

RL78/G22

16

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

16-bit Single Chip Microcontrollers

All information contained in these materials, including products and product specifications, represents information on the product at the time of publication and is subject to change by Renesas Electronics Corp. without notice. Please review the latest information published by Renesas Electronics Corp. through various means, including the Renesas Electronics Corp. website (<http://www.renesas.com>).

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
 2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
 3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
 4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
 5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
 6. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
 - "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
 - "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.
- Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION ("Vulnerability Issues"). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
 8. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
 9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
 10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
 11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
 12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
 13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
 14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-1 October 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan

www.renesas.com

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/.

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

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 RL78/G22 Capacitive Touch Evaluation System (RTK0EG0042S01001BJ). 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.

Renesas RTK0EG0042S01001BJ Disclaimer

By using this RTK0EG0042S01001BJ, the User accepts the following terms, which are in addition to, and control in the event of disagreement, with Renesas' General Terms and Conditions available at <https://www.renesas.com/en-us/legal/disclaimer.html>.

The RTK0EG0042S01001BJ is not guaranteed to be error free, and the entire risk as to the results and performance of the RTK0EG0042S01001BJ is assumed by the User. The RTK0EG0042S01001BJ is provided by Renesas on an "as is" basis without warranty of any kind whether express or implied, including but not limited to the implied warranties of good workmanship, fitness for a particular purpose, title, merchantability, and non-infringement of intellectual property rights. Renesas expressly disclaims any implied warranty.

Renesas does not consider the RTK0EG0042S01001BJ to be a finished product and therefore the RTK0EG0042S01001BJ may not comply with some requirements applicable to finished products, including, but not limited to recycling, restricted substances and electromagnetic compatibility regulations. Refer to Certifications section, for information about certifications and compliance information for the RTK0EG0042S01001BJ. It is the kit User's responsibility to make sure the kit meets any local requirements applicable to their region.

Renesas or its affiliates shall in no event be liable for any loss of profit, loss of data, loss of contract, loss of business, damage to reputation or goodwill, any economic loss, any reprogramming or recall costs (whether the foregoing losses are direct or indirect) nor shall Renesas or its affiliates be liable for any other direct or indirect special, incidental or consequential damages arising out of or in relation to the use of this RTK0EG0042S01001BJ, even if Renesas or its affiliates have been advised of the possibility of such damages.

Renesas has used reasonable care in preparing the information included in this document, but Renesas does not warrant that such information is error free nor does Renesas guarantee an exact match for every application or parameter to part numbers designated by other vendors listed herein. The information provided in this document is intended solely to enable the use of Renesas products. No express or implied license to any intellectual property right is granted by this document or in connection with the sale of Renesas products. Renesas reserves the right to make changes to specifications and product descriptions at any time without notice. Renesas assumes no liability for any damages incurred by you resulting from errors in or omissions from the information included herein. Renesas cannot verify, and assumes no liability for, the accuracy of information available on another company's website.

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 \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.



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>".

Table of Contents

1. Purpose and Target Readers.....	2
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.....	11
2.3.8 Application Header.....	12
2.3.9 CTSU Related Circuits.....	13
3. Application Board (Self-Capacitance Electrode Board).....	14
3.1 Board Layout.....	14
3.2 Application Headers.....	14
4. Reference Materials.....	16
5. Additional Information.....	17
Appendix: Self-Capacitance Touch Electrode Board Connection.....	18

RL78/G22

Capacitive Touch Evaluation System User's Manual

1. Overview

1.1 Purpose

The RL78/G22 Capacitive Touch Evaluation System (RTK0EG0042S01001BJ) is a kit created for evaluating the Renesas Electronics RL78/G22 of MCUs. This manual describes the RL78/G22 Cap Touch Evaluation System's hardware.

1.2 Main Characteristics and Functions

The main functions of the RL78/G22 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 (CTS02La)
 - 29channels 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	RTK0EG0041C01001BJ
MCU	Model No.: R7F102GGE2DFB
	Package: 48pin LQFP
	On-chip memory: ROM 64KB, RAM 4KB, Data Flash 2KB
	High-speed on-chip oscillator (f_{IH}): 32MHz
External resonator connection	Main clock: 20MHz (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 input USB bus powered (VBUS): 5V
Debug interface	Renesas Electronics E2/E2 Lite 14-pin box header
Slide switch	CTSU temperature compensation circuit selection: 1 pole x 1 Board function selection : 2pole x 3
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 (CTSU)	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.

- 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: RL78/G22 Capacitive Touch Evaluation System
 - Type name: RTK0EG0042S01001BJ

Environmental Compliance and Certifications:

