Capacitive Sensor Microcontrollers

Touchless Button Electrode Board

Introduction

This application note describes how to use the hardware of the Touchless button electrode board.

The touchless button electrode board is a product to evaluate and demonstrate Renesas Capacitive Sensor Microcontrollers. This product is worked with the CPU board of Capacitive Touch Evaluation System.

Target Device

RX130 Group

Related Documents

1. RX130 Group Touchless Button Demo Solution Sample Software (R11AN0504)
2. RX130 Group RX Capacitive Touch Evaluation System CPU Board User's Manual (R12UZ0003)

⚠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 JP2 (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".

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 : 2013 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

    - Equipment 1
    Product name: Touchless Button Electrode Board with housing
    Type name: RTK0ES1001D01001BJ
    Product name: RX130 Capacitive Touch Evaluation System CPU Board
    Type name: RTK0EG0004C01002BJ

    - Equipment 2
    Product name: Touchless Button Electrode Board without housing
    Type name: RTK0ES1001D02001BJ
    Product name: RX130 Capacitive Touch Evaluation System CPU Board
    Type name: RTK0EG0004C01002BJ

Environmental Compliance and Certifications:

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

Contents

1. Overview

The touchless button electrode board is a product that evaluates and demonstrates Renesas Capacitive Sensor Microcontrollers. This product is worked with the CPU board of Capacitive Touch Evaluation System.

The product has the following features.

- Compatible with CPU board

  At recent stage, the performance by RX130 CPU board (RTK0EG0004C01002BJ) was confirmed

  Demonstration can be performed in combination with the sample software described in related document.

- Two types of kits (with/without housing)
- 3 types of self-capacitive electrodes (4 buttons, 9 buttons, 12 buttons)
- Power supply (from CPU board)
- Stand-alone operation (no need of PC)

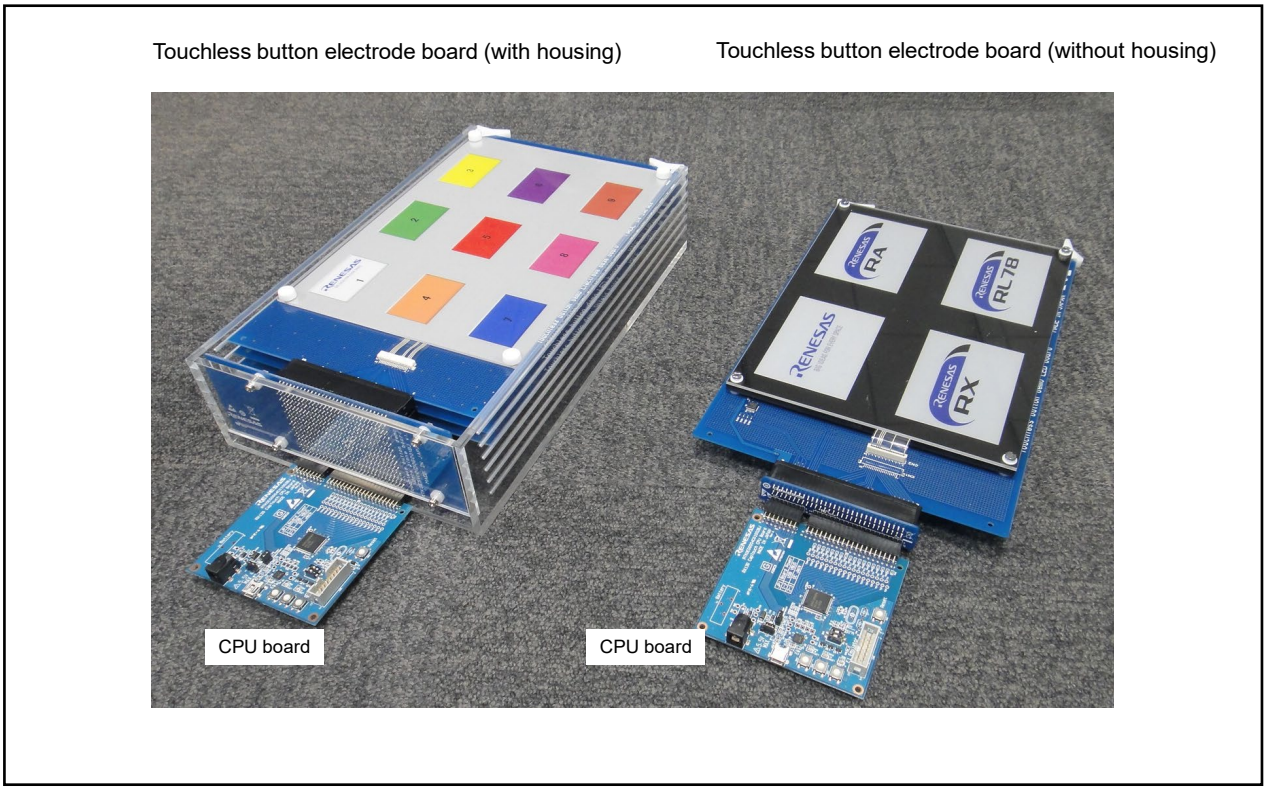
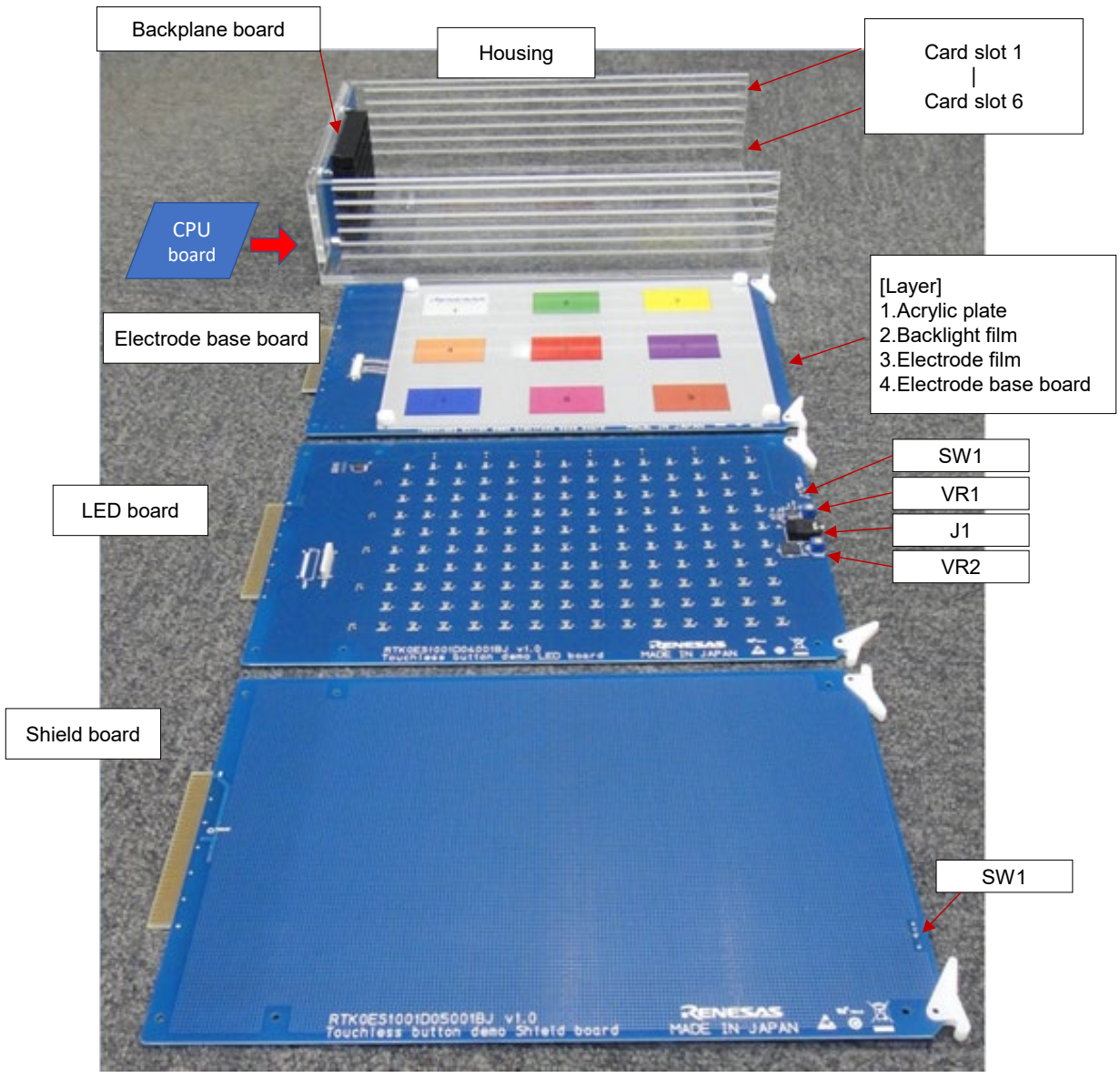


Figure 1-1 Touchless button electrode board

2. Product Configuration

2.1 Product configuration (with housing)



[Standard setting] The position of each board is inserted as followings:

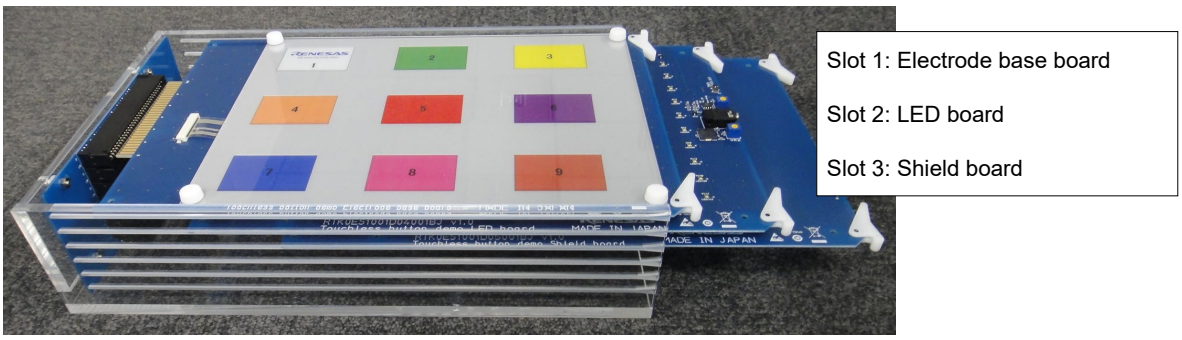


Figure 2-1 Touchless button electrode boad (with housing): Production configuraiton

2.2 Product configuration (without housing)

'Without housing' only uses the LED board from the 3 types of boards in 'with housing' demo. A CPU relay board is used to connect with CPU board

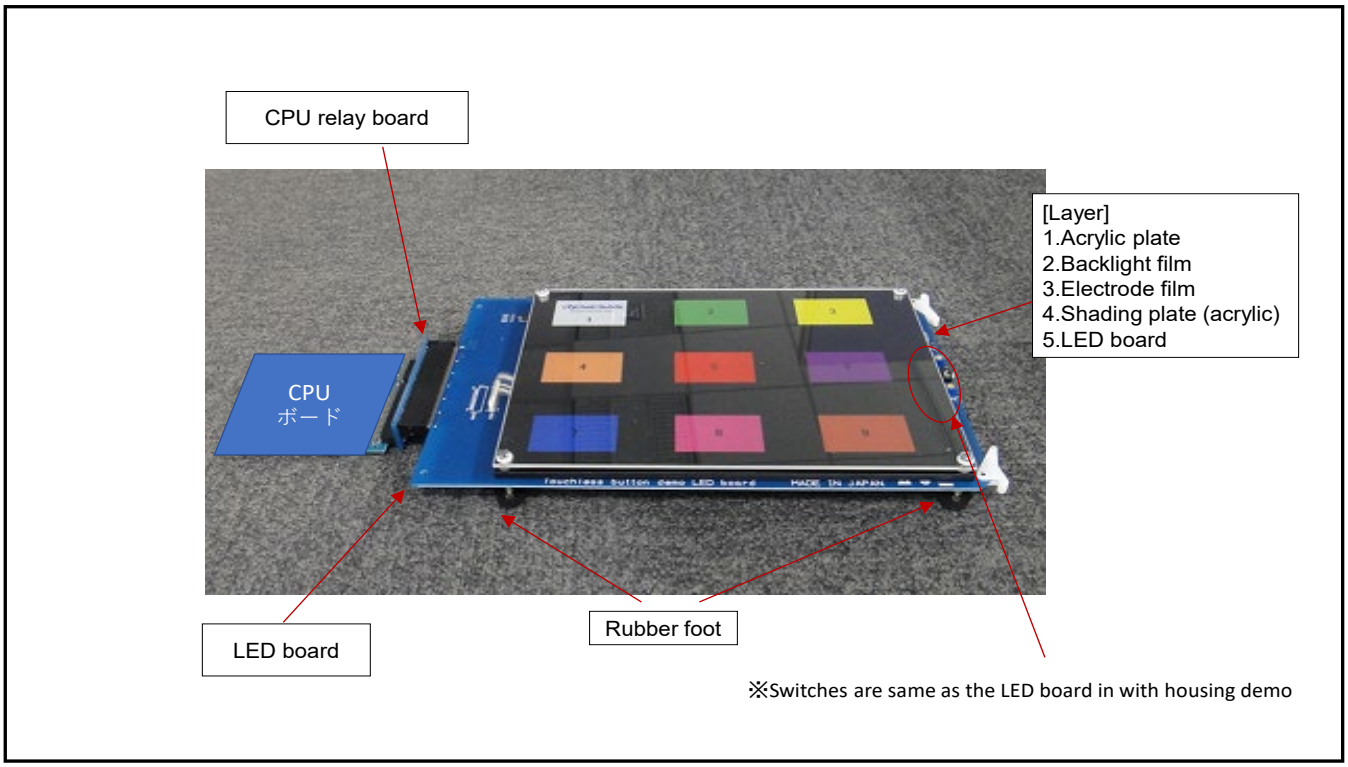


Figure 2-2 Touchless button electrode boad (without housing): Production configuraiton

3. Assembly

3.1 Electrode board replacement, CPU board connection (with housing)

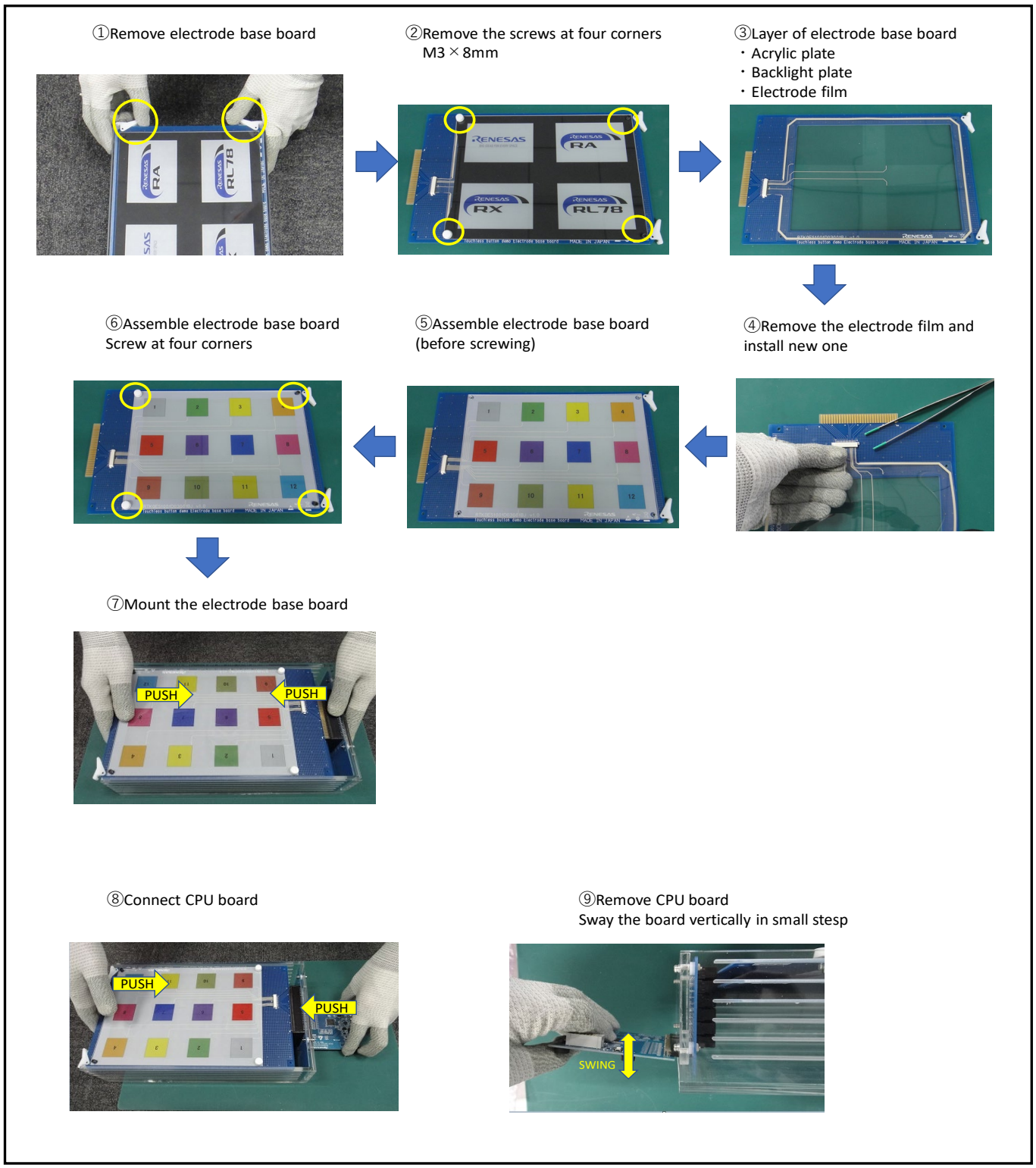


Figure 3-1 Replace electrodes, connect CPU board (with housing)

