

## RX130 Group

R01AN4320EJ0100

Rev.1.00

CTSU Application Example: 3D Gesture Demo Set Small version (Hardware) Apr 12, 2018

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### Introduction

The RX130 Group is equipped with hardware (Capacitive Touch Sensor Unit; CTSU) that senses contact of the human body by measuring the capacitance generated between the touch electrode and the human body (hand, etc.).

This application note explains the hardware specifications of the 3D Gesture Demo Set (RTK0EG0014D00001BJ) which is a sample application of the CTSU mutual capacitance method.

### Target Device

RX130 Group

### Related Documents

1. RX Family CTSU API Reference Guide (R30AN0215EJ)
2. RX Family CTSU Mutual-capacitance Touch Measurement (R30AN0217EJ)
3. RX113 Group CTSU Basis of Cap Touch Detection (R30AN0218EJ)
4. RX Family CTSU 3D Gesture Demo Set Sample Software (R01AN4101EJ)
5. RX231 Group CTSU Application Example: 3D Gesture Demo Set (Hardware) (R01AN4219EJ)

## Contents

1. Overview .....	3
2. External Appearance.....	4
3. Hardware Specification .....	6
4. Block Diagram.....	7
5. Circuit Diagram .....	8
5.1 CPU Board: RTK0EG0014C00001BJ.....	8
5.2 Electrode Board: RTK0EG0014B00001BJ .....	9
6. CPU Board Layouts .....	10
6.1 CPU Board: RTK0EG0014C00001BJ .....	10
6.2 Electrode Board: RTK0EG0014B00001BJ .....	16
7. CPU Board/Electrode Board BOM (parts list).....	20
8. EMC Countermeasure Examples.....	23
8.1 Power Input Section Filter .....	23
8.2 Metal Plate Shielding .....	23

## 1. Overview

The RTK0EG0014D00001BJ is a demonstration kit that detects 3D gesture motion by CTSU of RX130. This demo kit has the following features.

- Simple parts configuration: gesture detection only requires an MCU, electrodes on a substrate pattern, a resistor and a capacitor.
- Quick and easy setup and operation: compact and light, powered via USB, uses just three switches
- Detection distance from about 100 mm (board size: 80 mm x 80 mm)
- Easy-to-use demo (runs with PC demo application)
- Includes all tools and necessary interfaces (USB, BLE, E1 emulator)

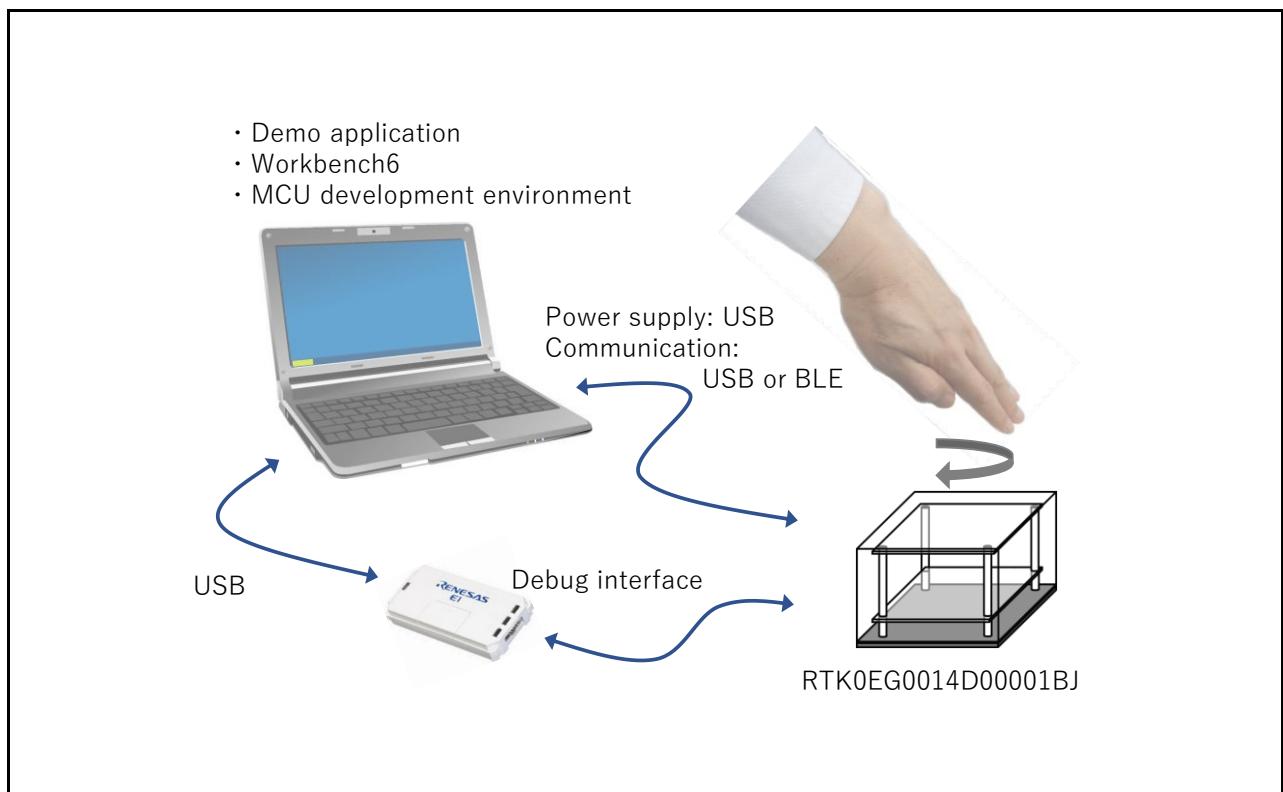


Figure 1-1 3D Gesture Demo System

## 2. External Appearance

Figure 2-1 to Figure 2-3 show the external appearance and part names related to the 3D Gesture Demo Set.

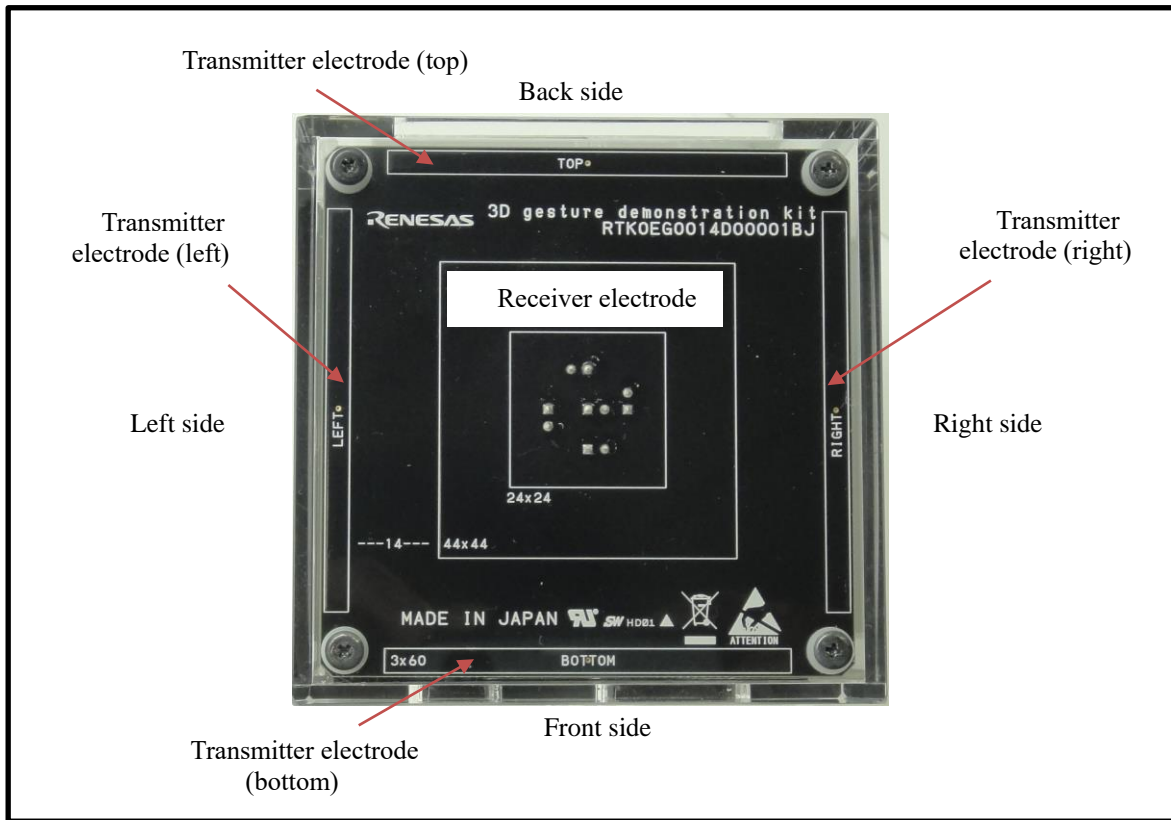


Figure 2-1 External Appearance (top view)

