User's Manual

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RL78/G22 Group

Capacitive Touch Appliance UI Reference Design Manual

RENESAS MCU
RL78 Family

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Rev.1.00 May 2026

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(Rev.5.0-1 October 2020)

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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.

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Revision History

RL78/G22 Group

Capacitive Touch Appliance UI Reference Design Manual

Introduction

This document introduces the home appliance panel UI demo set using CTSU2La on RL78/G22 with touch buttons and Multiple Electrode Connection (MEC) function (hereinafter Appliance UI Demo).

The Multiple Electrode Connection (MEC) function is that regards multiple touch electrodes as a one electrode. For example, there is a system with six touch buttons and this function is ideal for a system that returns from standby mode by touching any of the touch buttons. Devices without the MEC function require six scans to determine whether a touch is detected, whereas RL78/G22 can determine whether a touch is detected with one scan. Thus, fewer scans are required, which enables low power consumption operation.

Also, setting the touch detection with high sensitivity when using the MEC function allows multiple touch electrodes can be used as one large proximity sensor electrode.

1. Outline

This document describes the application example of the Multiple Electrode Connection (MEC) function, using the Appliance UI Demo with a refrigerator panel motif.

Appliance UI Demo is equipped with seven touch buttons. These touch buttons work as independent touch buttons during normal mode. If the touch panel is not operated for a certain time, the panel is hidden and the device transitions to standby mode. In standby mode, the six touch buttons function as one touch button by MEC function.

1.1 Multiple Electrode Connection (MEC) function

The Multiple Electrode Connection (MEC) function is a function to measure multiple channels of touch electrodes as one electrode.

1.1.1 Advantage 1 of MEC Function: Return from Standby Mode by Touching Any Electrode

In Appliance UI Demo, six touch electrodes are used as one electrode as shown in Figure 1-1 by using the MEC function during standby mode. This allows the user to return from standby mode by touching any electrode within the white frame.

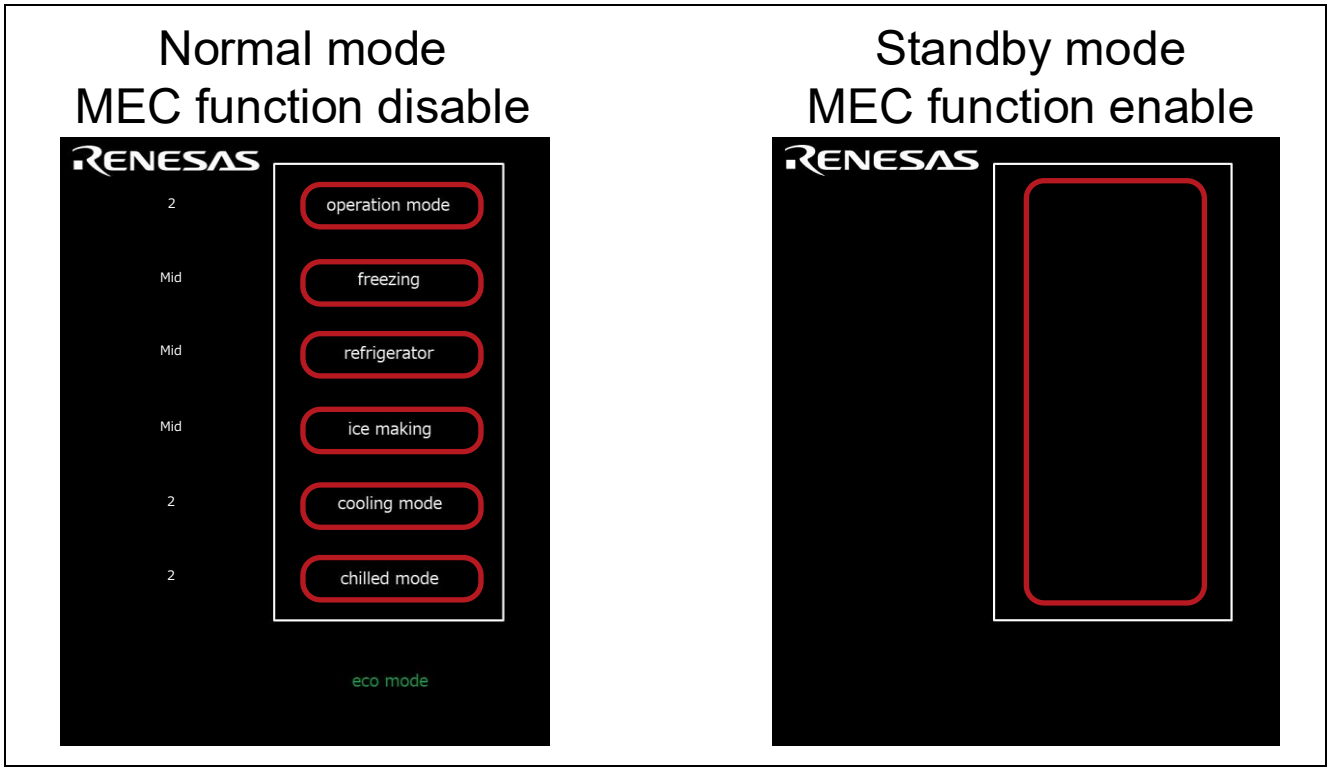

Figure 1-1 MEC function (one electrode)

1.1.2 Advantage 2 of MEC Function: Available as a Proximity Sensor

By using the MEC function in an arrangement configuration that places touch electrodes in proximity, multiple touch electrodes can be regarded as one large electrode. Also depending on the touch threshold setting, it is available to be used as a proximity sensor. The detection distance of the proximity sensor is approximately 20 mm.

