

RX Capacitive Touch Evaluation System

Self-Capacitance Touch Buttons/Wheels/Slider Board

User's Manual

Renesas Solution Starter Kit

RX Capacitive Touch Evaluation System

Application Board

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

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

1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with 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 newest versions of the documents listed may be obtained from the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
User's manual	Description of application board hardware specifications	RX Capacitive Touch Evaluation System: Self-Capacitance Buttons/Wheels/Slider 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

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Precautions

This Evaluation Kit is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area, or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:

- Ensure attached cables do not lie across the equipment.
- Reorient the receiving antenna.
- Increase the distance between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that which the receiver is connected.
- Power down the equipment when not in use.
- Consult the dealer or an experienced radio/TV technician for help.

Note: It is recommended that wherever possible shielded interface cables are used.

The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken:

- The user is advised that mobile phones should not be used within 10 m of the product when in use.
- The user is advised to take ESD precautions when handling the equipment.

The Evaluation Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

Safety Items

Definitions of Symbols

A variety of symbols are used in this document and on the product itself to prevent in advance danger to you the user or any third parties and to prevent in advance damage to any physical property.

This section, Safety Items, presents these symbols and their meanings. It also presents safety notes to assure that this produce is used safely and correctly.

This product should only be used after fully understanding the material presented in this section.



Warning

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



Caution

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

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

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

A triangular mark  indicates a warning or caution.

Example:



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



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>".

Electromagnetic Environment



Electromagnetic Environment



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

EMI: Electro Magnetic Interference

Standard		Level	Guidance for EMC protection
Test Item	EN 55011	Group1 Class A	This product has no intentional external emissions, but internal RF emissions may affect nearby electromagnetically sensitive electronic equipment.
Radiated Emissions	:2009+A1:2010		

EMS: Electro Magnetic Susceptibility

Standard		Level	Guidance for EMC protection
Electrostatic Discharge	EN 61000-4-2:2009	B ^{*1}	This product is intended for use in electromagnetic environments in industrial settings. The user of the product should pay particular attention to the following electromagnetic immunity. <ul style="list-style-type: none">• Power supply quality• Protection against static electricity• Protection against external high-power radio waves• Protection against external magnetic fields
Radio Frequency Electromagnetic Field	EN 61000-4-3:2006+A1:2008+A2:2010	A ^{*2}	

*1 Test Condition of Electrostatic Discharge

Discharge Method		Test Voltage	Result
Indirect Discharge	VCP	±4.0kV	Pass
	HCP	±4.0kV	Pass
Direct Discharge	Contact Discharge	±4.0kV	Pass
	Air Discharge	±2.0kV	Pass
		±4.0kV	Pass
		±8.0kV	Pass

*2 Test Condition of Radio Frequency Electromagnetic Field

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

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Self-Capacitance Touch Buttons/Wheels/Slider Board RX Capacitive Touch Evaluation System Application Board

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
- Button/wheel/slider board
 - 3 self-capacitance button electrodes
 - 2 types of wheel electrodes (8-electrode and 4-electrode)
 - 1 slider electrode (5 electrodes)
- 3-mm thick acrylic overlay (attached)
- Dimensions (L x W x H) : 145mm x 151mm x 12mm

