

RL78/G16

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

16-bit Single Chip Microcontrollers

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(Rev.5.0-1 October 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
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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.

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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 RL78/G16 Capacitive Touch Evaluation System (RTK0EG0047S01001BJ). 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.

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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 \triangle indicates a warning or caution.

Example:



Electrical Shock Hazard

The



mark indicates something that is forbidden.

Example: :



Do Not Disassemble

Warning



Warning

Handling related warnings:

Do not disassemble or modify this product. Renesas does not guarantee this product if it has been disassembled or modified.



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.

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:



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:



The upper limit for the ambient temperature under which this product may be used is 35°C.

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 JP1 (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.



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Table of Contents

1. Overview.....	1
1.1 Purpose.....	1
1.2 Main Characteristics and Functions.....	1
1.3 Board Specifications	2
1.4 Regulatory Compliance Notices	3
1.4.1 European Union regulatory notices.....	3
2. CPU Board	4
2.1 System Block Diagram.....	4
2.2 Product Configuration	5
2.3 Hardware Details	6
2.3.1 Default Jumper Settings.....	6
2.3.2 Power Supply	7
2.3.3 Clock Circuit	8
2.3.4 Reset Circuit.....	9
2.3.5 Push Switch & LEDs	9
2.3.6 USB Serial Conversion	10
2.3.7 Debug Interface.....	10
2.3.8 Application Header.....	11
3. Application Board (Self-Capacitance Electrode Board)	13
3.1 Board Layout.....	13
3.2 Application Headers.....	13
4. Reference Materials.....	15
5. Additional Information.....	16
Appendix: Self-Capacitance Touch Electrode Board Connection.....	17

1. Overview

1.1 Purpose

The RL78/G16 Capacitive Touch Evaluation System (RTK0EG0047S01001BJ) is a kit created for evaluating the Renesas Electronics RL78/G16 of MCUs. This manual describes the RL78/G16 Cap Touch Evaluation System's hardware.

1.2 Main Characteristics and Functions

The main functions of the RL78/G16 Capacitive Touch Evaluation System are as follows:

- Renesas Microcontroller programming and debugging
 - E2/E2 Lite debugger connector
- General purpose switches and LEDs
- Capacitive Touch Sensor (CTSUb)
 - 15channels available
- Connects to Renesas Capacitive Touch Evaluation System Application Board (option)
 - Includes self-capacitance touch electrode application board

1.3 Board Specifications

Table 1-1. CPU Board Specifications

Item	Specifications
Board part No	RTK0EG0046C01001BJ
MCU	Model No.: R5F121BCAFP
	Package: 32pin LFQFP
	On-chip memory: ROM 32KB+2KB, RAM 1KB
	High-speed on-chip oscillator (f_{IH}): 16MHz
Input clock	Main clock: 12MHz (option)
	Sub clock: 32.768KHz (option)
Power supply	Operation voltage: 5.0 to 3.3V <ul style="list-style-type: none"> DC jack (2.1mm Center positive): 5.0 to 3.3V USB bus powered (VBUS): 5V
Debug interface	Renesas Electronics E2/E2 Lite 14-pin box header
Slide switch	Board function selection : 2pole × 1
Push switches	Reset switch: x 1
	User switches: x 2
LEDs	Power status: red x 1
	User LEDs: green x 1, yellow x 1
USB serial conversion interface	Connector: USB Micro B
	Driver: FT234XD USB serial IC manufactured by FTDI
Application board interface (GPIO)	2.54mm pitch, 16 pins x 1 (CN1)
Application board interface (CTSUS)	2.54mm pitch, 40 pins x 1 (CN2)
Current consumption	500mA or less (Total with all interfaces in use)
Operating Temperature Range	When operating: 10 to 35°C, in storage: -10 to 50°C (no condensation)
Board dimensions (L x W x H)	89mm x 95mm x 18mm (including connectors)

Table 1-2. Application Board Specifications

Item	Specifications
Board part No	RTK0EG0019B01002BJ
Self-capacitance detection touch electrodes	Buttons: 3 Wheel (4-electrode configuration): 1 Sliders (5-electrode configuration): 1
Touch electrode shields	Button, wheel, and slider areas: 1 shield each
LEDs	16
Renesas MCU Cap Touch CPU board interface	2.54mm pitch, 16 pins x 1 (CN1) 2.54mm pitch, 40 pins x 1 (CN2)
Overlay panel	2mm-thick acrylic panel
Current consumption	500mA or less
Operating Temperature Range	When operating: 10 to 35°C, in storage: -10 to 50°C (no condensation)
Board dimensions (L x W x H)	110mm x 116mm x 11mm (including connectors)

1.4 Regulatory Compliance Notices

1.4.1 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
EN61326-1 : 2021 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.
-

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 - 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
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 - Product name: RL78/G16 Capacitive Touch Evaluation System
 - Type name: RTK0EG0047S01001BJ

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2. CPU Board

2.1 System Block Diagram

Figure 2-1 shows the system block diagram of the CPU board.