3.2 Electrode board replacement, CPU board connection (without housing)

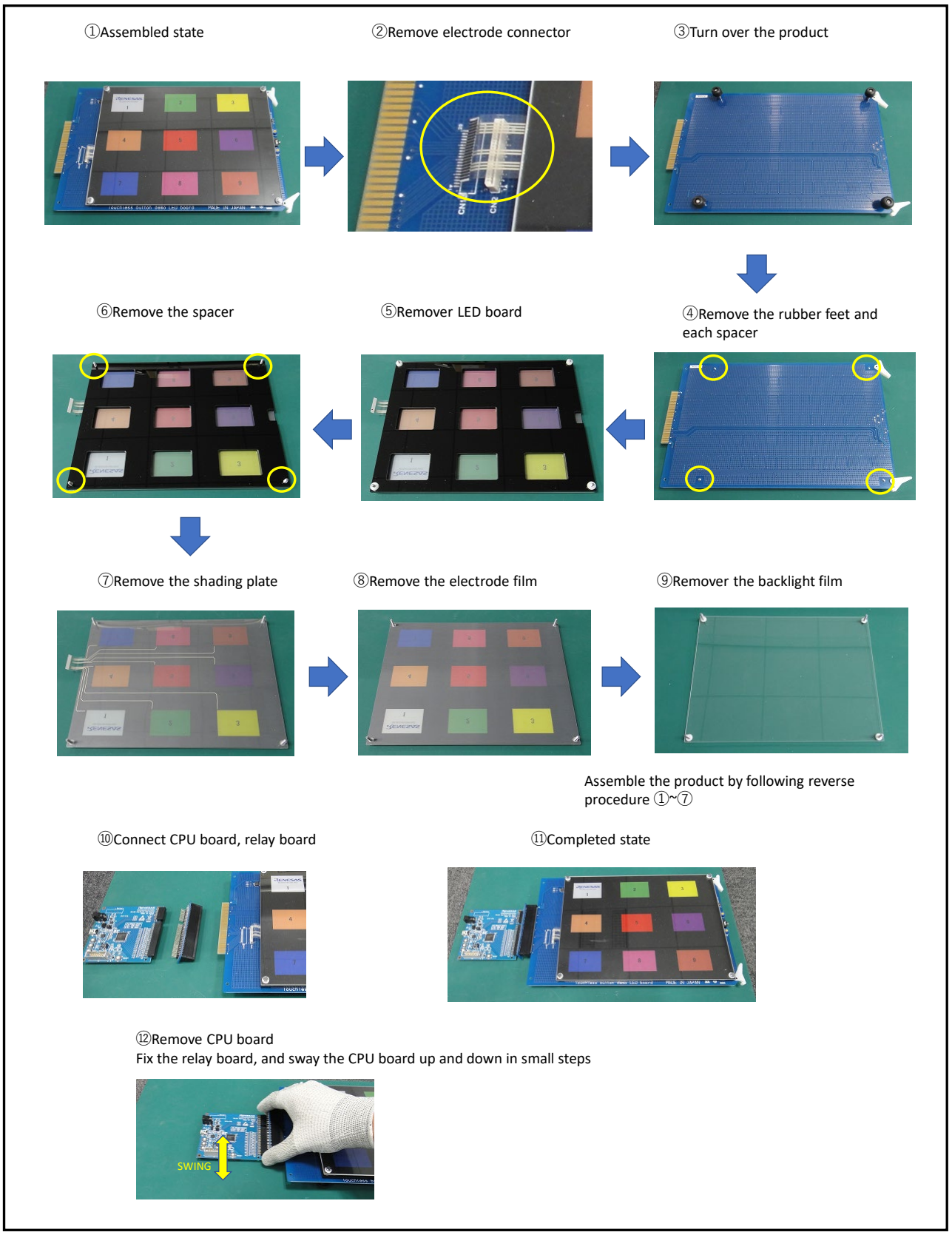


Figure 3-2 Replace electrodes, connect CPU board (without housing)

4. Switch Setting

4.1 LED board

LED board is used both in ‘with housing’ and ‘without housing’ type.

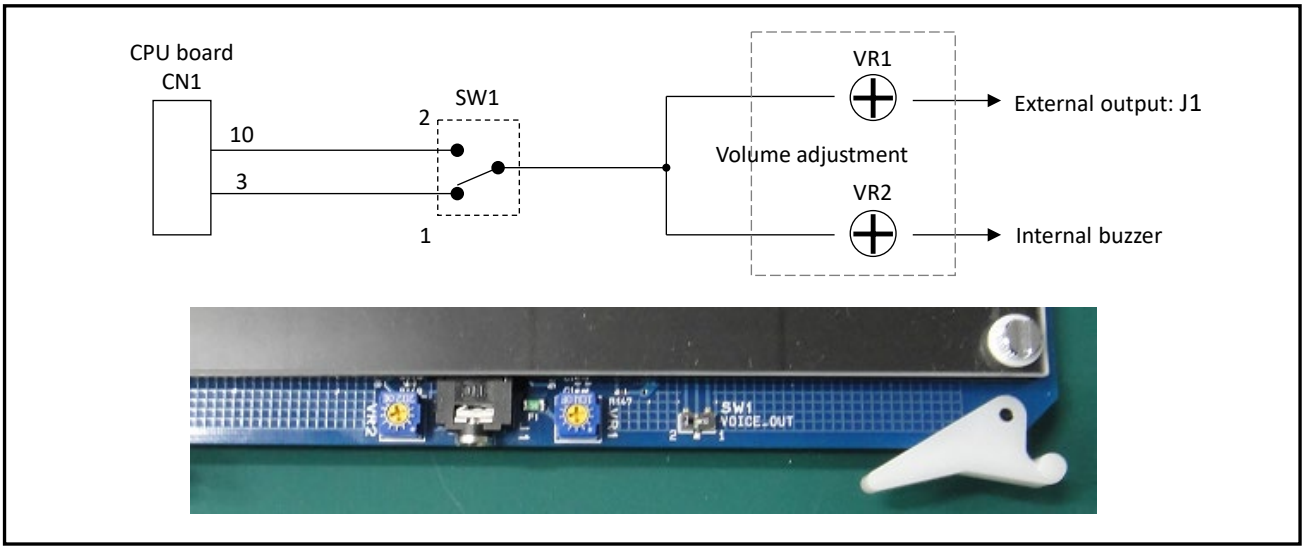


Figure 4-1 Switches on LED board

4.1.1 SW1 Sound source terminal selection

SW1 selects the sound source terminal from the CPU board

For RX130 CPU board sample program, set SW1 to ‘1’

4.1.2 VR1 External speaker’s volume adjustment

VR1 adjusts the volume of external speaker connected to J1.

Twist to the right to make the volume higher, and twist to the left to make the volume lower.

4.1.3 VR2 Internal buzzer’s volume adjustment

VR2 adjusts the volume of the buzzer on LED board.

Twist to the right to make the volume higher, and twist to the left to make the volume lower.

The buzzer on the board doesn’t make a sound when terminal of external speaker is connected to J1.

4.1.4 J1 External speaker connector

When using external speakers, please connect passive speakers.

4.2 Shield board

Shield board is only used in ‘with housing’ type.

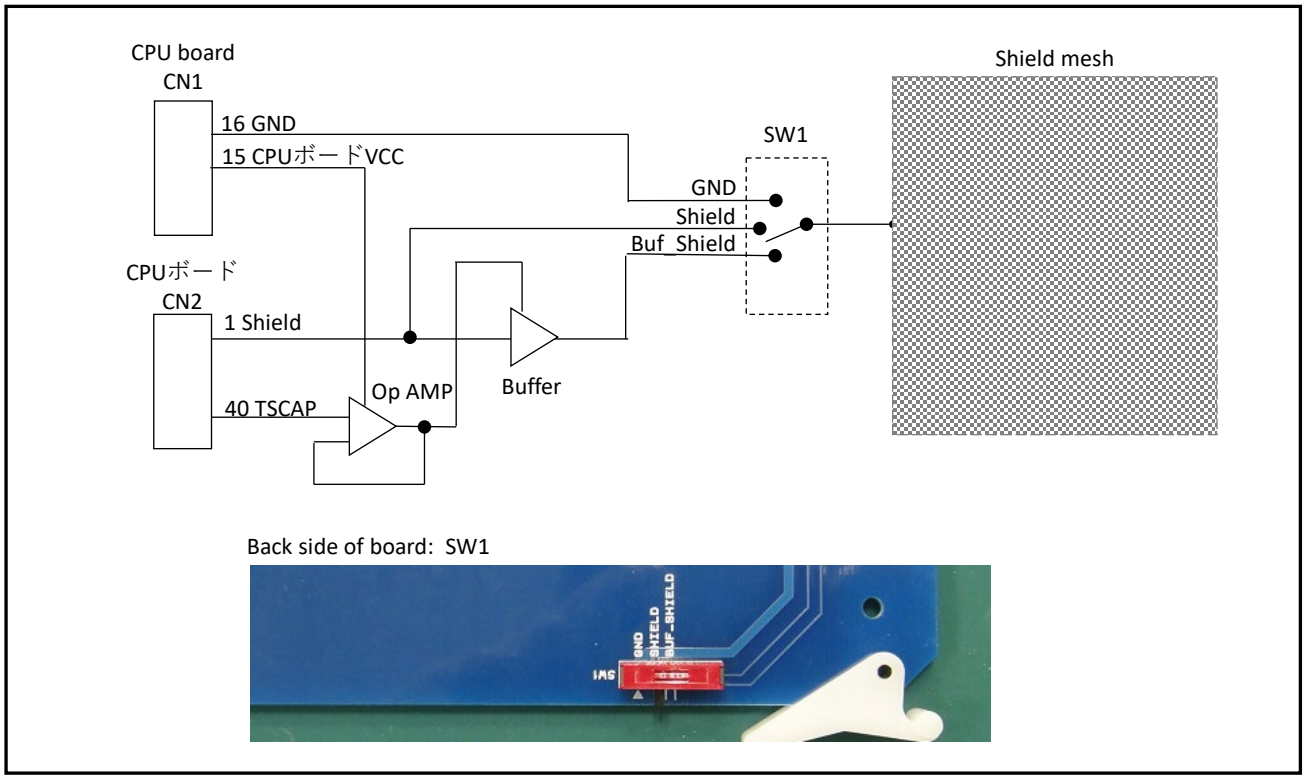


Figure 4-2 Switch on shield board SW1

4.2.1 SW1

SW1 selects the signal that connects to shield mesh on the entire surface of the shield board.

For RX130 CPU board sample program, set SW1 to ‘GND’

5. Block Diagram

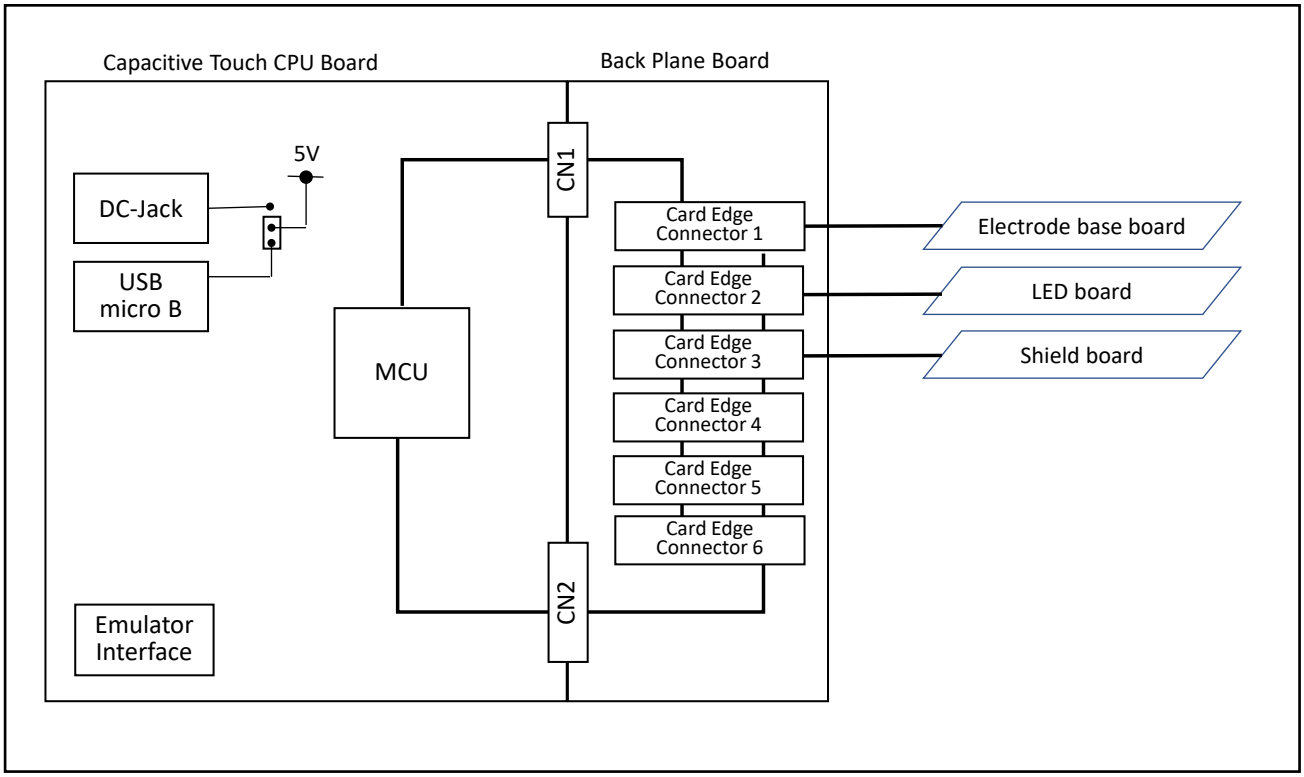


Figure 5-1 Block Diagram (with housing)

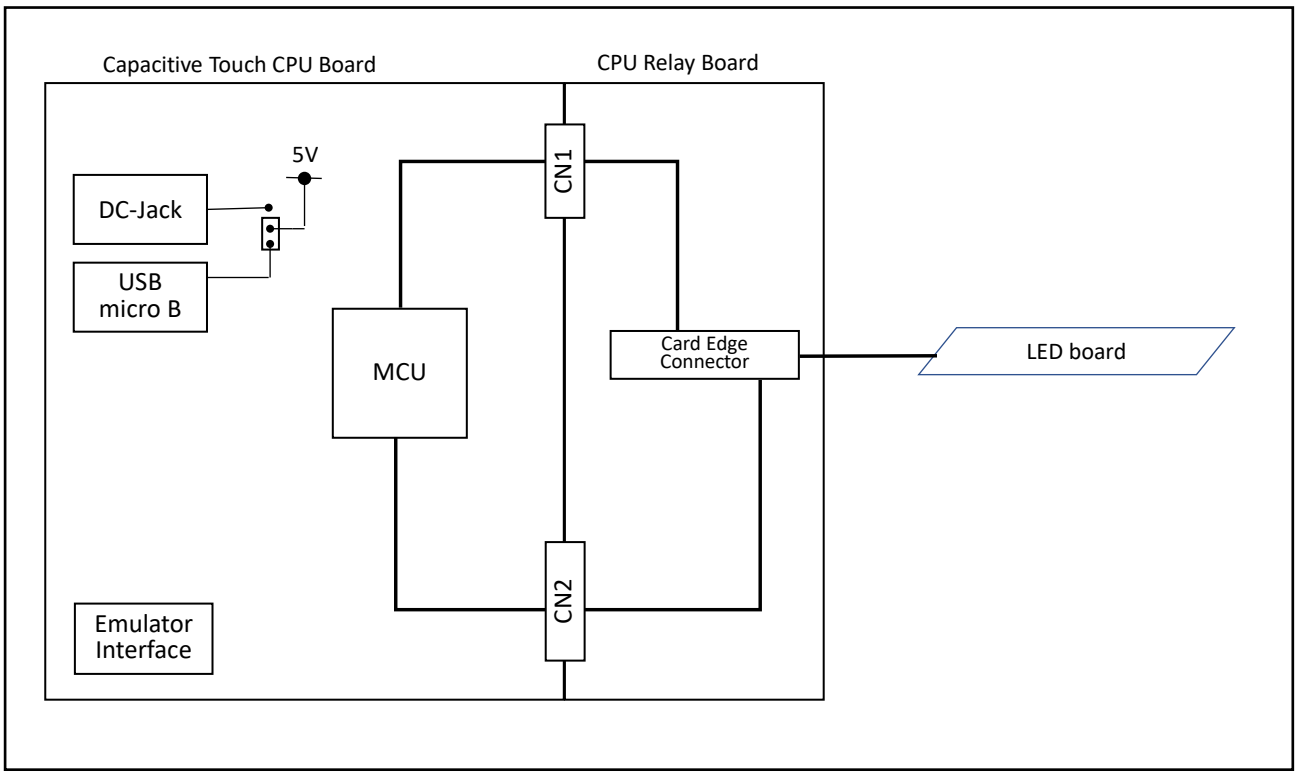


Figure 5-2 Block Diagram (without housing)

6. Operational Explanation

For operations other the procedure from assembly to power on, please refer to the application note ‘Touchless Button Electrode Board Sample Software’.

6.1 Power on

The power of the system is supplied from the CPU board.

Turn off the power when assembling the system. After all the assembly is completed, turn on the CPU board power to start the operation.

For the operation after the start, refer to the application note ‘Touchless Button Electrode Board Sample Software’ for each CPU board.

6.2 Combination of board connection to backplane board (with housing)

Electrode base board, LED board, Shield board are connected to backplane board. It is possible to change the connection positions and no problems will occur on the circuit (signal collision, etc.).

The parasitic capacitance of the electrodes may change due to the change of the boards’ coupling capacitance if the board space is changed.