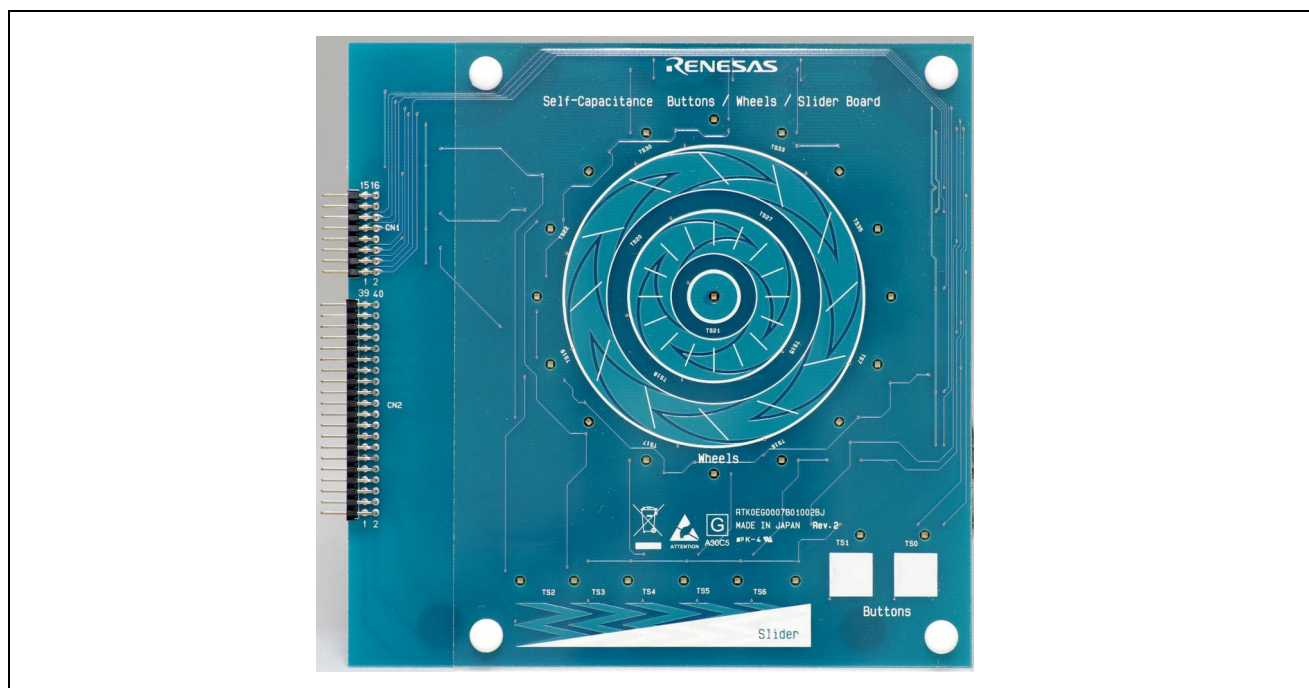


Figure 1.1 Application Board External Dimensions

1.3 Regulatory Compliance Notices

1.3.1 European Union regulatory notices

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

CE Certifications:

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

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

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 - 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: RX130 Capacitive Touch Evaluation System
Type name: RTK0EG0003S02001BJ

Environmental Compliance and Certifications:

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

2. Board Layout

2.1 Component Layout

Figure 2.1 shows the component layout of the application board.

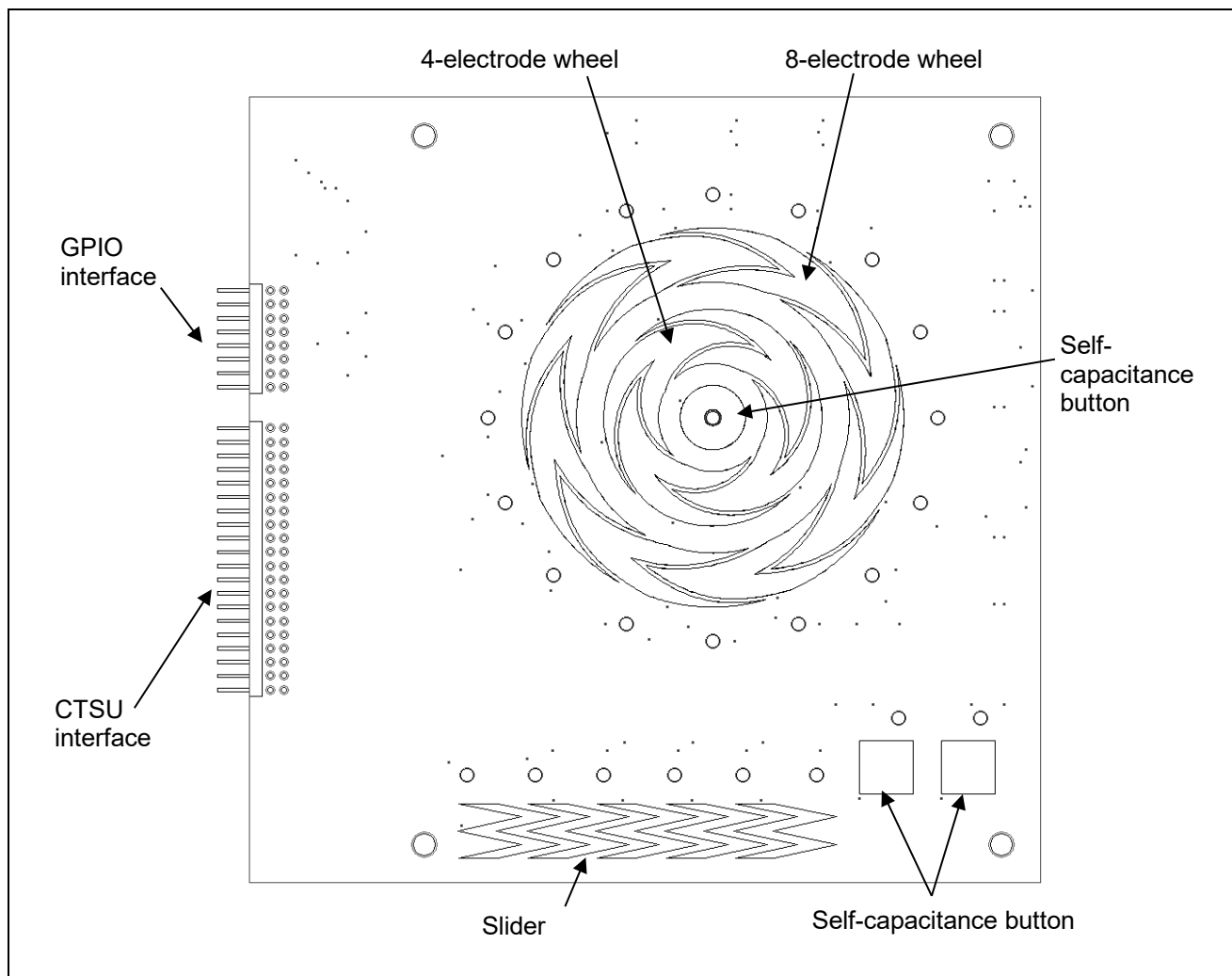


Figure 2.1 Component Layout

2.2 Overlay Dimensions

Figure 2.2 shows the dimensions of the overlay attached to the application board. Dimensions are shown in millimeters. Overlay thickness is 3.0 mm.