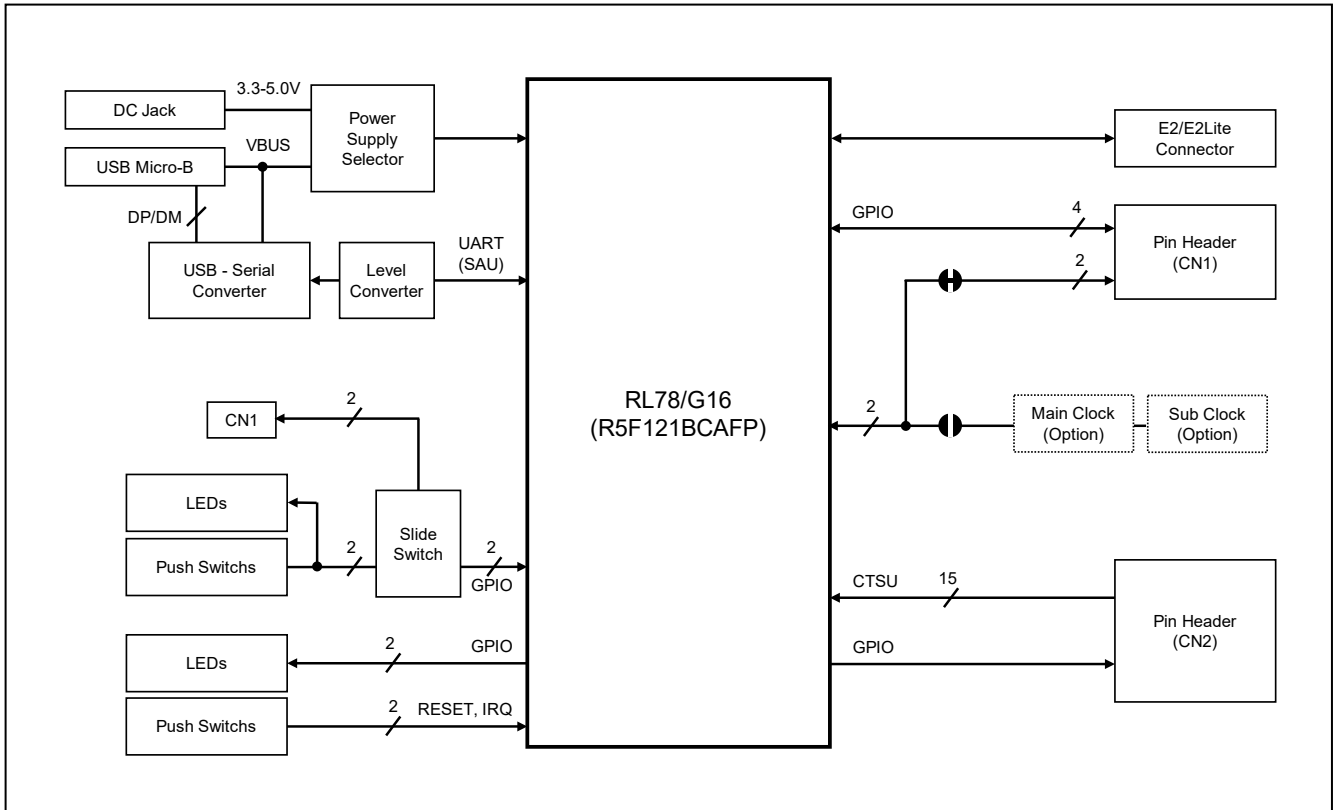


Figure 2-1. System Block Diagram

2.2 Product Configuration

Figure 2-2 shows the parts location. Figure 2-3 shows the board dimensions.