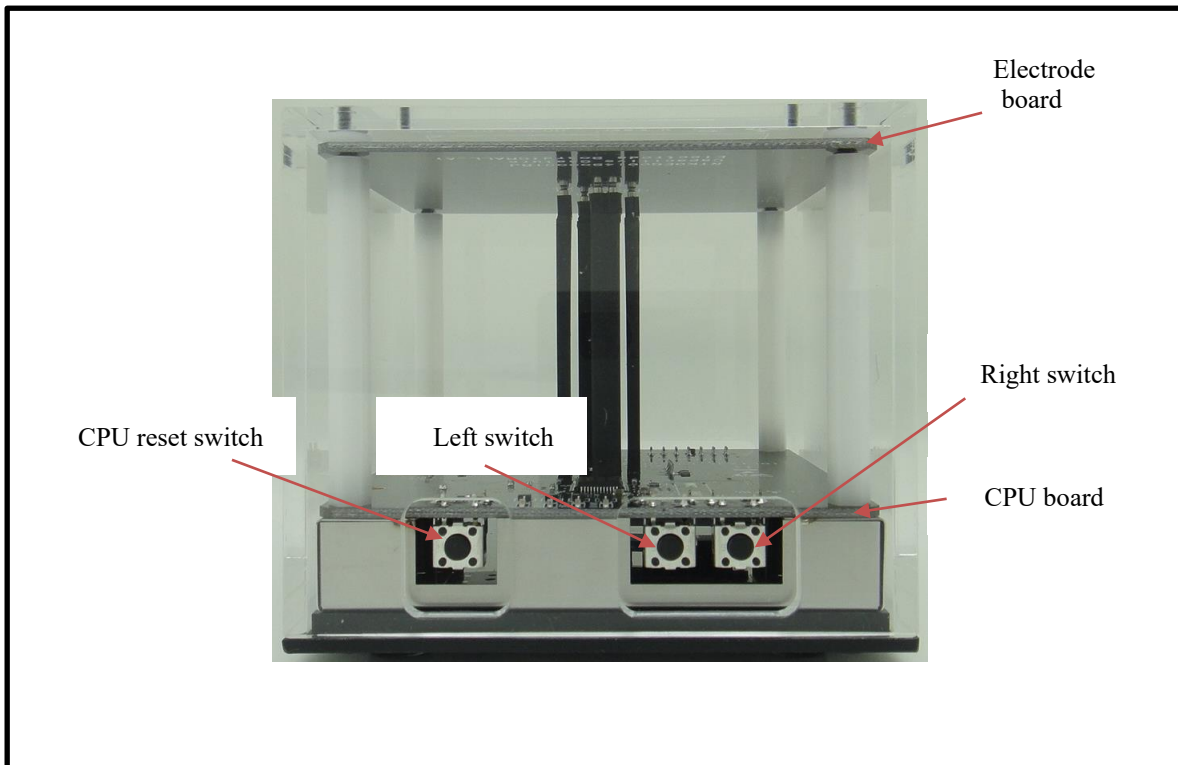


Figure 2-2 External Appearance (front view)

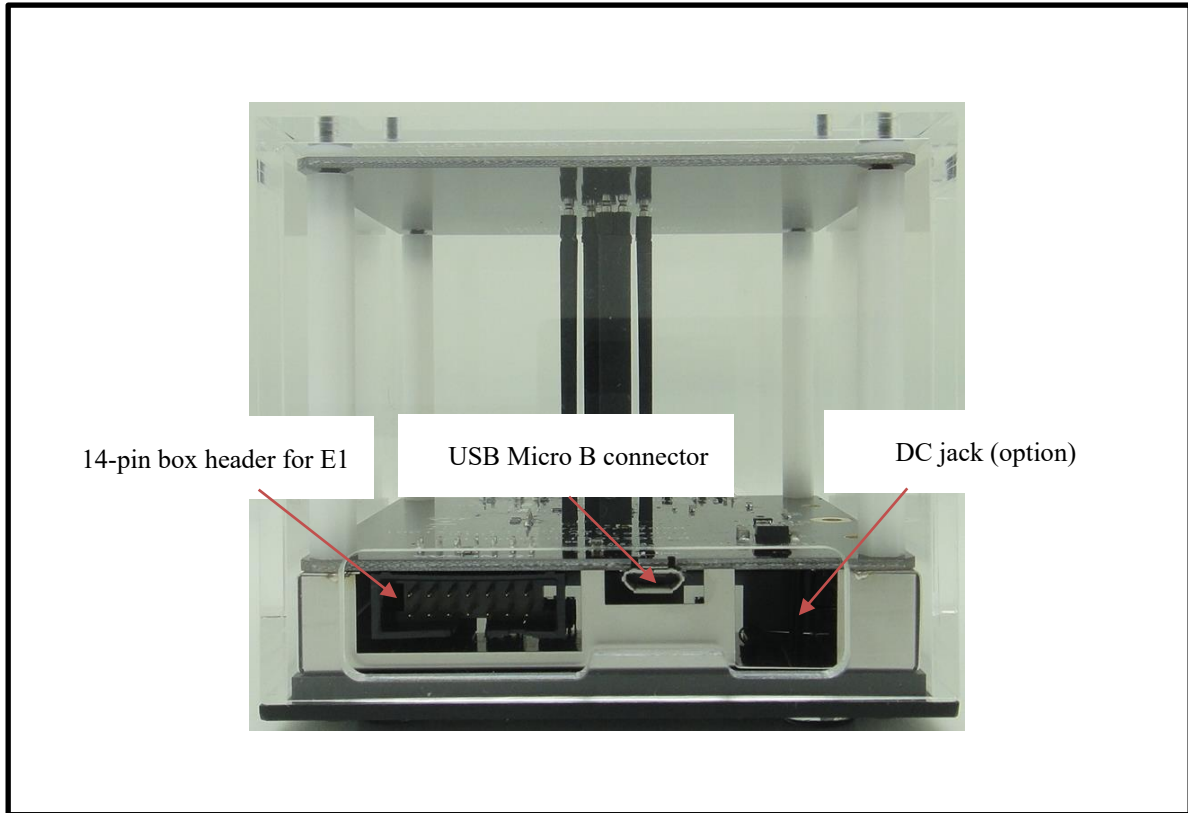


Figure 2-3 External Appearance (back view)

## 3. Hardware Specification

Table 3-1 Hardware Specification

Item	Description	Notes
Board size	80.0×80.0[mm]	Upper board: electrode board Lower board: CPU board
CPU	RX130 (R5F51305ADFL)	ROM: 128KB RAM: 16KB Data flash: 8KB Package: 48-pin LQFP (0.5mm pitch) Operating ambient temperature: -40~85°C
Clock input	On-chip oscillator	
	External 8MHz crystal unit	Option
LEDs	Power supply: 1 orange	
	Function display: 2 orange, 2 green	CPU port control
Switches	Push switch: 3	<ul style="list-style-type: none"> <li>• CPU reset switch</li> <li>• Left switch</li> <li>• Right switch</li> </ul>
	Slide switch: 4	<ul style="list-style-type: none"> <li>• Power supply input selection (USB/DC jack)</li> <li>• CPU drive voltage selection (5V/3.3V)</li> <li>• For internal adjustment (2). Settings cannot be changed.</li> </ul>
Gesture detection electrodes	Receiver electrode: 4	Top, bottom, left, right
	Transmitter electrode: 1	
USB serial conversion interface	Connector: USB Micro B	
	IC: FTDI's FT232RL	Full-speed transfer
Wireless module	RL78/G1D built-in module: RY7011A0000DZ00 Conversion board: RTK0EN0013A01001BJ	Bluetooth v4.1 specification (Low Energy, single mode)
Debug interface	14-pin box header for E1	
Power supply	USB bus powered (VBUS): 5 V	
	Power supply connector (DC jack): 5 V	Φ 5.5mm, center plus, option