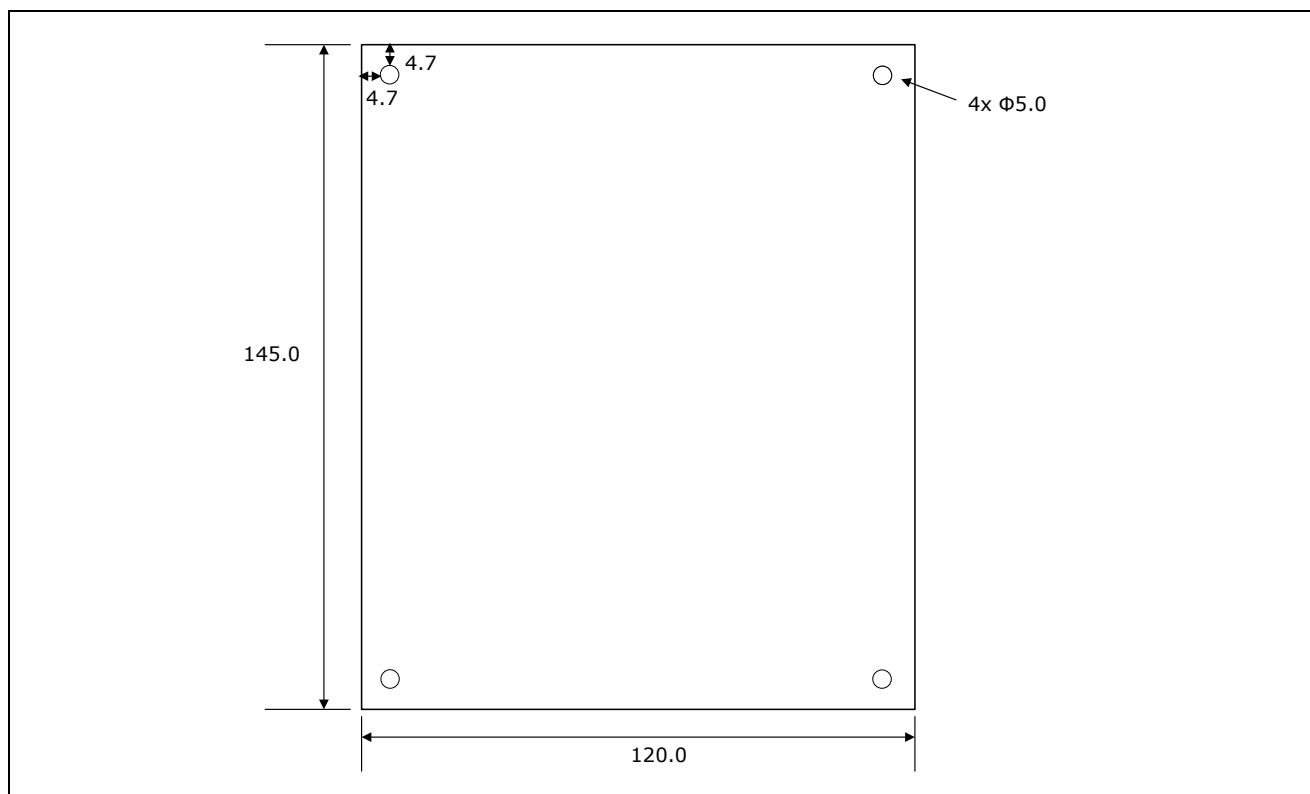


Figure 2.2 Overlay Dimensions

2.3 Component Placement

Figures 2.3 and 2.4 show the placement of individual components on the application board.