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

2. CPU Board

2.1 System Block Diagram

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

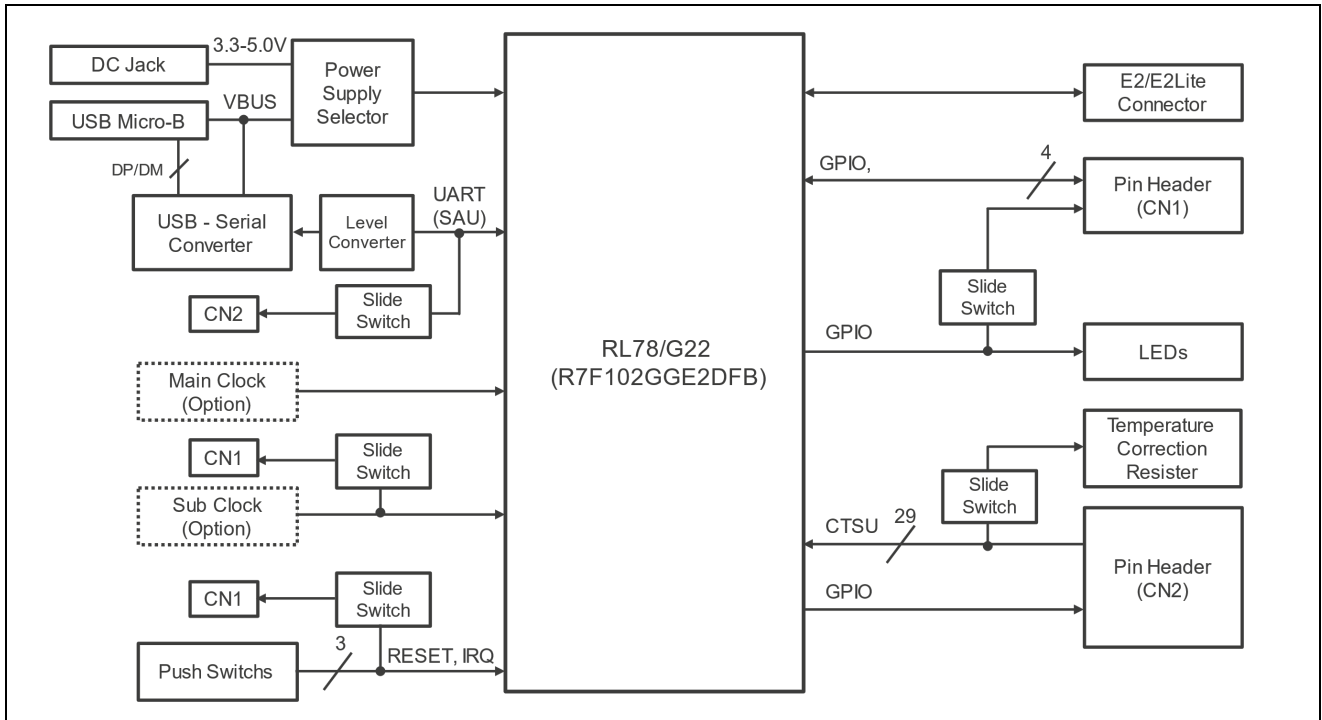


Figure 2-1. System Block Diagram

2.2 Product Configuration

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

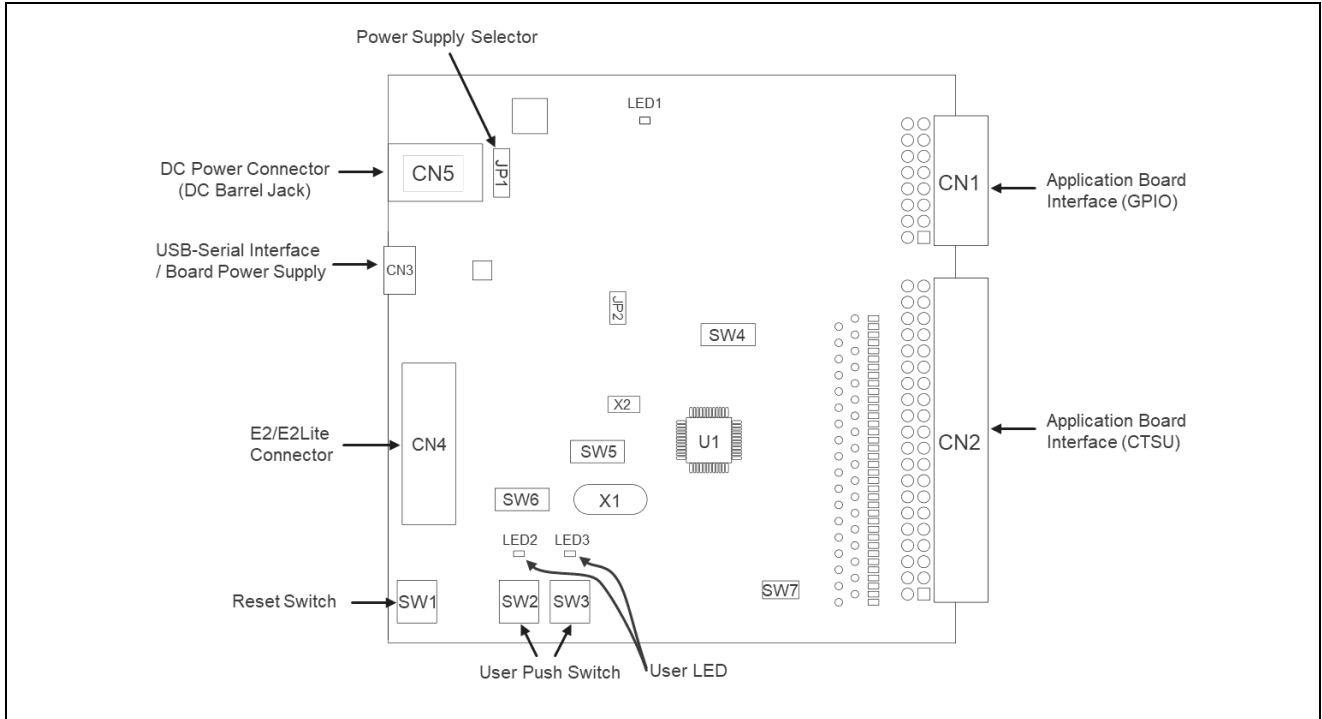


Figure 2-2. Parts Location

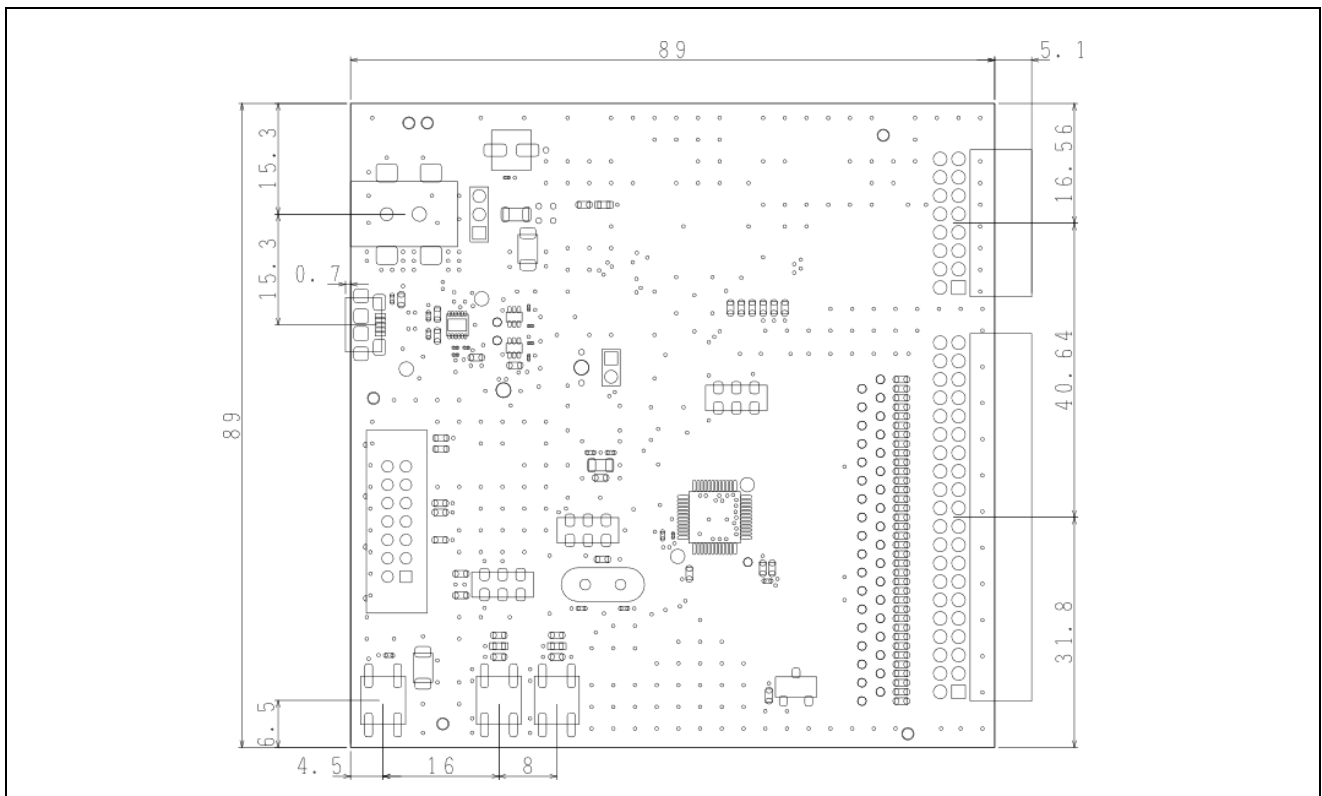


Figure 2-3. Board Dimensions

2.3 Hardware Details

2.3.1 Default Jumper Settings

Figure 2-4. shows the default positions of the jumpers. Table 2-1 lists the default jumper settings.

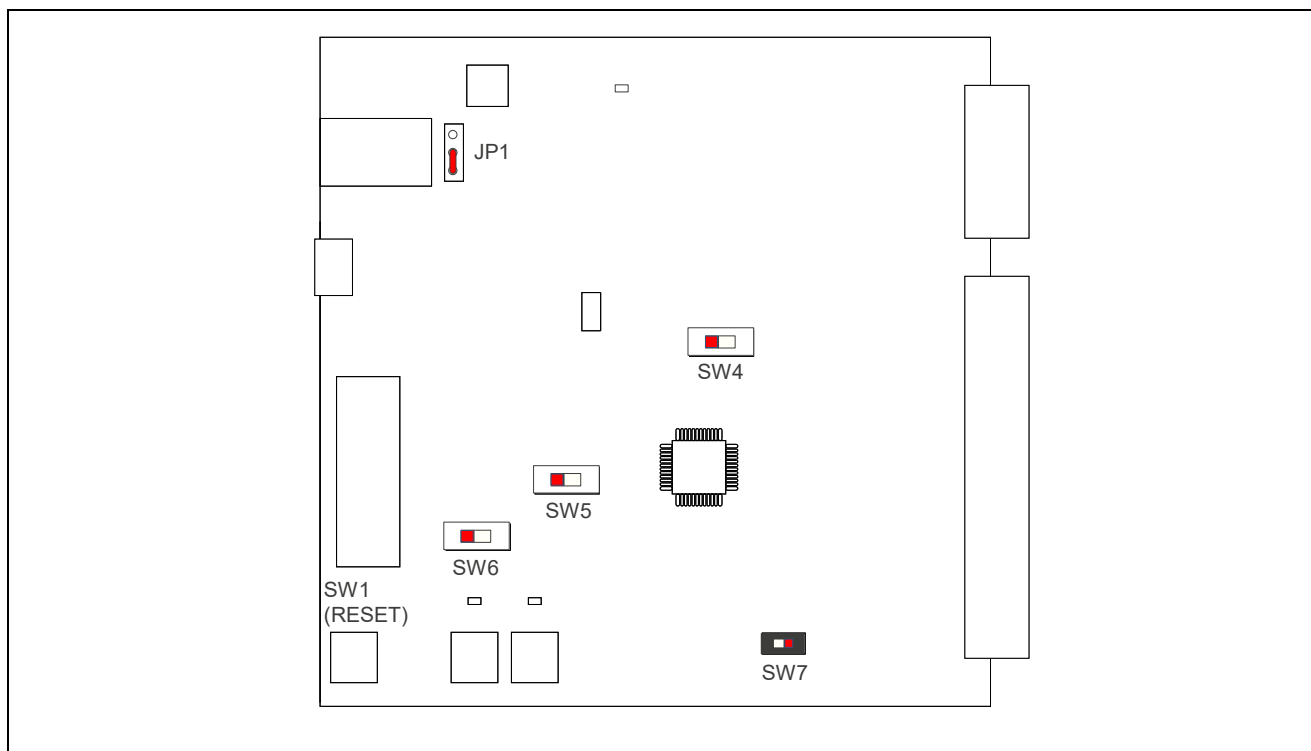


Figure 2-4. Default Jumper Positions

Table 2-1. Default Jumper Settings

Reference	Circuit Group	Default State	Function
JP1	Power supply	Shorted Pin 1-2	Supplies USB power to board USB
SW4	USB Serial Conversion / Application Header (CN2)	OFF	Uses P00/TS26/TxD1 and P01/TS27/RxD1 as serial communication pins.
SW5	Clock Circuit / Application Header (CN1)	OFF	Uses P121/X1 and P122/X2 as GPIO (CN1) pins.
SW6	Push Switch & LED / Application Header (CN1)	OFF	Uses P61 and P62 as GPIO (CN1) pins.
SW7	Capacitive Touch	OFF	Sets TS01 as normal CTSU pin.

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 a 2.1mm center positive DC barrel jack connector.

Table 2-2. Power Source Jumper Settings

Reference	Jumper Setting	Default Setting (X)	Function
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.