4. Block Diagram

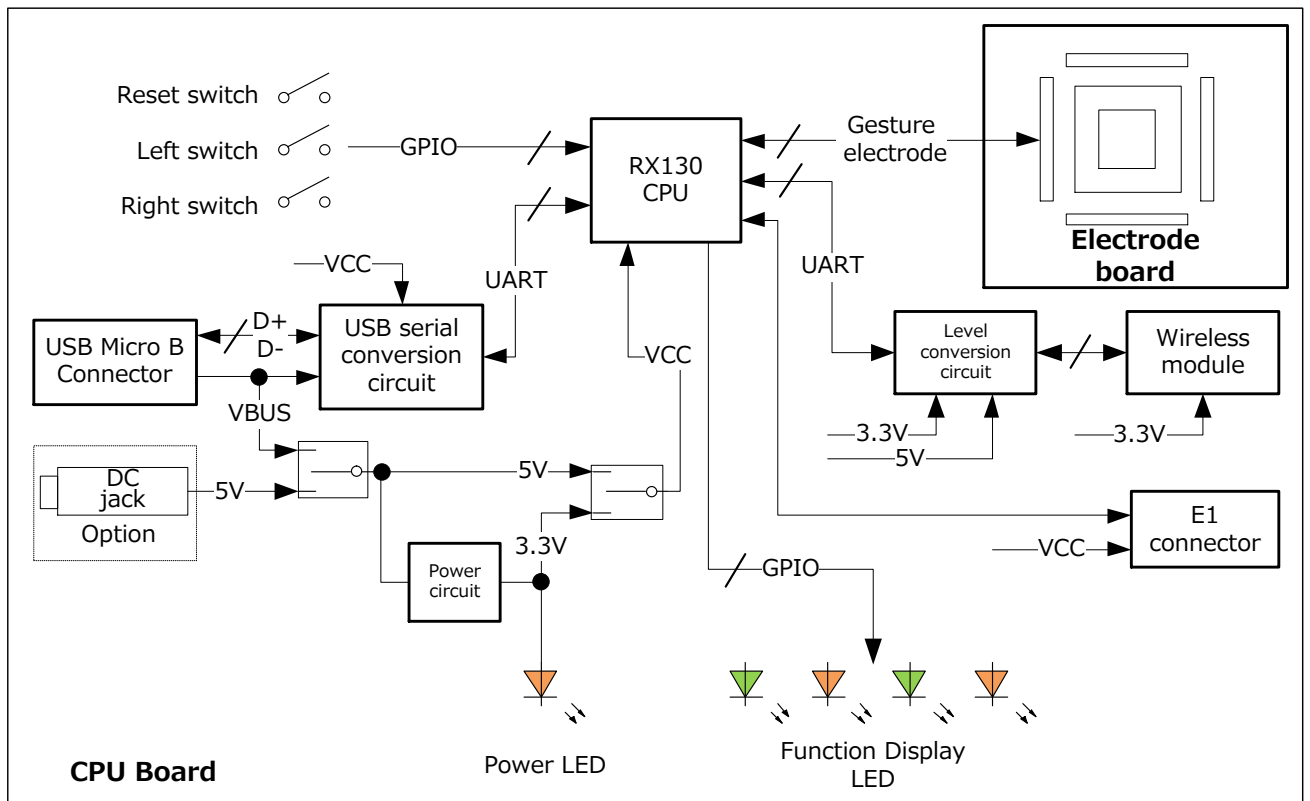


Figure 4-1 Block Diagram

5. Circuit Diagram

5.1 CPU Board: RTK0EG0014C00001BJ

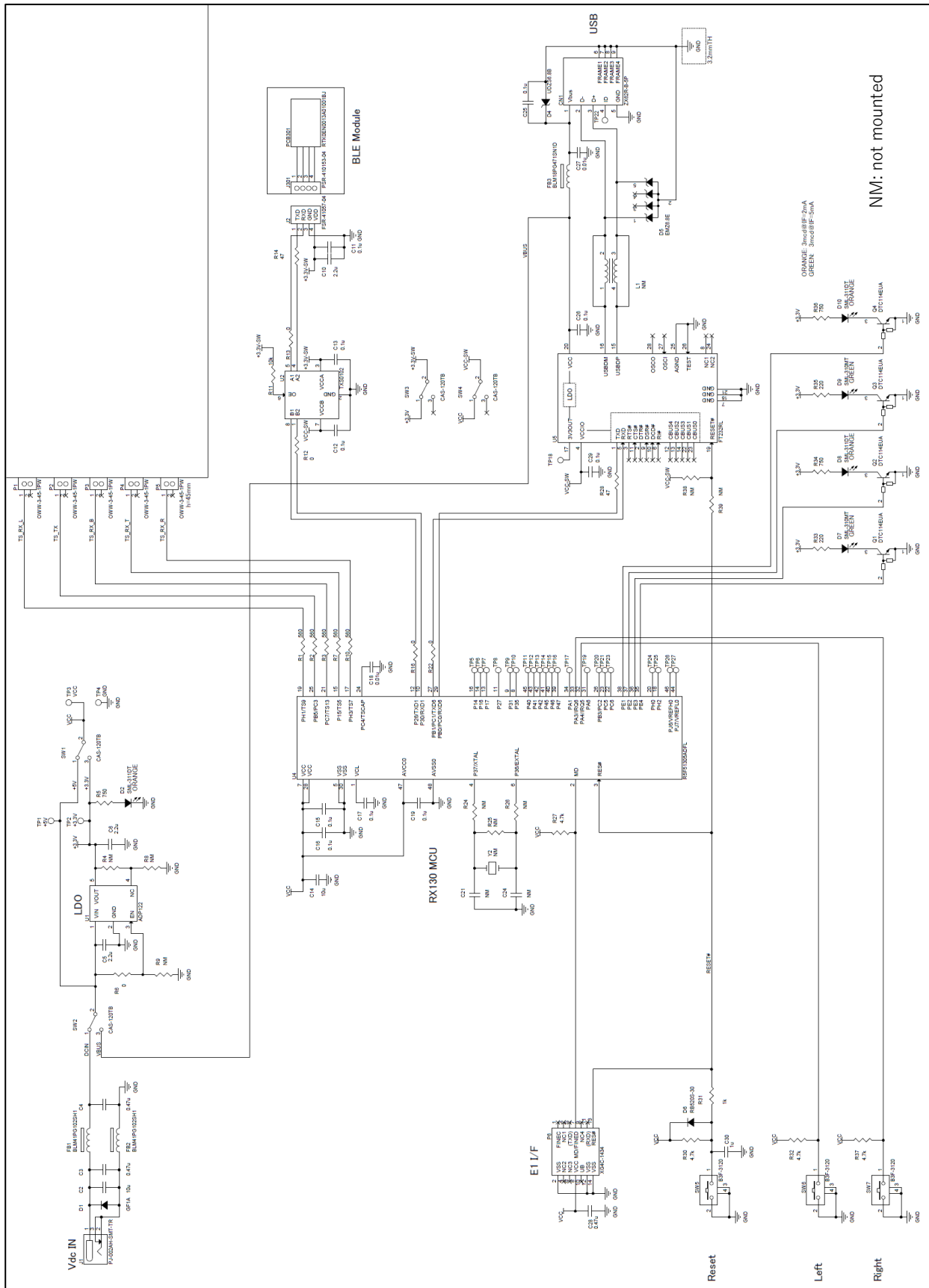


Figure 5-1 CPU Board (RTK0EG0014C00001BJ) Circuit Diagram



5.2 Electrode Board: RTK0EG0014B00001BJ

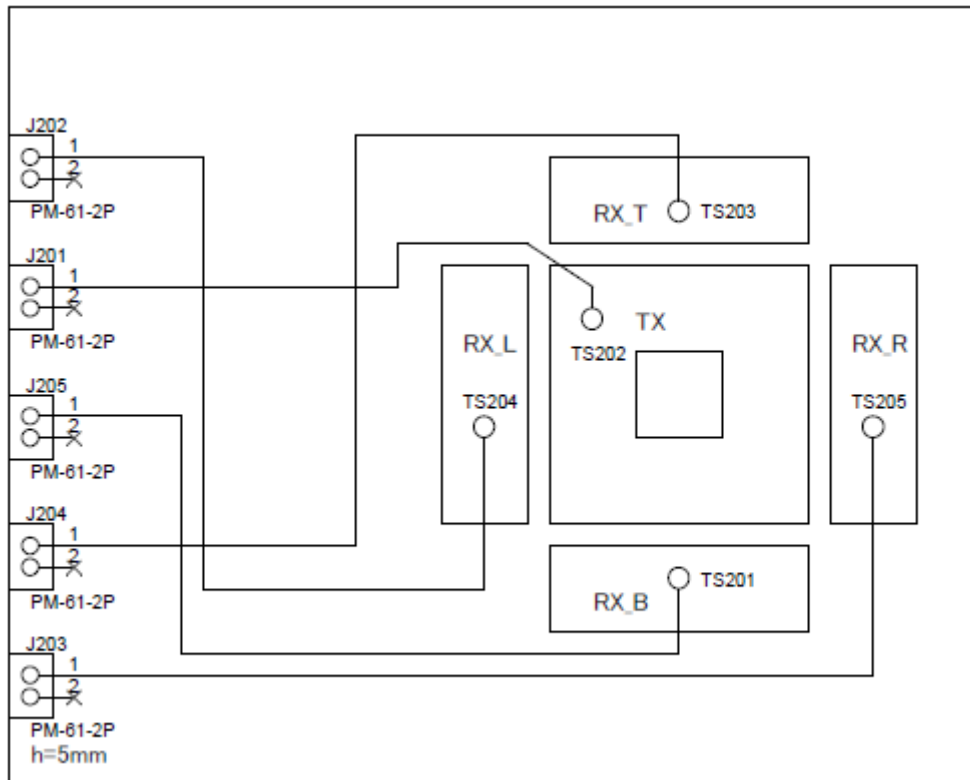


Figure 5-2 Electrode Board (RTK0EG0014B00001BJ) Circuit Diagram