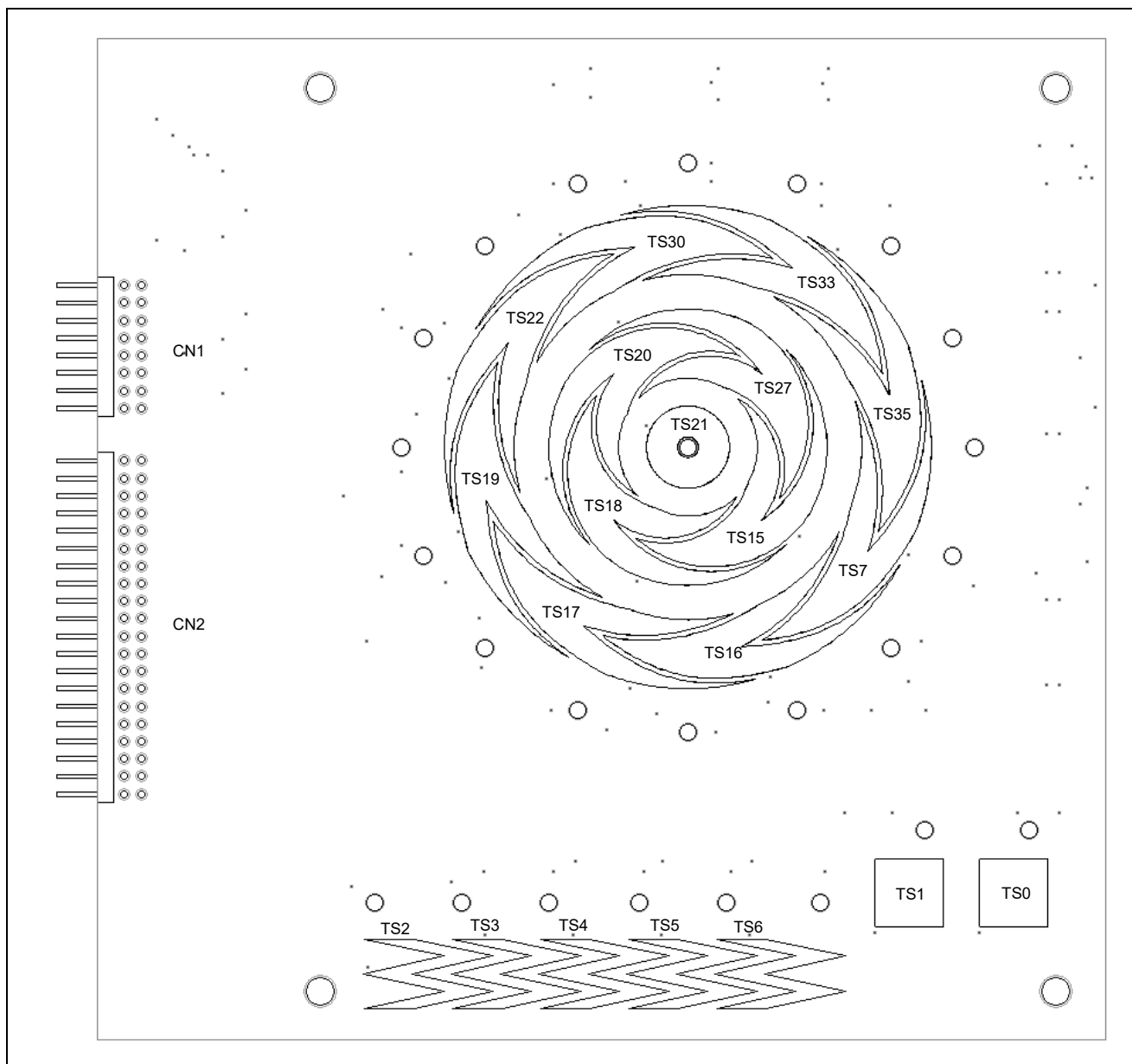


Figure 2.3 Application Board Component Placement (top/component side)