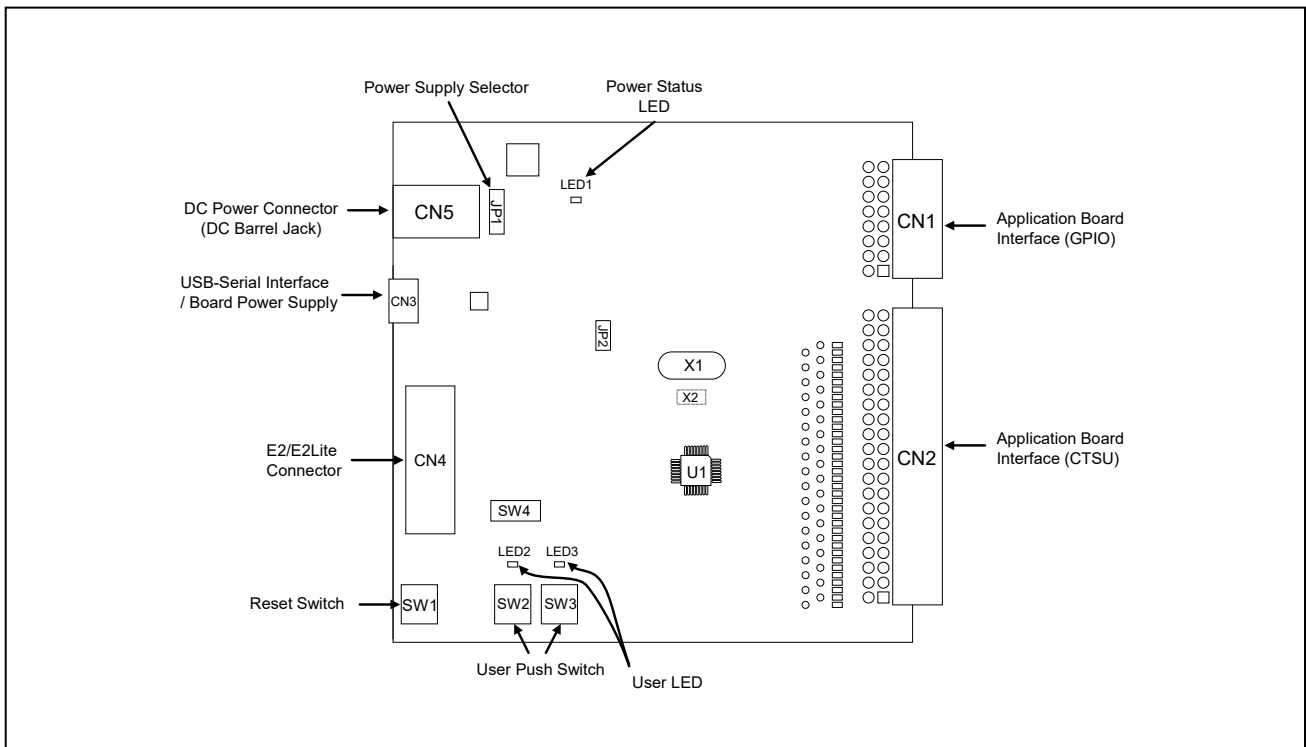


Figure 2-2. Parts Location

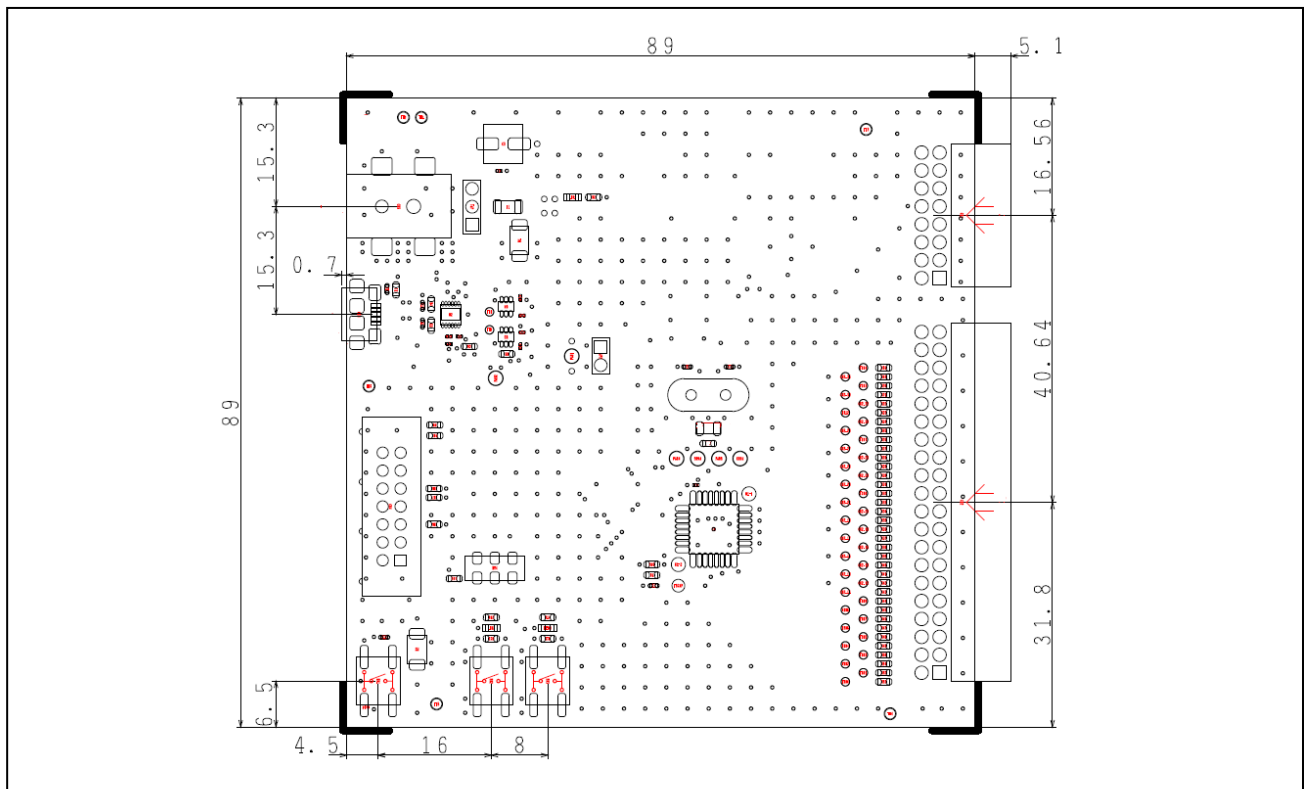


Figure 2-3. Board Dimensions

2.3 Hardware Details

2.3.1 Default Jumper Settings

Figure 2-4. shows the default positions of the jumpers and switches. Table 2-1 outlines the operation of jumpers and switches in the default state.