7. Circuit Diagram

7.1 RTK0ES1001D03001BJ Electrode base board

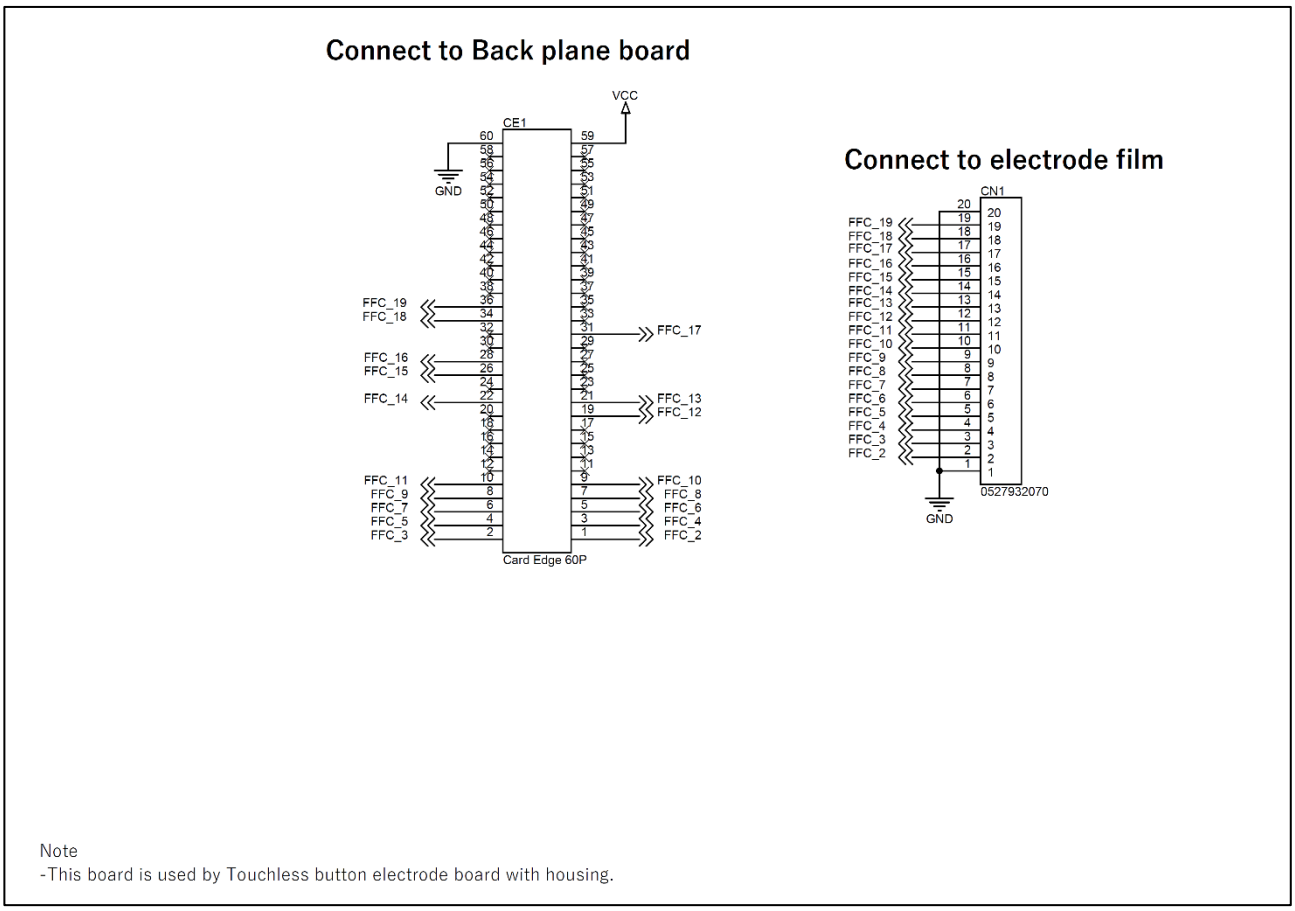


Figure 7-1 Electrode base board: Circuit Diagram

7.2 RTK0ES1001D04001BJ LED board

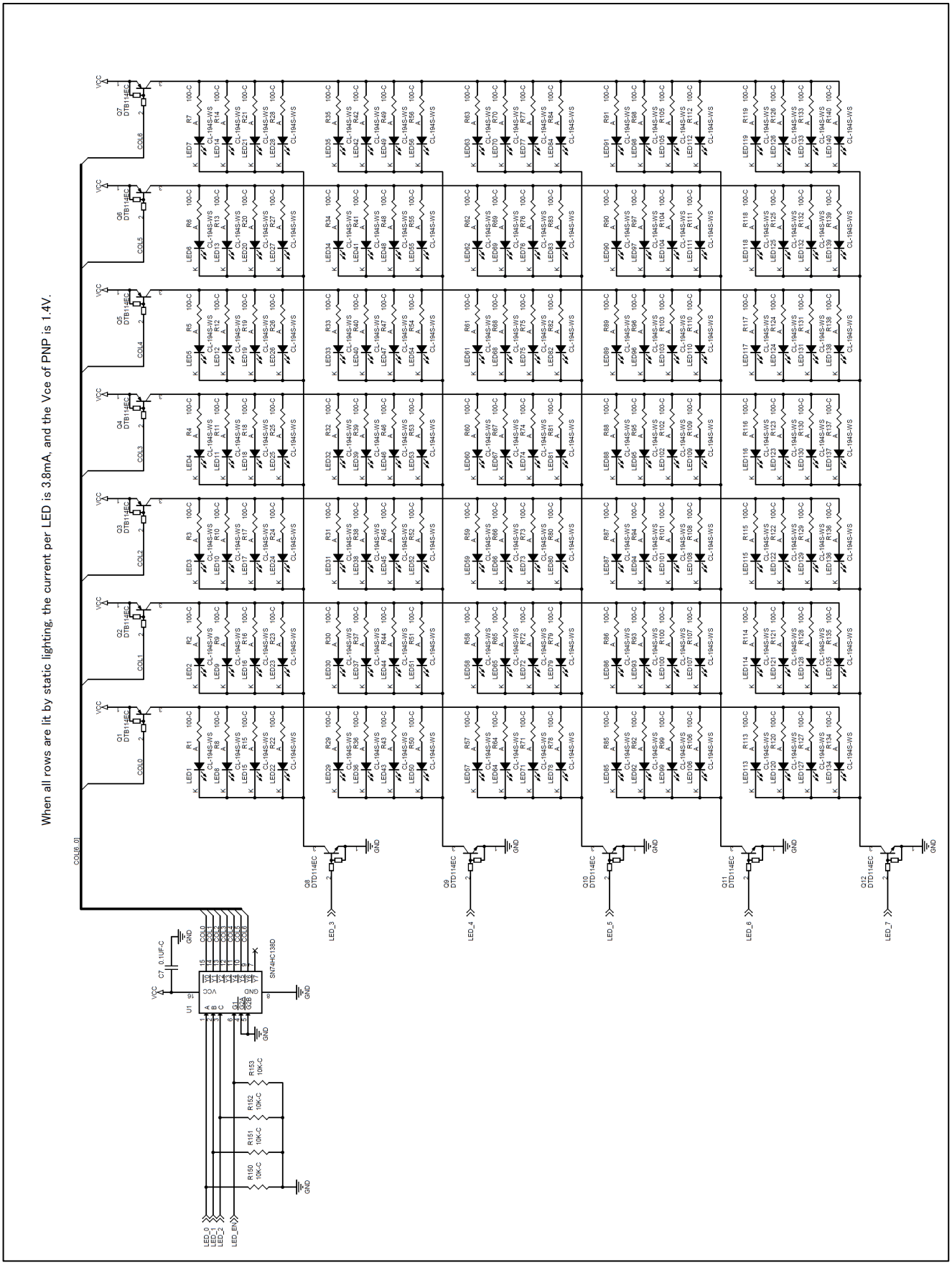


Figure 7-2 LED board: Circuit Diagram (1/2)

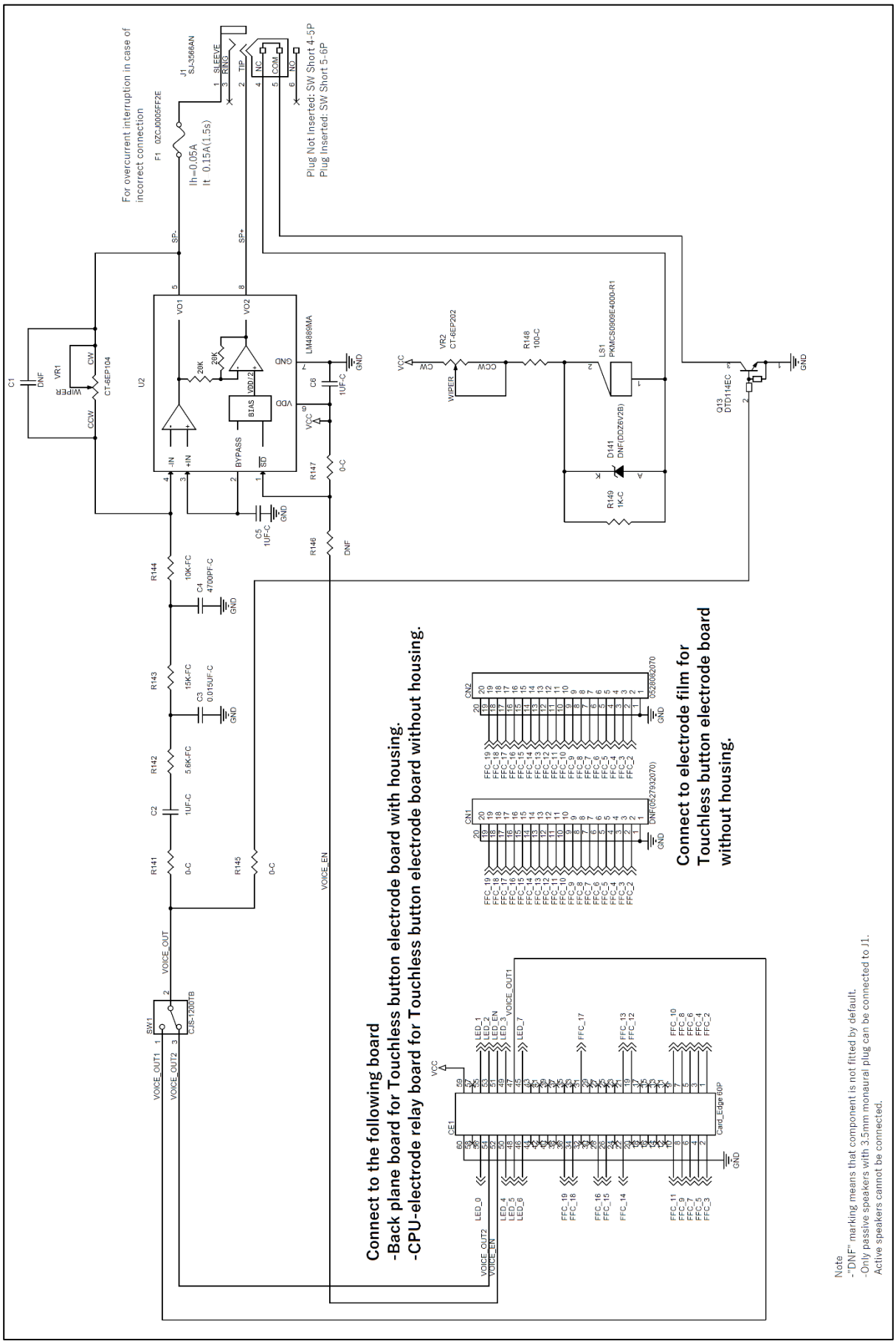


Figure 7-3 LED board: Circuit Diagram (2/2)