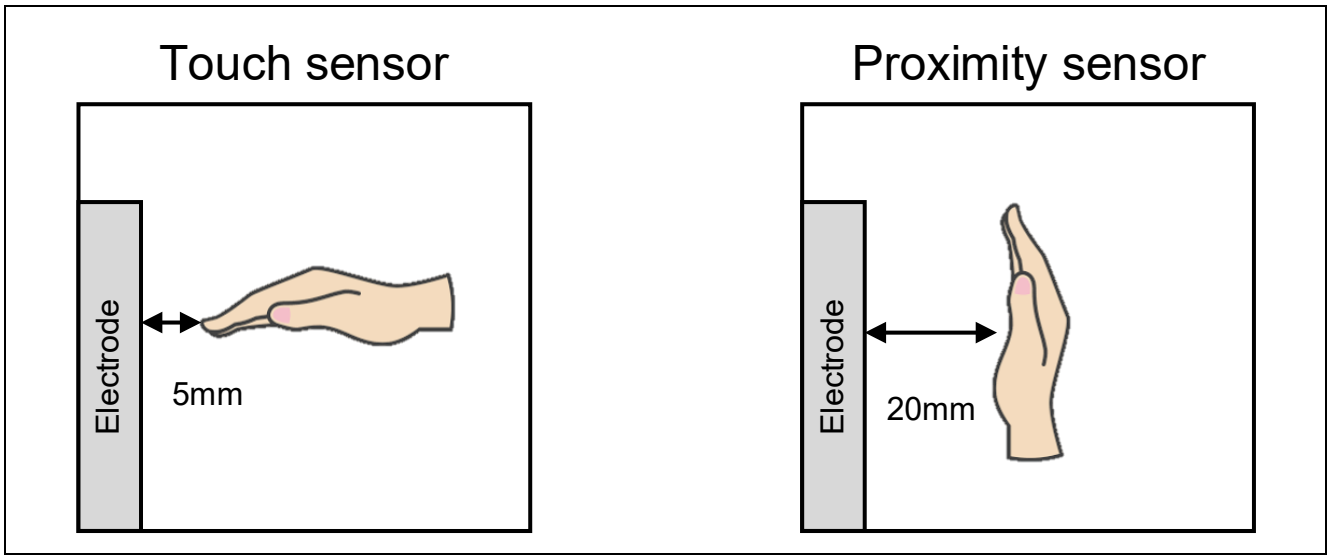

Figure 1-2 MEC function (proximity sensor)

1.1.3 Advantage 3 of MEC Function: Low Power Consumption

The MEC function uses multiple touch electrodes as one electrode. Thus, the electrodes can be scanned only once. Compared to when the MEC function is not used, the measurement time of the electrode can be reduced, enabling operation with low power consumption.

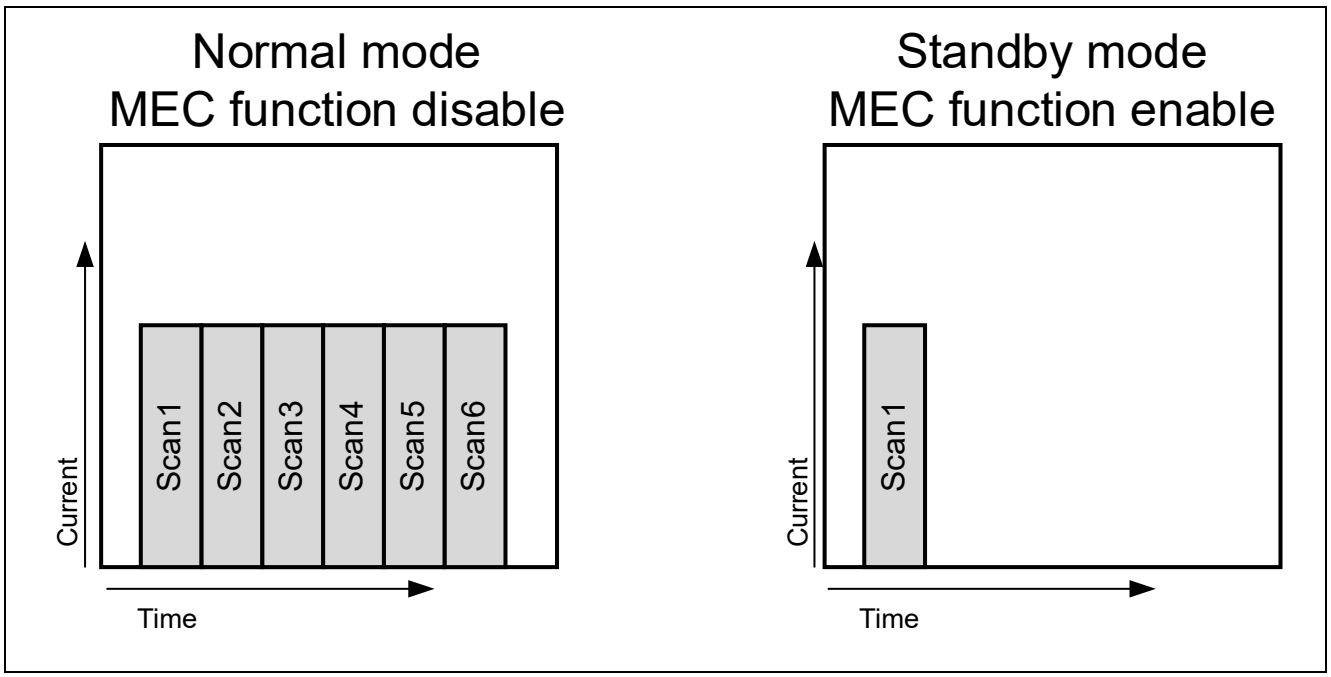

Figure 1-3 MEC function (low power consumption)

1.2 How to Utilize the MEC Function in Appliance UI Demo

Appliance UI Demo implements a variation of standby mode operation using the MEC function as operation mode.

Operation mode 1 operates as a proximity sensor during standby mode. In this mode, the touch threshold of the buttons is set low enough to detect at hand proximity. Holding the hand over the white frame area returns from standby mode. CPU will make the decision to return from standby mode.

Operation mode 2 operates as a touch sensor during standby mode. In this mode, the touch threshold of the buttons is set to detect a direct hand touch. Touching any buttons returns from standby mode. CPU will make the decision to return from standby mode.

Operation mode 3 performs auto judgment measurements using Snooze Mode Sequencer (SMS) and operates as a touch sensor. The touch threshold of the touch button is set in the same way as in operation mode2.

In this mode, uses SMS to determine whether to return from standby mode. This reduces power consumption during standby time.

