User's Manual

RX Capacitative Touch Evaluation System

Mutual-Capacitance Matrix Key/Proximity Sensor Board

User's Manual

Renesas Solution Starter Kit
RX Capacitive Touch Evaluation System
Application Board

Renesas Electronics
www.renesas.com

Rev.1.00 Feb 2016

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 of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
3. Renesas Electronics does not assume any liability for infringement of 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. 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 should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
5. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The recommended 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; and industrial robots etc.

   “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc.

   Renesas Electronics products are neither intended nor 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 damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, 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, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technology may 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 should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

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. 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with a general understanding of the Capacitive Touch Application Board and its electrical characteristics. It is intended for users designing sample code on the RSSK platform, using the many different incorporated peripheral devices.

The manual includes an overview of the Capacitive Touch Application Board functions, but does not serve as a guide for embedded programming or hardware design. 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.

The following documents apply to the Capacitive Touch Application Board included in the Renesas Capacitive Touch Evaluation System. Make sure to refer to the latest versions of these documents. The latest versions of all documents are available for download from the Renesas Electronics website.

Document Type	Description	Document Title	Document No.
User's manual	Description of application board hardware specifications	RX Capacitive Touch Evaluation System: Mutual-Capacitance Button/Proximity Sensor Board User's Manual	This User's Manual

2. List of Abbreviations and Acronyms

Abbreviation	Full Form
ACIA	Asynchronous Communications Interface Adapter
bps	bits per second
CRC	Cyclic Redundancy Check
DMA	Direct Memory Access
DMAC	Direct Memory Access Controller
GSM	Global System for Mobile Communications
Hi-Z	High Impedance
IEBus	Inter Equipment Bus
I/O	Input/Output
IrDA	Infrared Data Association
LSB	Least Significant Bit
MSB	Most Significant Bit
NC	Non-Connect
PLL	Phase Locked Loop
PWM	Pulse Width Modulation
SFR	Special Function Register
SIM	Subscriber Identity Module
UART	Universal Asynchronous Receiver/Transmitter
VCO	Voltage Controlled Oscillator

Table of Contents

1. Overview

1.1 Purpose

This product was developed for use with a CPU board as an evaluation tool for the Renesas RX Capacitive Touch Evaluation System.

1.2 Features

This application board offers the following features:

- Connectable to the CPU board included in the Renesas RX Capacitive Touch Evaluation System
- Same interface as the CPU board included in Renesas RX Capacitive Touch Evaluation System
- Evaluation for two methods of touch detection:
  - Mutual-Capacitance method: 20 channels for touch buttons
  - Self-Capacitance method: 1 channel for proximity sensor (film type)
- 3-mm thick acrylic overlay (attached)

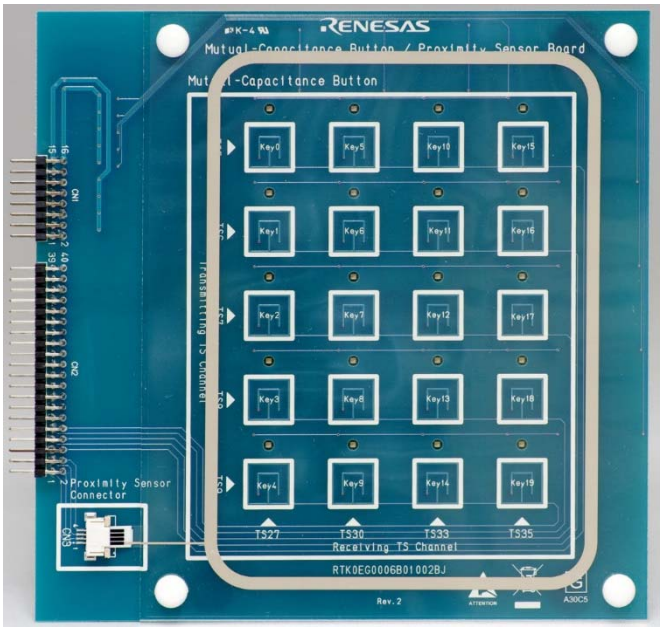


Figure 1.1 Application Board External Dimensions

2. Board Layout

2.1 Component Layout

Figure2.1 shows the component layout of the application board.