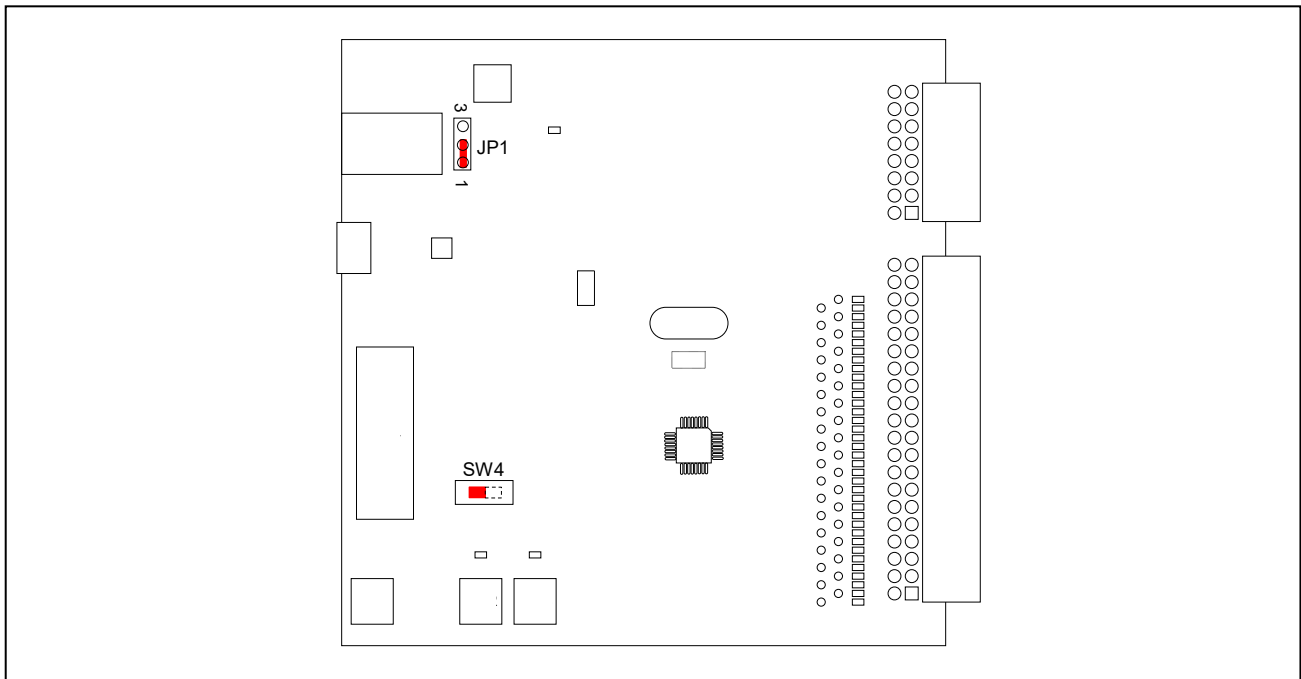


Figure 2-4. Default Jumpers and Switches Positions

Table 2-1. Default Jumper and Switches Settings

Reference	Functional overview	Default State	Description
JP1	Power supply selection (USB / DC-Jack)	Powered by USB	2.3.2 Power Supply
SW4	RL78/G16 terminal (10, 17) connection destination selection (CN1/ LED2, SW2)	Connect to CN1	2.3.5 Push Switch & LEDs

2.3.2 Power Supply

Table 2-2 provides the power supply jumper settings. This CPU board can be supplied with 5V power by USB or DC jack (2.1mm center positive).

Table 2-2. Power Source Jumper Settings

Reference	Jumper Setting	Default Setting (X)	Description
JP1	Shorted Pins 1-2	X	Supplies USB power source to board power.
	Shorted Pins 2-3		Supplies DC jack (CN5) to board power source.
JP2 / PAD1	Shorted Pins 1-2	X	Supplies board power source to MCU.
	Open		MCU current consumption measurement setting

Figure 2-5 shows the power source system diagram.