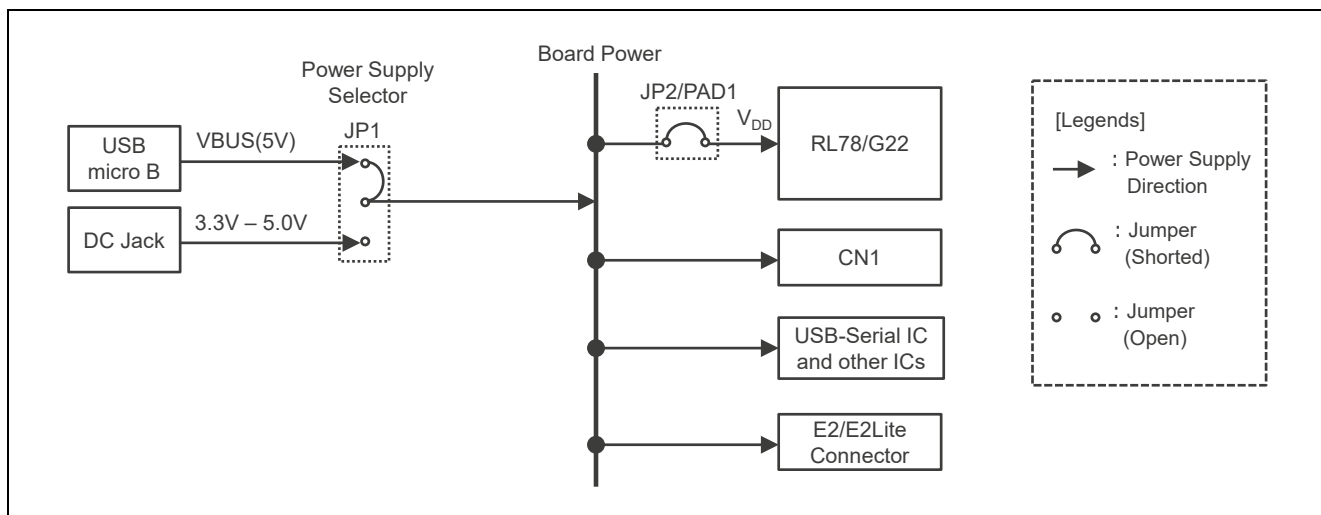


Figure 2-5. Power Source System Diagram

2.3.3 Clock Circuit

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

Table 2-3. Clock Specifications

Clock	Function	Default State	Frequency	Package
X1	Main clock (crystal resonator)	Not mounted	20MHz	HC-49/S
X2	Sub clock	Not mounted	32.768kHz	3.2mm x 2.5mm SMD

Table 2-4 lists the switch specifications for board function selection switch (SW5). P121/X1 and P122/X2 of RL78/G22 are connected to the clock circuit or CN1 by slide switch SW5.

Table 2-4. Switch Specifications for Board Function Selection Switch Setting (SW5)

Reference	Position	Default Setting (X)	Function
SW5	OFF (1-2, 4-5 pin)	X	P121/X1 and P122/X2 are connected to CN1.
	ON (2-3, 5-6 pin)		P121/X1 and P122/X2 are connected to the clock circuit.

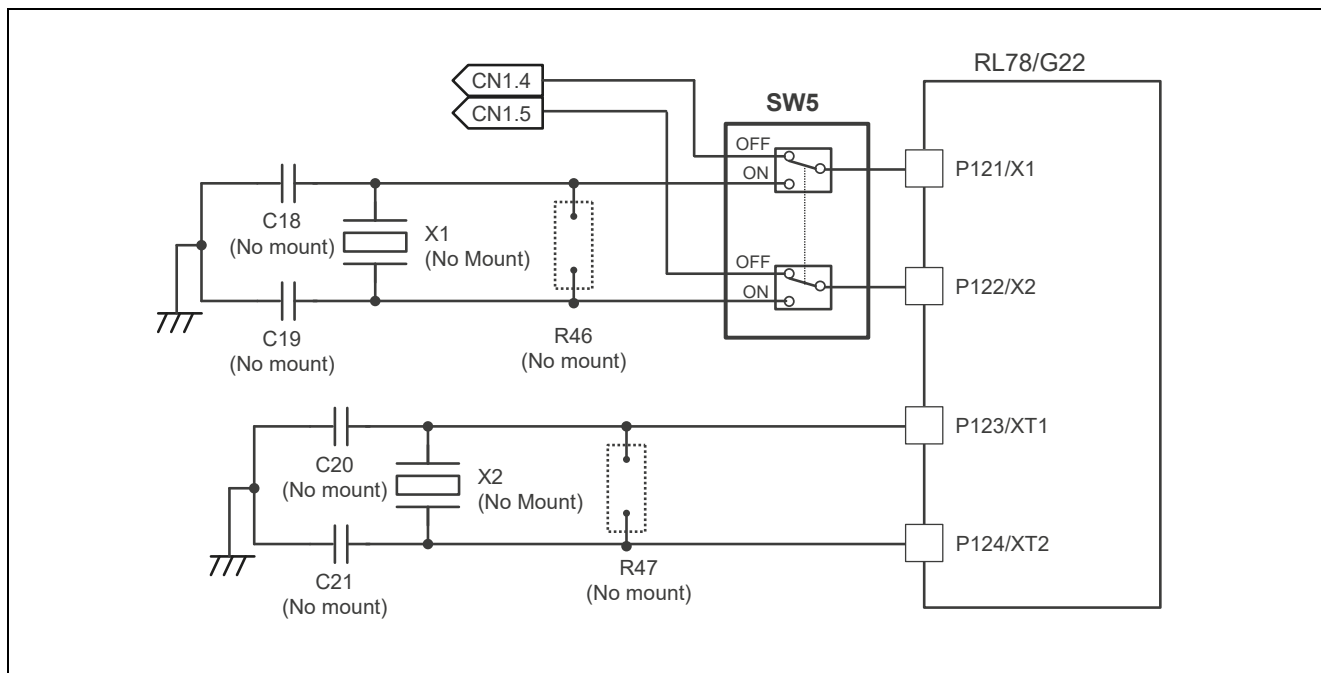


Figure 2-6. Clock Circuit

2.3.4 Reset Circuit

The RL78/G22 CPU Board is equipped with a reset switch (SW1) which generates a reset signal to restart the main MCU.

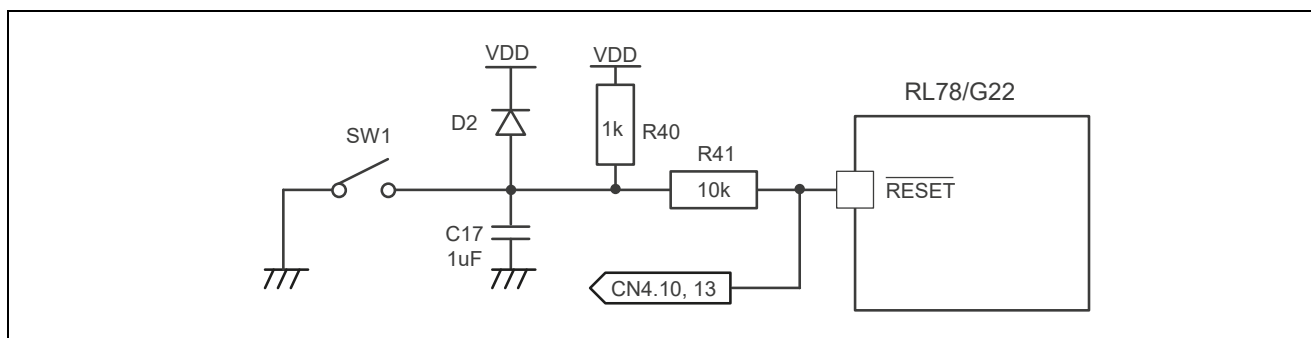


Figure 2-7. Reset Circuit

2.3.5 Push Switch & LEDs

Table 2-5. lists the push switch specifications. Figure 2-8 lists the LED specifications.