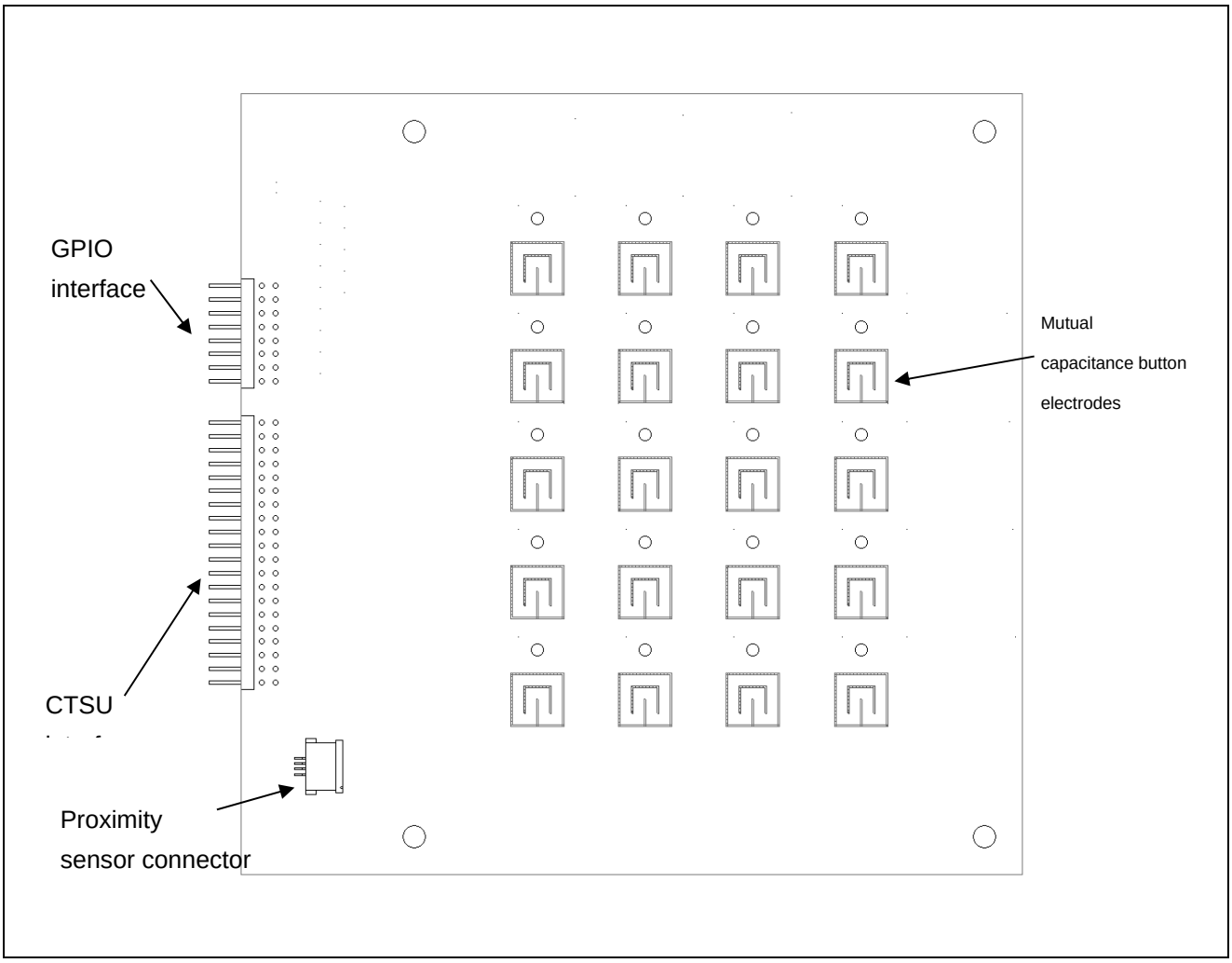


Figure2.1 Component Layout

2.2 Overlay Dimensions

Figure2.2 shows the dimensions of the overlay attached to the application board. Dimensions are shown in millimeters. Overlay thickness is 3.0 mm.

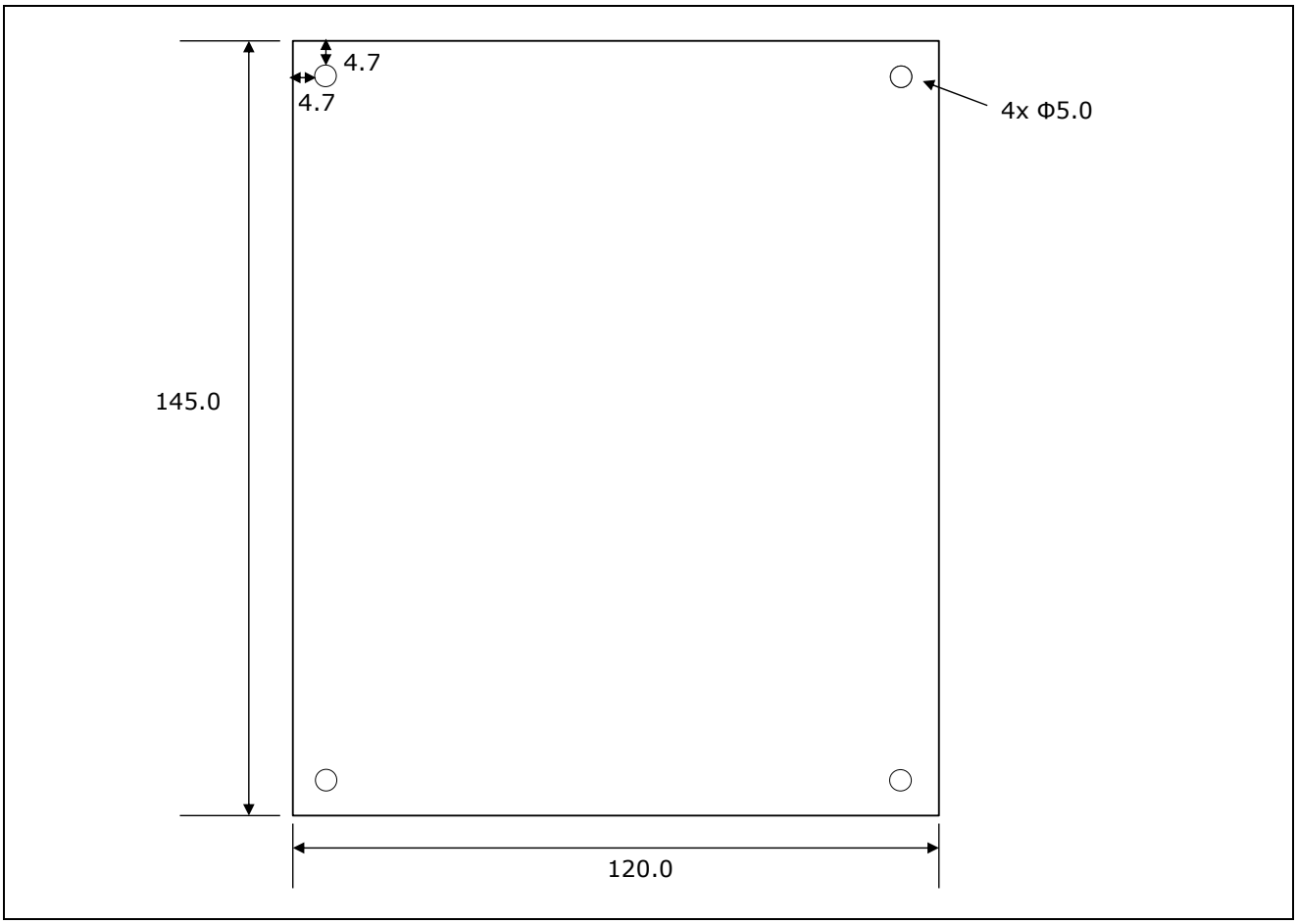


Figure2.2 Overlay Dimensions

2.3 Proximity Sensor Dimensions

Figure2.3 shows the film base dimensions of the proximity sensor and Figure2.4 shows the dimensions of the proximity sensor electrode area. Dimensions are shown in millimeters.