6. CPU Board Layouts

6.1 CPU Board: RTK0EG0014C00001BJ

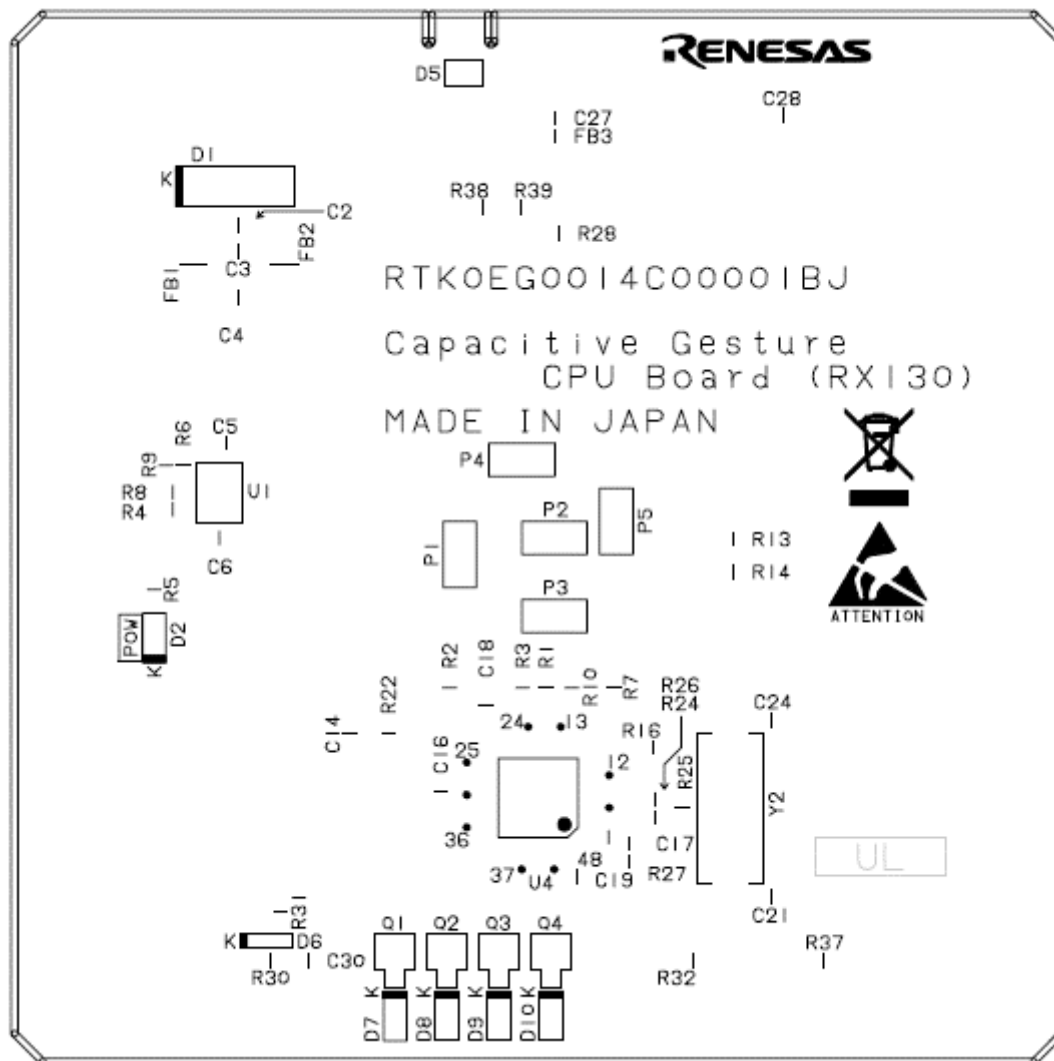


Figure 6-1 Component Side Silkscreen (top view)

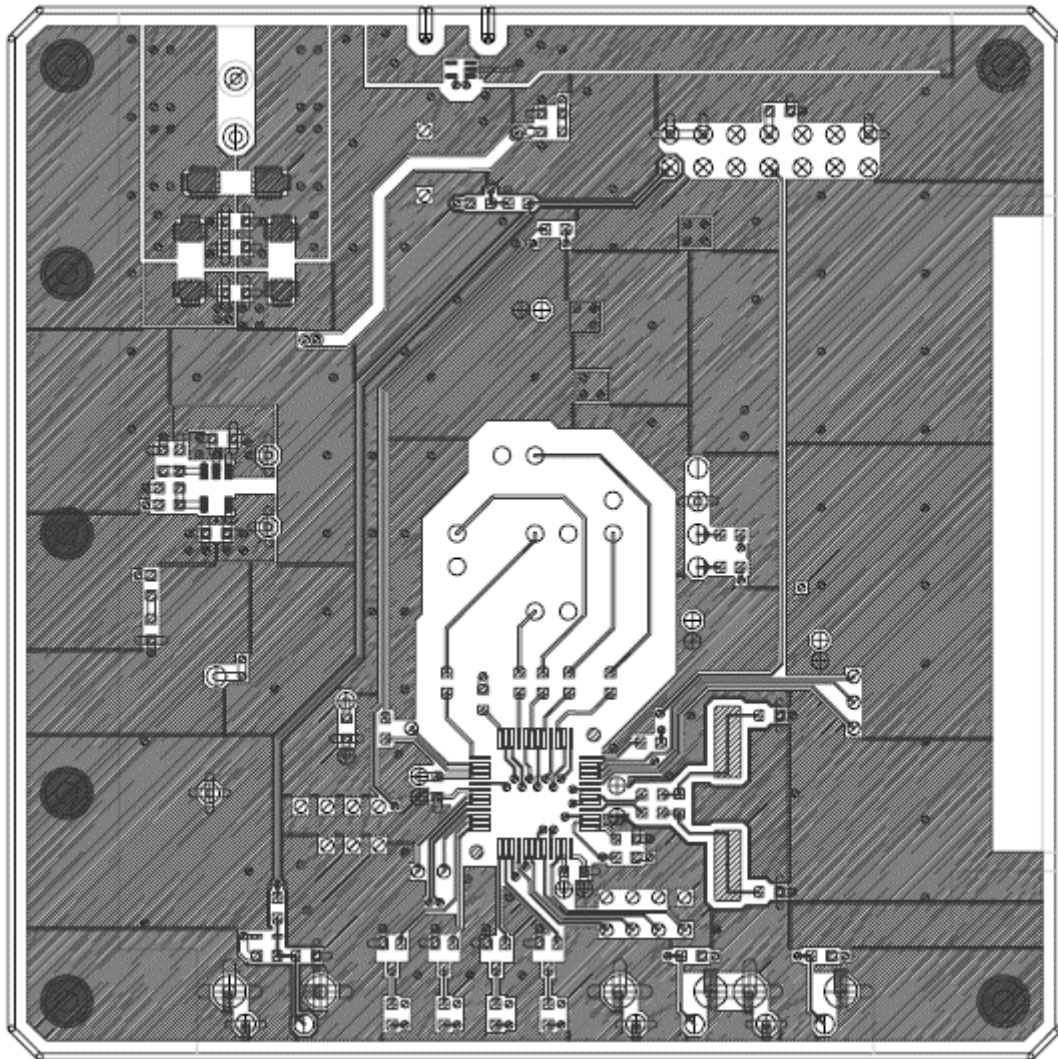


Figure 6-2 1st Layer Pattern (top view)

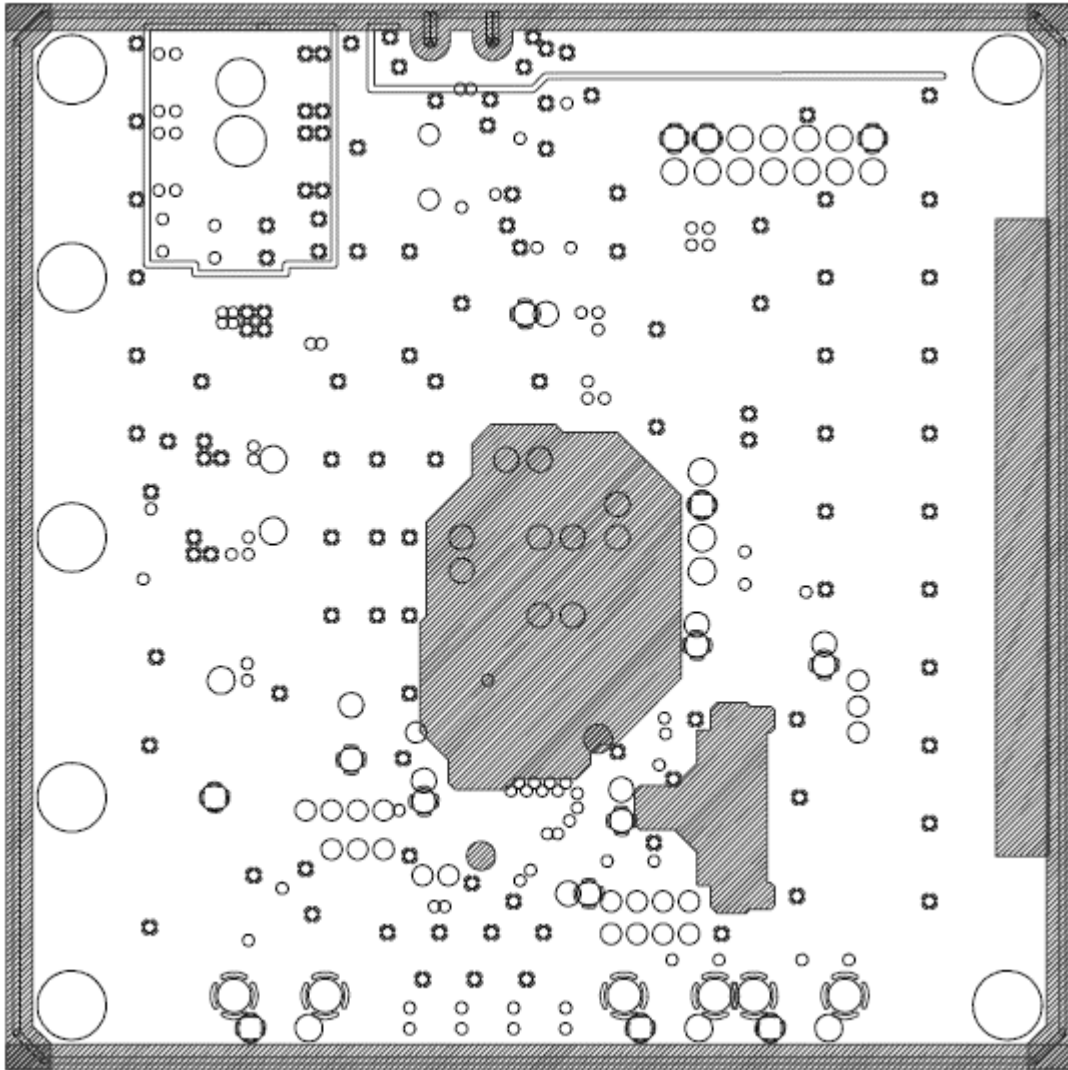


Figure 6-3 2nd Layer Pattern (top view, negative-positive inversion)

