EJ0110