Table 2-5. Push Switch Specifications

Reference	MCU Control Port	Function
SW1 (Reset)	RES#	Resets the MCU.
SW2	P62	User controllable switch.
SW3	P60	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	P63	User LED	Yellow

Table 2-7 lists the switch specifications for board function selection switch (SW6). P61 and P62 of RL78/G22 are connected to the push switch and LED or CN1 by slide switch SW6.

Table 2-7. Switch Specifications for Board Function Selection Switch (SW6)

Reference	Position	Default Setting (X)	Function
SW6	OFF (1-2, 4-5 pin)	X	P61 and P62 are connected to LED2 (P61) and SW2 (P62).
	ON (2-3, 5-6 pin)		P61 and P62 are connected to CN1 (GPIO).

Figure 2-8 shows the push switch and LED circuit

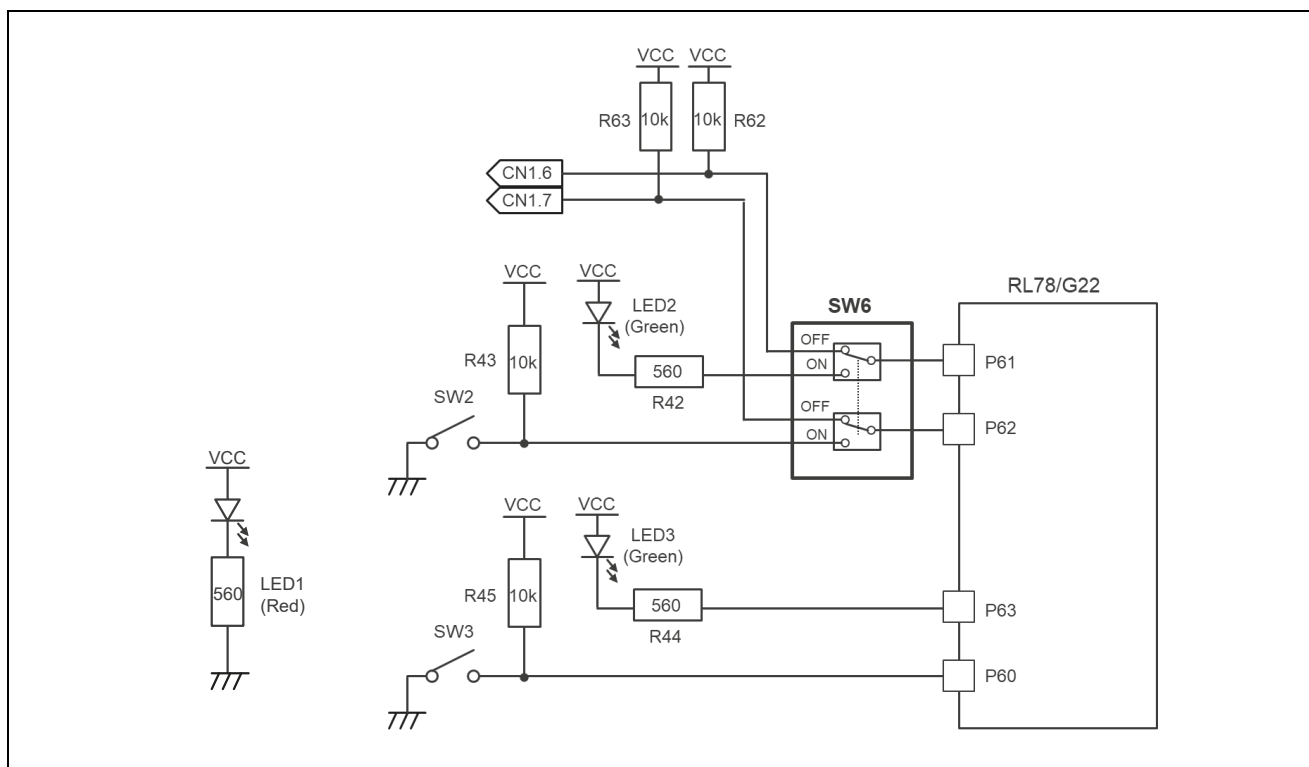


Figure 2-8. Push Switch and LED Circuit

2.3.6 USB Serial Conversion

Table 2-8 lists connections for USB serial IC and MCU controller. The RL78/G22 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/G22's Serial Array Unit (SAU) module.

Table 2-8 USB Serial Conversion

Signal Name	MCU Control Port	Function
TXD1	P00/TS26/TxD1	SAU transmit data signal
RXD1	P01/TS27/RxD1	SAU receive data signal

Table 2-9 lists the switch specifications for board function selection switch (SW4). P00/TS26/TxD1 and P01/TS27/RxD1 of RL78/G22 are connected to USB-serial conversion or TS pins by slide switch SW4.

Table 2-9. Switch Specifications for Board Function Selection Switch (SW4)

Reference	Position	Default Setting (X)	Function
SW4	OFF (1-2, 4-5 pin)	X	P00/TS26/TxD1 and P01/TS27/RxD1 are connected to USB-Serial conversion. TS26 and TS27 of CN2 cannot be used.
	ON (2-3, 5-6 pin)		P00/TS26/TxD1 and P01/TS27/RxD1 are connected to CN2 (TS26 and TS27). USB-Serial communication cannot be used.