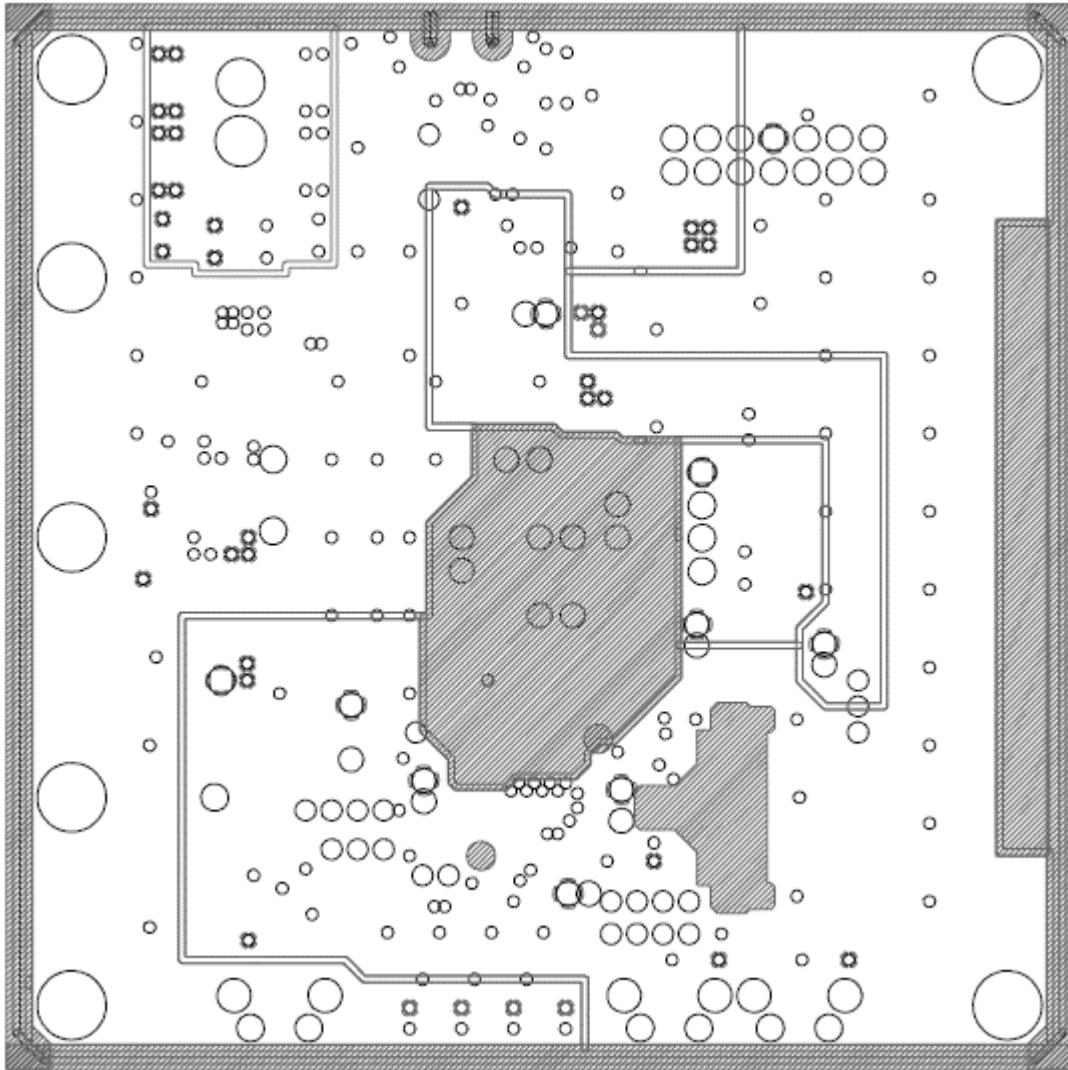


Figure 6-4 3rd Layer Pattern (top view, negative-positive inversion)



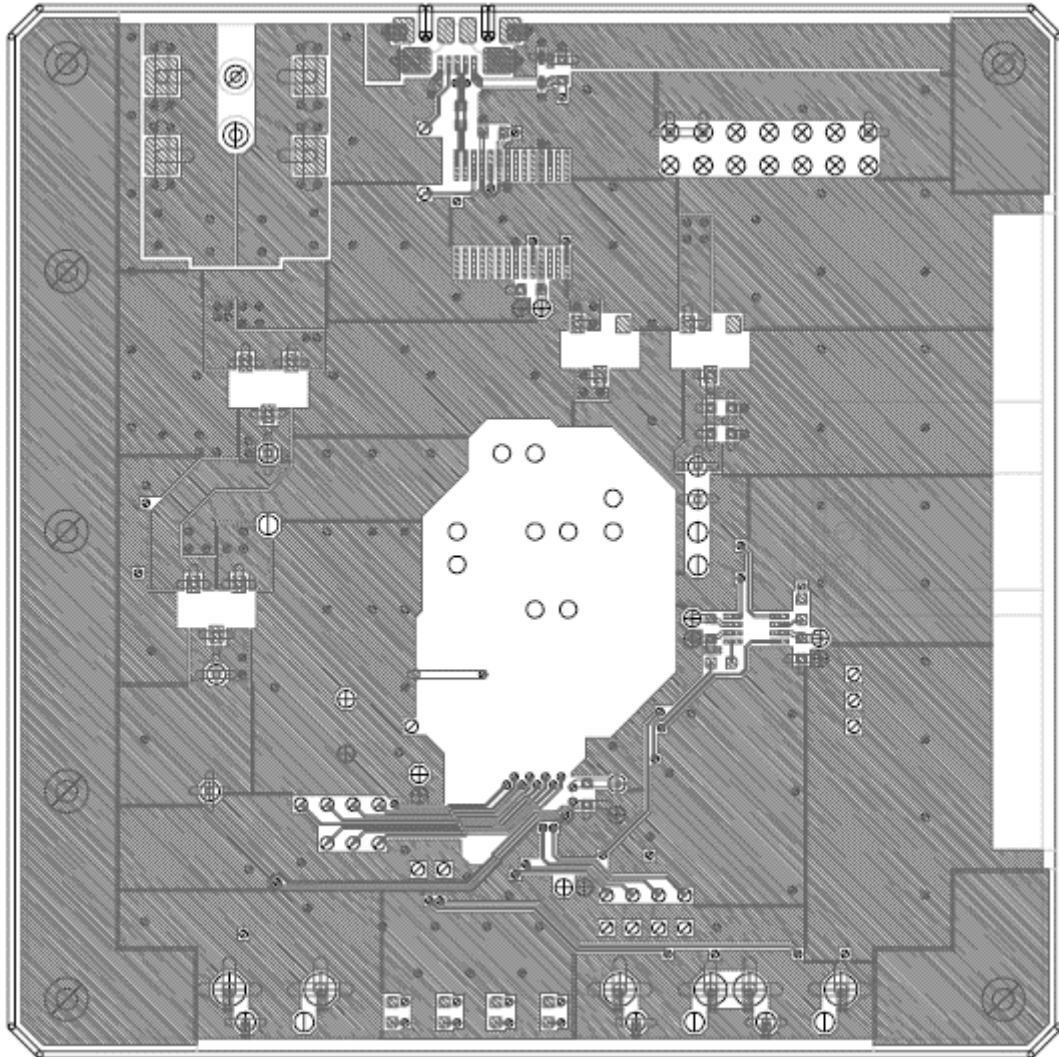


Figure 6-5 4th Layer Pattern (top view)

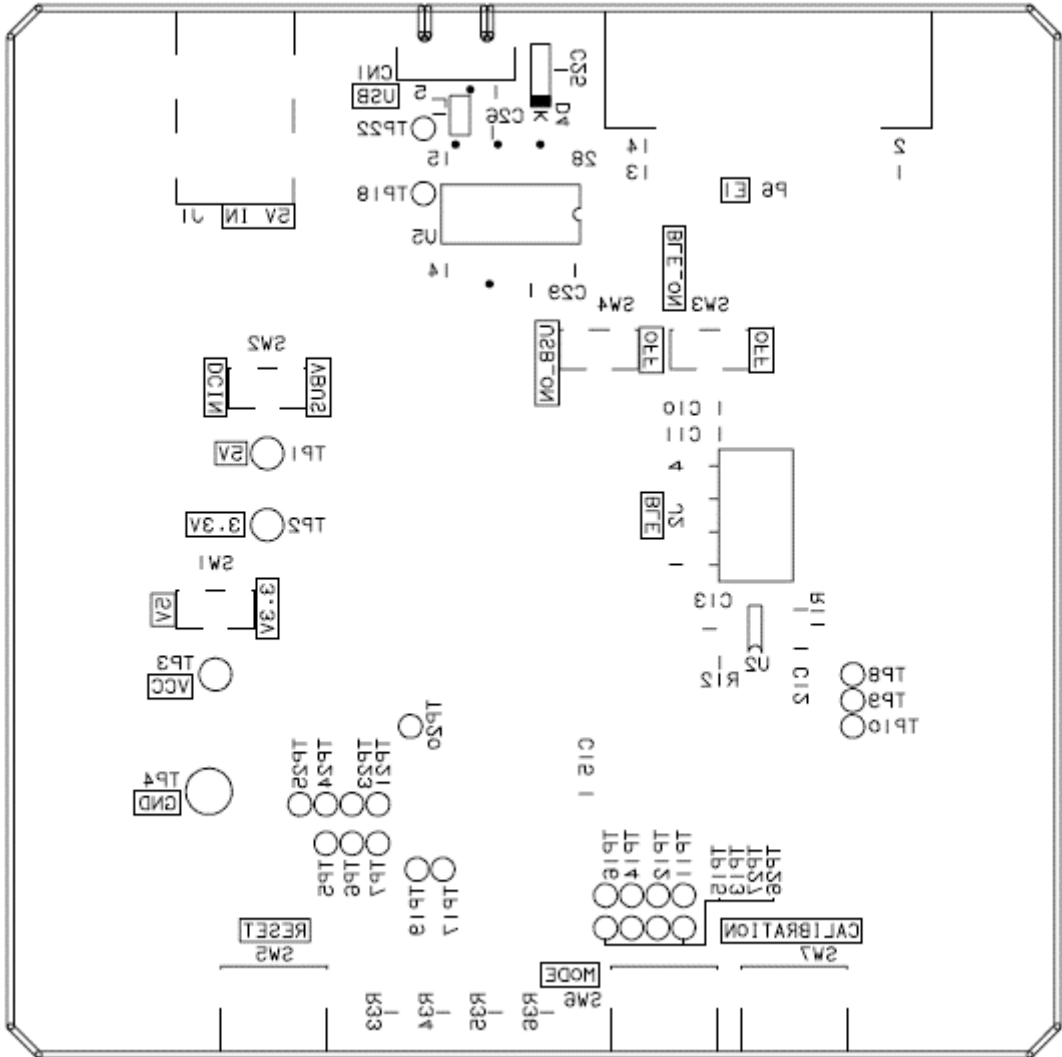


Figure 6-6 Solder Side Silkscreen (top view)