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2. Appliance UI Demo Hardware Overview

2.1 External View of the Enclosure

The following shows an external view of Appliance UI Demo.

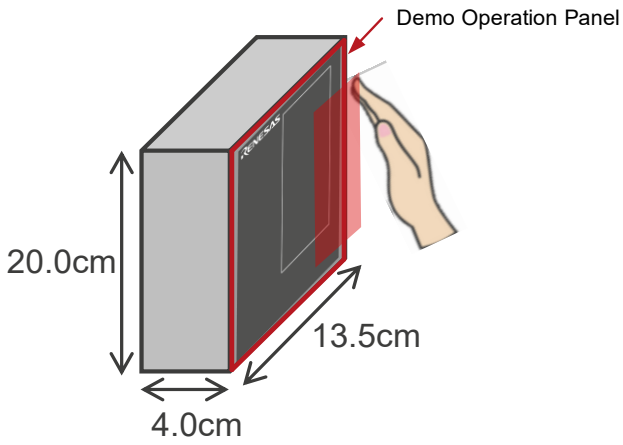

Figure 2-1 External view of Appliance UI Demo

The following figure shows the appearance of the Appliance UI Demo Operation Panel. Yellow areas in the figure indicate the position and size of the touch sensor electrodes. The size of each electrode is 50 × 15 mm. The electrodes are not visible from the actual appearance.

The front of the demo operation panel consists of a 135 × 200 × 2 mm acrylic plate. The surface of the operation panel is processed using blackout printing and silk printing.

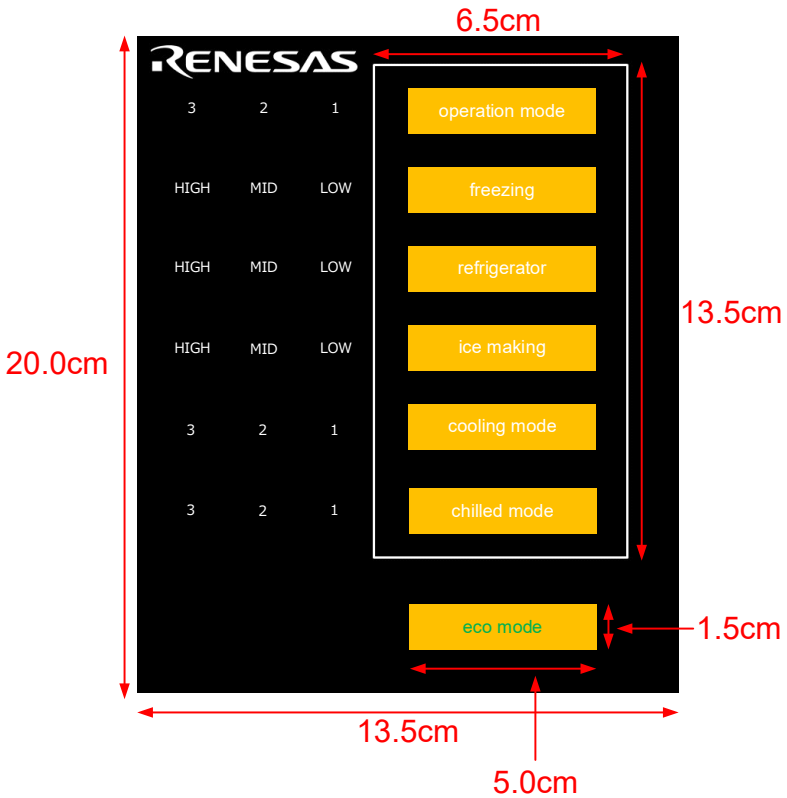

Figure 2-2 External view of Demo Operation Panel and electrode size

2.2 Appliance UI Demo Configuration

Appliance UI Demo consists of the CPU Board (RTK0EG0041C01001BJ) of RL78/G22 Capacitive Touch Evaluation System (RTK0EG0042S01001BJ) and an electrode board. For details of the electrode board, refer to Chapter 4 Design Documents for Electrode Board onward.