Figure 2-9 shows the board function selection switch circuit (SW4)

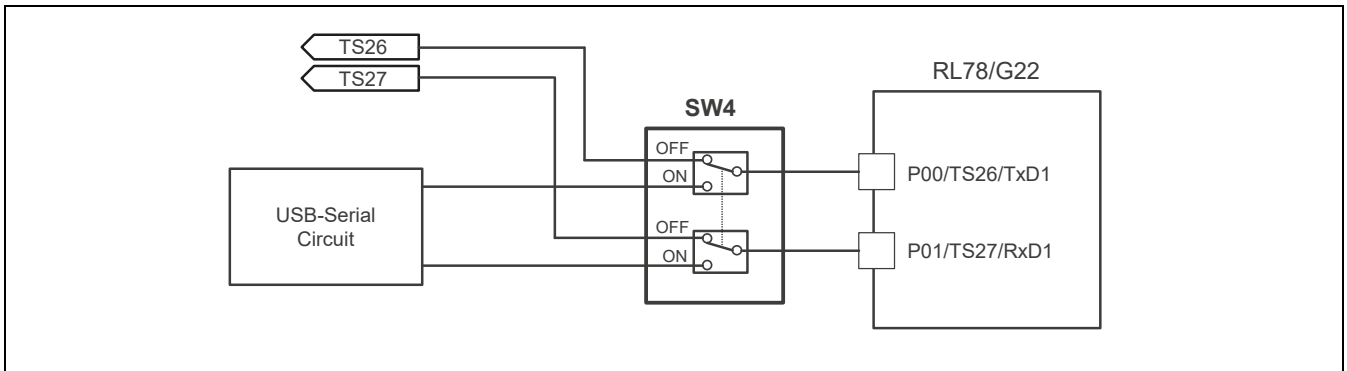


Figure 2-9. Board Function Selection Switch Circuit (SW4)

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 2-10. Application Header (CN1)

CN1			MCU			CN1			MCU		
Pin	Port	Peripheral	Pin	Port	Peripheral	Pin	Port	Peripheral	Pin	Port	Peripheral
16	VSS (GND)		15	VCC							
14	P21		13	P20							
12	P120		11	P41							
10	P27 (Note1)	TS25	9	P147 (Note1)	TS10						
8	P146 (Note1)	TS09	7	P62 (Note2)							
6	P61 (Note2)		5	P122 (Note3)	X2						
4	P121 (Note3)	X1	3	P22 (Note1)	TS20						
2	P24 (Note1)	TS22	1	P25 (Note1)	TS23						

Note1 : Not connected by board default. Can be used by connecting a resistor. See Figure 2-10 for details.

Note2 : Not connected by board default. Can be switched by SW6. See "2.3.5 Push Switch & LEDs" section for details.

Note3 : Not connected by board default. Can be switched by SW6. See "2.3.3 Clock Circuit" section for details.

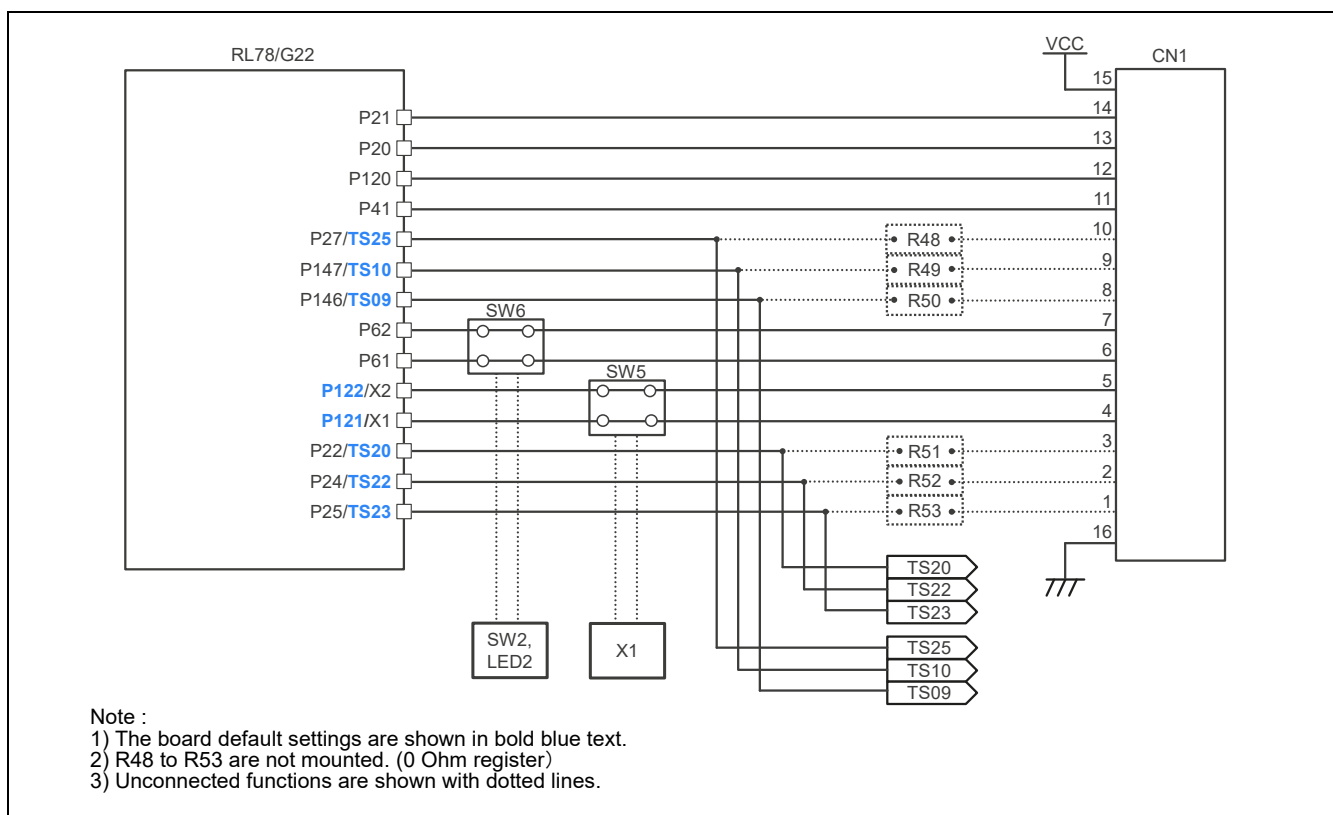


Figure 2-10. CN1 Circuit Diagram

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

Table 2-11. Application Header (CN2)