6.2 Electrode Board: RTK0EG0014B00001BJ

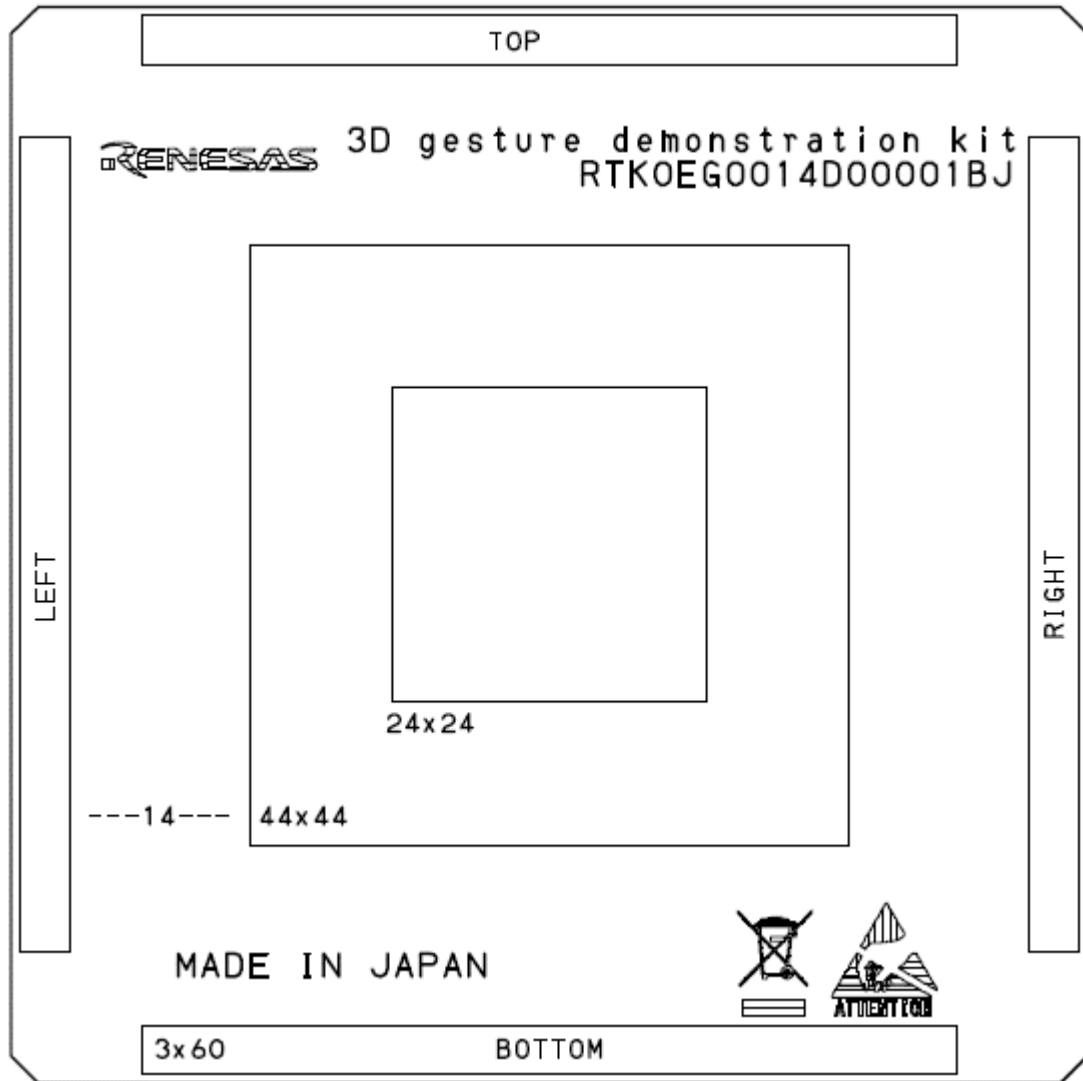


Figure 6-7 Component Side Silkscreen (top view)



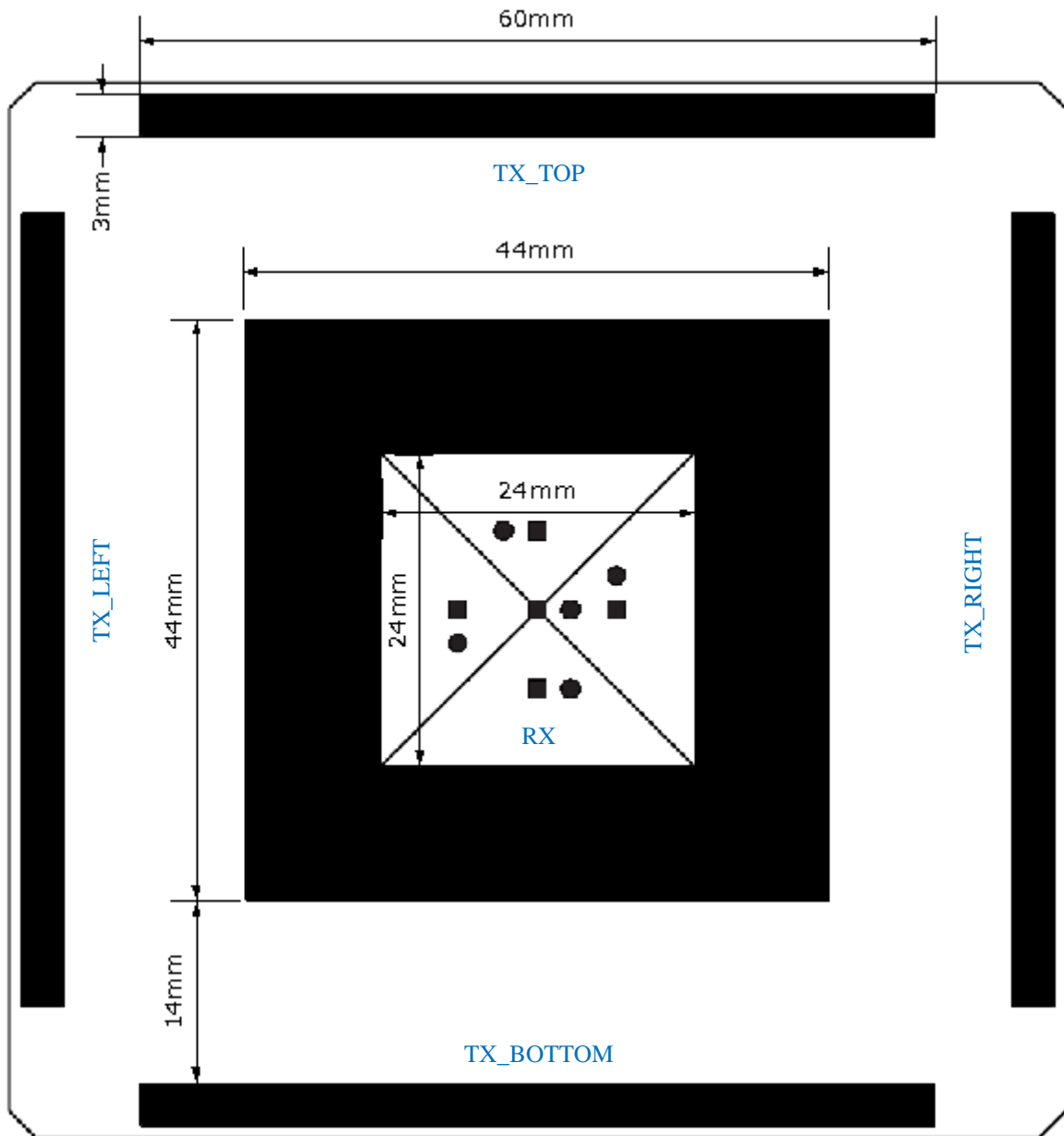


Figure 6-8 Component Side Pattern (top view)

The TX and 4 RX electrodes are all copper solid patterns.