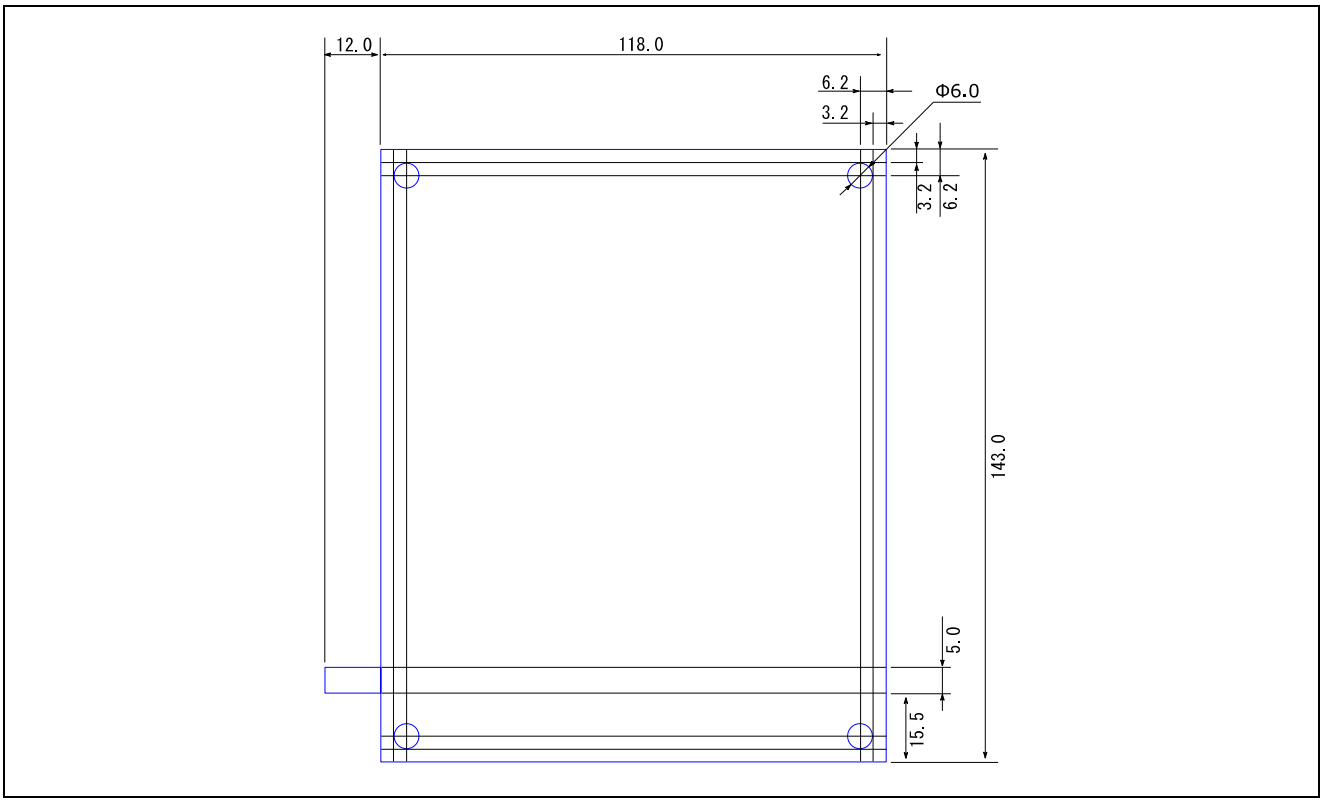


Figure2.3 Film Base Dimensions

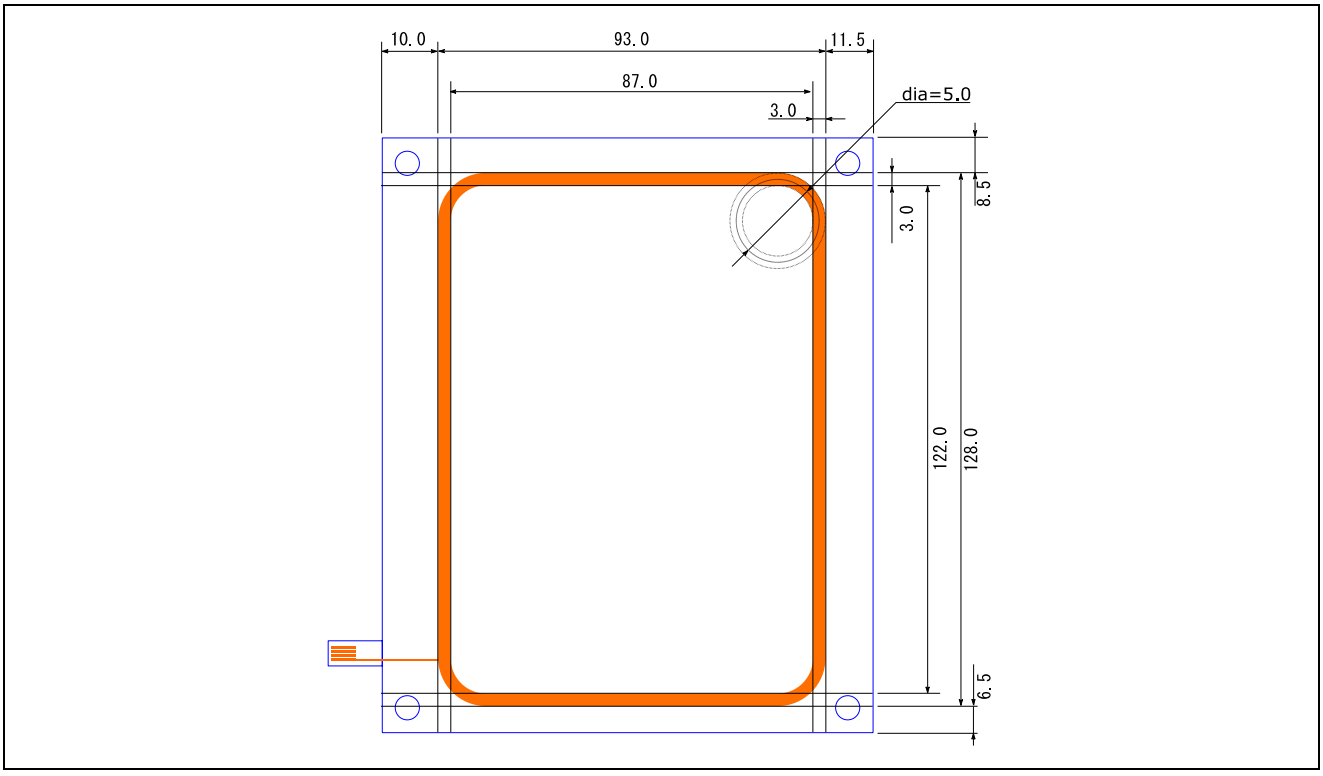


Figure2.4 Proximity Sensor Electrode Area Dimensions

2.4 Component Placement

Figure2.5 and Figure2.6 show the placement of individual components on the application board.