7.3 RTK0ES1001D05001BJ Shield board

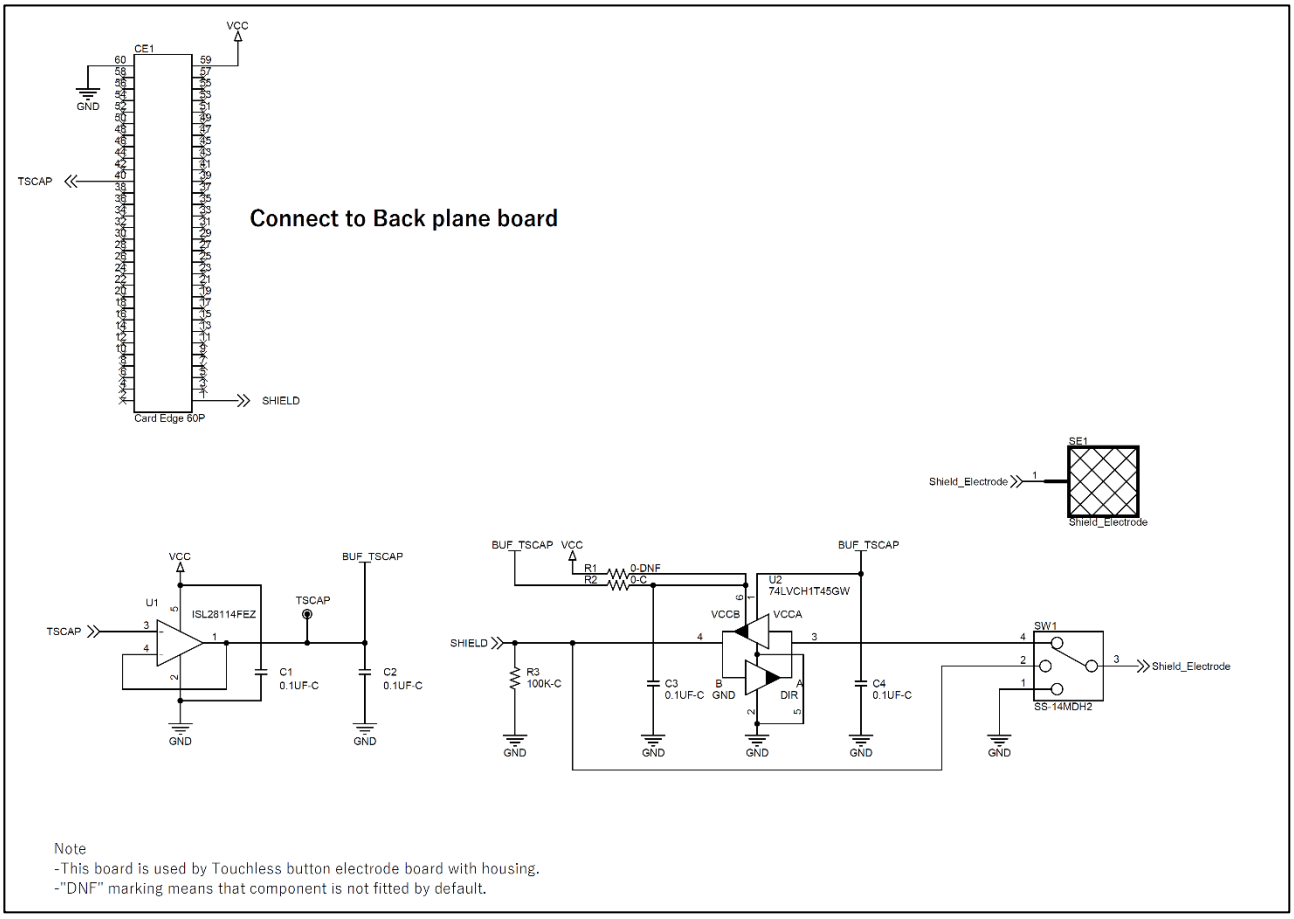


Figure 7-4 Shield board: Circuit Diagram

7.4 RTK0ES1001D06001BJ Backplane board

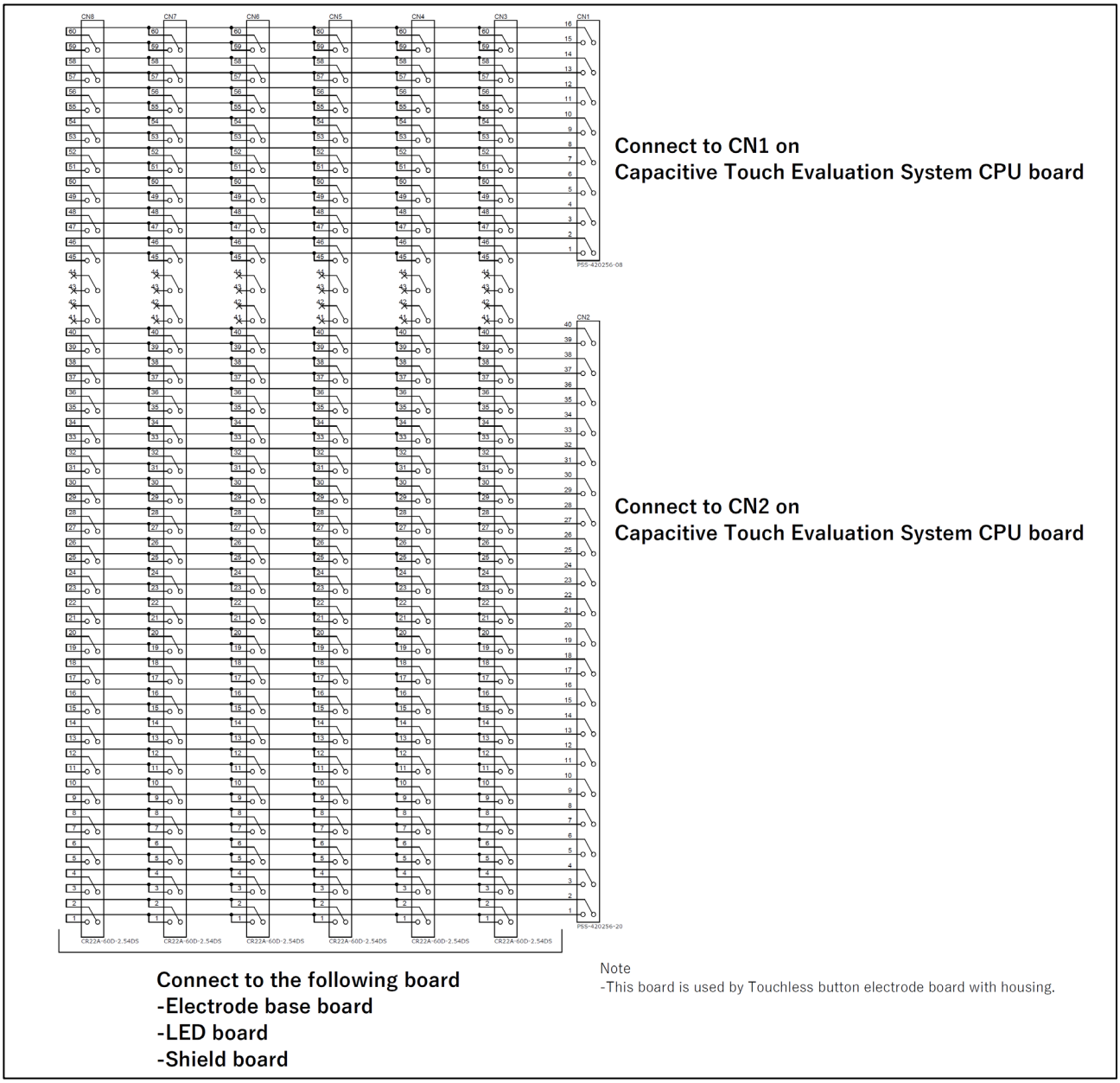


Figure 7-5 Backplane board: Circuit Diagram

7.5 RTK0ES1001D07001BJ CPU-Electrode relay board

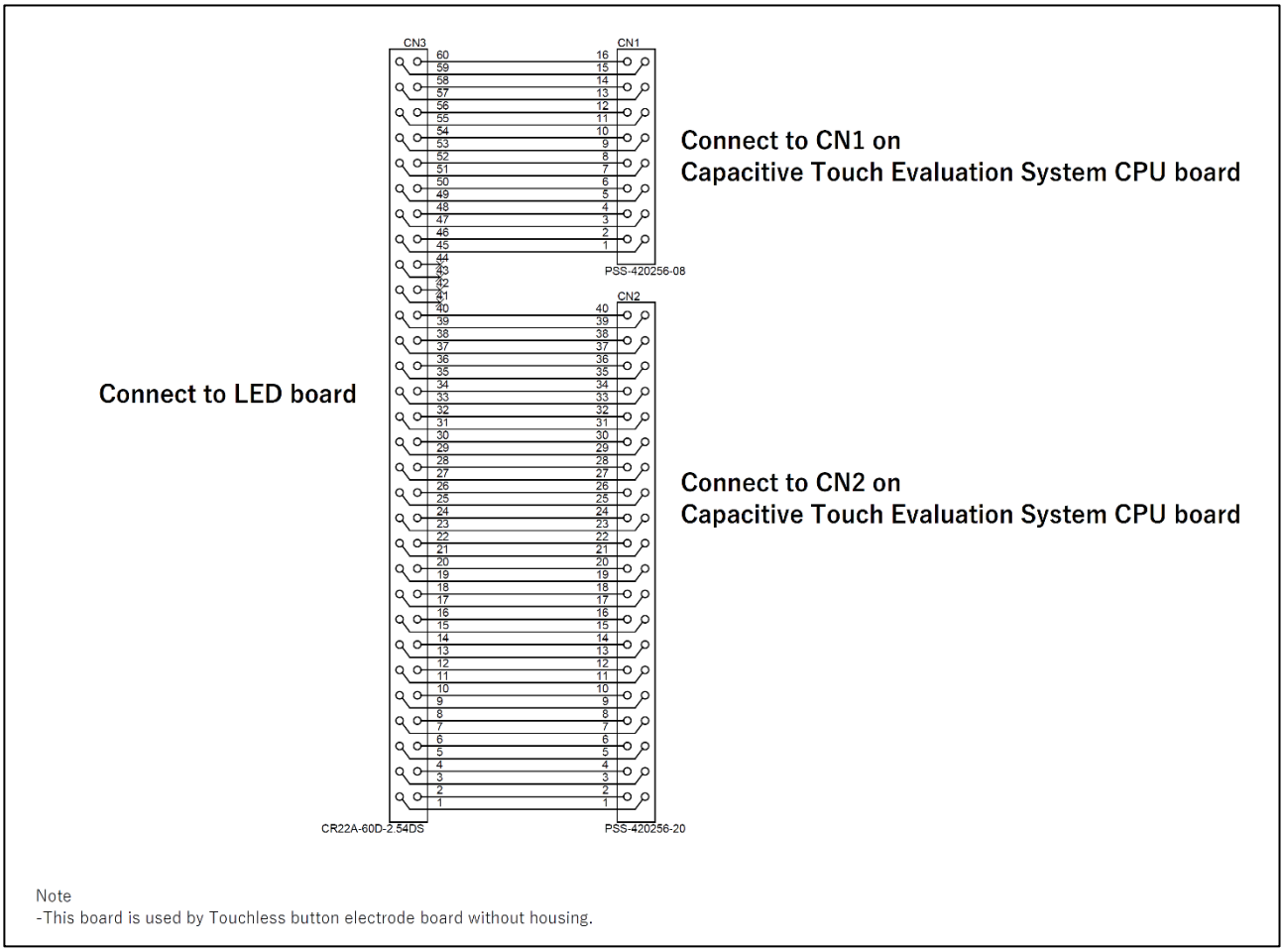


Figure 7-6 CPU-Electrode relay board: Circuit Diagram

8. Board Layouts

All board layouts are component side view.