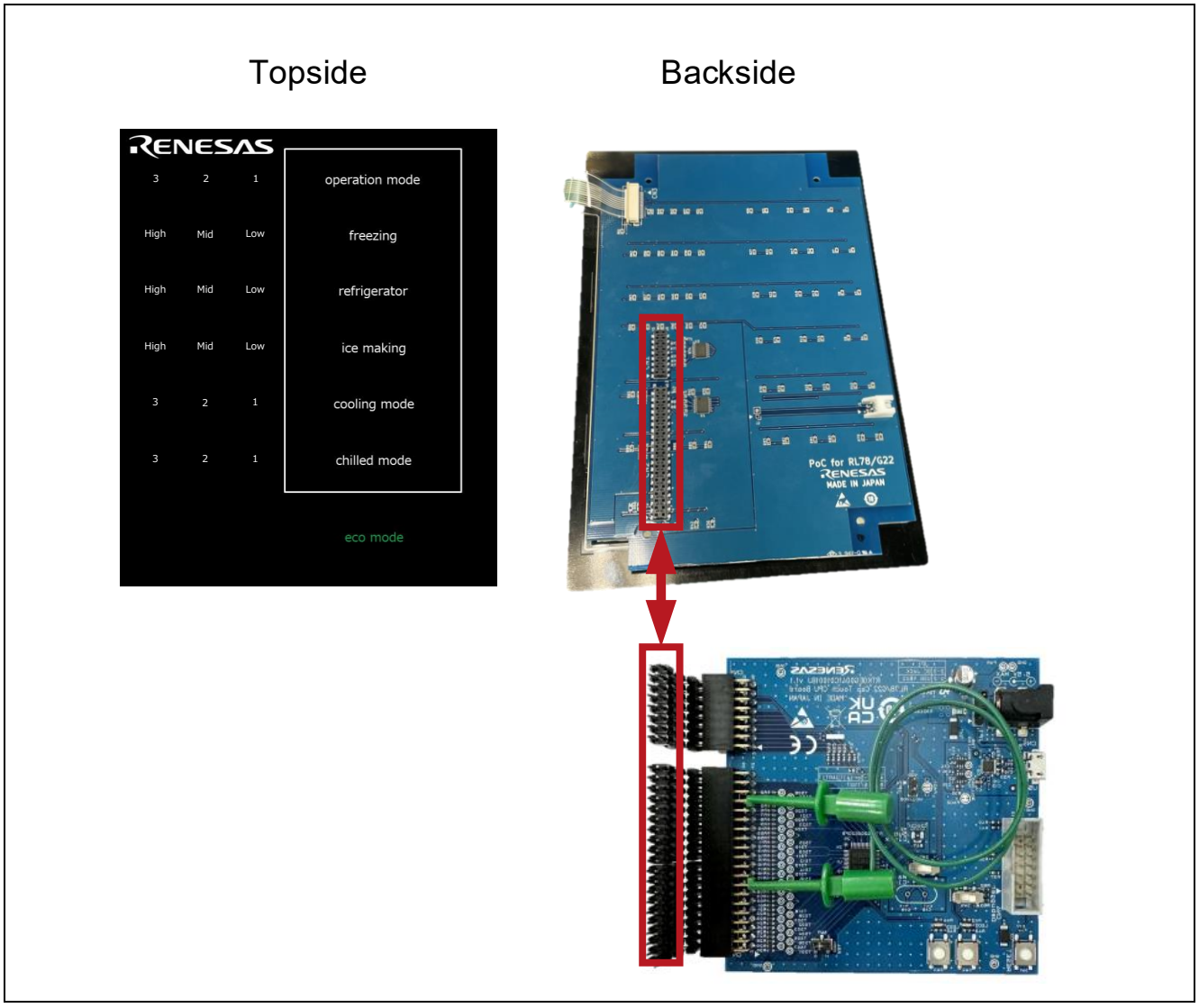

Figure 2-3 Appliance UI Demo board configuration diagram

2.3 RL78/G22 CPU board Configuration (Connection of external trigger)

To perform auto judgment measurement using SMS with RL78/G22, please make the following settings.
Connect the CN2 34th pin (P130/TS19) and 16th pin (P16/INTP5/TS17) on the MCU board side.

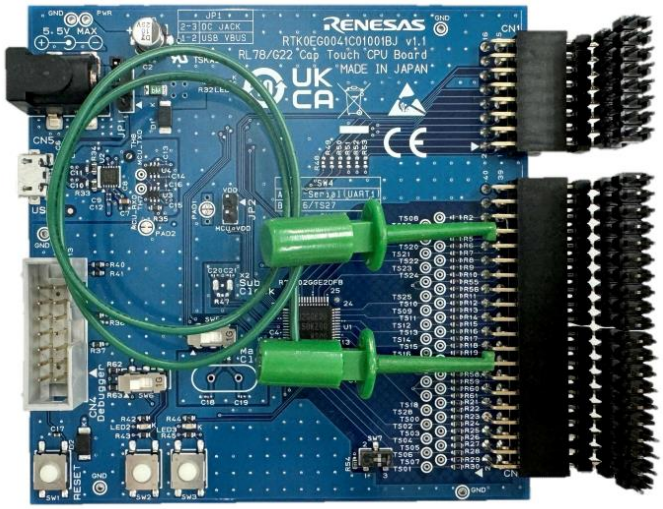

Figure 2-4 Connection of external trigger on RL78/G22 CPU board

3. Starting a Demonstration

When the E2 emulator Lite connector is disconnected and Appliance UI Demo power is turned on, the demonstration program will start. This demonstration program assumes control of the display and settings of the refrigerator panel. The display settings of the refrigerator panel are configured with the touch buttons checking the setting display.

Hereafter, touch buttons are referred to as buttons.