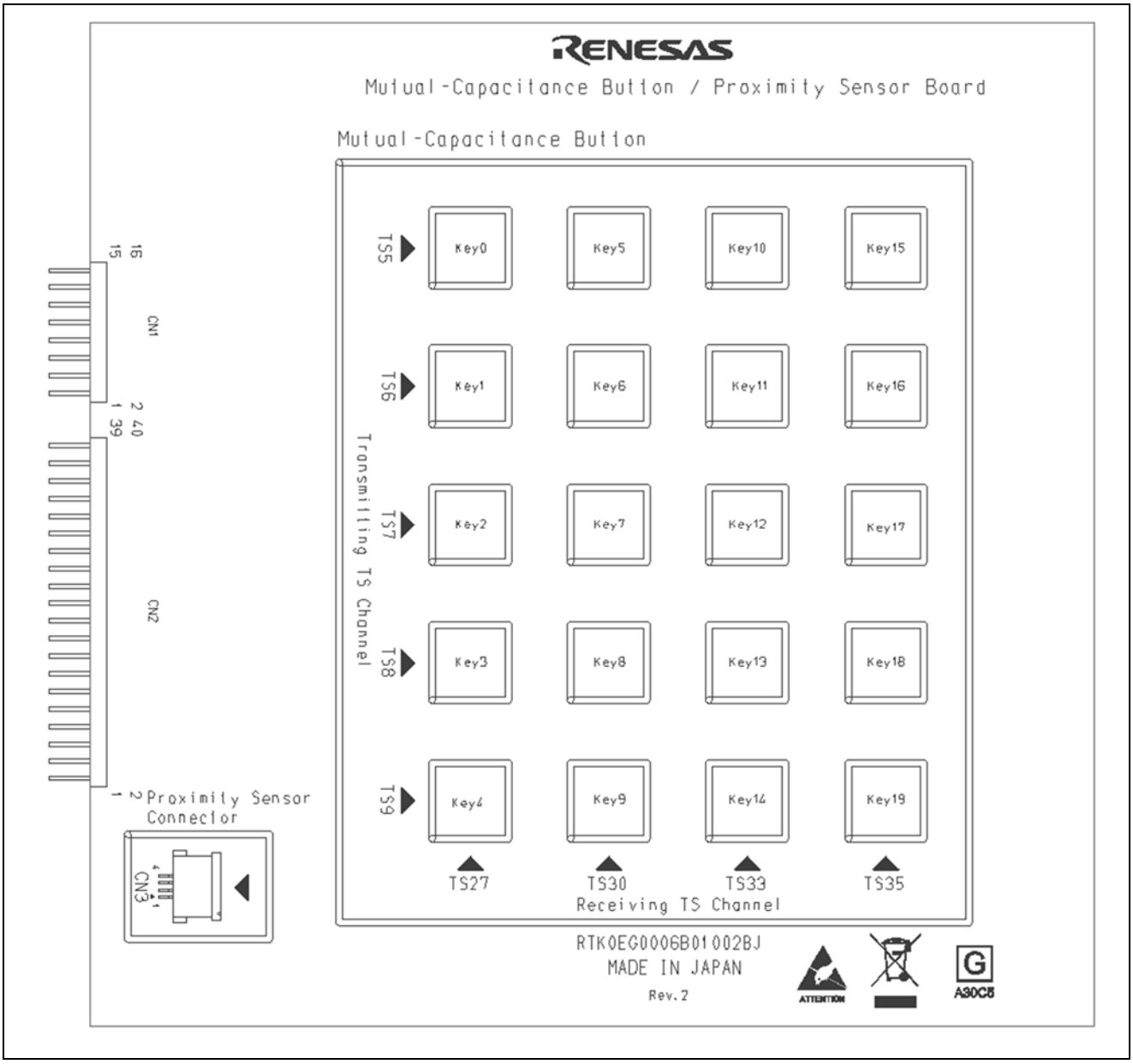


Figure2.5 Application Board Component Placement (top/component side)