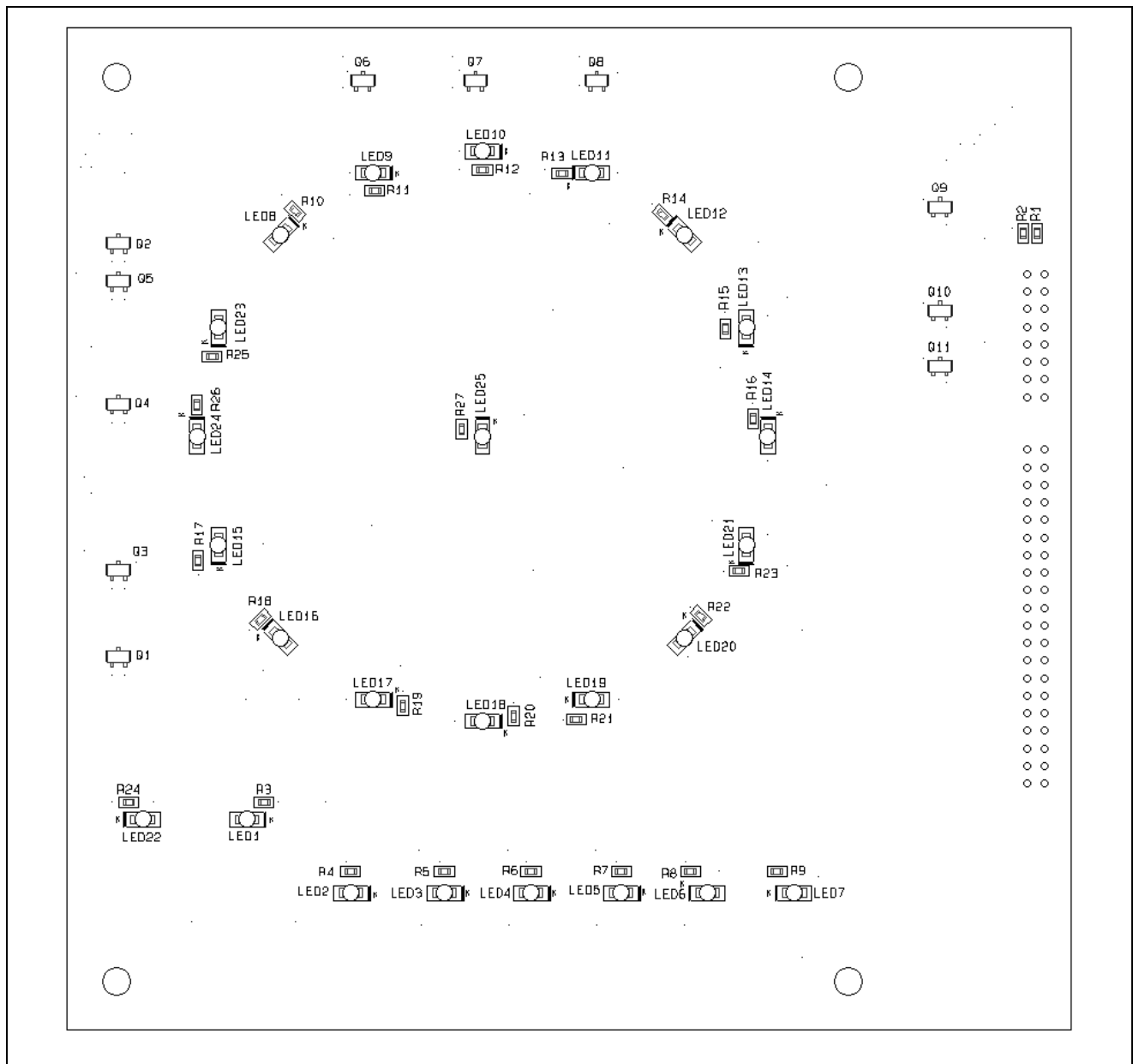


Figure 2.4 Application Board Component Placement (bottom/soldered side)

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.