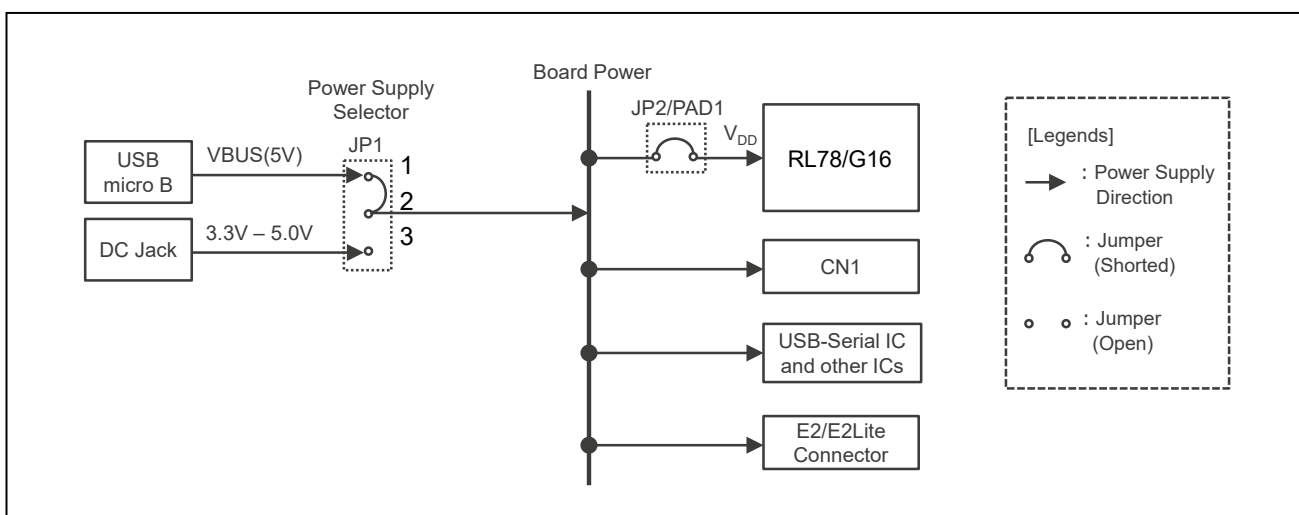


Figure 2-5. Power Source System Diagram

2.3.3 Clock Circuit

Table 2-3 lists the clock specifications of the CPU board. Figure 2-6 shows the clock circuit (initial state).

Table 2-3. Clock Specifications

Clock	Function	Default State	Frequency	Package
X1	Main clock (crystal resonator)	Not mounted	12MHz	HC-49/S
X2	Sub clock	Not mounted	32.768kHz	3.2mm x 2.5mm SMD

Table 2-4 lists Clock circuit short PAD (PAD3-6) specifications. P121/X1 and P122/X2 of RL78/G16 are connected to the clock circuit or CN1 by short PAD(PAD3-6).

Table 2-4. Clock circuit short PAD (PAD3-6) specifications

Reference	Position	Default Setting (X)	Function
PAD3-6	PAD3 Shorted PAD4 Shorted	X	P121/X1/XT1 and P122/X2/XT2 are connected to CN1.
	PAD5 Open PAD6 Open		
PAD3-6	PAD3 Open PAD4 Open		P121/X1/XT1 and P122/X2/XT2 are connected to the clock circuit.
	PAD5 Shorted PAD6 Shorted		

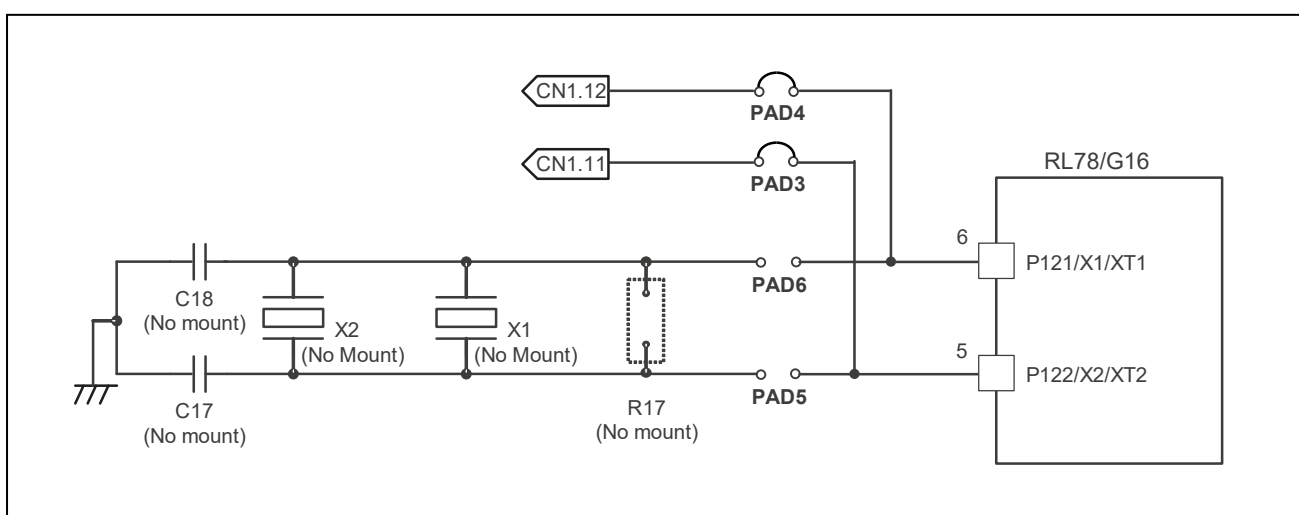


Figure 2-6. Clock Circuit

2.3.4 Reset Circuit

The RL78/G16 CPU Board is equipped with a reset switch (SW1) which generates a reset signal to restart the main MCU.

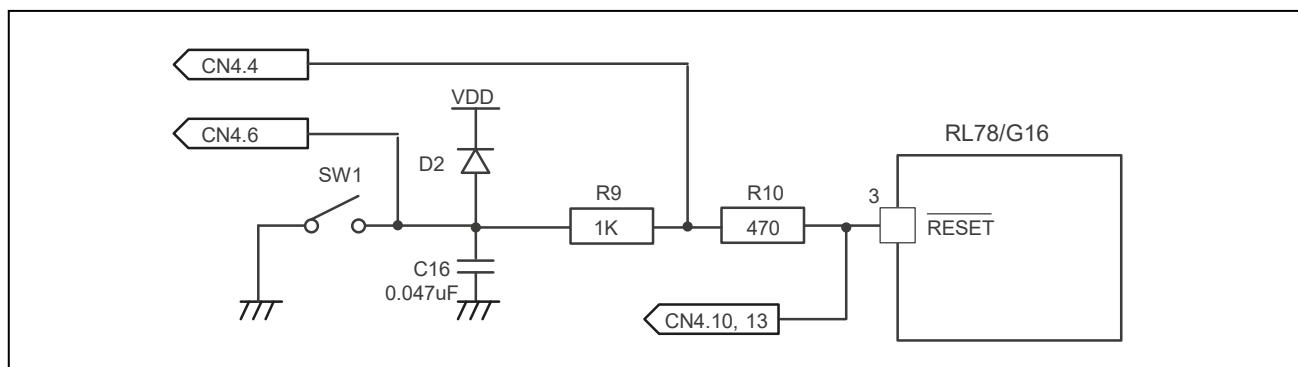


Figure 2-7. Reset Circuit

2.3.5 Push Switch & LEDs

Table 2-5. lists the push switch specifications. Table 2-6. lists the LED specifications.