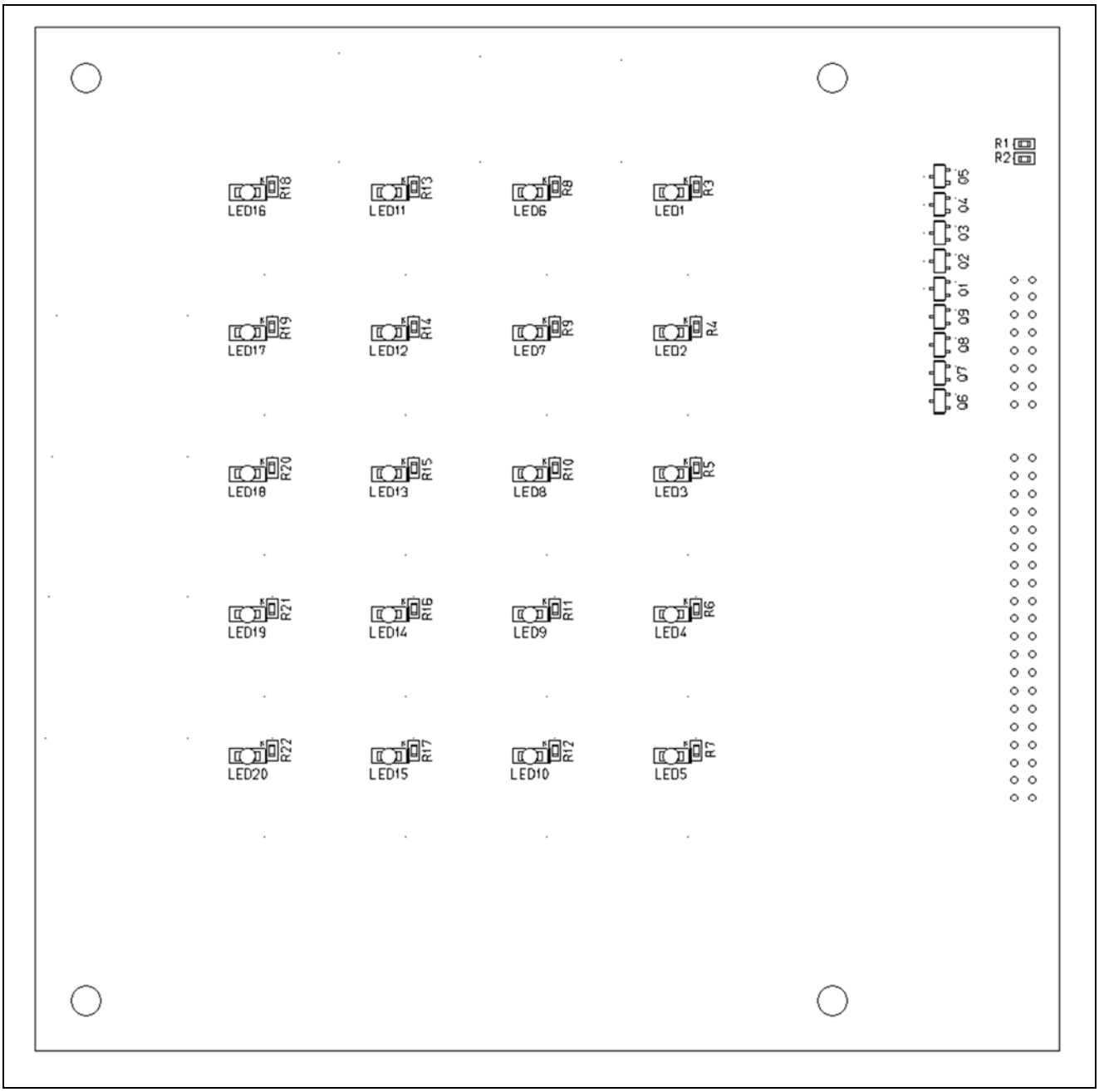


Figure2.6 Application Board Component Placement (bottom/soldered side)

3. Board Attachment & Specifications

3.1 Board Connection Configuration

Insert headers CN1 and CN2 on the application board into the corresponding CN1 and CN2 sockets on the CPU board. Make sure both headers are inserted to match the direction and number of pins on the corresponding connectors and that the pins are fully inserted into the sockets.