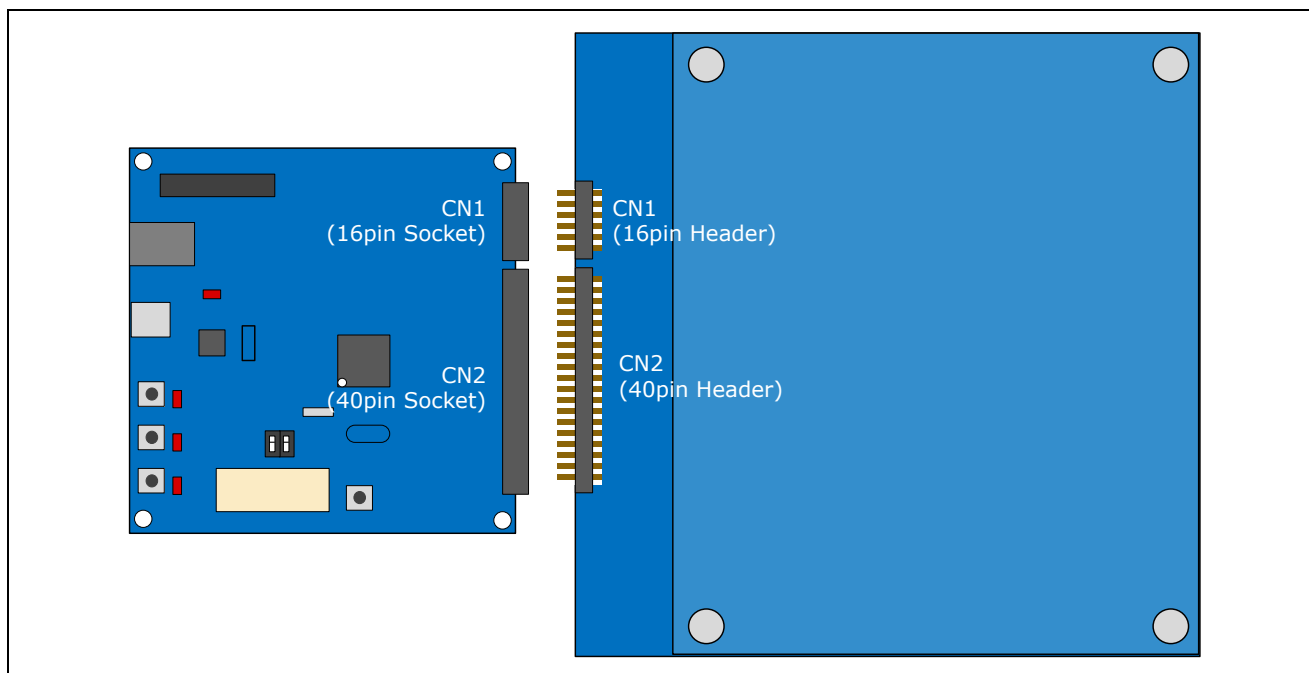


Figure 3.1 Board Connection Direction

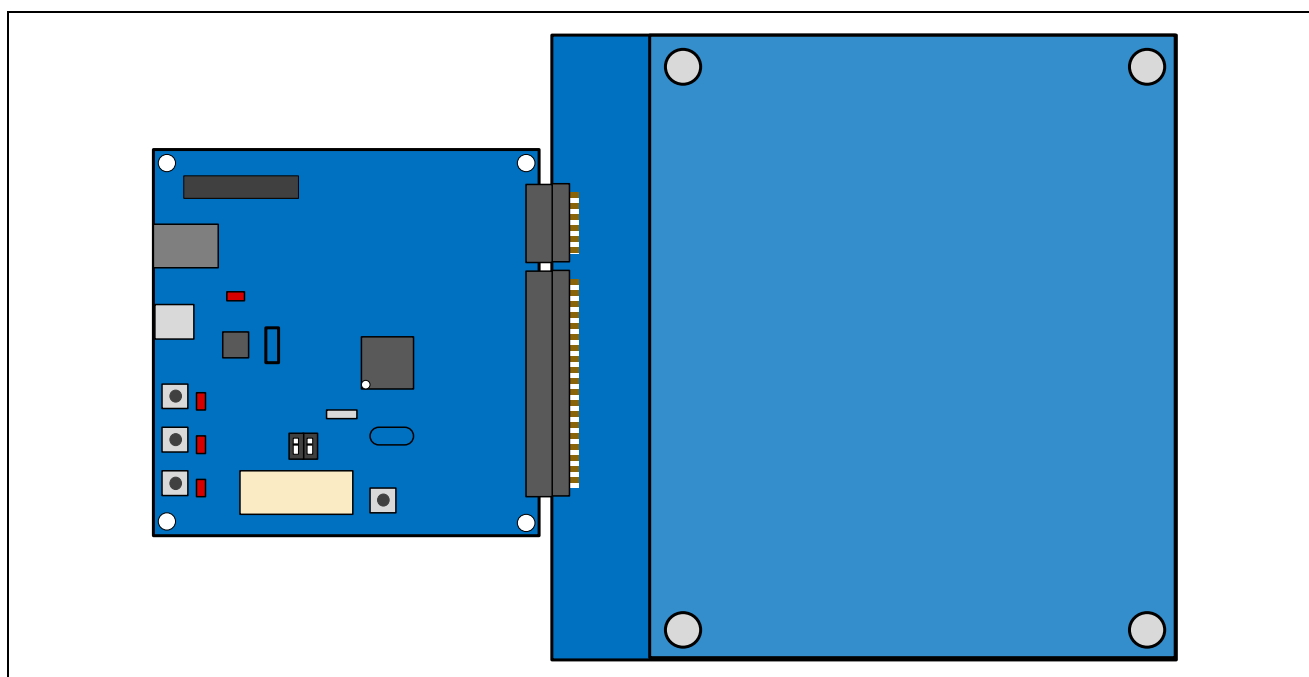


Figure 3.2 Connected Boards

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

Table 4.1 Application Headers (CN1)

Pin	Header Name	Pin	Header Name
1	LED_LOW0	2	LED_LOW 1
3	LED_LOW 2	4	LED_LOW 3
5	LED_LOW 4	6	LED_LOW 5
7	LED_LOW 6	8	-
9	LED_COL1	10	LED_COL2
11	LED_COL3	12	LED_COL4
13	-	14	ADC
15	VCC_LED	16	VSS_GND

- : Non Connection

4.2 CTSU Interface

Table 4.2 Application Headers (CN2)

Pin	Header Name	Pin	Header Name
1	TS0	2	TS1
3	TS2	4	TS3
5	TS4	6	TS5
7	TS6	8	TS7
9	-	10	-
11	-	12	-
13	-	14	-
15	-	16	TS15
17	TS16	18	TS17
19	TS18	20	TS19
21	TS20	22	TS21
23	TS22	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 User's Hardware Manual.

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CPU Board Header B

Pin	Signal
15	VCC_LED
13	ADC
11	LED_COLO
9	LED_COLO
7	LED_LOW6
5	LED_LOW4
3	LED_LOW2
1	LED_LOW0

CPU Board Header B

Pin	Signal
39	TS30
37	TS29
35	TS28
33	TS27
31	TS26
29	TS25
27	TS24
25	TS23
23	TS22
21	TS21
19	TS20
17	TS19
15	TS18
13	TS17
11	TS16
9	TS15
7	TS14
5	TS13
3	TS12
1	TS11