Table 2-5. Push Switch Specifications

Reference	MCU Control Port	Function
SW1 (Reset)	RES#	Resets the MCU.
SW2	P00	User controllable switch.
SW3	P137//INTP0	User controllable switch.

Table 2-6. LED Specifications

Reference	MCU Control Port	Function	Color
LED1 (Power)	VCC	Power status display	Red.
LED2	P61	User LED	Green
LED3	P60	User LED	Yellow

Table 2-7 lists the switch specifications for board function selection switch (SW4). P61 and P00 of RL78/G16 are connected to the push switch and LED or CN1 by slide switch SW4.

Table 2-7. Switch Specifications for Board Function Selection Switch (SW4)

Reference	Position	Default Setting (X)	Function
SW4	OFF (1-2, 4-5 pin)	X	P61 and P00 are connected to LED2 (P61) and SW2 (P00).
	ON (2-3, 5-6 pin)		P61 and P00 are connected to CN1 (GPIO).

Figure 2-8 shows the push switch and LED circuit

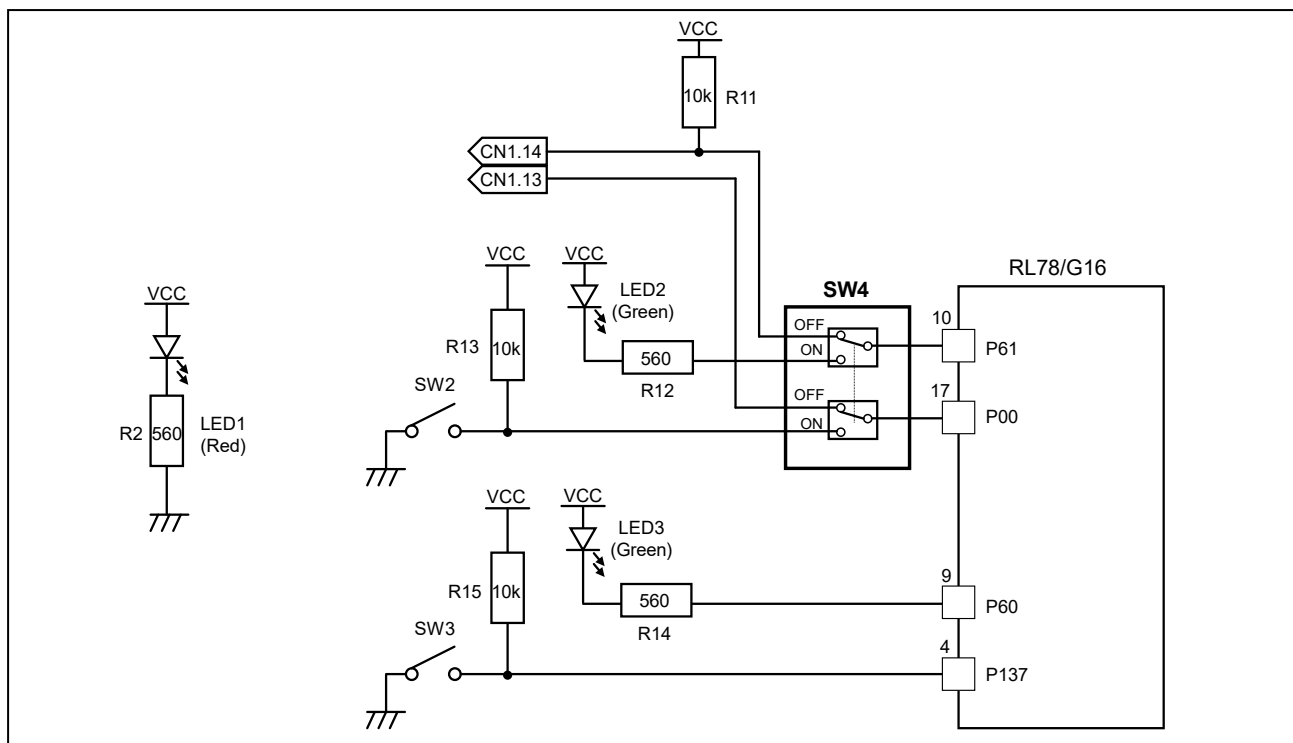


Figure 2-8. Push Switch and LED Circuit

2.3.6 USB Serial Conversion

Table 2-8 lists connections for USB serial IC and MCU controller. The RL78/G16 Cap Touch Evaluation System Board is equipped with USB serial IC FT234XD (FTDI Ltd.) for USB serial conversion. The FT234XD is connected to the RL78/G16's Serial Array Unit (SAU) module.