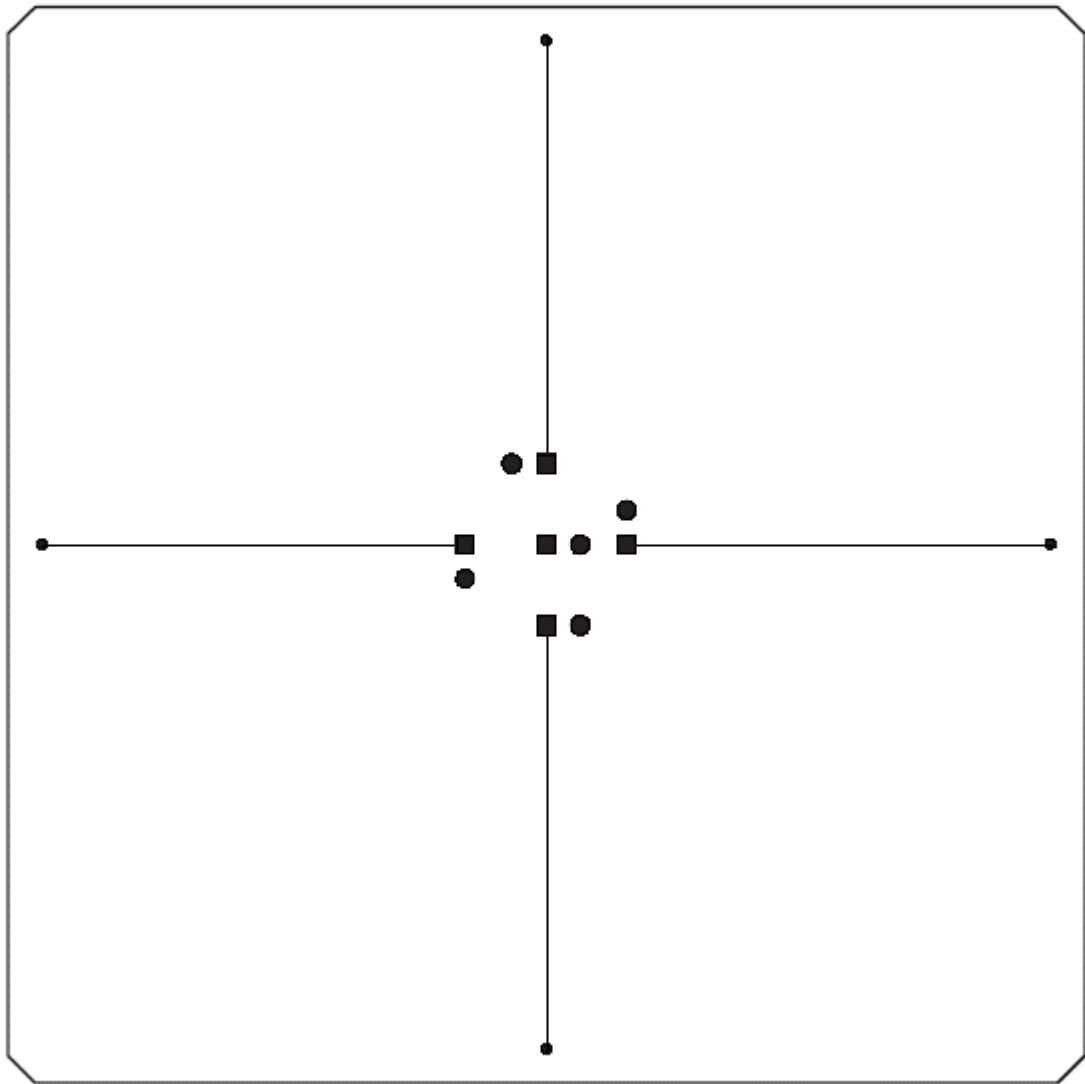


Figure 6-9 Solder Side Pattern (top view)

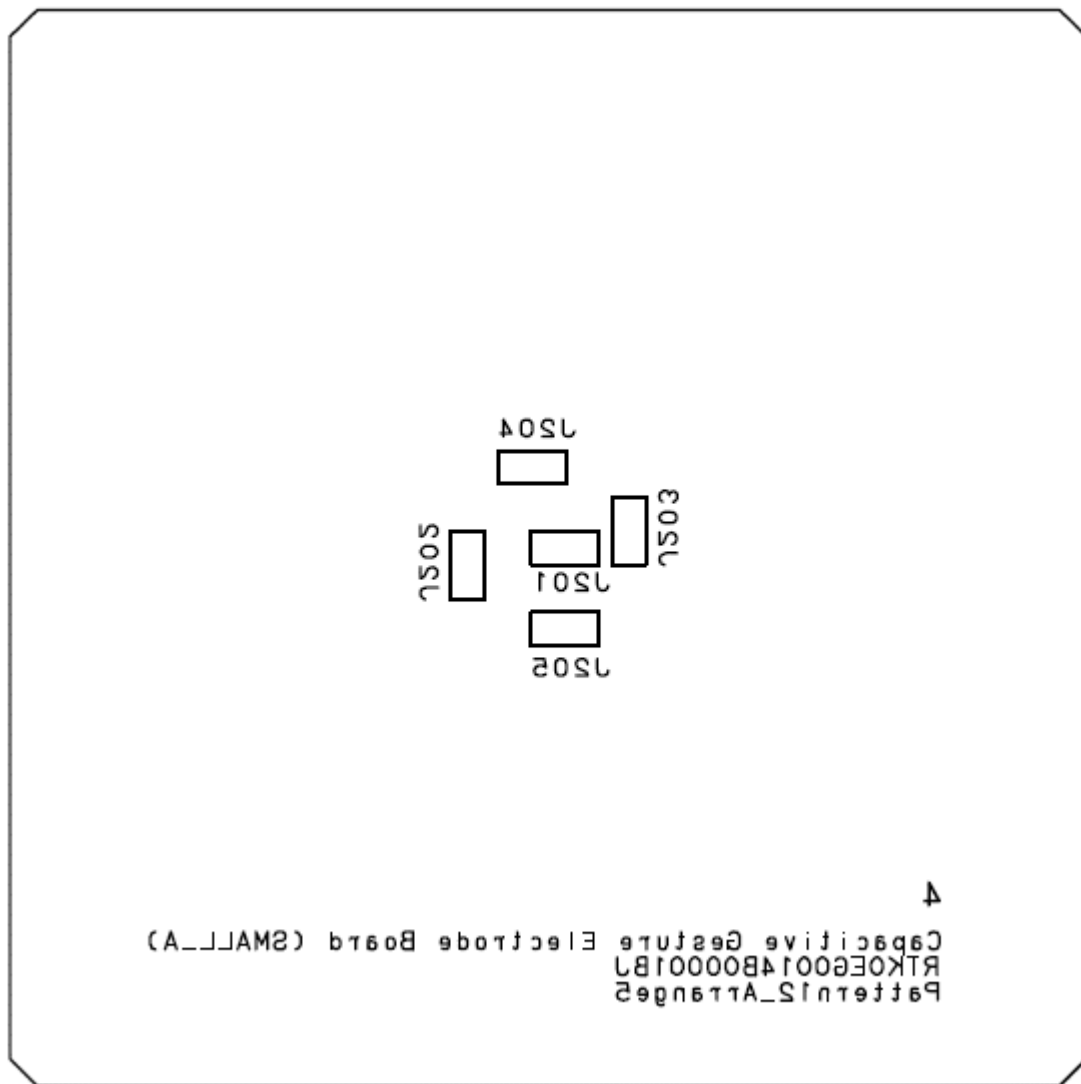


Figure 6-10 Solder Side Silkscreen (top view)

## 7. CPU Board/Electrode Board: BOM (parts list)

Table 7-1 CPU Board/Electrode Board: BOM (1/3)

Item	Quantity	Reference	Part	Manufacturer	Part number	Remarks
1	1	CN1	ZX62R-B-5P	HIROSE	ZX62R-B-5P	MICRO USB B CONNECTOR SMD
2	2	C2,C14	10u	MURATA	GRM188R61E106MA73D	CAP CERAMIC 10UF 25V X5R 1608
3	3	C3,C4,C28	0.47u	MURATA	GRM188B31E474KA75D	CAP CERAMIC 0.47UF 25V B 1608
4	3	C5,C6,C10	2.2u	MURATA	GRM188B31C225KE14D	CAP CERAMIC 2.2UF 16V B 1608
5	10	C11,C12,C13,C15,C16,C17,C19,C25,C26,C29	0.1u	MURATA	GRM188B11E104KA01	CAP CERAMIC 0.1UF 25V B 1608
6	2	C18,C27	0.01u	MURATA	GRM188B11H103K	CAP CERAMIC 0.01UF 50V B 1608
7	2	C21,C24	NM			1608 PAD
8	1	C30	1u	MURATA	GRM188B31E105KA75D	CAP CERAMIC 1UF 25V B 1608
9	1	D1	GF1A	Vishay	GF1A-E3/67A	DIODE 50V 1A
10	3	D2,D8,D10	SML-311DT	ROHM	SML-311DTT86	LED ORANGE 1608
11	1	D4	UDZS6.8B	ROHM	UDZSTE-176.8B	DIODE ZENER 6.8V 200MW UMD2
12	1	D5	EMZ6.8E	ROHM	EMZ6.8ET2R	DIODE ZENER ARRAY 6.8V EMD5
13	1	D6	RB520S-30	ROHM	RB520S-30	DIODE SCHOTTKY 30V 200MA EMD2
14	2	D7,D9	SML-310MT	ROHM	SML-310MTT86	LED GREEN 1608
15	2	FB1,FB2	BLM41PG102SH1	MURATA	BLM41PG102SH1	FERRITE BEAD 1 KOHM 4.5x1.6
16	1	FB3	BLM18PG471SN1D	MURATA	BLM18PG471SN1	FERRITE BEAD 470 OHM 1608
17	1	J1	PJ-002AH-SMT-TR	CUI	PJ-002AH-SMT-TR	DC JACK
18	1	J2	FSR-41057-04	Hirosugi-Keiki	FSR-41057-04	2.54MM PITCH RIGHT ANGLE SOCKET PIN
19	5	J201,J202,J203,J204,J205	PM-61-2P	MAC EIGHT(MAC8)	PM-61-2P	STACKING CONNECTOR 1x2P H=5mm
20	1	J301	PSR-410153-04	Hirosugi-Keiki	PSR-410153-04	2.54MM RIGHT ANGLE HEADER 1x4PIN
21	1	L1	NM	MURATA	DLP11SN900HL2L	COMMON MODE CHOKE COIL 150MA 90 OHM SMD
22	1	PCB301	RTK0EN0013A01001BJ	RENESAS	RTK0EN0013A01001BJ	RL78/G1D CONVERSION BOARD