8.1 RTK0ES1001D03001BJ Electrode base board

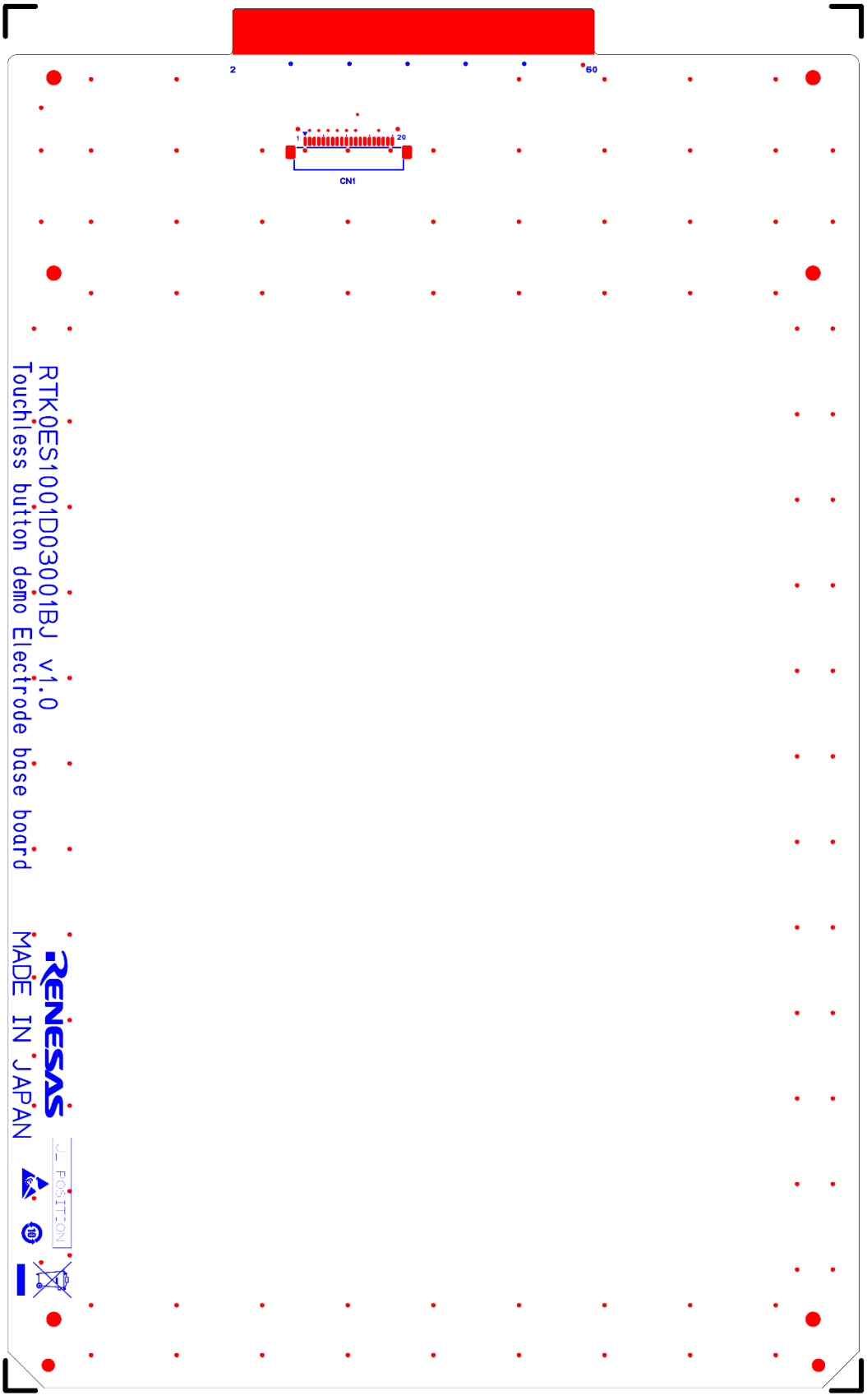


Figure 8-1 Electrode base board: Component Side Silkscreen

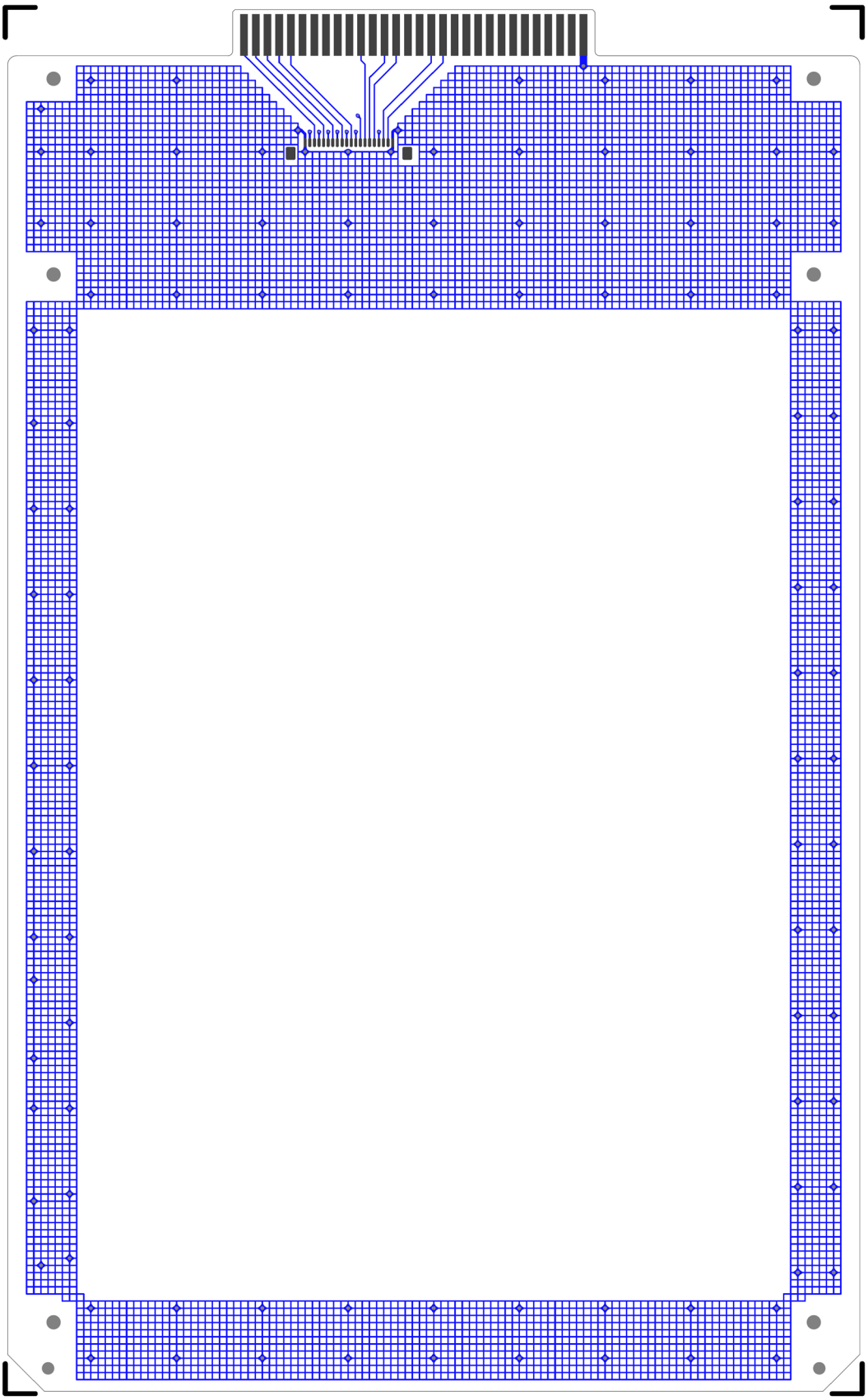


Figure 8-2 Electrode base board: Component Side Pattern

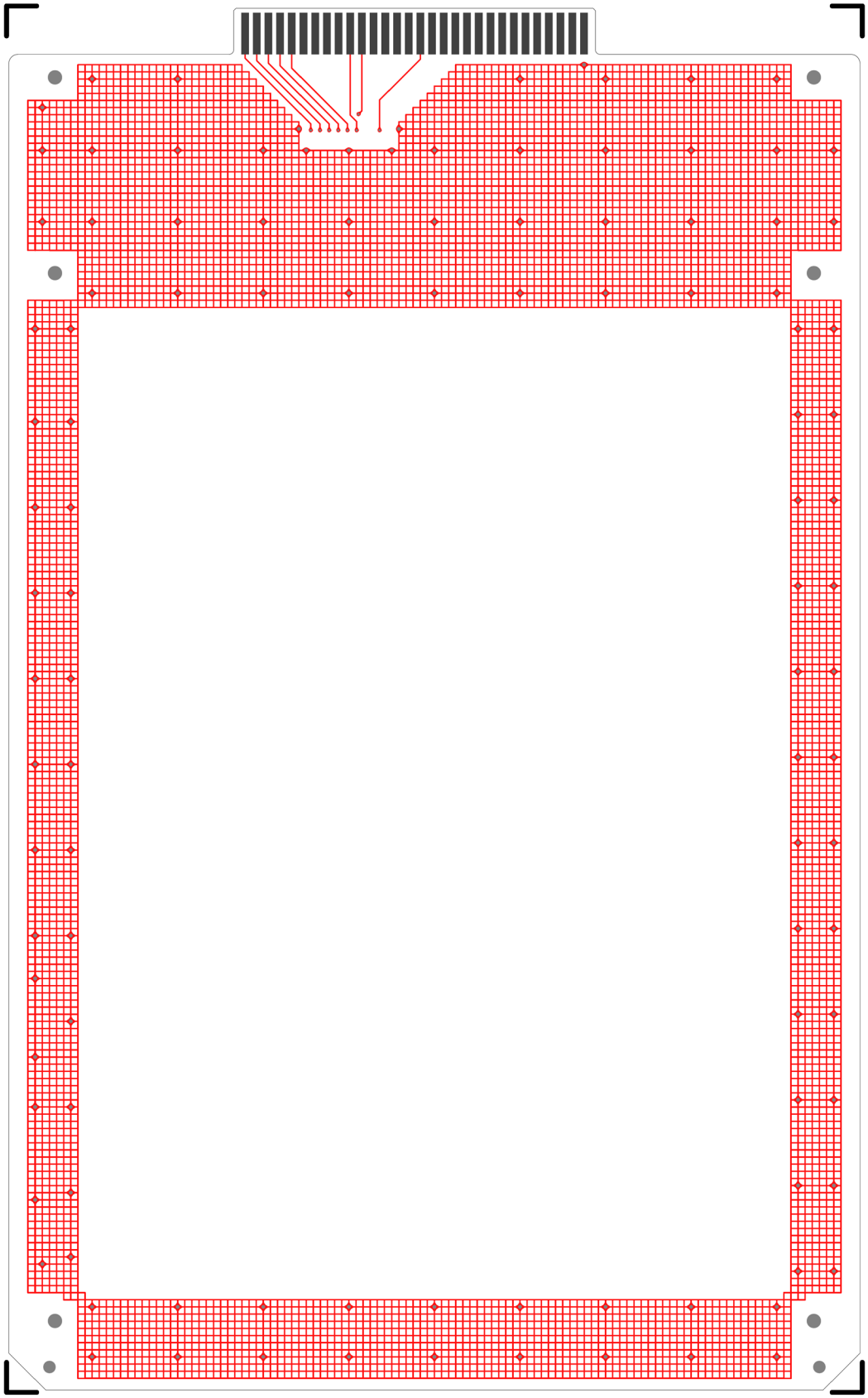


Figure 8-3 Electrode base board: Solder Side Pattern

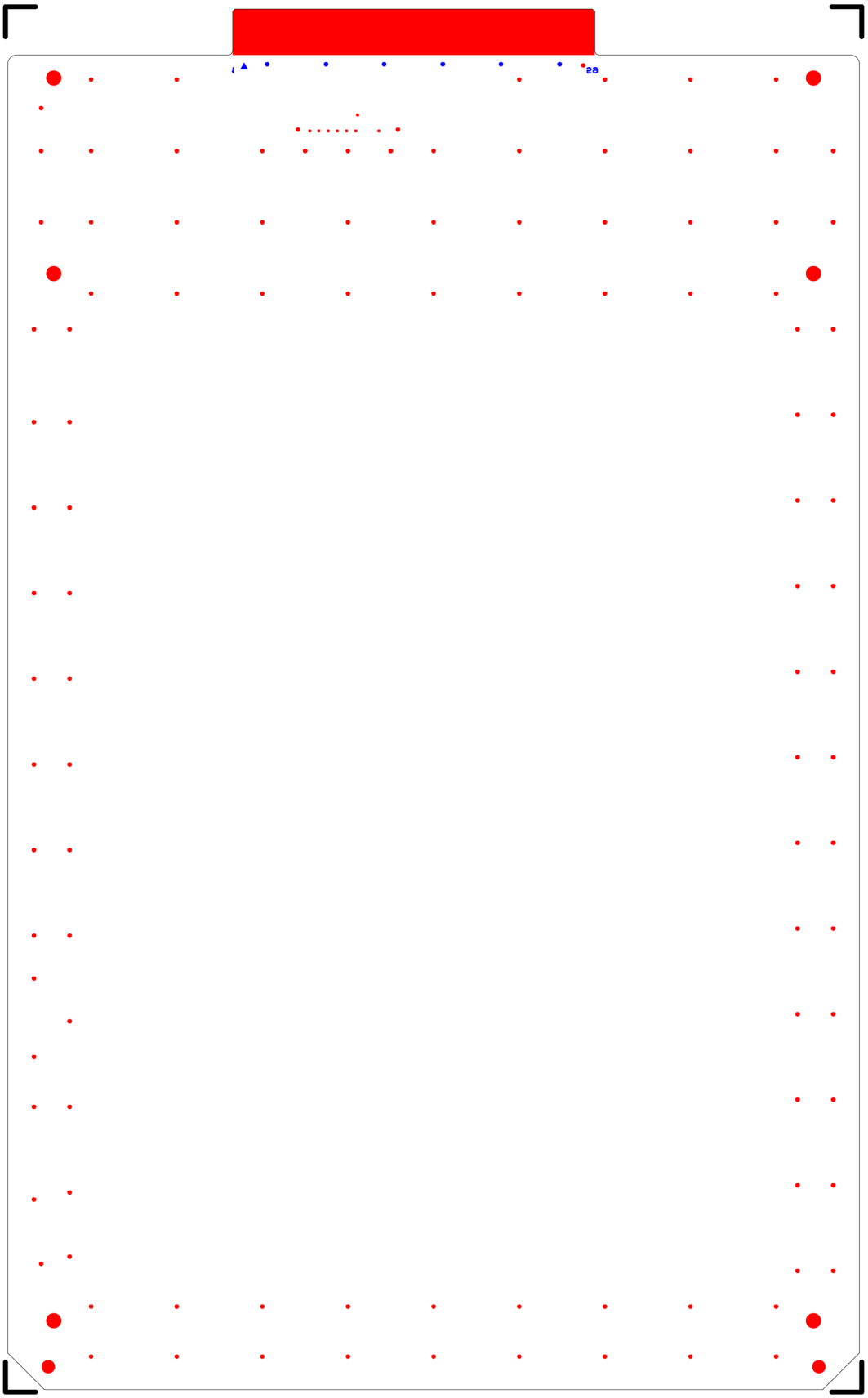


Figure 8-4 Electrode base board: Solder Side Silkscreen

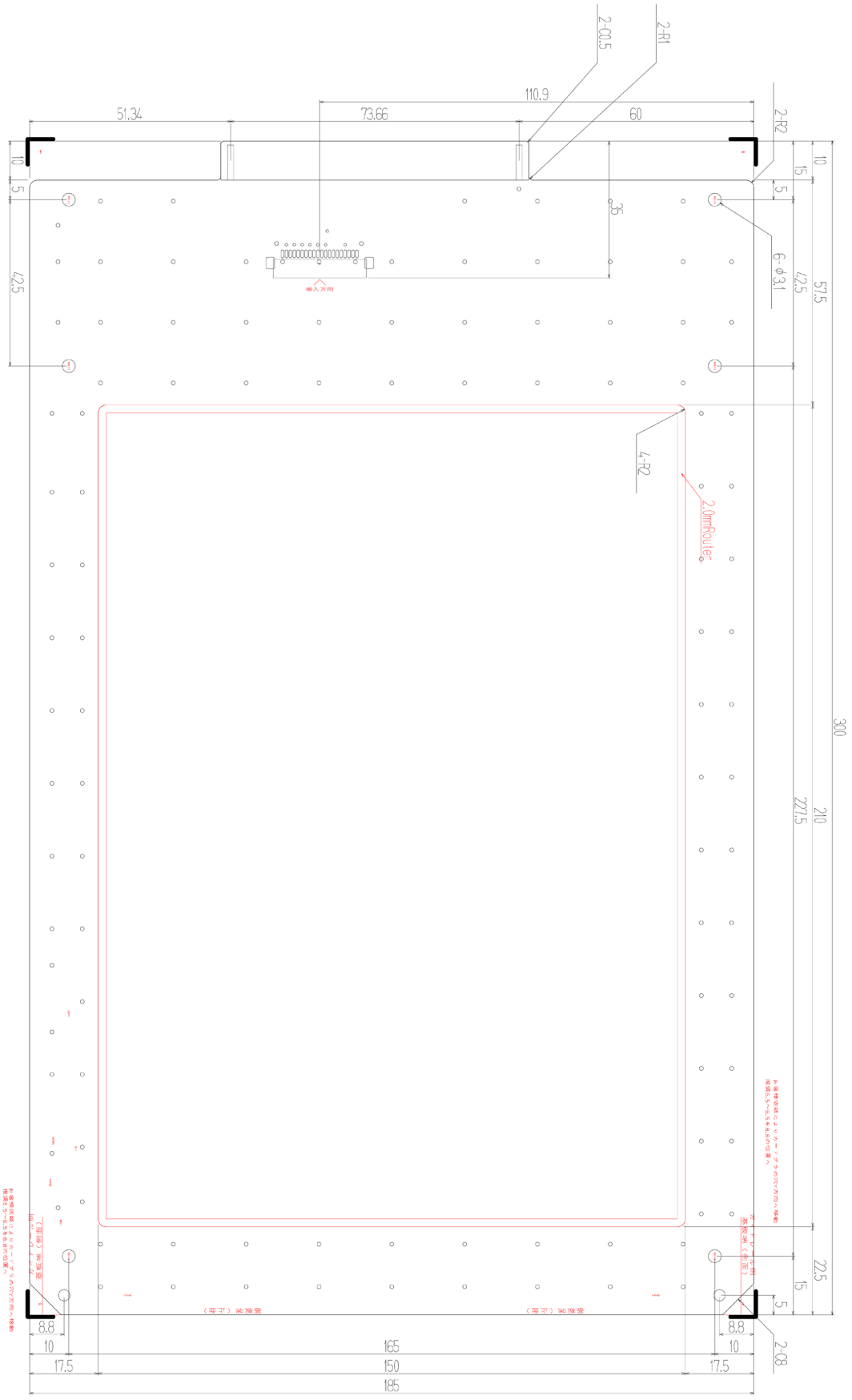


Figure 8-5 Electrode base board: Board Outline

8.2 RTK0ES1001D04001BJ LED board

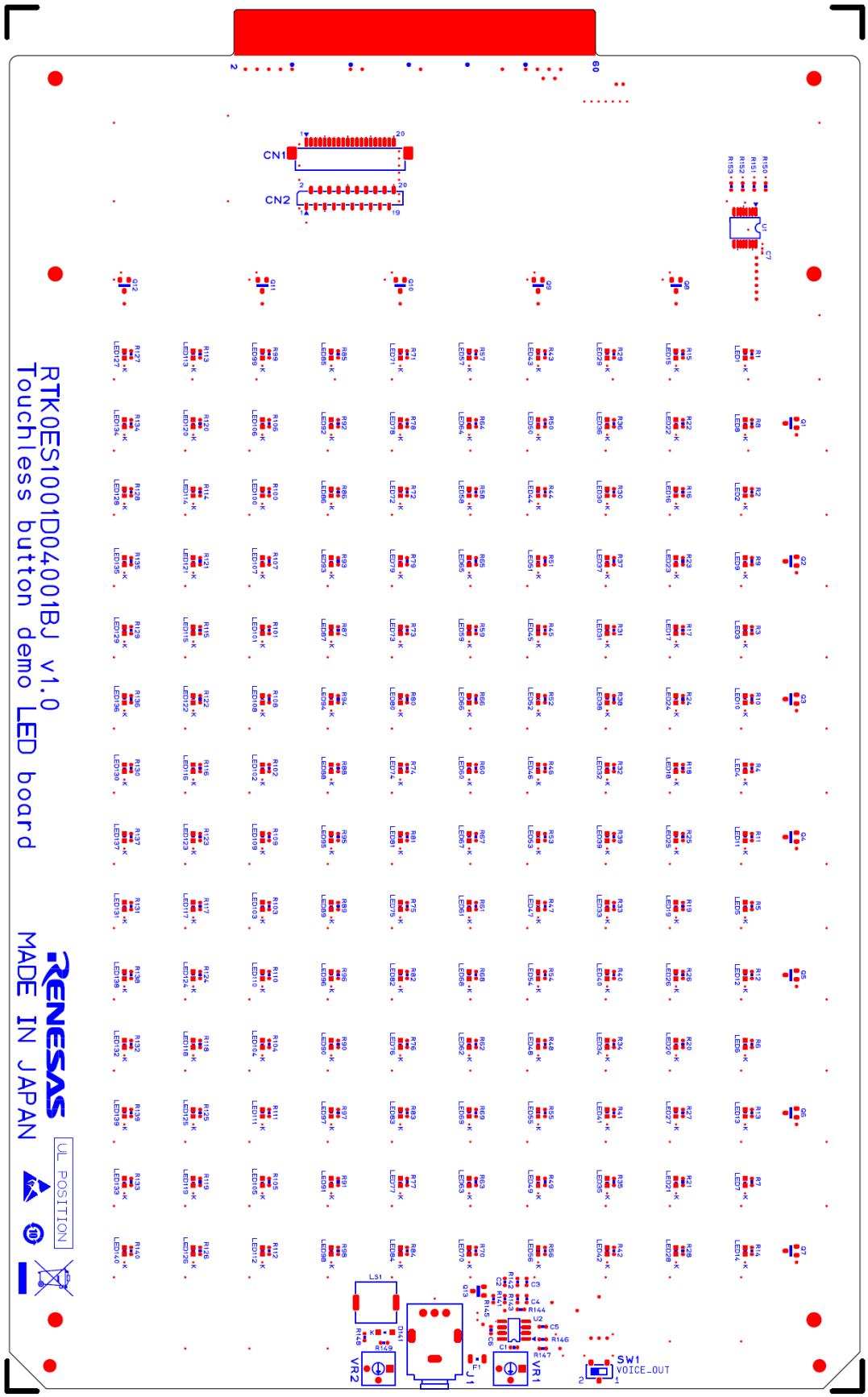


Figure 8-6 LED board: Component Side Silkscreen

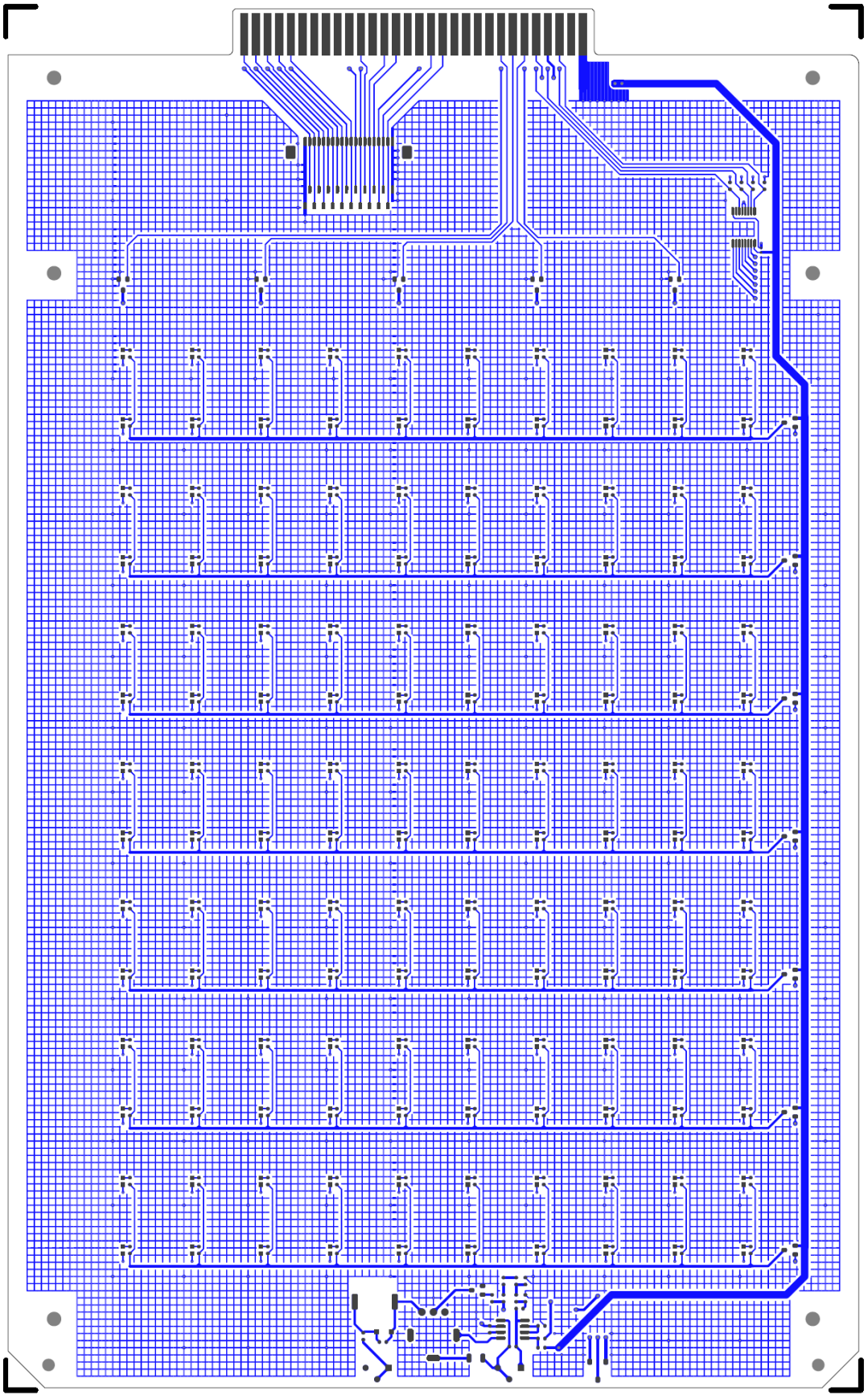


Figure 8-7 LED board: Component Side Pattern

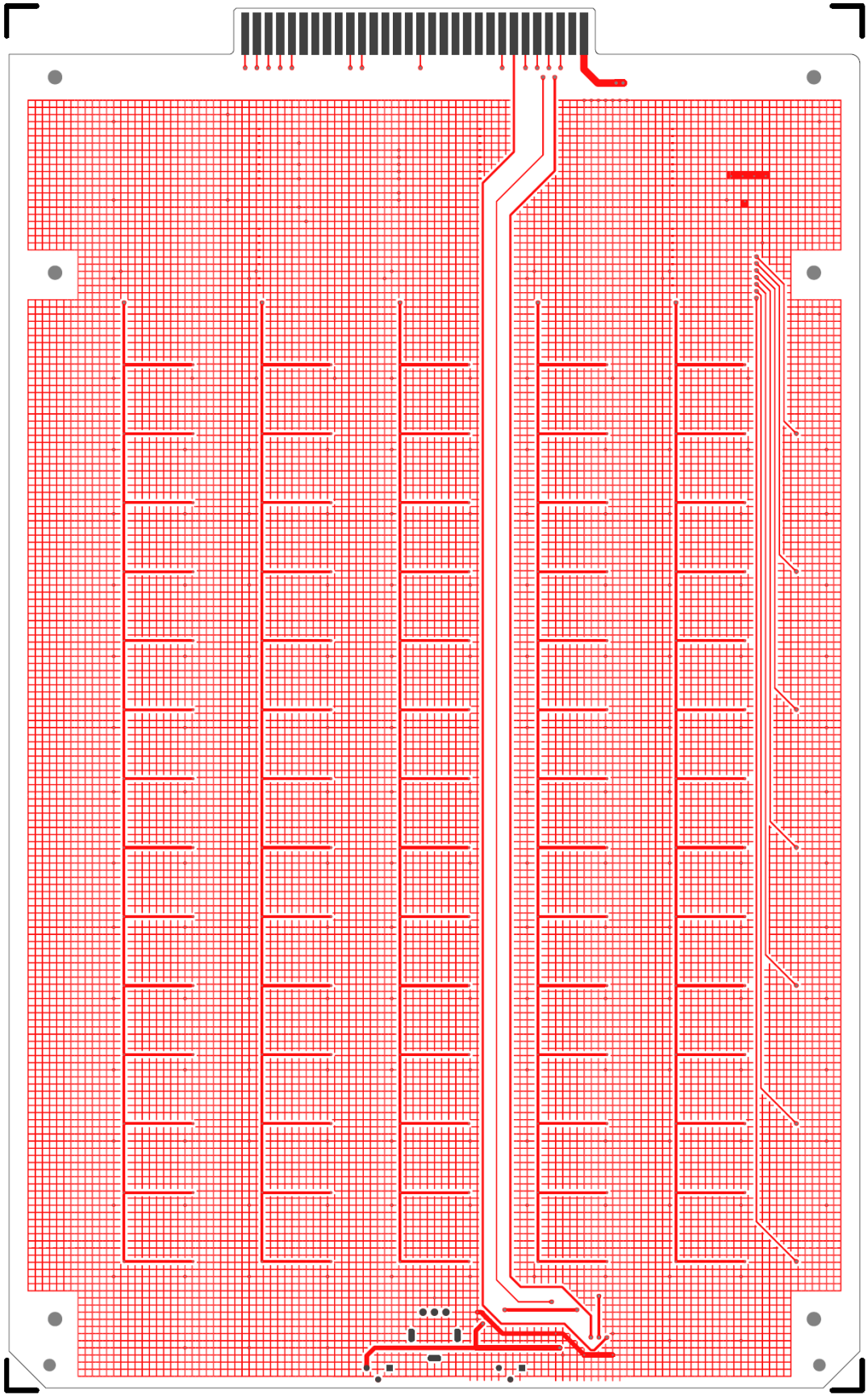


Figure 8-8 LED board: Solder Side Pattern

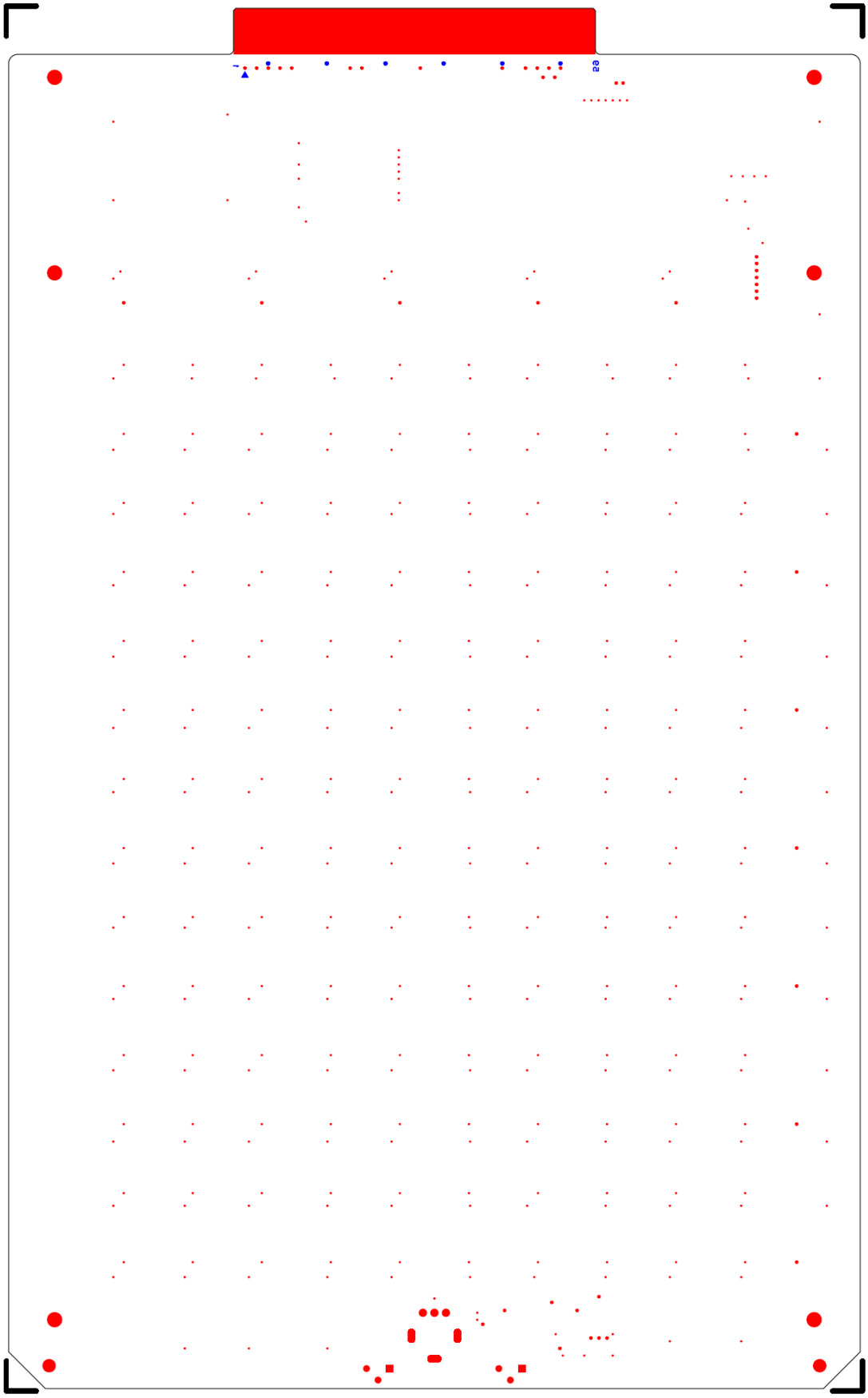


Figure 8-9 LED board: Solder Side Silkscreen

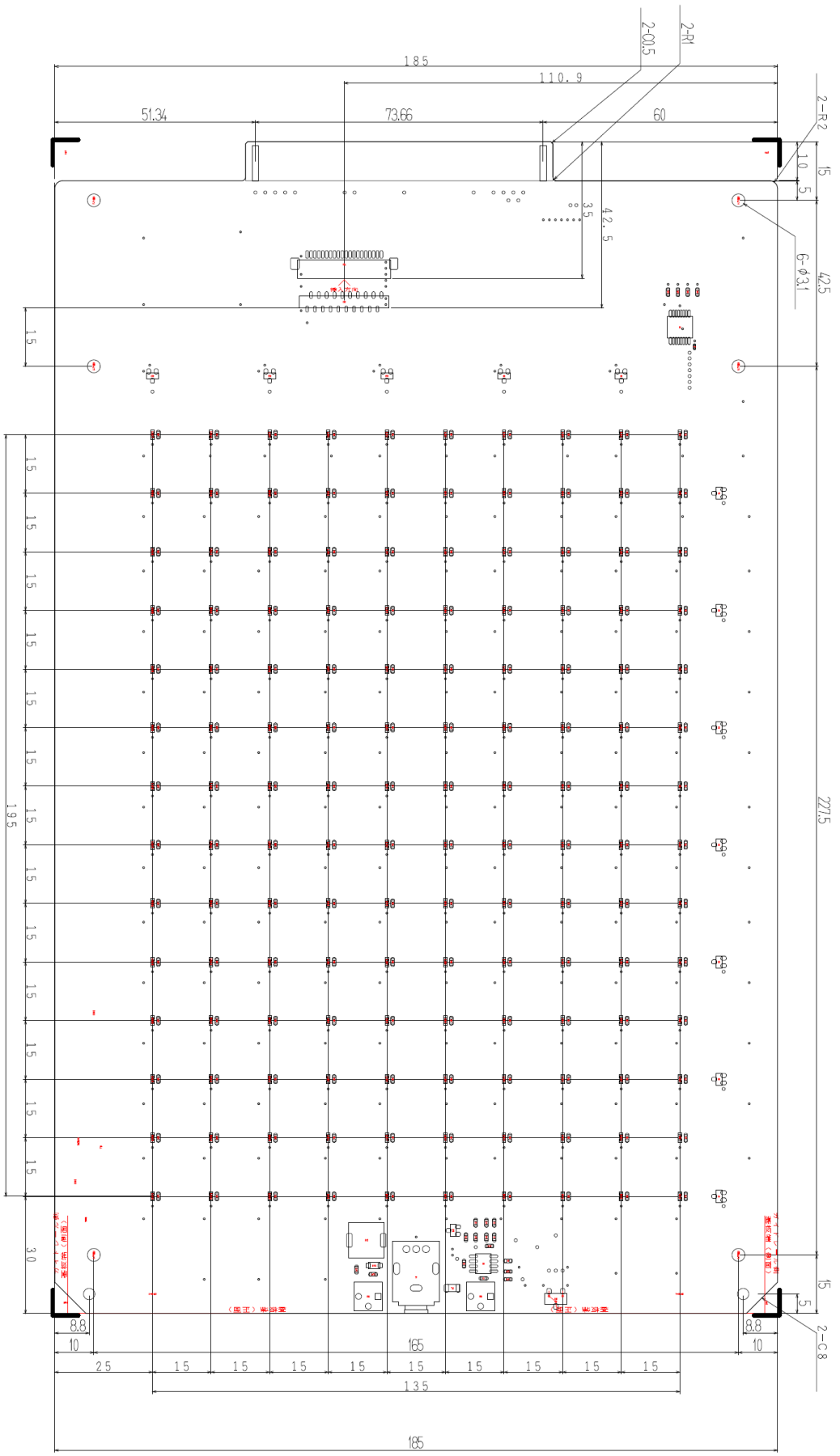


Figure 8-10 LED board: Board Outline

8.3 RTK0ES1001D05001BJ Shield board

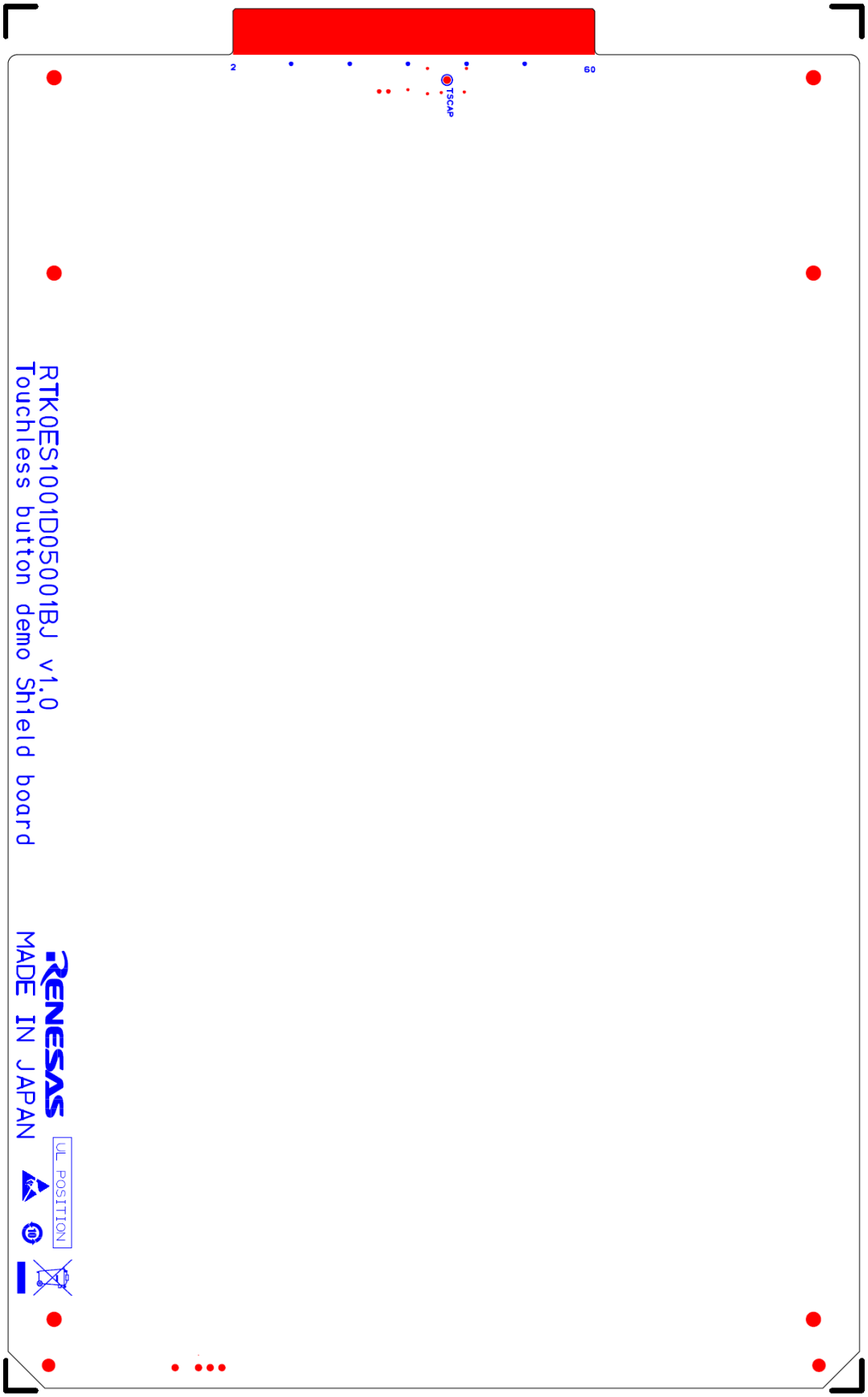


Figure 8-11 Shield board: Component Side Silkscreen

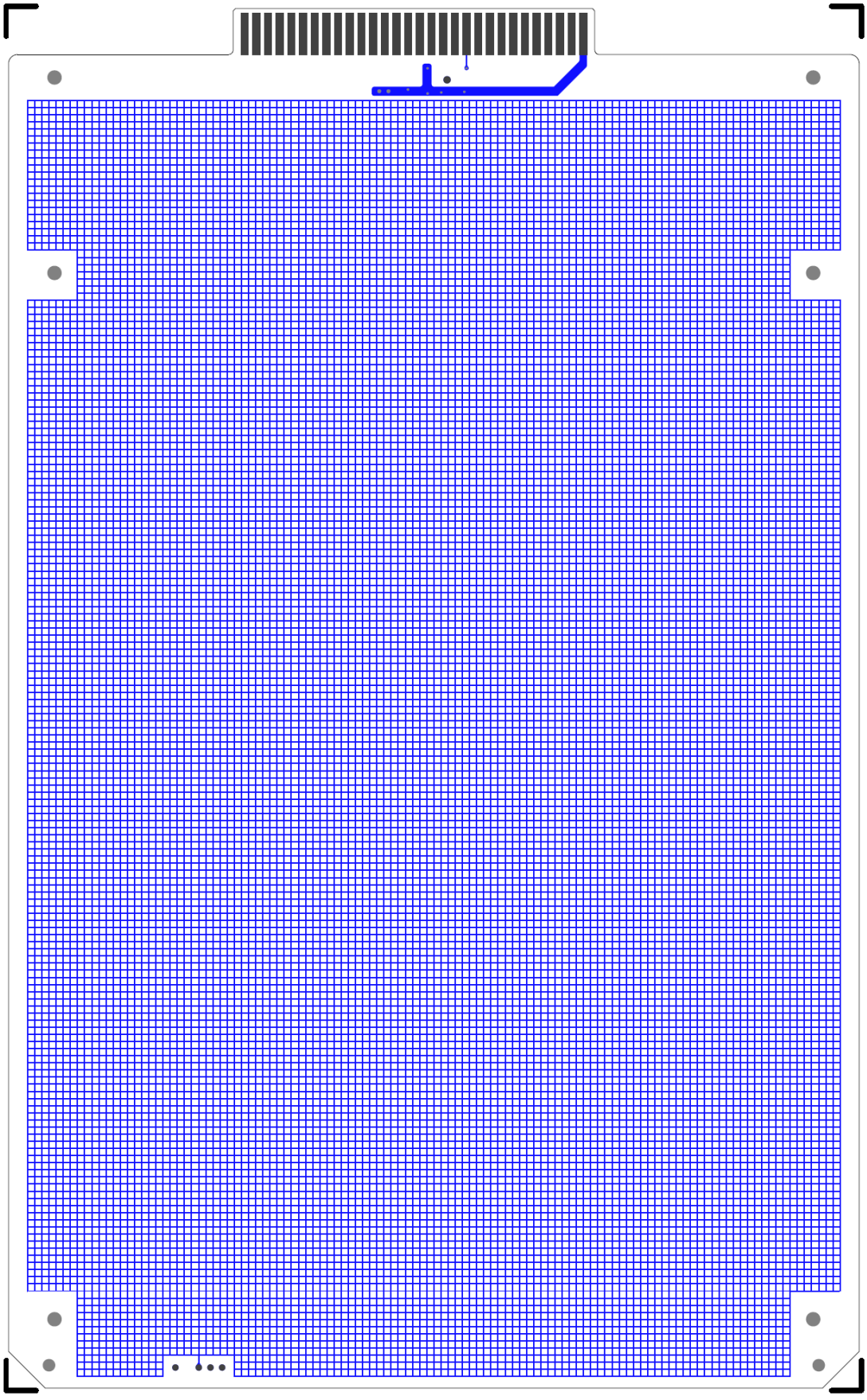


Figure 8-12 Shield board: Component Side Pattern

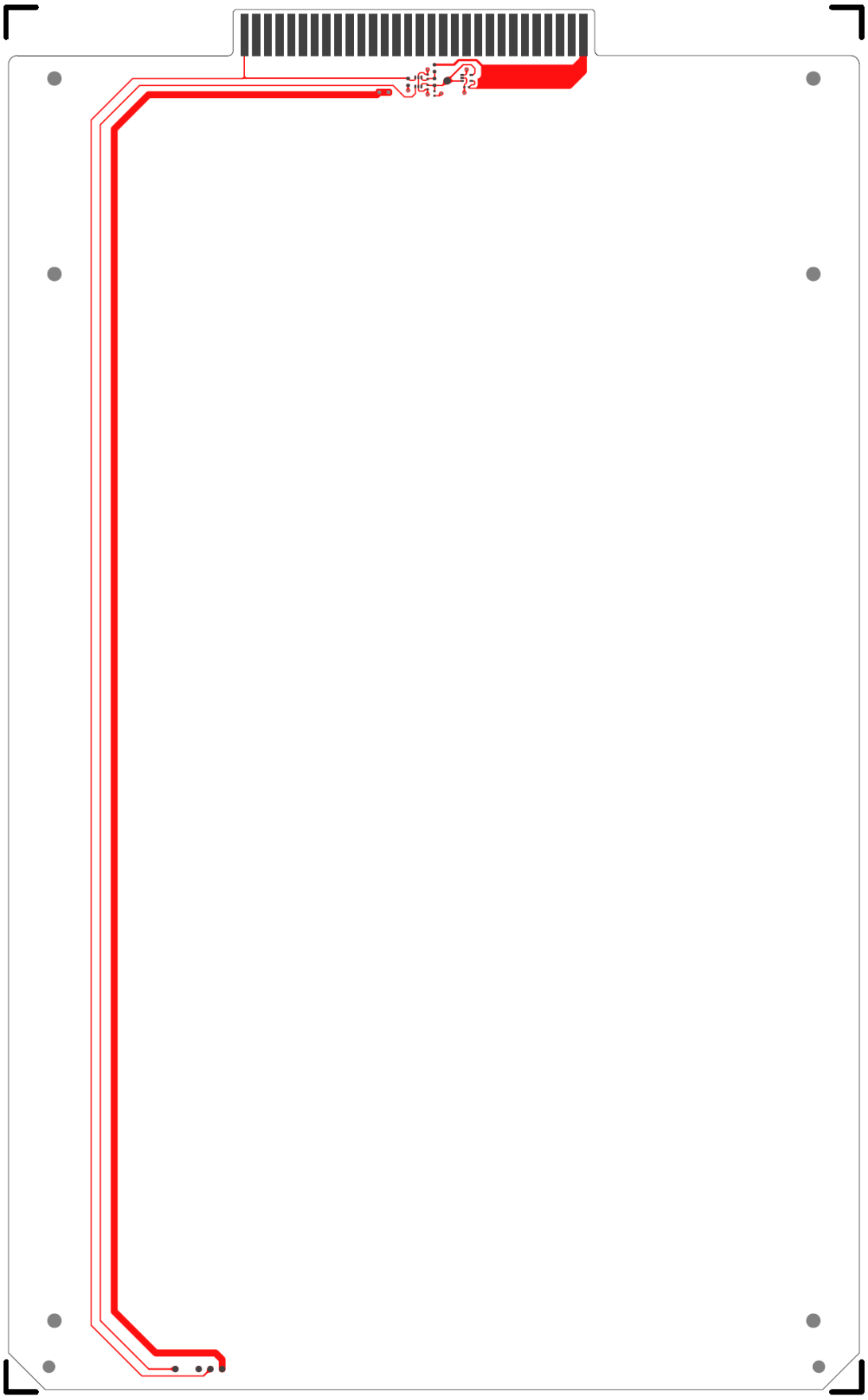


Figure 8-13 Shield board: Solder Side Pattern

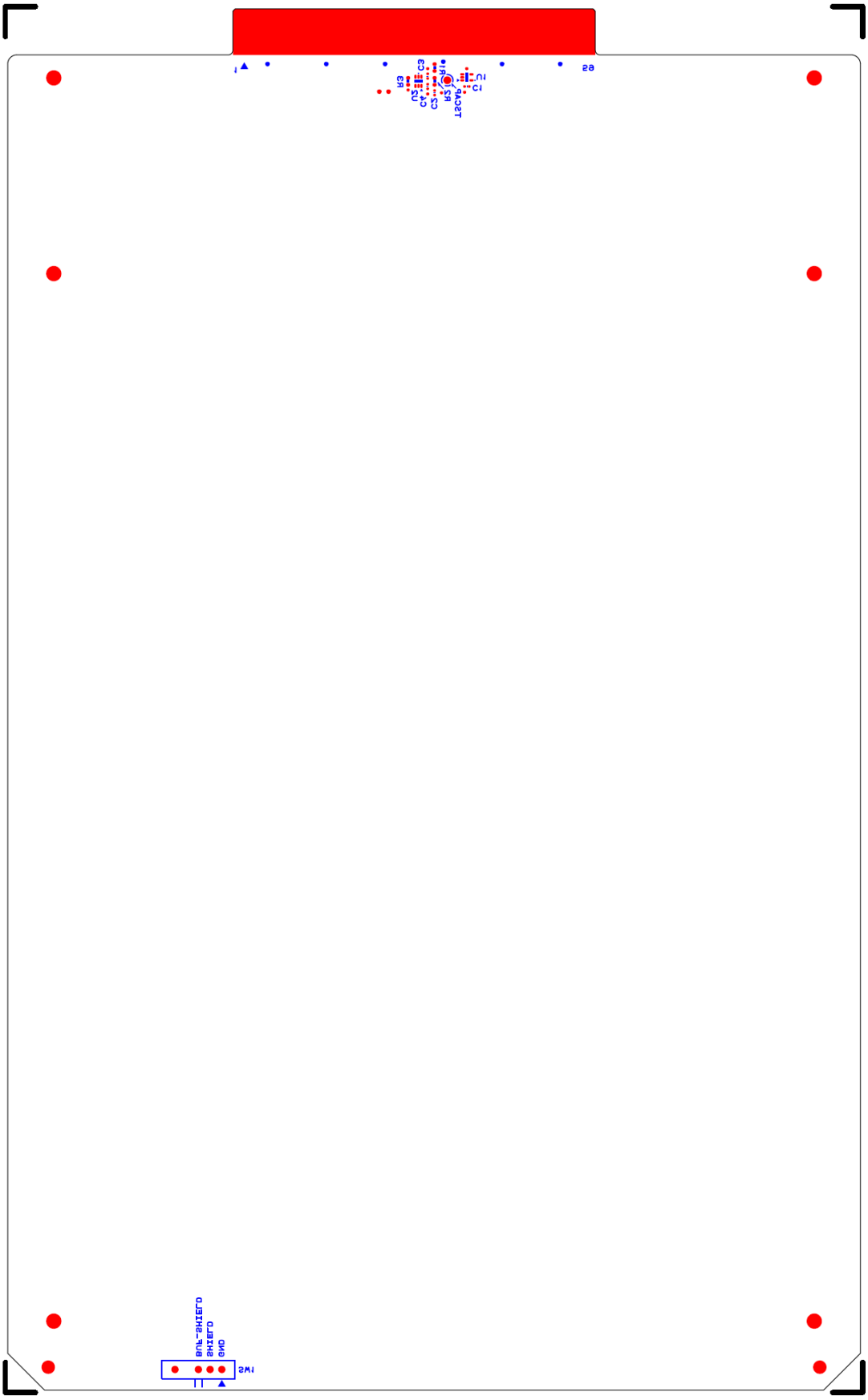


Figure 8-14 Shield board: Solder Side Silkscreen

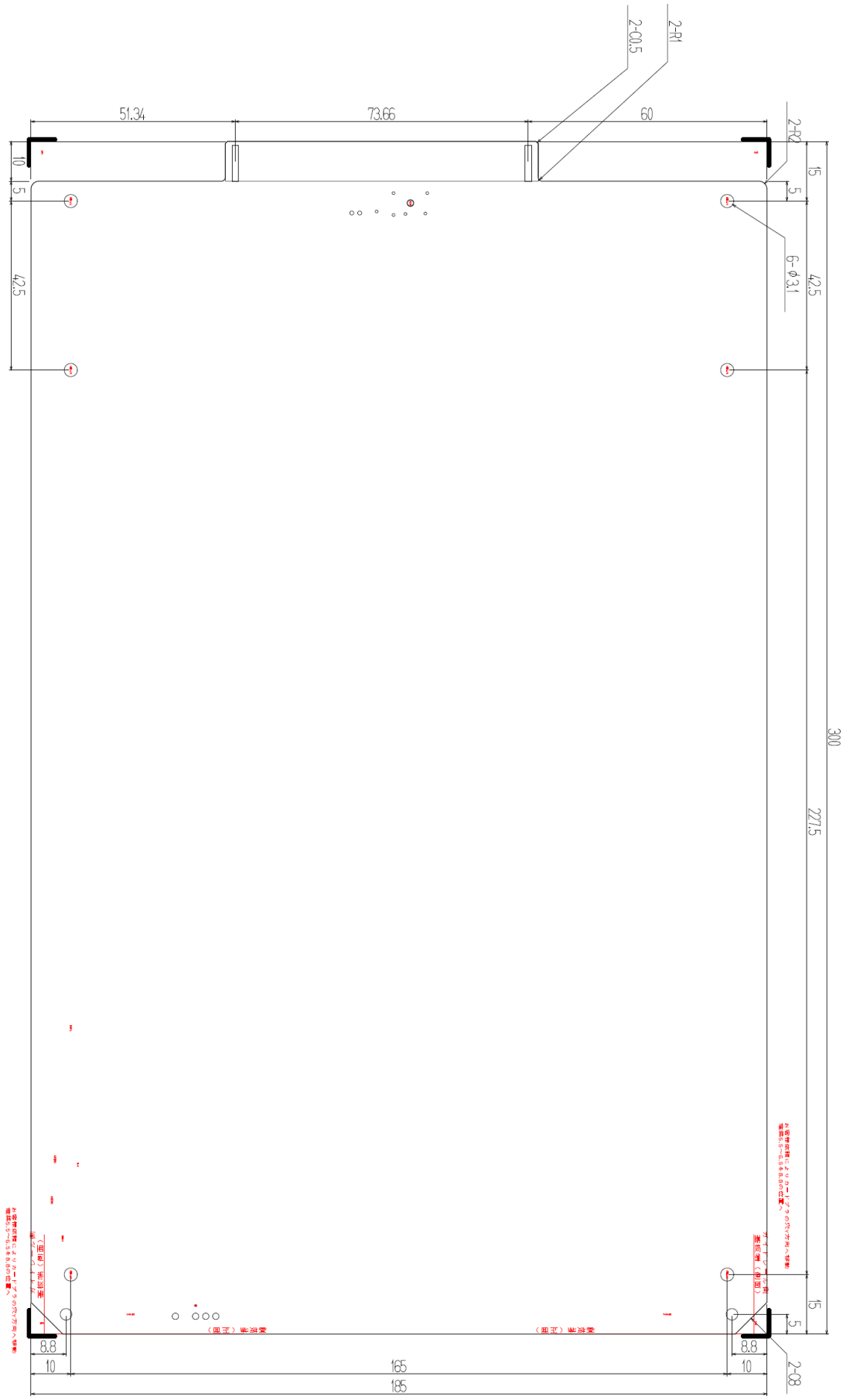


Figure 8-15 Shield board: Board Outline

8.4 RTK0ES1001D06001BJ Backplane board

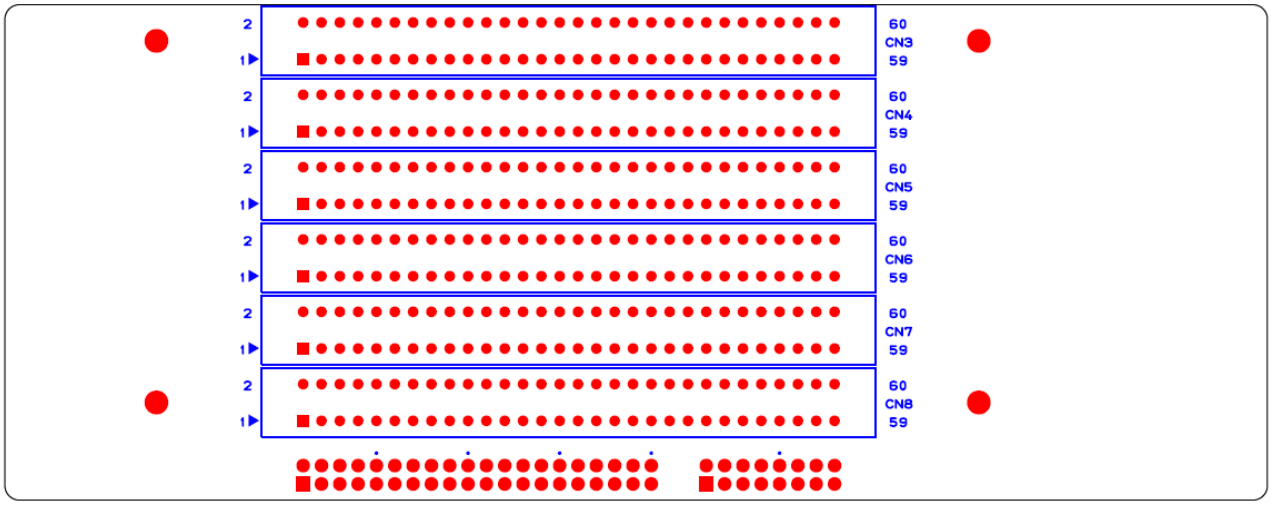


Figure 8-16 Backplane board: Component Side Silkscreen

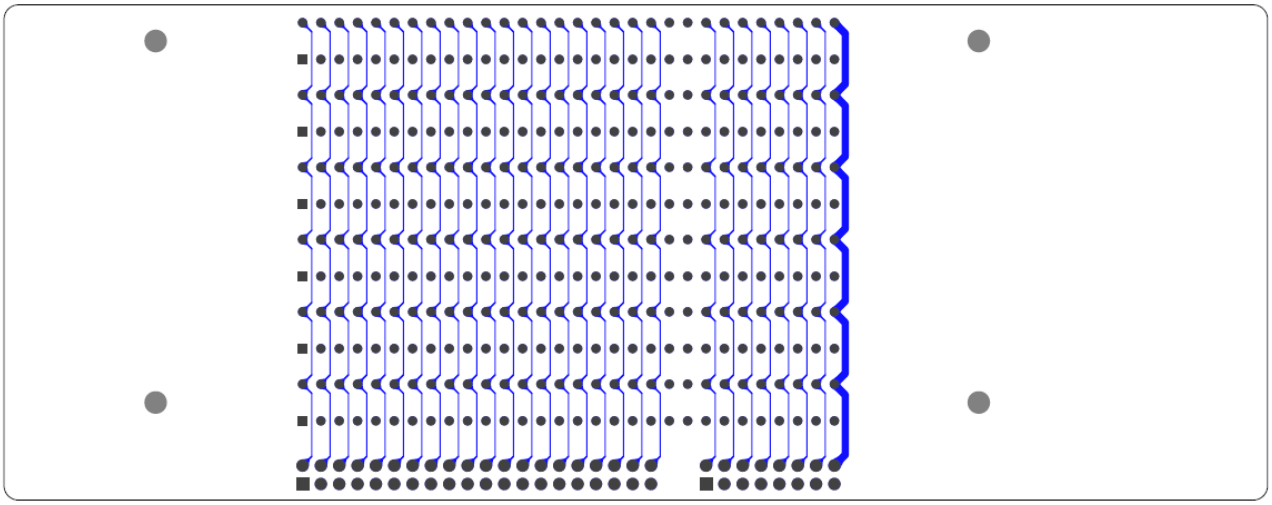


Figure 8-17 Backplane board: Component Side Pattern

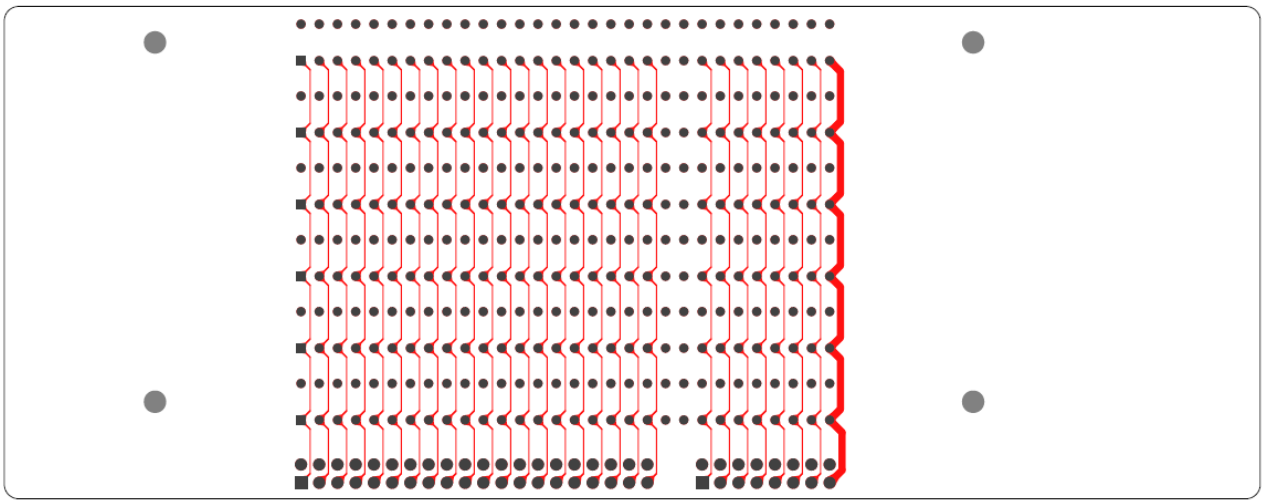


Figure 8-18 Backplane board: Solder Side Pattern

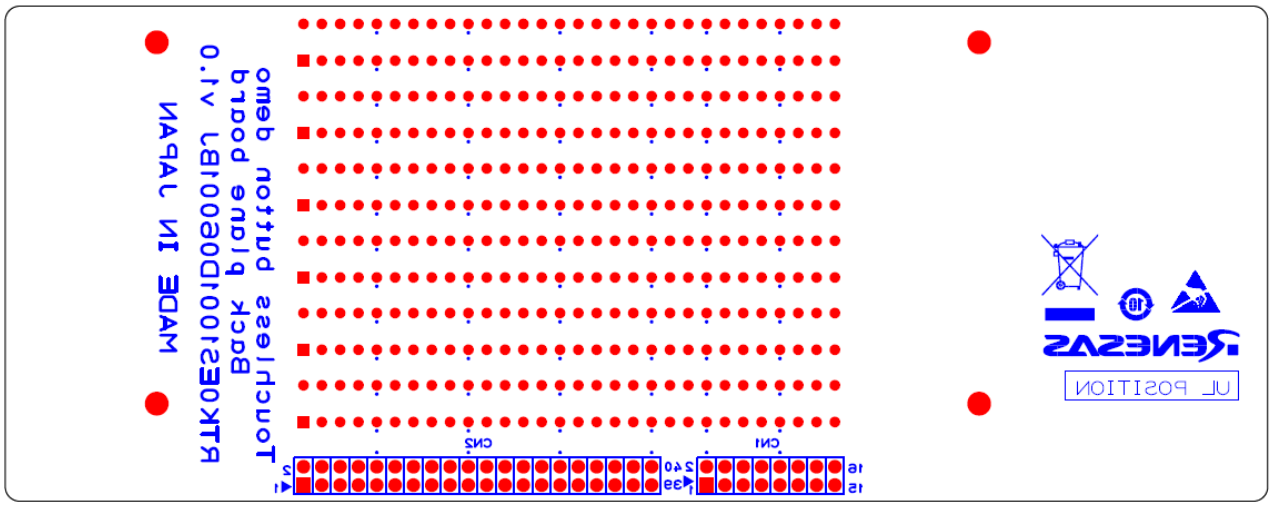


Figure 8-19 Backplane board: Solder Side Silkscreen

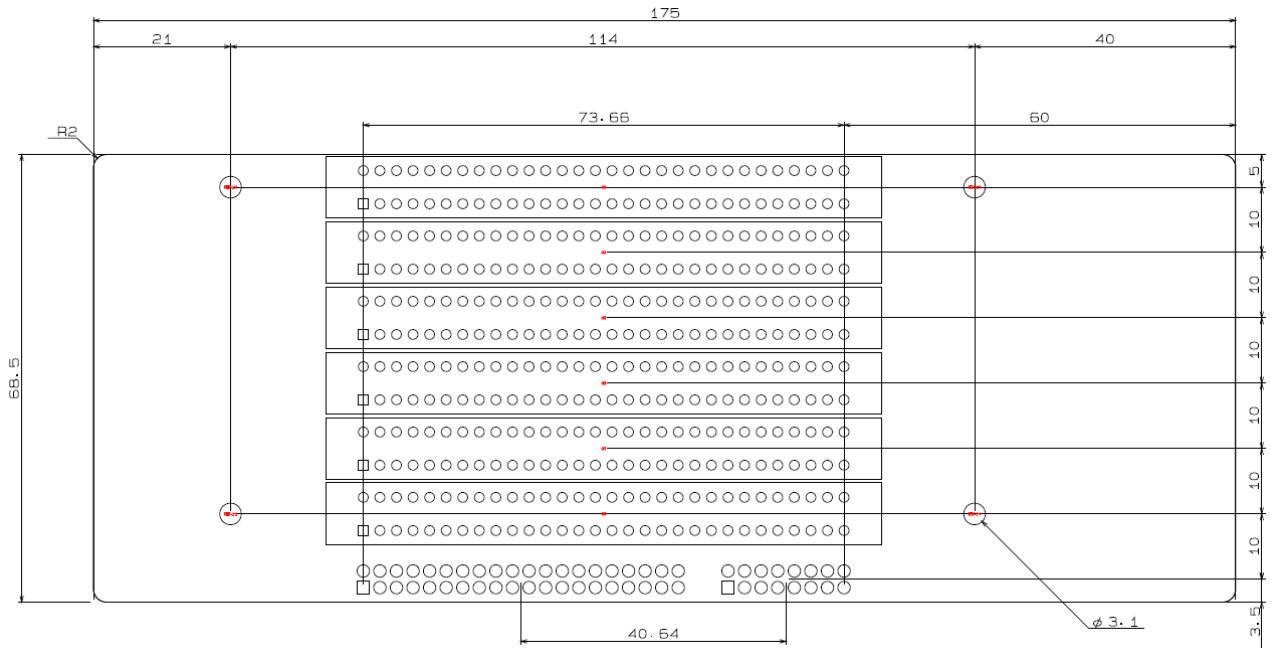


Figure 8-20 Backplane board: Board Outline