CN2			MCU			CN2			MCU		
Pin	Port	CTSU	Pin	Port	CTSU	Pin	Port	CTSU	Pin	Port	CTSU
40	P30	TSCAP	39	—	—	39	—	—	39	—	—
38	—	—	37	—	—	37	—	—	37	—	—
36	P140	TS08	35	P00/TxD1	TS26 (Note)	35	P00/TxD1	TS26 (Note)	35	P00/TxD1	TS26 (Note)
34	P130	TS19	33	P01/RxD1	TS27 (Note)	33	P01/RxD1	TS27 (Note)	33	P01/RxD1	TS27 (Note)
32	P22	TS20	31	P23	TS21	31	P23	TS21	31	P23	TS21
30	P24	TS22	29	P25	TS23	29	P25	TS23	29	P25	TS23
28	P26	TS24	27	VSS (GND)	—	27	VSS (GND)	—	27	VSS (GND)	—
26	VSS (GND)	—	25	P27	TS25	25	P27	TS25	25	P27	TS25
24	P147	TS10	23	P146	TS09	23	P146	TS09	23	P146	TS09
22	P10	TS11	21	P11	TS12	21	P11	TS12	21	P11	TS12
20	P12	TS13	19	P13	TS14	19	P13	TS14	19	P13	TS14
18	P14	TS15	17	P15	TS16	17	P15	TS16	17	P15	TS16
16	P16	TS17	15	VSS (GND)	—	15	VSS (GND)	—	15	VSS (GND)	—
14	VSS (GND)	—	13	VSS (GND)	—	13	VSS (GND)	—	13	VSS (GND)	—
12	VSS (GND)	—	11	VSS (GND)	—	11	VSS (GND)	—	11	VSS (GND)	—
10	P17	TS18	9	P51	TS28	9	P51	TS28	9	P51	TS28
8	P50	TS00	7	P70	TS02	7	P70	TS02	7	P70	TS02
6	P71	TS03	5	P72	TS04	5	P72	TS04	5	P72	TS04
4	P73	TS05	3	P74	TS06	3	P74	TS06	3	P74	TS06
2	P75	TS07	1	P31	TS01	1	P31	TS01	1	P31	TS01

— : Not Applicable

Note :Not connected by board default. Can be switched by SW6. See “2.3.6 USB Serial Conversion” section for details.

2.3.9 CTSU Related Circuits

2.3.9.1 CTSU correction circuit

This circuit improves the absolute accuracy of the CTSU's capacitive measurement. This function requires the use of additional control software (sold separately). When using the CTSU pin in normal conditions make sure you it set to the OFF position.

Table 2-12. CTSU Correction Circuit Settings

Reference	Position	Default Setting (X)	Function
SW7	OFF (2-3 pin)	X	Uses TS01 as the normal CTSU pin.
	ON (1-2 pin)		Uses TS01 as the CTSU correction pin.

3. Application Board (Self-Capacitance Electrode Board)

3.1 Board Layout

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

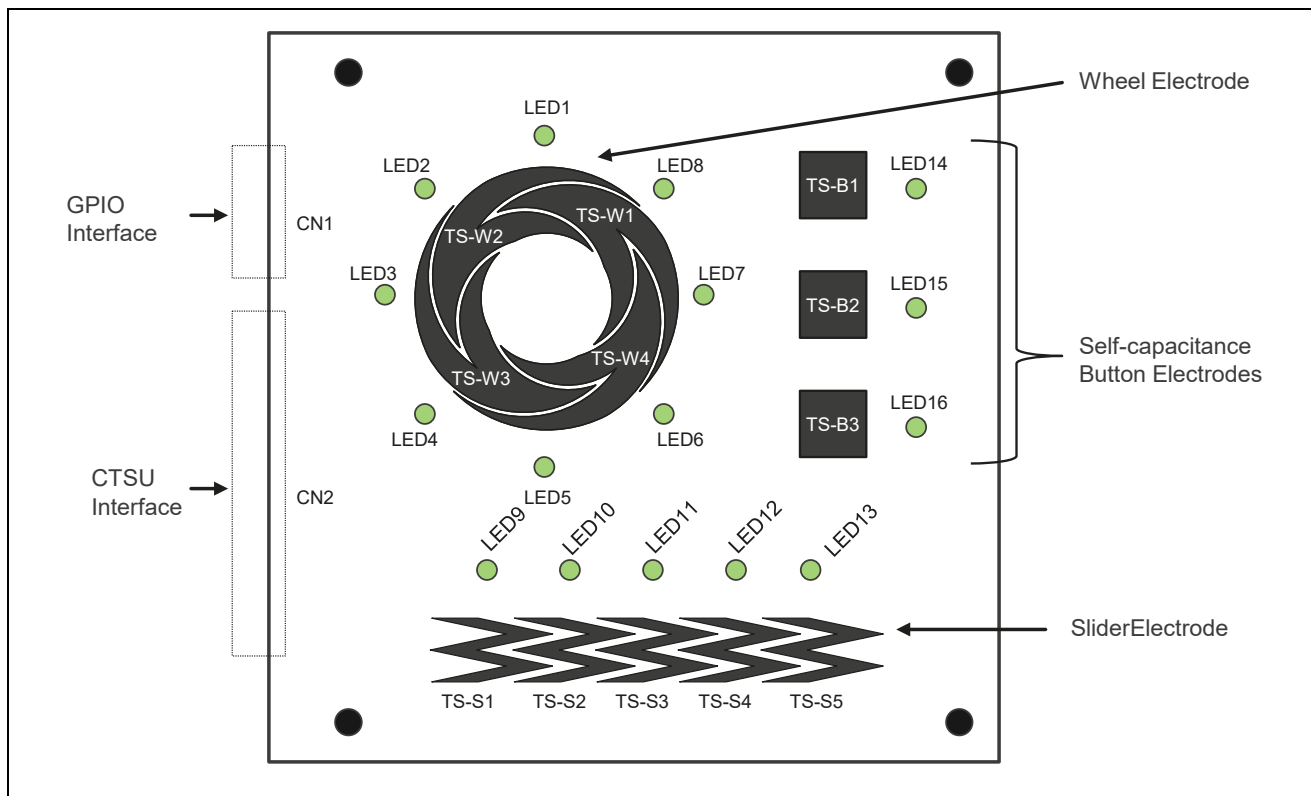


Figure 3-1. Board Layout and TS Pin Assignments

3.2 Application Headers

Application headers CN1 and CN2 are the interface for connection to the Renesas Capacitive Touch Evaluation System CPU board. Table 2-10 lists the pin assignments for CN1. Table 2-11 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	P20	14	LED_ROW1	P21
11	LED_ROW2	P41	12	LED_ROW3	P120
9	—	—	10	—	—
7	LED_COL3	P62	8	—	—
5	LED_COL1	P122	6	LED_COL2	P61
3	—	—	4	LED_COL0	P121
1	—	—	2	—	—

— : Not Applicable

Table 3-2. Application Header (CN2)

Pin	Touch Electrode	CTSUS (RL78/G22) (Note1)	Pin	Touch Electrode	CTSUS (RL78/G22) (Note1)
39	—	—	40	—	TSCAP
37	—	—	38	—	—
35	—	—	36	TS-W1	TS08
33	—	—	34	TS-W2	TS19
31	TS-W3	TS21	32	—	—
29	—	—	30	—	—
27	—	—	28	TS-W4	TS24
25	—	—	26	—	—
23	—	—	24	—	—
21	—	—	22	SHIELD-W1	TS11 (Note2)
19	—	—	20	—	—
17	—	—	18	—	—
15	—	—	16	—	—
13	—	—	14	—	—
11	—	—	12	—	—
9	TS-B1	TS28	10	TS-B2	TS18
7	SHIELD-B1	TS02 (Note2)	8	TS-B3	TS00
5	TS-S1	TS04	6	SHIELD-S1	TS03 (Note2)
3	TS-S3	TS06	4	TS-S2	TS05
1	TS-S5	TS01	2	TS-S4	TS07

— : 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 shield signal output mode by software.