Board ID

Pin	Signal
1	VCC_LED
2	ADC
3	VCC*(5/8)
4	VSS_LED

LEDs

LED	Color	Resistor	Transistor
LED_LOW0	GREEN	R3	Q5
LED_LOW1	GREEN	R4	Q6
LED_LOW2	GREEN	R5	Q7
LED_LOW3	GREEN	R6	Q8
LED_LOW4	GREEN	R7	Q9
LED_LOW5	GREEN	R8	Q10
LED_LOW6	GREEN	R9	Q11
LED_COLO	GREEN	R10	Q1
LED_COLO1	GREEN	R11	Q2
LED_COLO2	GREEN	R12	Q3
LED_COLO3	GREEN	R13	Q4
LED1	GREEN	R14	
LED2	GREEN	R15	
LED3	GREEN	R16	
LED4	GREEN	R17	
LED5	GREEN	R18	
LED6	GREEN	R19	
LED7	GREEN	R20	
LED8	GREEN	R21	
LED9	GREEN	R22	
LED10	GREEN	R23	
LED11	GREEN	R24	
LED12	GREEN	R25	
LED13	GREEN	R26	
LED14	GREEN	R27	
LED15	GREEN	R28	
LED16	GREEN	R29	
LED17	GREEN	R30	
LED18	GREEN	R31	
LED19	GREEN	R32	
LED20	GREEN	R33	
LED21	GREEN	R34	
LED22	GREEN	R35	
LED23	GREEN	R36	
LED24	GREEN	R37	
LED25	GREEN	R38	

Buttons

Key	Transistor
Key1	TS0
Key4	TS1
Key7	TS2

Slider(5ch)

Key	Transistor
Key12	TS3
Key13	TS4
Key16	TS5
Key19	TS6
Key20	TS7

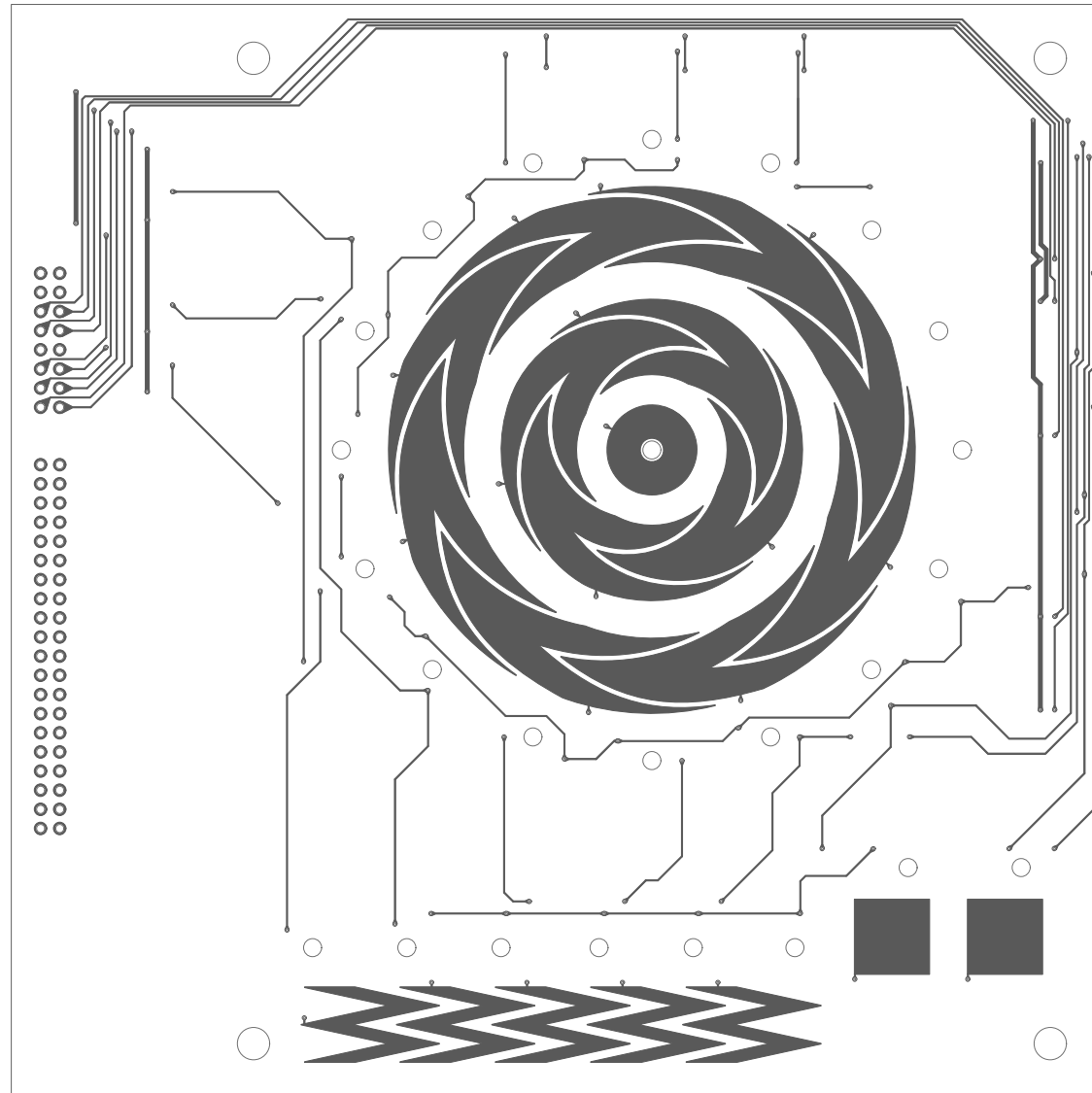
Wheel(8ch)