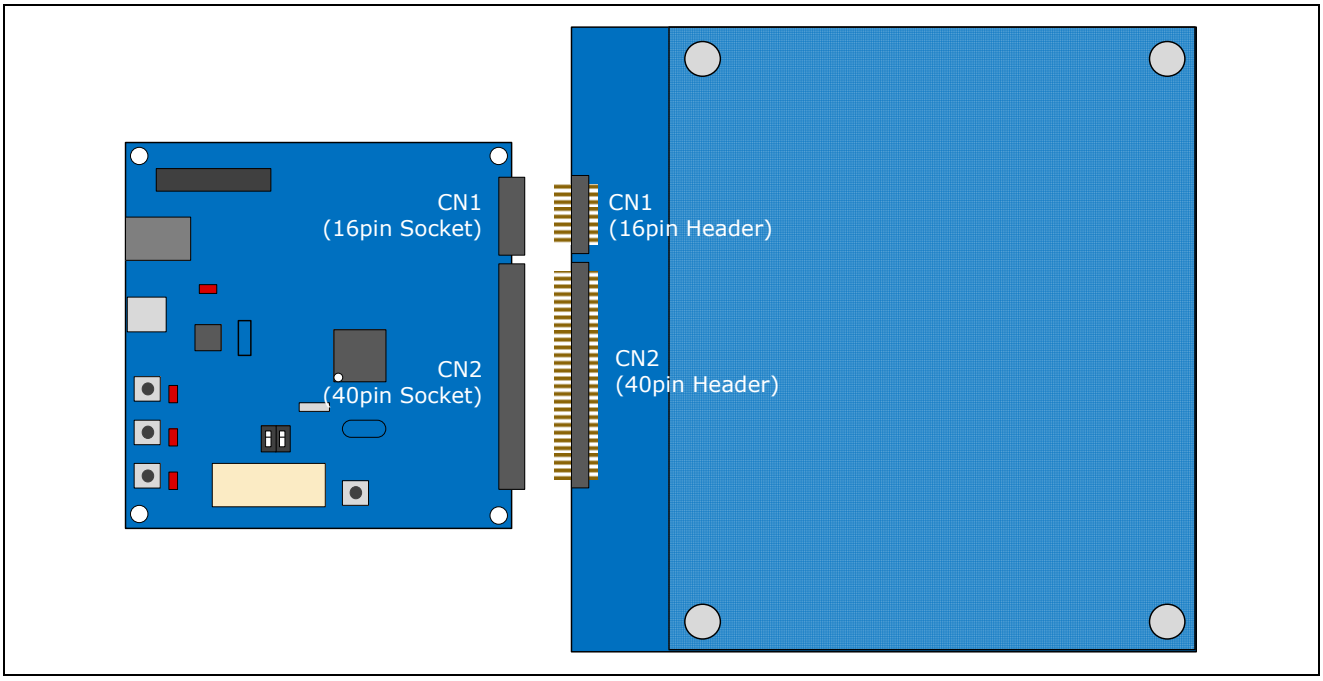


Figure3.1 Board Connection Direction

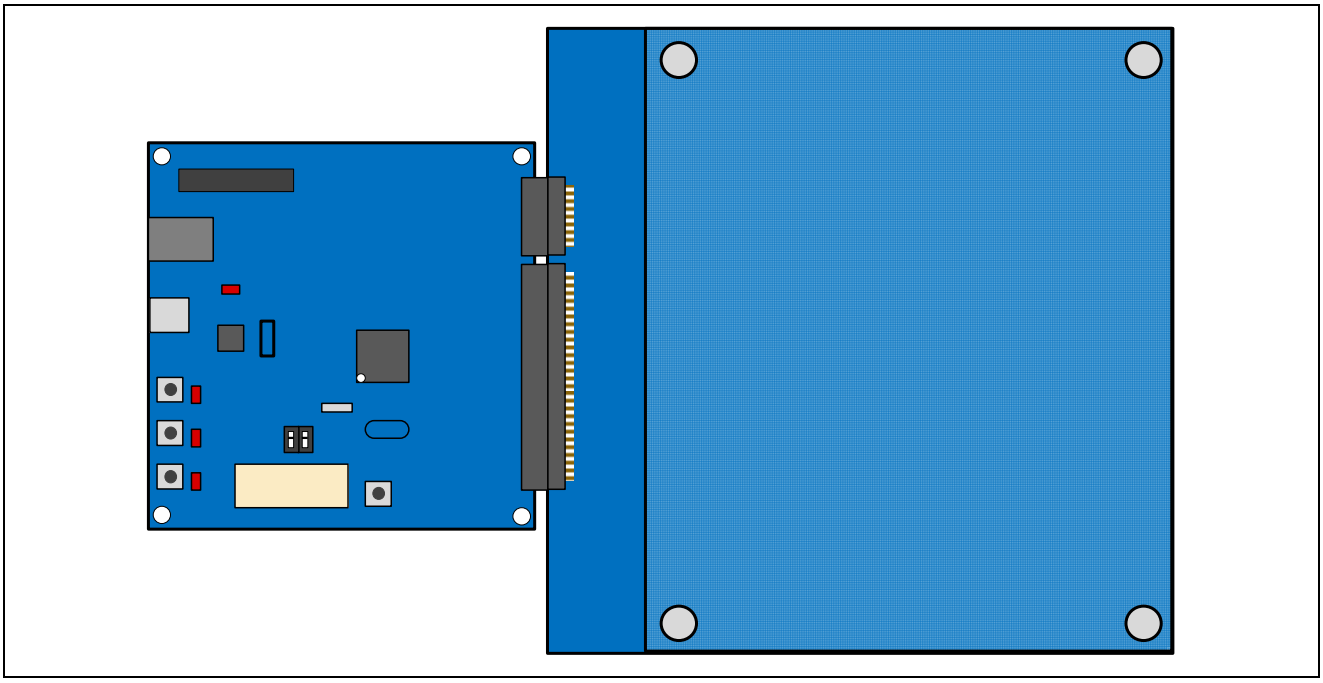


Figure3.2 Connected Boards

3.2 Mutual-Capacitance Button Specification

The user can configure up to 20 channels for mutual-capacitance buttons on the application board. To use the mutual-capacitance buttons, first set the capacitive touch sensor pins connected to electrodes to mutual-capacitance mode, and then set the transmit/receive pins. The mutual-capacitance electrodes are pre-determined for transmit or receive. Confirm the names of the application board circuit nets and the names of the MCU's connection pins, and set the appropriate pin functions by software. For details concerning how to set pins, please refer to the corresponding MCU user's manual. Table3.1 shows the application board circuit net names and transmit/receive pin assignments.

Table3.1 Application Board Circuit Net Names and Transmit/Receive Pin Assignments

Application Board Circuit Net Name	Capacitive Touch Sensor Pin Function	Application Board Circuit Net Name	Capacitive Touch Sensor Pin Function
TS5	Transmission	TS27	Reception
TS6		TS30	
TS7		TS33	
TS8		TS35	
TS9			

3.3 Proximity Sensor Connector

Table3.2 shows the specifications for the proximity sensor connection pins (CN3). To use the proximity sensor, set the capacitive touch sensor pins connected to electrodes to self-capacitance mode. Confirm the names of the application board circuit nets and the names of the MCU's connection pins, and set the appropriate pin functions by software.

Table3.2 Proximity Sensor Connection Pin (CN3) Specifications

CN3 Pin	Circuit Net Name	Proximity Sensor Pin Function
1	TS0	Connect to electrode
2	TS1	Not connected
3	TS2	Not connected
4	TS3	Not connected

3.4 LEDs

There are 20 LEDs on the application board, connected in a 4 x 5 matrix.

4. Headers

Header names (circuit net names) differ for the application board and the CPU board. This section provides details on all headers; the following information can serve as verification tables when using the extension board function.

4.1 GPIO Interface

Table4.1 Application Headers (CN1)

Pin	Header Name	Pin	Header Name
1	LED0	2	LED1
3	LED2	4	LED3
5	-	6	-
7	LED6	8	LED7
9	LED8	10	LED9
11	LED10	12	-
13	-	14	ADC
15	VCC_LED	16	VSS_GND

- : Non Connection

4.2 CTSU Interface

Table4.2 Application Headers (CN2)

Pin	Header Name	Pin	Header Name
1	TS0	2	TS1
3	TS2	4	TS3
5	-	6	TS5
7	TS6	8	TS7
9	TS8	10	TS9
11	-	12	-
13	-	14	-
15	-	16	-
17	-	18	-
19	-	20	-
21	-	22	-
23	-	24	-
25	-	26	-
27	-	28	TS27
29	-	30	-
31	TS30	32	-
33	-	34	TS33
35	-	36	TS35
37	-	38	-
39	-	40	-

- : Non Connection

5. Circuit Diagram

The circuit diagram is shown on the Appendix 1.

6. PCB Layout Diagram

The PCB layout diagram is shown on the Appendix 2.

7. Parts List

The parts list is shown on the Appendix 3.

8. Additional Information

Technical Support

For more information about how to use the application board, refer to the Renesas website.

For information about the target microcontroller, refer to the corresponding hardware manual.

For information about Assembler language, refer to the RX Family software manual.

For information about Workbench6, refer to the Workbench6 Capacitive Touch Integrated Development Environment User's Manual.

Online tech support and other information is available at the following website:
http://www.renesas.com/

You can also send technical inquiries to the following email addresses:
csc@renesas.com

General information on Renesas Microcontrollers can be found on the Renesas website at:
http://www.renesas.com/

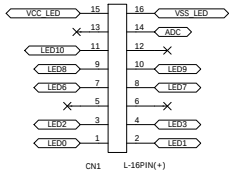
Trademarks

All brand or product names used in this manual are trademarks or registered trademarks of their respective companies or organisations.

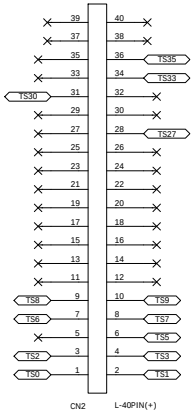
Copyright

Appendix 1.