8.5 RTK0ES1001D07001BJ CPU-Electrode relay board

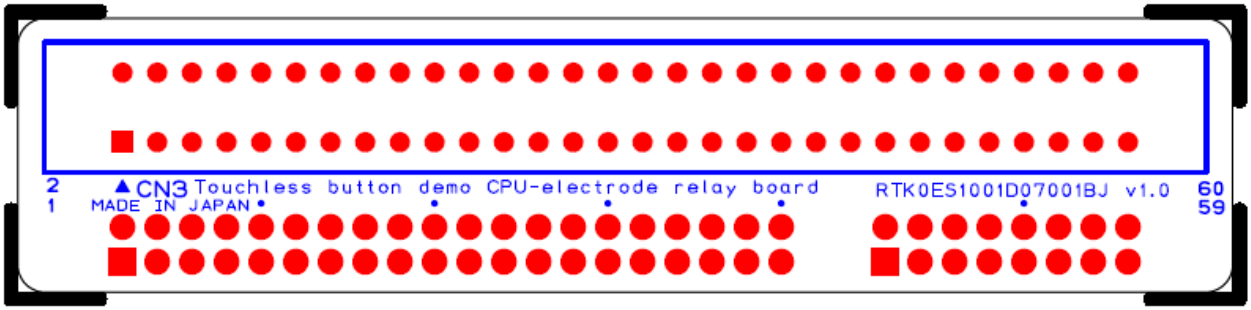


Figure 8-21 CPU-Electrode relay board: Component Side Silkscreen

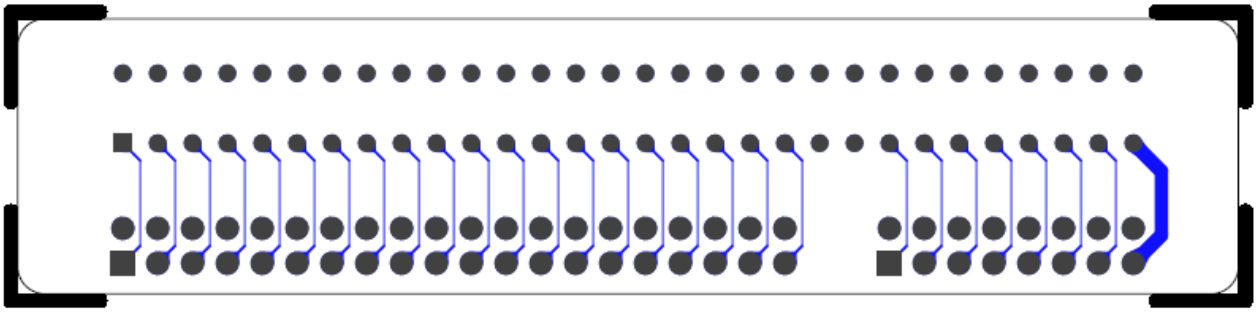


Figure 8-22 CPU-Electrode relay board: Component Side Pattern

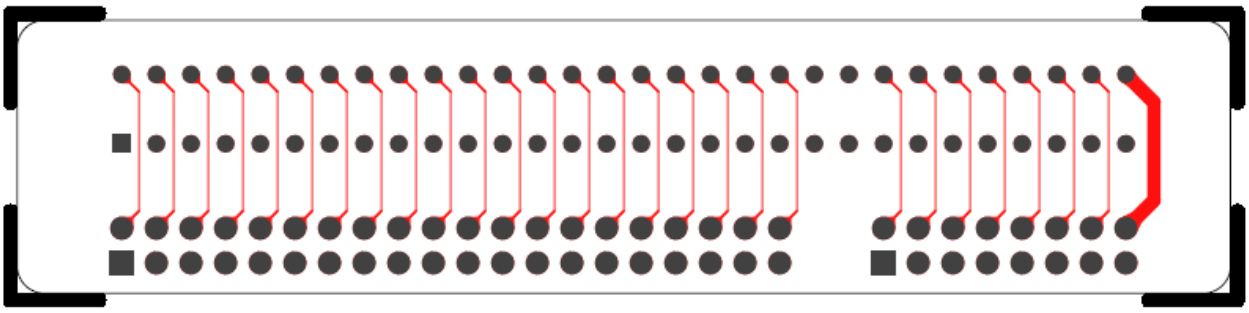


Figure 8-23 CPU-Electrode relay board: Solder Side Pattern

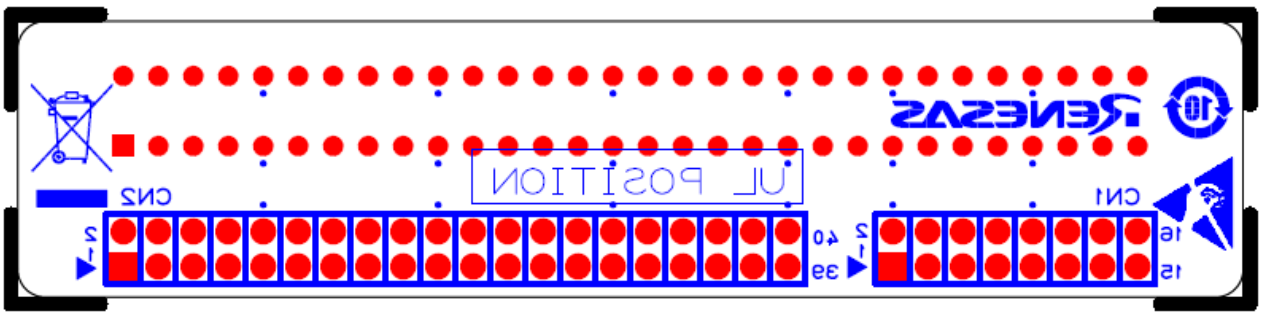


Figure 8-24 CPU-Electrode relay board: Solder Side Silkscreen

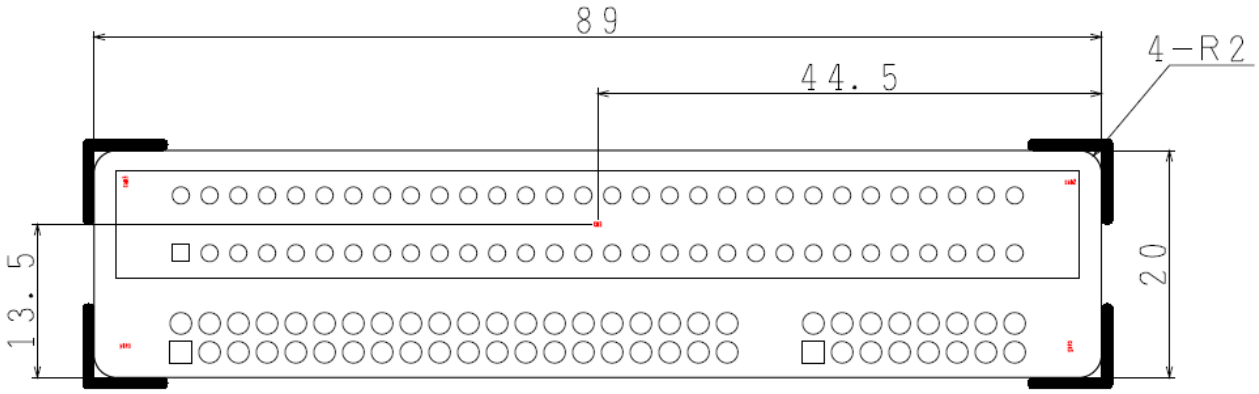


Figure 8-25 CPU-Electrode relay board: Board Outline

9. BOM (part list)

9.1 RTK0ES1001D03001BJ Electrode base board

Table 9-1 Electrode base board: BOM

Item	Parts Type	Reference	Part Number	Manufacture	Impl	Qty	Remarks
1	PCB	-	RTK0ES1001D03001BJ	TSK	-	1	
2	Connector	CN1	0527932070	Molex	Mount	1	
3	Card Puller	-	CRP-04	KEL	Mount	2	

9.2 RTK0ES1001D04001BJ LED board

Table 9-2 LED board: BOM (1/2)

Item	Parts Type	Reference	Part Number	Manufacture	Impl	Qty	Remarks
1	PCB	-	RTK0ES1001D04001BJ	TSK	-	1	
2	IC decoder	U1	SN74HC138DBR	TI	Mount	1	SSOP
3	IC Audio amp	RN1	LM4889MAX/NOPB	TI	Mount	1	
4	Digital transistor	Q1,Q2,Q3,Q4,Q5,Q6,Q7	DTB114ECT116	Rohm Semiconductor	Mount	7	PNP, 500mA
5	Digital transistor	Q8,Q9,Q10,Q11,Q12,Q13	DTD114ECT116	Rohm Semiconductor	Mount	6	NPN, 500mA
6	Chip LED	LED1,LED2,LED3,LED4,LED5,LED6,LED7,LED8,LED9,LED10,LED11,LED12,LED13,LED14,LED15,LED16,LED17,LED18,LED19,LED20,LED21,LED22,LED23,LED24,LED25,LED26,LED27,LED28,LED29,LED30,LED31,LED32,LED33,LED34,LED35,LED36,LED37,LED38,LED39,LED40,LED41,LED42,LED43,LED44,LED45,LED46,LED47,LED48,LED49,LED50,LED51,LED52,LED53,LED54,LED55,LED56,LED57,LED58,LED59,LED60,LED61,LED62,LED63,LED64,LED65,LED66,LED67,LED68,LED69,LED70,LED71,LED72,LED73,LED74,LED75,LED76,LED77,LED78,LED79,LED80,LED81,LED82,LED83,LED84,LED85,LED86,LED87,LED88,LED89,LED90,LED91,LED92,LED93,LED94,LED95,LED96,LED97,LED98,LED99,LED100,LED101,LED102,LED103,LED104,LED105,LED106,LED107,LED108,LED109,LED110,LED111,LED112,LED113,LED114,LED115,LED116,LED117,LED118,LED119,LED120,LED121,LED122,LED123,LED124,LED125,LED126,LED127,LED128,LED129,LED130,LED131,LED132,LED133,LED134,LED135,LED136,LED137,LED138,LED139,LED140	CL-194S-WS-SD-T	Citizen	Mount	140	White