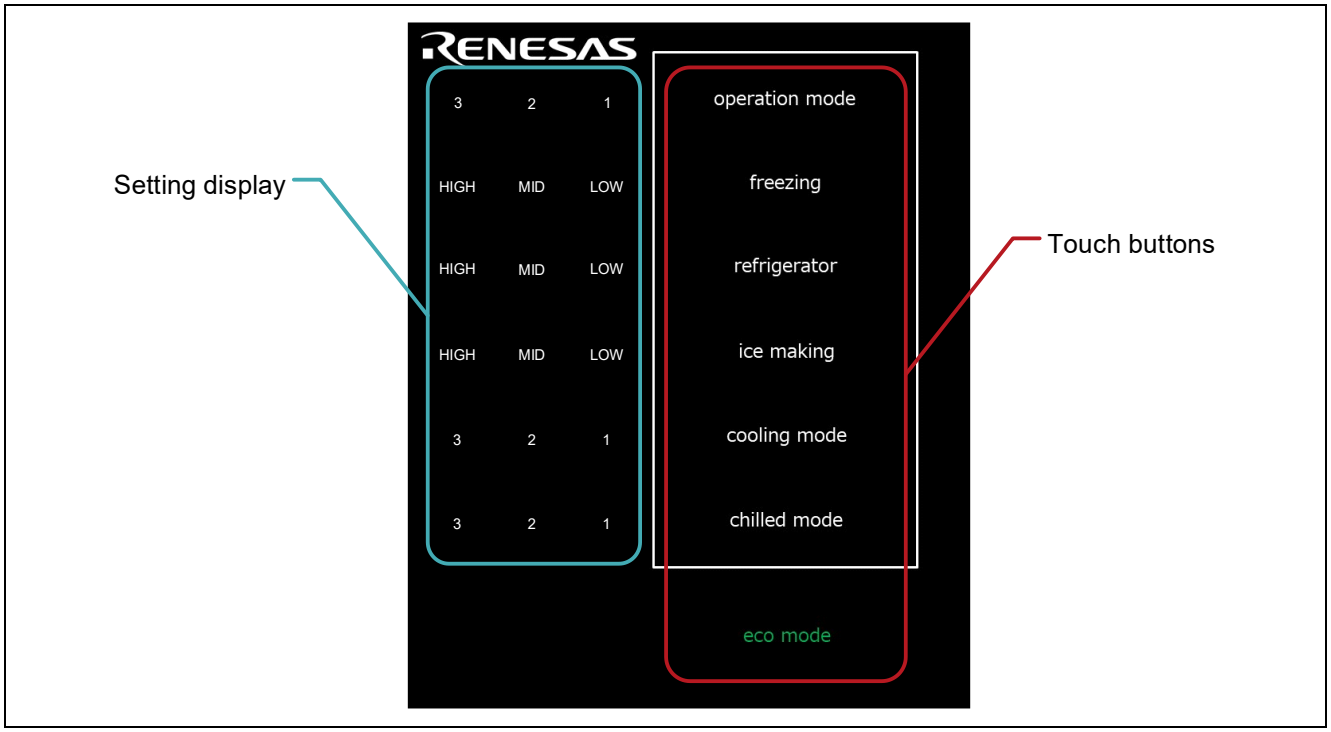

Figure 3-1 Demonstration Operation Panel

3.1 Powered on Appliance UI Demo and Menu Screen

When Appliance UI Demo is powered on, all characters on the touch panel are displayed for approximately 5 seconds. After the display finishes, the demonstration program starts and Appliance UI Demo transits the standby mode (operation mode1).

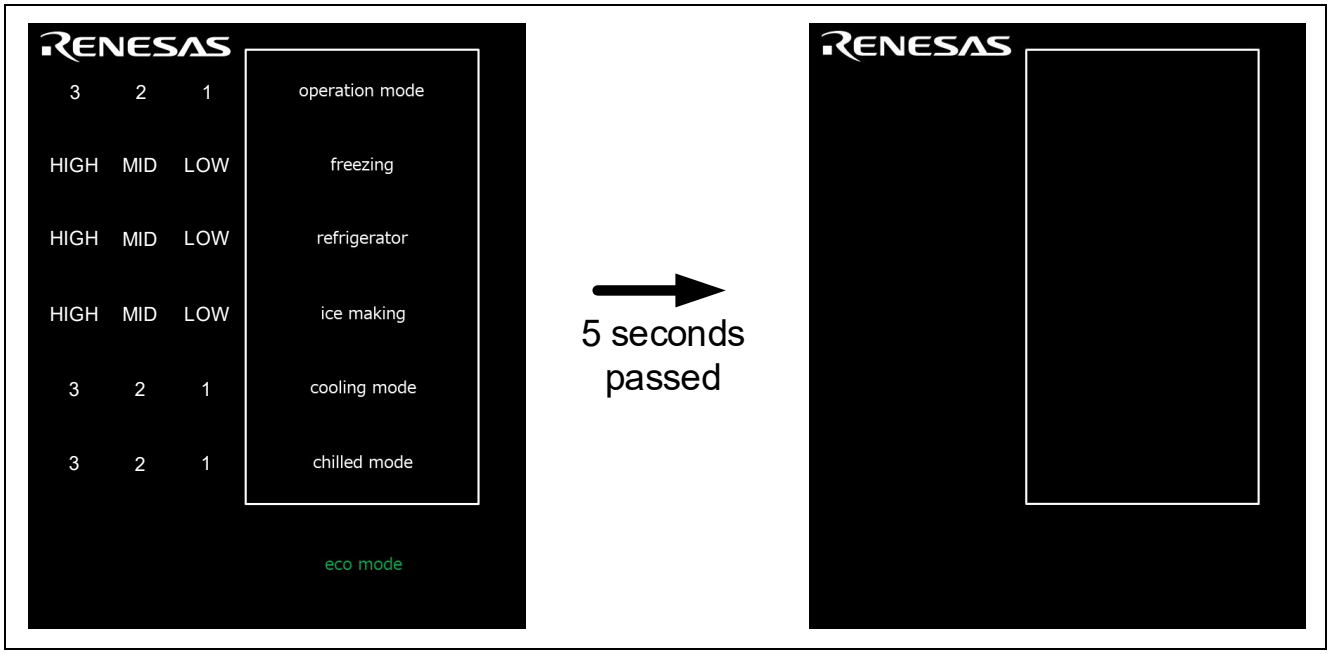

Figure 3-2 Start of the Demonstration

3.2 Return from Standby Mode

Touching within the white frame returns from standby mode. Each setting value indicates the center value such as 2 or MID.