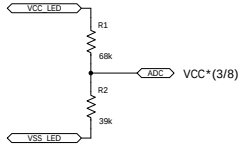
CPU Board Header B



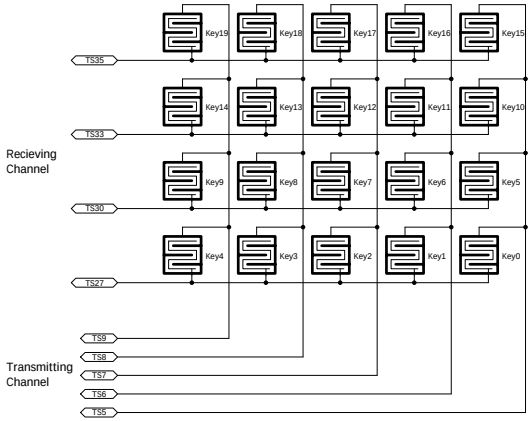
CPU Board Header B



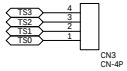
Board ID



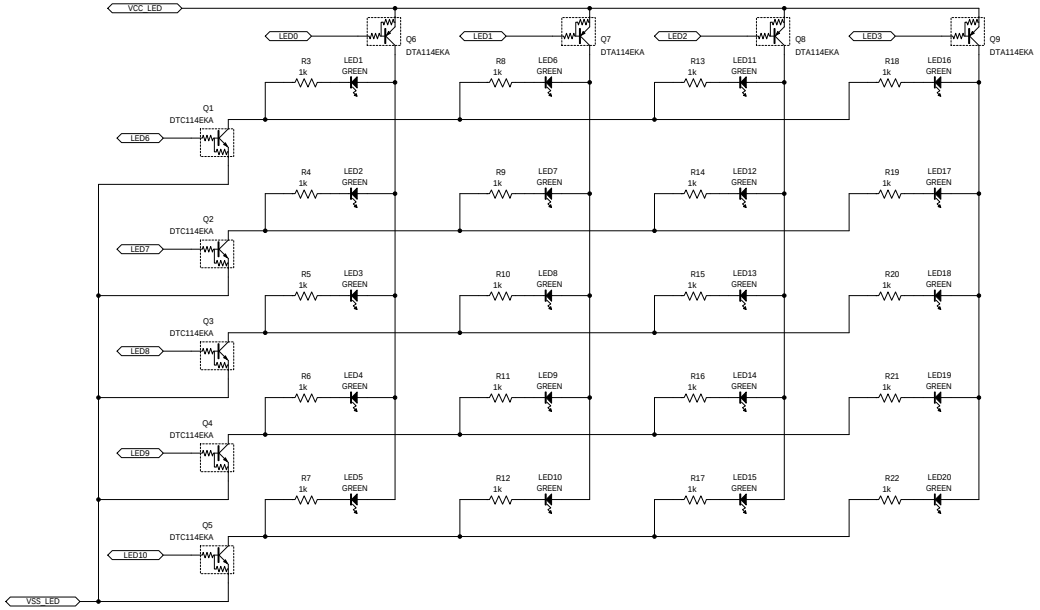
Mutual Capacitance Button



Proximity Sensor Connector

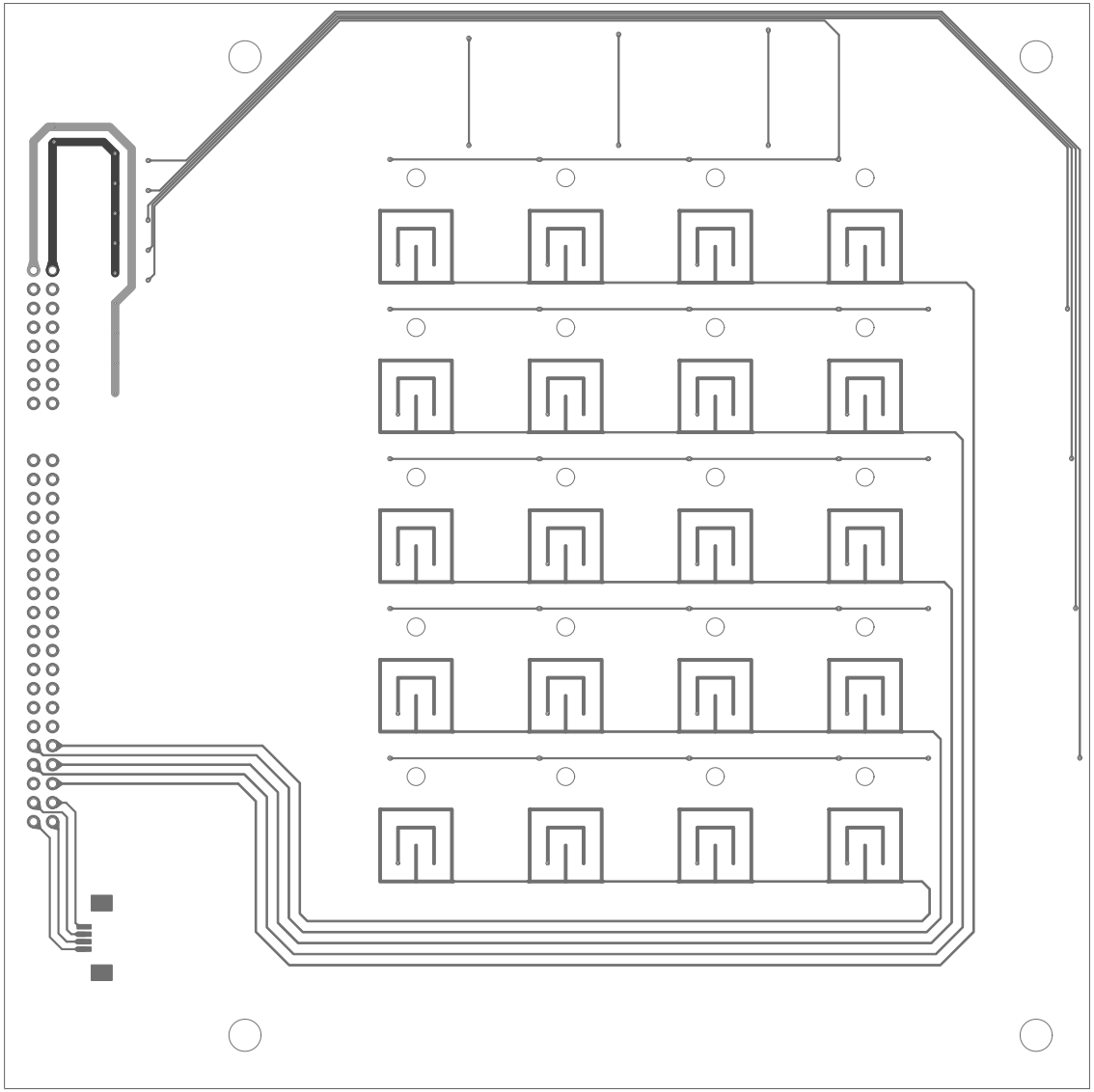


EDs

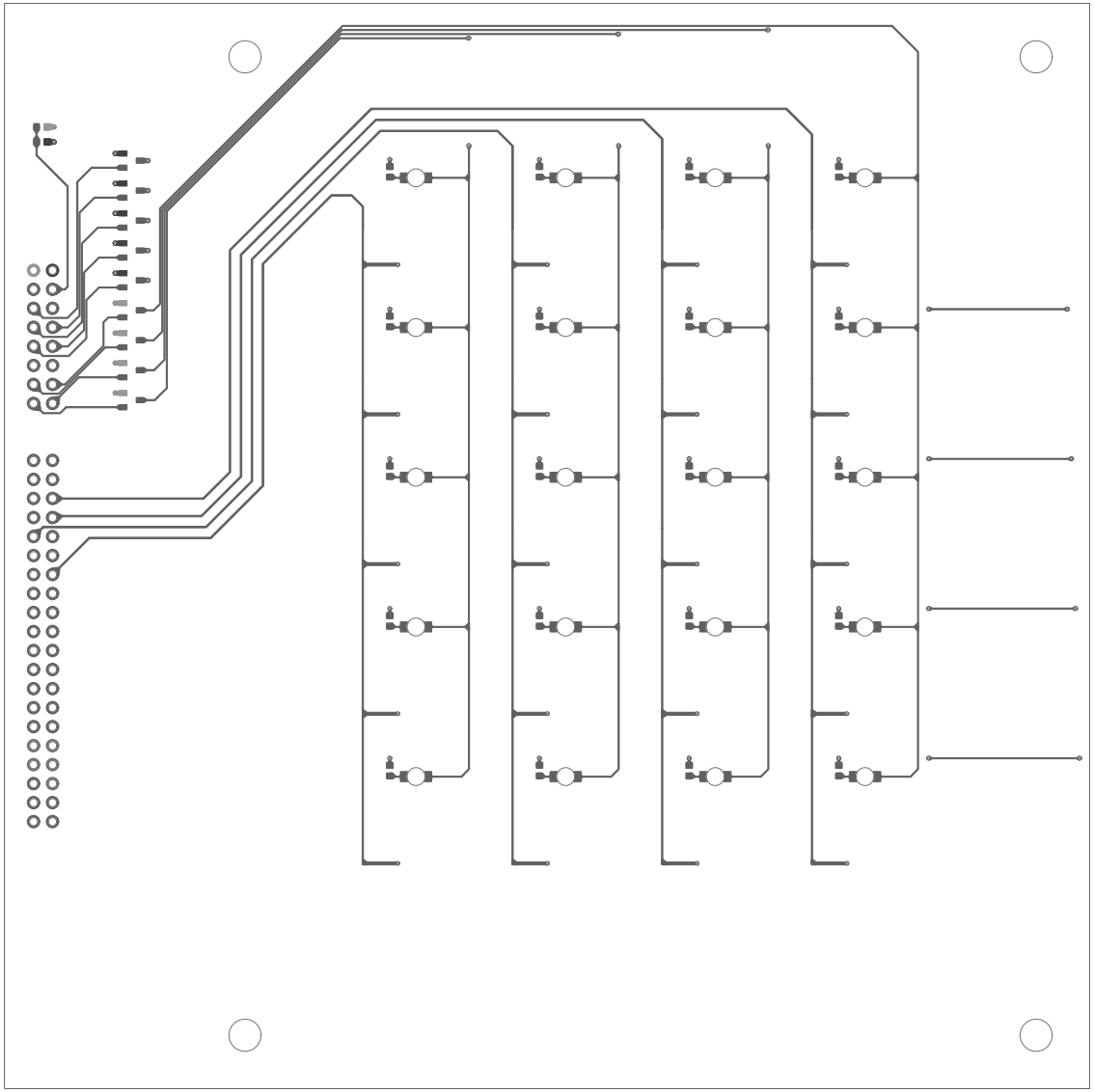


Renesas Electronics Corp.			
Title: Mutual Capacitance Button & Proximity Sensor Board			
Size: A3	Document Number: D-RTK0EG0006B01002BJ-B-C		Rev: C
Date: 07.August.2015		Sheet 1/1	IAAS-AB-15-0208-1

Appendix 2.



PCB Top-side Layout



PCB Bottom-side Layout

Appendix 3.

PartNo	RTK0EG0006B01002BJ	Title	Mutual-Capacitance Matrix Button/Proxmity Sensor Board BOM

No	Component Name		Component Specification			Qty/Set	Remarks
	Type	Reference	Product Number (Specfication)	Manufacture	Mount/Unmount		
1	Right Angle Pin Header	CN1	PSR-420256-08	Hirosugi-Keiki	Mount	1	16-pin(2x8), 2.54mm-pitch
2	Right Angle Pin Header	CN2	PSR-420256-20	Hirosugi-Keiki	Mount	1	40-pin(2x20), 2.54mm-pitch
3	FFC Connector	CN3	052207-0460	Molex	Mount	1	4-pole,1.00mm-pitch Top Contact Type