7	Piezoelectric sounder	LS1	PKMCS0909E4000-R1	Murata Electronics	Mount	1	Externally Driven
8	Variable resistor	VR2	CT-6ER202	Nidec Copal Electronics	Mount	1	2kΩ
9	Variable resistor	VR1	CT-6ER104	Nidec Copal Electronics	Mount	1	100kΩ
10	Chip Resistor	R141,R145,R147	MCR03EZPJ000	Rohm Semiconductor	Mount	3	0Ω

Table 9-3 LED board: BOM (2/2)

Item	Parts Type	Reference	Part Number	Manufacture	Impl	Qty	Remarks
11	Chip Resistor	R1,R2,R3,R4,R5,R6,R7,R8,R9,R10,R11,R12,R13,R14,R15,R16,R17,R18,R19,R20,R21,R22,R23,R24,R25,R26,R27,R28,R29,R30,R31,R32,R33,R34,R35,R36,R37,R38,R39,R40,R41,R42,R43,R44,R45,R46,R47,R48,R49,R50,R51,R52,R53,R54,R55,R56,R57,R58,R59,R60,R61,R62,R63,R64,R65,R66,R67,R68,R69,R70,R71,R72,R73,R74,R75,R76,R77,R78,R79,R80,R81,R82,R83,R84,R85,R86,R87,R88,R89,R90,R91,R92,R93,R94,R95,R96,R97,R98,R99,R100,R101,R102,R103,R104,R105,R106,R107,R108,R109,R110,R111,R112,R113,R114,R115,R116,R117,R118,R119,R120,R121,R122,R123,R124,R125,R126,R127,R128,R129,R130,R131,R132,R133,R134,R135,R136,R137,R138,R139,R140,R148	MCR03EZPJ101	Rohm Semiconductor	Mount	141	100Ω 5%
12	Chip Resistor	R149	MCR03EZPJ102	Rohm Semiconductor	Mount	1	1kΩ 5%
13	Chip Resistor	R142	MCR03EZPFX5601	Rohm Semiconductor	Mount	1	5.6kΩ 1%
14	Chip Resistor	R144	MCR03EZPFX1002	Rohm Semiconductor	Mount	1	10kΩ 1%
15	Chip Resistor	R150,R151,R152,R153	MCR03EZPJ103	Rohm Semiconductor	Mount	4	10kΩ 5%
16	Chip Resistor	R143	MCR03EZPFX1502	Rohm Semiconductor	Mount	1	15kΩ 1%
17	Ceramic Capacitor	C4	06035C472KAT2A	AVX	Mount	1	4700pF/50V
18	Ceramic Capacitor	C3	06035C153KAT2A	AVX	Mount	1	0.015uF/50V
19	Ceramic Capacitor	C7	GRM155R71E104KE14J	Murata Electronics	Mount	1	0.1uF/25V
20	Ceramic Capacitor	C2,C5,C6	TMK107B7105KA-T	Taiyo Yuden	Mount	3	1uF/25V
21	Slide switch	SW1	CJS-1200TB	Nidec Copal Electronics	Mount	1	
22	Flexible Flat Cable	CN2	528082070	Molex	Mount	1	20P, Straight