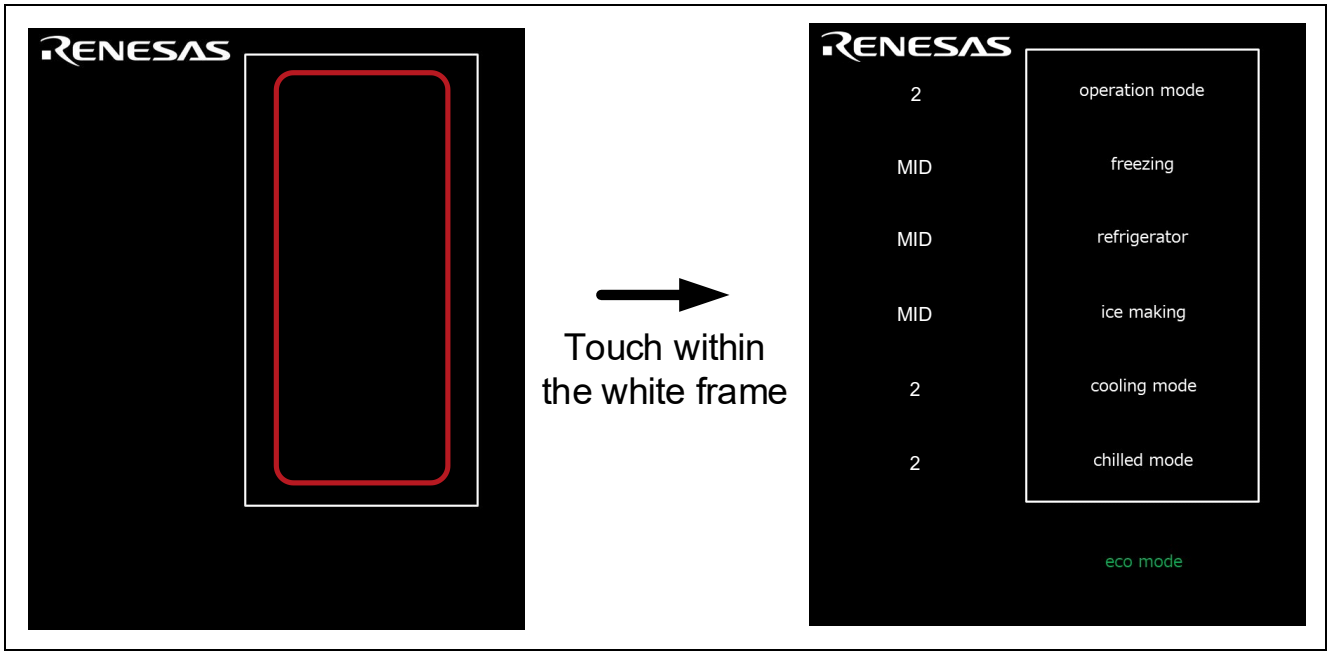

Figure 3-3 How to Operate the Menu Screen

3.3 Touch Operation

3.3.1 Set operation mode

By touching the operation mode button, the setting values can be changed in the order shown in Figure 3-4.

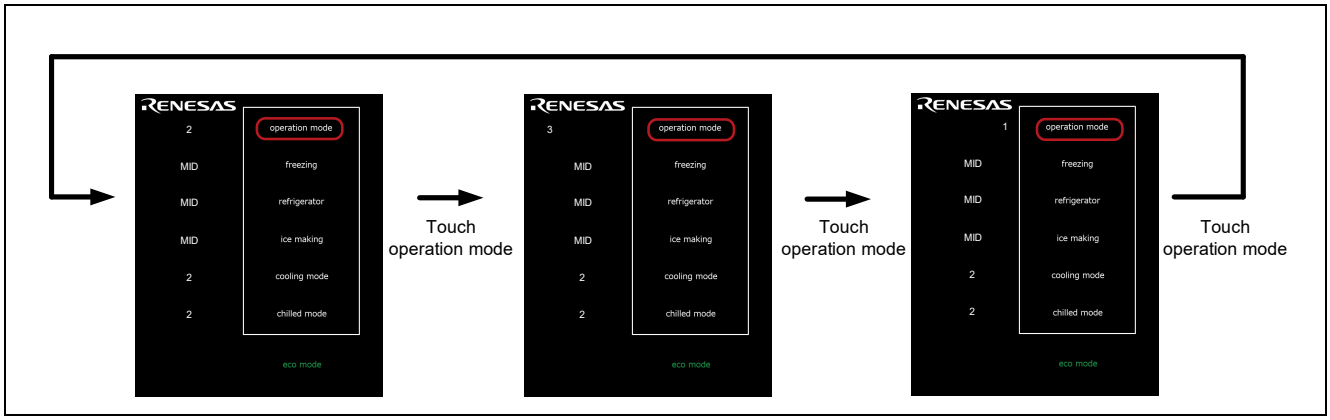

Figure 3-4 Set operation mode

3.3.2 Set freezing

By touching the freezing button, the setting values can be changed in the order shown in Figure 3-5.

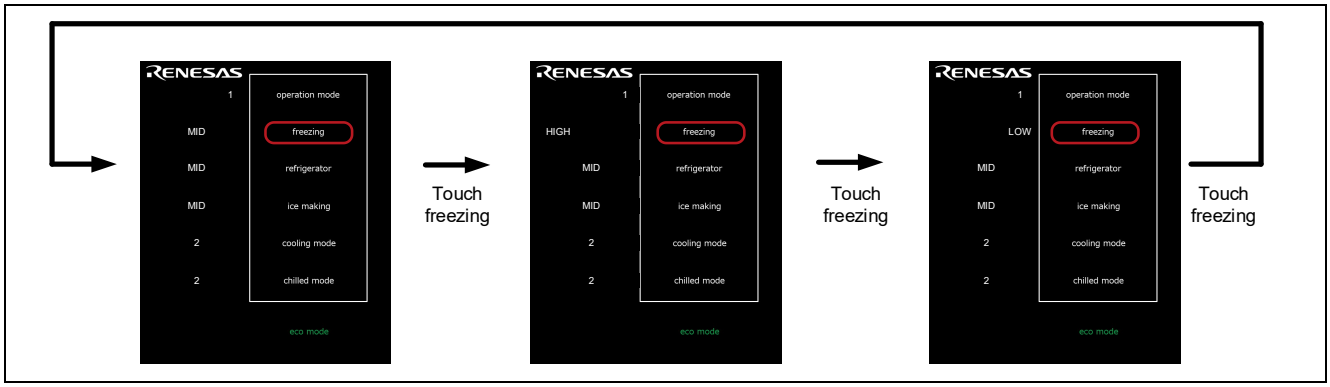

Figure 3-5 Set freezing

3.3.3 Set refrigerator

By touching the refrigerator button, the setting values can be changed in the order shown in Figure 3-6.

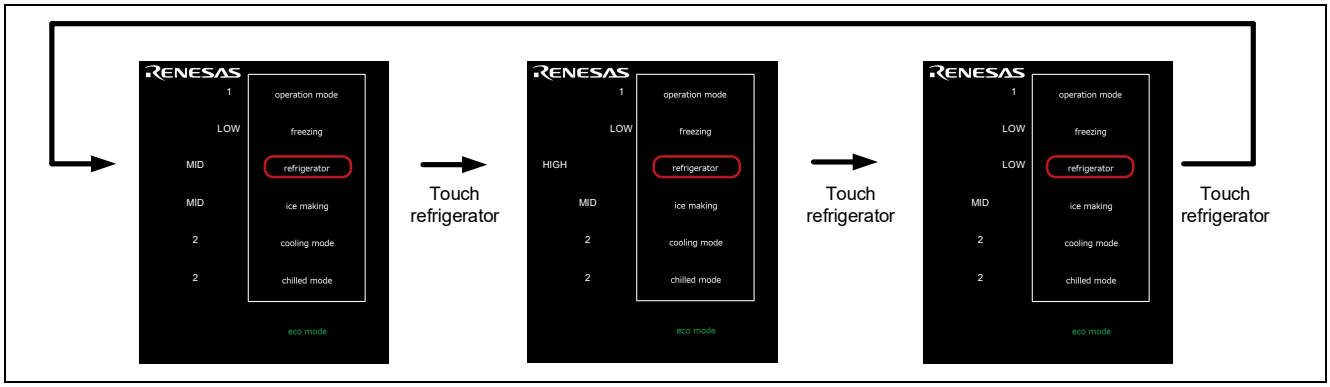

Figure 3-6 Set refrigerator

3.3.4 Set ice making

By touching the ice making button, the setting values can be changed in the order shown in Figure 3-7.