4	Chip Resistor	R1	MCR03ERTJ683	ROHM	Mount	1	68k
5	Chip Resistor	R2	MCR03ERTJ393	ROHM	Mount	1	39k
6	Chip Resistor	R3-22	MCR03ERTJ102	ROHM	Mount	20	1k
7	LED	LED1-LED20	SML-812MT	ROHM	Mount	20	Green, Reverse-mount available type
8	Transistor	Q1-Q5	DTC114EKA	ROHM	Mount	5	
9	Transistor	Q6-Q9	DTA114EKA	ROHM	Mount	4	
10	Touch Electrode	Key1-20	—	—	Mount	20	
11	PCB		RTK0EG0006B01002BJ REV.A		Mount	1	

Revision History	Mutual-Capacitance Button/Proximity Sensor Board User's Manual

Rev.	Date	Description	
		Page	Summary
1.00	Feb 17, 2016	–	First Edition issued

Mutual-Capacitance Button/Proximity Sensor Board User's Manual

Publication Date: Rev.1.00 Feb 17, 2016

Published by:Renesas Electronics Corporation
3-2-24 Toyosu, Koto Ward, Tokyo, 135-0061, Japan

SALES OFFICES Renesas Electronics Corporation http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HALII Stage, Indiranagar, Bangalore, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

Colophon 4.0

RX Capacitative Touch Evaluation System

Mutual-Capacitance Matrix Key/Proximity Sensor Board User's Manual

Renesas Electronics Corporation

R12UZ0006EJ0100