4. Reference Materials

- [1]. Renesas RL78/G22 User's Manual: Hardware (01UH0978)
- [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/G22 User's Manual Hardware Version for more information on RL78/G22 MCUs.

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

Trademarks

All trade names and product names used in this document are trademarks or registered trademarks of their respective companies or organizations.

Copyright

All or part of this manual may be changed without notice.

Renesas Electronics Corporation holds the copyright for this document.

Reproduction, in whole or in part, without the written consent of Renesas Electronics Corporation is prohibited.

© 2022 Renesas Electronics Corporation.

Appendix: Self-Capacitance Touch Electrode Board Connection

The following describes how to use the Renesas Self-Capacitance Touch Electrode Board (RTK0EG0019B01002BJ).

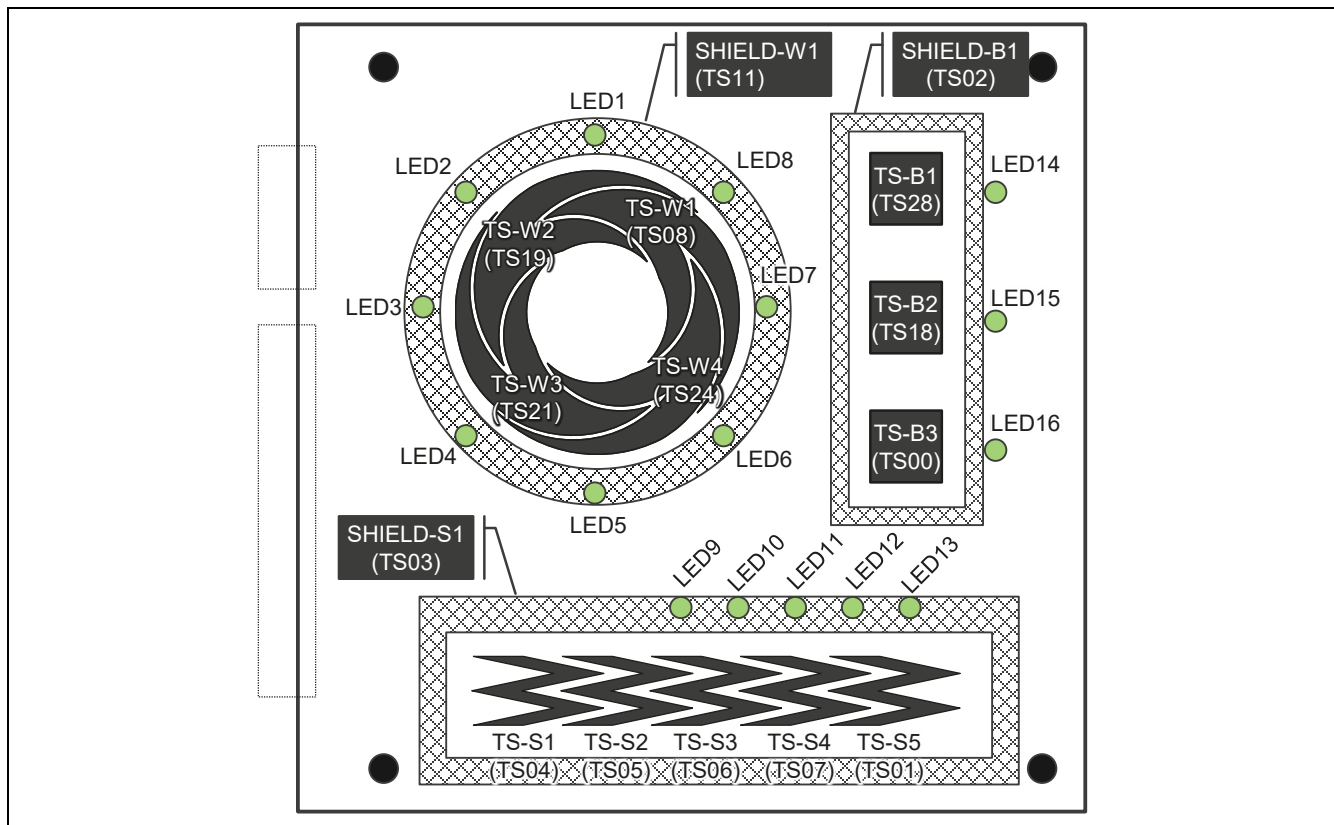


Figure 1. Board Layout and TS Pin Assignments

Table 1. TS Pin (CN2) Assignments

Touch Electrode	CTSU (RL78/G22)	Description
TS-W1	TS08	Wheel Electrode
TS-W2	TS19	
TS-W3	TS21	
TS-W4	TS24	
SHIELD-W1	TS11 (Note)	Wheel Shield Electrode
TS-B1	TS28	Button Electrode
TS-B2	TS18	
TS-B3	TS00	
SHIELD-B1	TS02 (Note)	Button Shield Electrode
TS-S1	TS04	Slider Electrode
TS-S2	TS05	
TS-S3	TS06	
TS-S4	TS07	
TS-S5	TS01	
SHIELD-S1	TS03 (Note)	Slider Shield Electrode

Note: Set the pin to shield signal output mode by software

Table 2. TS Pin (CN2) Assignments

Signal	RL78/G22 Port	Description
LED_ROW0	P20	LED Matrix, High Side Transistor Drive
LED_ROW1	P21	
LED_ROW2	P41	
LED_ROW3	P120	
LED_COL0	P121	LED Matrix, Low Side Transistor Drive
LED_COL1	P122	
LED_COL2	P61	
LED_COL3	P62	
LED_VCC	VCC	VCC
LED_GND	VSS (GND)	GND

Table 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 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

Revision History	RL78/G22 Capacitive Touch Evaluation System User's Manual
------------------	--

Rev.	Date	Description	
		Page	Summary
1.00	Sep.30.22	—	First Edition issued

RL78/G22 Renesas Solution Starter Kit
Capacitive Touch Evaluation System User's Manual

Publication Date: Rev. 1.00 Sep.30.2022

Published by: Renesas Electronics Corporation

RL78/G22

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