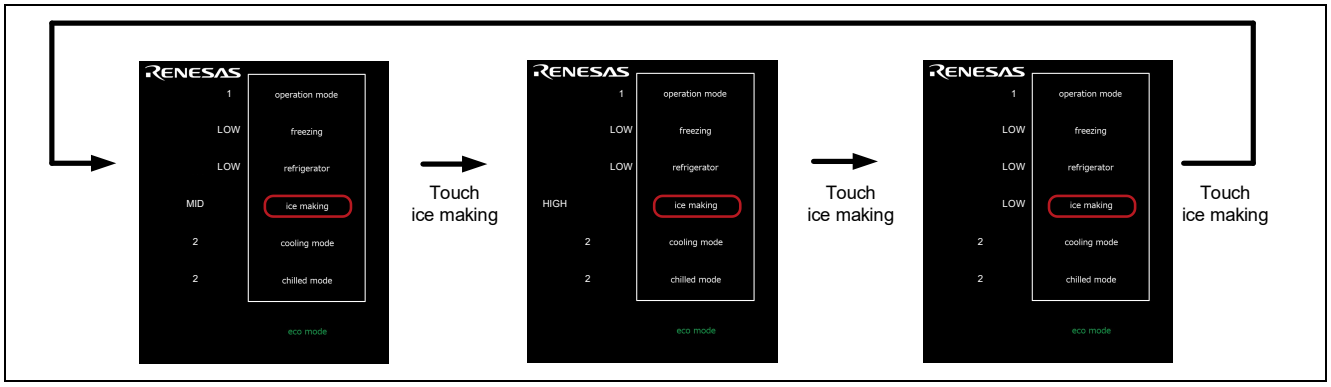

Figure 3-7 Set ice making

3.3.5 Set cooling mode

By touching the cooling mode button, the setting values can be changed in the order shown in Figure 3-8.

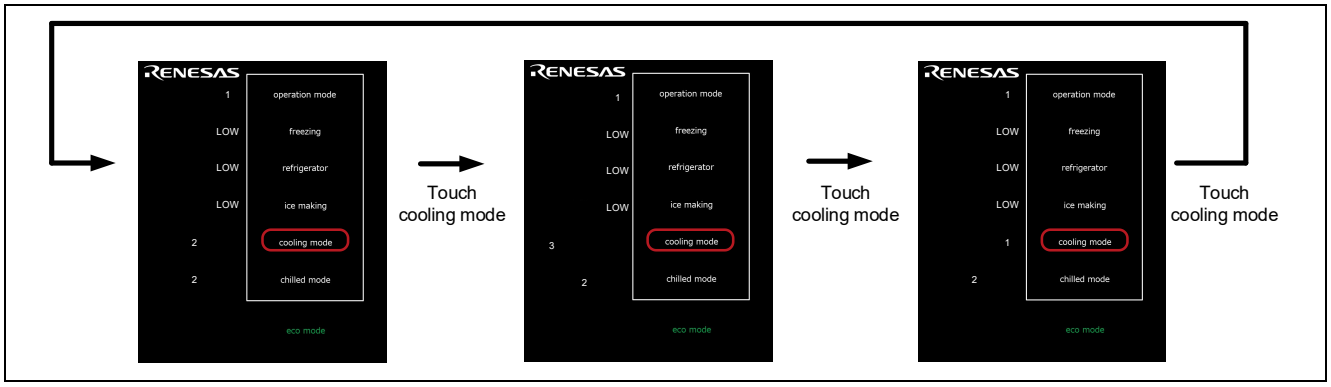

Figure 3-8 Set cooling mode

3.3.6 Set chilled mode

By touching the chilled mode button, the setting values can be changed in the order shown in Figure 3-9.

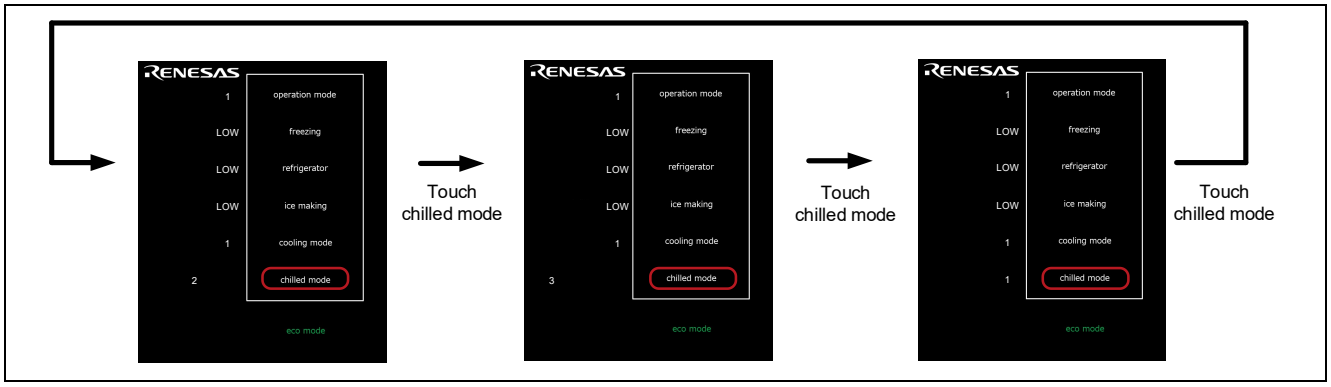

Figure 3-9 Set chilled mode

3.3.7 eco mode (Proximity Sensor Mode)

Touching the eco mode button when the operating mode is set to 1, the device transits the standby mode in the proximity sensor mode. In proximity sensor mode, holding the hand within the white frame returns to normal mode. CPU will make the decision to return from standby mode.