Table 2-8 USB Serial Conversion

Signal Name	MCU Control Port	Function
TXD1	P11/(TxD1)	SAU transmit data signal
RXD1	P10/(RxD1)	SAU receive data signal

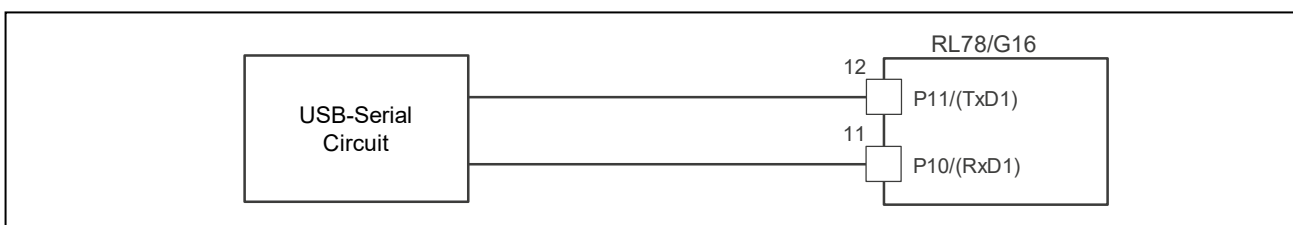


Figure 2-9. Interface of MCU to USB Serial Conversion Circuit

2.3.7 Debug Interface

The CPU board is equipped with an E2/E2 Lite connector (14-pin box connector) for use as debugging interface. For details, refer to Reference Materials [2].

2.3.8 Application Header

The two application headers, CN1 and CN2, can be used as interface for the user's own board.

CN1 is used for GPIO pins. For more details regarding peripheral functions not listed here, refer to the User's Manual Hardware Version.

Table 2-9. Application Header (CN1)

CN1		MCU		CN1		MCU	
Pin	Port	Peripheral	Pin	Port	Peripheral		
16	VSS (GND)		15	VCC			
14	P61 (Note1)		13	P00 (Note1)			
12	P121 (Note2)	X1/XT1	11	P122 (Note2)	X2/XT2		
10	—	—	9	—	—		
8	—	—	7	P15			
6	P14		5	P13			
4	P12		3	—	—		
2	—	—	1	—	—		

Note1 : Not connected by board default. Can be switched by SW4. See "2.3.5 Push Switch & LEDs" section for details.

Note2 : Not connected by board default. Can be switched by short Pad. See "2.3.3 Clock Circuit" section for details.

CN2 is mainly used for CTSU pins. Fix the GPIO pins to low by software. Do not connect anything to TSCAP.

Table 2-10. Application Header (CN2)

CN2 Pin	MCU		CN2 Pin	MCU	
	Port	CTSU		Port	CTSU
40	P02	TSCAP	39	—	—
38	—	—	37	—	—
36	P43	TS14	35	VSS (GND)	—
34	P41	TS13	33	VSS (GND)	—
32	VSS (GND)	—	31	P42	TS12
30	VSS (GND)	—	29	VSS (GND)	—
28	P20	TS11	27	VSS (GND)	—
26	VSS (GND)	—	25	VSS (GND)	—
24	VSS (GND)	—	23	VSS (GND)	—
22	P21	TS10	21	VSS (GND)	—
20	VSS (GND)	—	19	VSS (GND)	—
18	VSS (GND)	—	17	VSS (GND)	—
16	VSS (GND)	—	15	VSS (GND)	—
14	VSS (GND)	—	13	VSS (GND)	—
12	VSS (GND)	—	11	VSS (GND)	—
10	P22	TS09	9	P23	TS08
8	P07	TS07	7	P06	TS06
6	P05	TS05	5	P04	TS04
4	P03	TS03	3	P17	TS02
2	P16	TS01	1	P01	TS00

— : Not Applicable

3. Application Board (Self-Capacitance Electrode Board)

3.1 Board Layout

Figure 3-1 shows the layout of the application board.