Key	Transistor
Key2	TS8
Key5	TS9
Key8	TS10
Key10	TS11
Key11	TS12
Key9	TS13
Key6	TS14
Key3	TS15

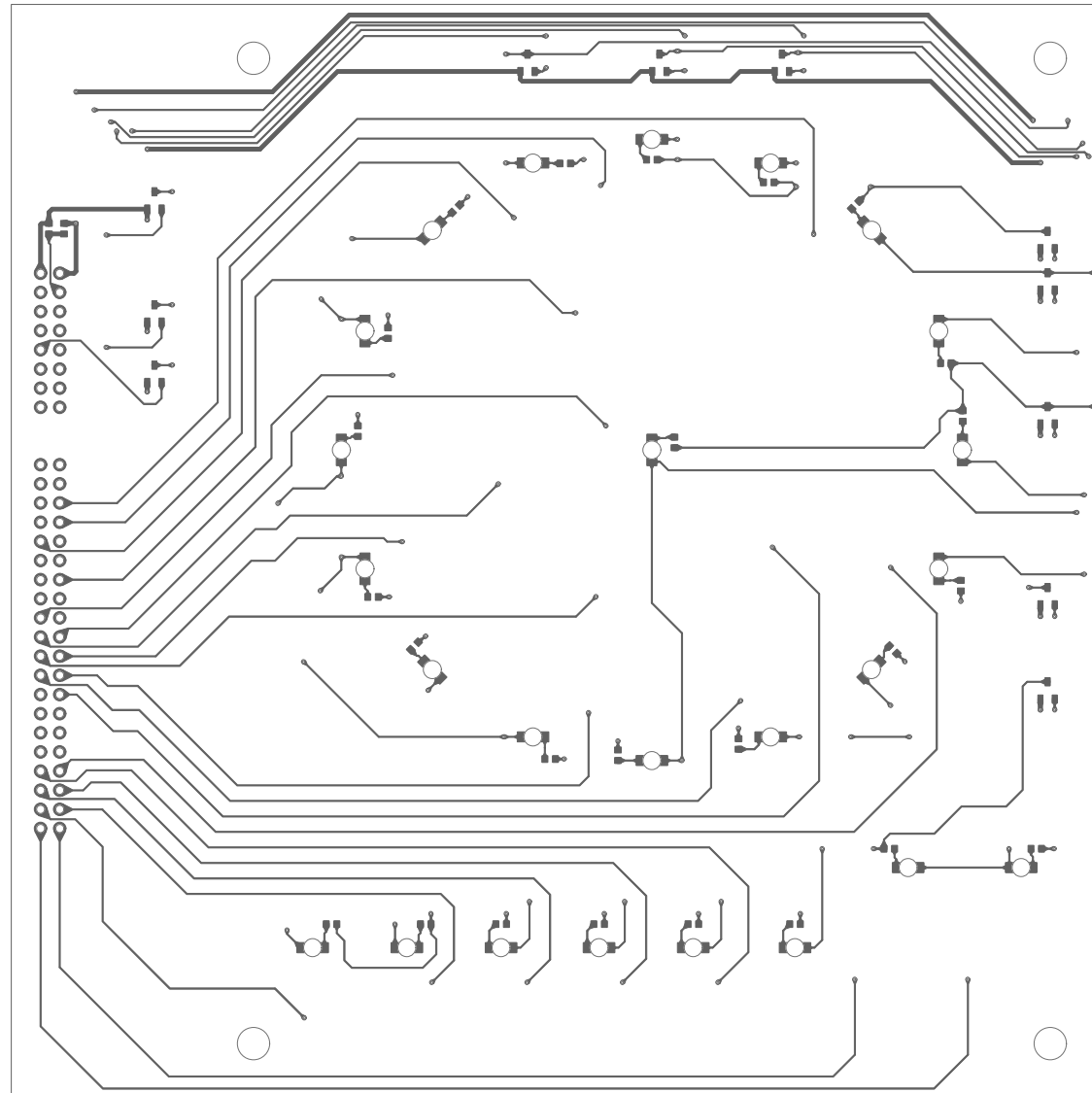
Wheel(4ch)

Key	Transistor
Key14	TS16
Key17	TS17
Key15	TS18
Key18	TS19

Size	Document Number	Date	Sheet	Rev
A3	D-RTX0E000078010028J-B-B	04.August.2015	1/1	B



PCB Top-side Layout



PCB Bottom-side Layout

[illegible]

Revision History	Self-Capacitance Touch Buttons/Wheels/Slider Board User's Manual
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Rev.	Date	Description	
		Page	
1.00	Feb 17, 2016	—	First Edition issued
1.01	Apr 26, 2024	—	Update Notice and How to Use This Manual
		1	Added board dimensions
		2	Added regulatory compliance notices
		12	Update Additional Information

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Self-Capacitance Touch Buttons/Wheels/Slider Board
User's Manual