Table 7-2 CPU Board/Electrode Board: BOM (2/3)

Item	Quantity	Reference	Part	Manufacturer	Part number	Remarks
23	5	P1,P2,P3,P4,P5	OWW-3-45-1PW	MAC EIGHT(MAC8)	OWW-3-45-1PW	STACKING CONNECTOR 1x2P H=45mm
24	1	P6	XG4C-1434	OMRON	XG4C-1434	14P CONNECTOR, RIGHT ANGLE, TH
25	4	Q1,Q2,Q3,Q4	DTC114EUA	ROHM	DTC114EUAT106	DTR 200MW UMT3
26	5	R1,R2,R3,R7,R10	560	ROHM	MCR03ERTJ561	RES SMD 560 OHM 5% 1/10W 1608
27	1	R4	NM	ROHM	MCR03EZPFX5602	1608 PAD
28	3	R5,R34,R36	750	ROHM	MCR03ERTJ751	RES SMD 750 OHM 5% 1/10W 1608
29	5	R6,R12,R13,R16,R22	0	ROHM	MCR03EZPJ000	RES SMD 0 OHM JUMPER 1/10W 1608
30	1	R8	NM	ROHM	MCR03EZPFX1002	1608 PAD
31	1	R9	NM	ROHM	MCR03EZPJ000	1608 PAD
32	1	R11	10k	ROHM	MCR03ERTJ103	RES SMD 10K OHM 5% 1/10W 1608
33	2	R14,R28	47	ROHM	MCR03ERTF47R0	RES SMD 47 OHM 5% 1/10W 1608
34	5	R24,R25,R26,R38,R39	NM	ROHM		1608 PAD
35	4	R27,R30,R32,R37	4.7k	ROHM	MCR03ERTJ472	RES SMD 4.7K OHM 5% 1/10W 1608
36	1	R31	1k	ROHM	MCR03EZPJ102	RES SMD 1K OHM 5% 1/10W 1608
37	2	R33,R35	220	ROHM	MCR03ERTF2200	RES SMD 220 OHM 5% 1/10W 1608
38	4	SW1,SW2,SW3,SW4	CAS-120TB	Nidec Copal Electronics	CAS-120TB	SWITCH SLIDE SPDT 100MA 6V
39	3	SW5,SW6,SW7	B3F-3120	OMRON	B3F-3120	TACT SW, RIGHT ANGLE, TH
40	1	TP1	+5V			1mm TH, SILK"5V"
41	1	TP2	+3.3V			1mm TH, SILK"3.3V"
42	1	TP3	VCC			1mm TH, SILK"VCC"
43	1	TP4	GND	SUNHAYATO	SLC-22G-K	TEST POINT, SILK"GND"
44	23	TP5,TP6,TP7,TP8,TP9,TP10,TP11,TP12,TP13,TP14,TP15,TP16,TP17,TP18,TP19,TP20,TP21,TP22,TP23,TP24,TP25,TP26,TP27	TP			0.5mm TH

**Table 7-3 CPU Board/Electrode Board: BOM (3/3)**

Item	Quantity	Reference	Part	Manufacturer	Part number	Remarks
45	1	TS201	RX-BOTTOM			ELECTRODE PATTERN
46	1	TS202	TX			ELECTRODE PATTERN
47	1	TS203	RX_TOP			ELECTRODE PATTERN
48	1	TS204	RX_LEFT			ELECTRODE PATTERN
49	1	TS205	RX_RIGHT			ELECTRODE PATTERN
50	1	U1	ADP122	Analog Devices	ADP122AUJZ-3.3-R7	LDO 3.3V 300MA TSOT5
51	1	U2	TXS0102	Texas Instruments	TXS0102DCTR	Voltage Level Translator 2ch SM8
52	1	U4	R5F51305ADFL	RENESAS	R5F51305ADFL#30	RX130 MCU 48LQFP
53	1	U5	FT232RL	FTDI	FT232RL	USB to Serial UART Enhanced IC SSOP-28
54	1	Y2	NM	RALTRON	AS-8.000-18-SMD	CRYSTAL 8M HC-49 18PF

NM indicates “not mounted.”

## 8. EMC Countermeasure Examples

Detection of 3D gestures uses linear data sampled at regular time intervals. Therefore, unlike switches that only judge two values, i.e. ON/OFF, EMC countermeasures for 3D detection is difficult because a noise margin cannot be secured.

In this demo set, noise countermeasures are implemented from both hardware and software standpoints. This document describes examples of hardware-based countermeasures.

Required noise immunity and countermeasures differ depending on user system specifications. The countermeasures shown here are just a few examples and may not be applicable to all systems. When implementing countermeasures, please carry out thorough evaluations on your product system.

### 8.1 Power Input Section Filter

The filter circuit shown in Figure 8-1 is added to the demo set to suppress noise input and output from the power cable.

### 8.2 Metal Plate Shielding

The demo set is shielded with the metal plate shown in Figure 8-1 to improve the coupling between the ground (earth) and the CPU board GND, as well as strengthen the GND.

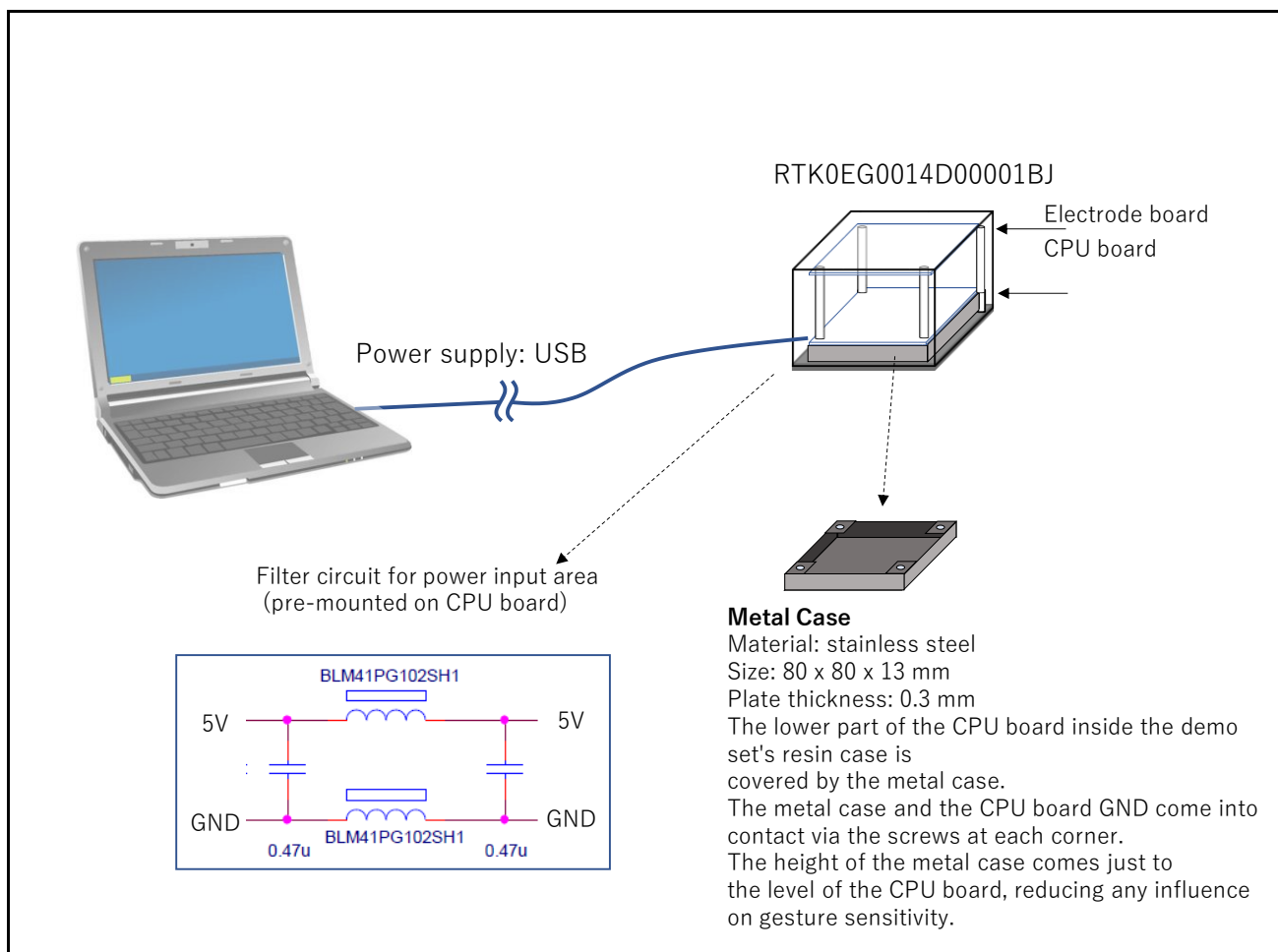


Figure 8-1 EMC Countermeasure Example

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## Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr 12, 2018		First edition issued

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

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### 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.

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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.

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