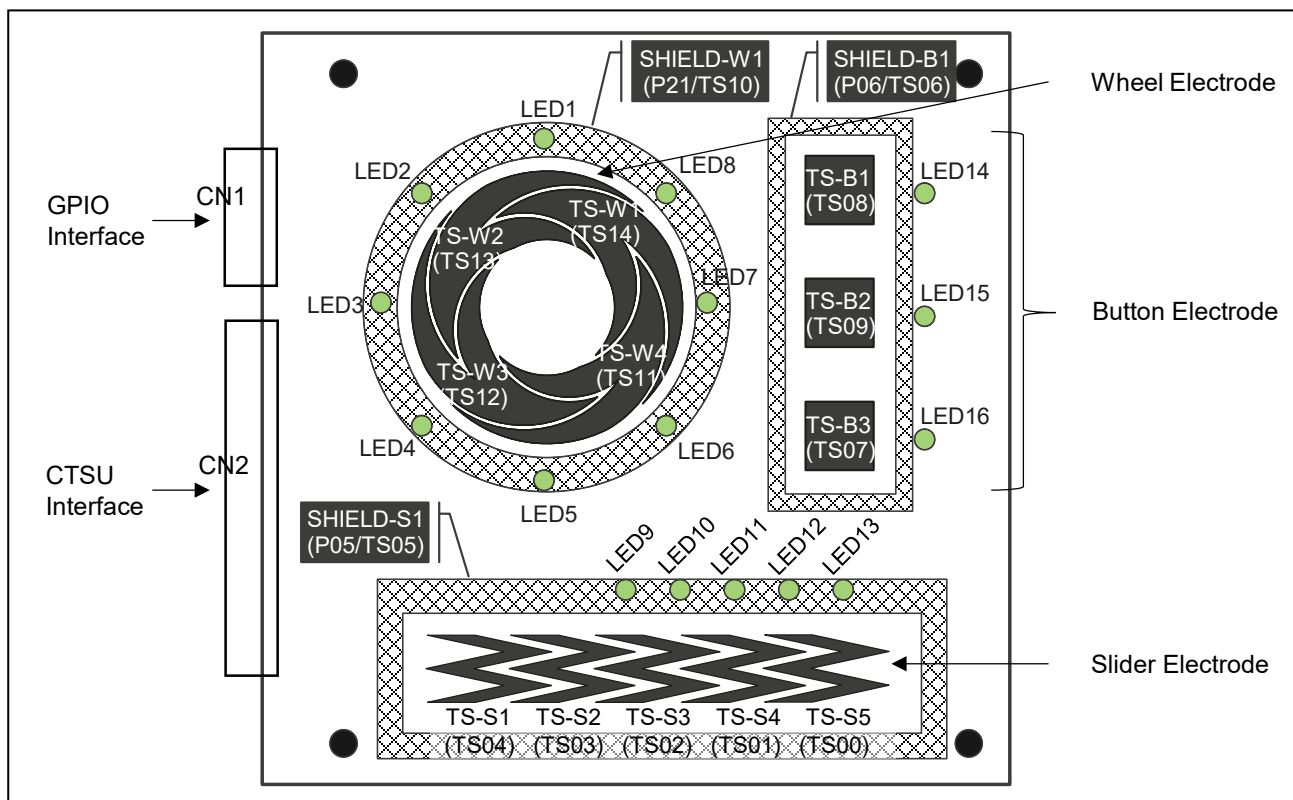


Figure 3-1. Board Layout and TS Pin Assignments

3.2 Application Headers

Application headers CN1 and CN2 are the interface for connection to the Renesas Capacitive Touch Evaluation System CPU board. Table 3-1 lists the pin assignments for CN1. Table 3-2 lists the pin assignments for CN2.

Table 3-1. Application Header (CN1)

Pin	Function	MCU Connection	Pin	Function	MCU Connection
15	LED_VCC	VCC	16	LED_VSS (GND)	VSS (GND)
13	LED_ROW0	P00	14	LED_ROW1	P61
11	LED_ROW2	P122	12	LED_ROW3	P121
9	—	—	10	—	—
7	LED_COL3	P15	8	—	—
5	LED_COL1	P13	6	LED_COL2	P14
3	—	—	4	LED_COL0	P12
1	—	—	2	—	—

— : Not Applicable

Table 3-2. Application Header (CN2)

Pin	Touch Electrode	CTSUS (RL78/G16) (Note1)	Pin	Touch Electrode	CTSUS (RL78/G16) (Note1)
39	—	—	40	—	TSCAP
37	—	—	38	—	—
35	—	—	36	TS-W1	TS14
33	—	—	34	TS-W2	TS13
31	TS-W3	TS12	32	—	—
29	—	—	30	—	—
27	—	—	28	TS-W4	TS11
25	—	—	26	—	—
23	—	—	24	—	—
21	—	—	22	SHIELD-W1	TS10 (Note2)
19	—	—	20	—	—
17	—	—	18	—	—
15	—	—	16	—	—
13	—	—	14	—	—
11	—	—	12	—	—
9	TS-B1	TS08	10	TS-B2	TS09
7	SHIELD-B1	TS06 (Note2)	8	TS-B3	TS07
5	TS-S1	TS04	6	SHIELD-S1	TS05 (Note2)
3	TS-S3	TS02	4	TS-S2	TS03
1	TS-S5	TS00	2	TS-S4	TS01

— : Not Applicable

Note 1: Set output of all unassigned pins to low by software.

Note 2: SHIELD-S1, SHIELD-W1 and SHIELD-B1 are shield electrodes. To enable the function, set the pin to low by software.

Table 3-3. 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 3-4. 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

4. Reference Materials

- [1]. Renesas RL78/G16 User's Manual: Hardware (01UH0980)
- [2]. E1/E20/E2 Emulator, E2 Emulator Lite Additional Document for User's Manual (Notes on Connection of RL78 Devices) (R20UT1994)

5. Additional Information

Support

Refer to the Integrated Development Environment help menu for more information on how to use the IDE.

Refer to the RL78/G16 User's Manual Hardware Version for more information on RL78/G16 MCUs.

For general information on Renesas microcontrollers, visit : <https://www.renesas.com/>

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Revision History	RL78/G16 Capacitive Touch Evaluation System User's Manual
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Rev.	Date	Description	
		Page	Summary
1.00	Dec.31.22	—	First Edition issued

RL78/G16 Renesas Solution Starter Kit
Capacitive Touch Evaluation System User's Manual

Publication Date: Rev. 1.00 Dec.31.2022

Published by: Renesas Electronics Corporation