23	Flexible Flat Cable	CN1	527932070	Molex	UnMount	1	20P, Right Angle
24	Resettable Fuse	F1	0ZCJ0005FF2E	Bel Fuse	Mount	1	60V 50mA
25	Jack	J1	SJ-3566AN	CUI	Mount	1	3.50mm, Mini Plug
26	Pad	C1,R146	-	-	UnMount	2	1608 Metric
27	Zener Diode	D141	DDZ6V2B	Diodes	UnMount	1	6.2V, 500mW
28	Card Puller	-	CRP-04	KEL	Mount	2	

9.3 RTK0ES1001D05001BJ Shield board

Table 9-4 Shield board: BOM

Item	Parts Type	Reference	Part Number	Manufacture	Impl	Qty	Remarks
1	PCB		RTK0ES1001D05001BJ	TSK	-	1	
2	IC OPAMP	U1	ISL28114FEZ-T7A	Renesas Electronics	Mount	1	
3	IC Bus transceiver	U2	74LVCH1T45GW	Nexperia	Mount	1	
4	Chip Resistor	R2	MCR03EZPJ000	Rohm Semiconductor	Mount	1	0Ω
5	Chip Resistor	R1	MCR03EZPJ000	Rohm Semiconductor	UnMount	1	1Ω
6	Chip Resistor	R3	MCR03EZPJ104	Rohm Semiconductor	Mount	1	100kΩ 5%
7	Ceramic Capacitor	C1,C2,C3,C4	GRM155R71E104KE14J	Murata Electronics	Mount	4	0.1uF/25V
8	Slide switch	SW1	SS-14MDH2	NKK Switches	Mount	1	
9	Card Puller	-	CRP-04	KEL	Mount	2	

9.4 RTK0ES1001D06001BJ Backplane board

Table 9-5 Backplane board: BOM

Item	Parts Type	Reference	Part Number	Manufacture	Impl	Qty	Remarks
1	PCB	-	RTK0ES1001D06001BJ	TSK	-	1	
2	Connector	CN3,CN4,CN5,CN6 ,CN7,CN8	CR22A-60D-2.54DS	Hirose	Mount	6	Card Edge Connector
3	Pin header	CN1	PSS-420256-08	Hirosugi-Keiki	Mount	1	16 position
4	Pin header	CN2	PSS-420256-20	Hirosugi-Keiki	Mount	1	40 position

9.5 RTK0ES1001D07001BJ CPU-Electrode relay board

Table 9-6 CPU-Electrode relay board: BOM

Item	Parts Type	Reference	Part Number	Manufacture	Impl	Qty	Remarks
1	PCB	-	RTK0ES1001D07001BJ	TSK	-	1	
2	Connector	CN3	CR22A-60D-2.54DS	Hirose	Mount	1	
3	Pin header	CN1	PSS-420256-08	Hirosugi-Keiki	Mount	1	
4	Pin header	CN2	PSS-420256-20	Hirosugi-Keiki	Mount	1	

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	May.10.21	-	First edition issued

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.

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

Trademarks

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

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/.