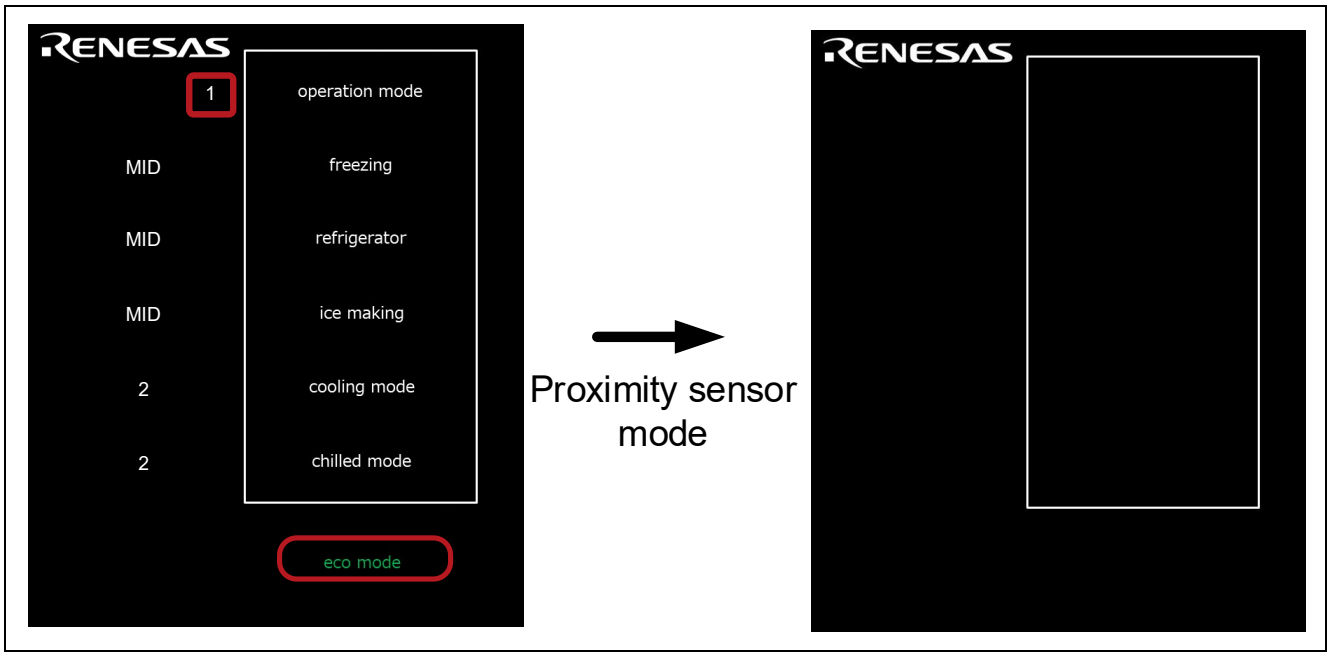

Figure 3-10 When operating mode 1 is Set, Touch eco mode

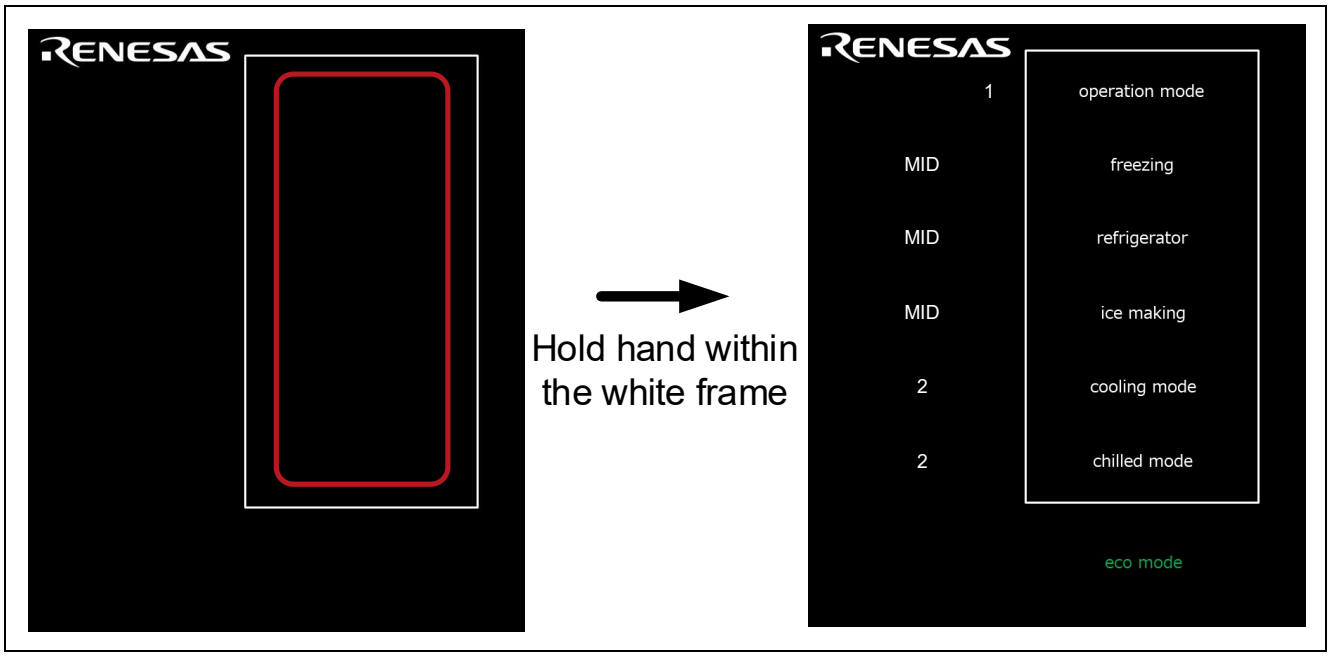

Figure 3-11 Return from Standby Mode in Proximity Sensor Mode

3.3.8 eco mode (Touch Sensor Mode)

Touching the eco mode button when the operating mode is set to 2, the device transits the standby mode in the touch sensor mode. In touch sensor mode, touching the button in the white frame returns to normal mode. CPU will make the decision to return from standby mode.

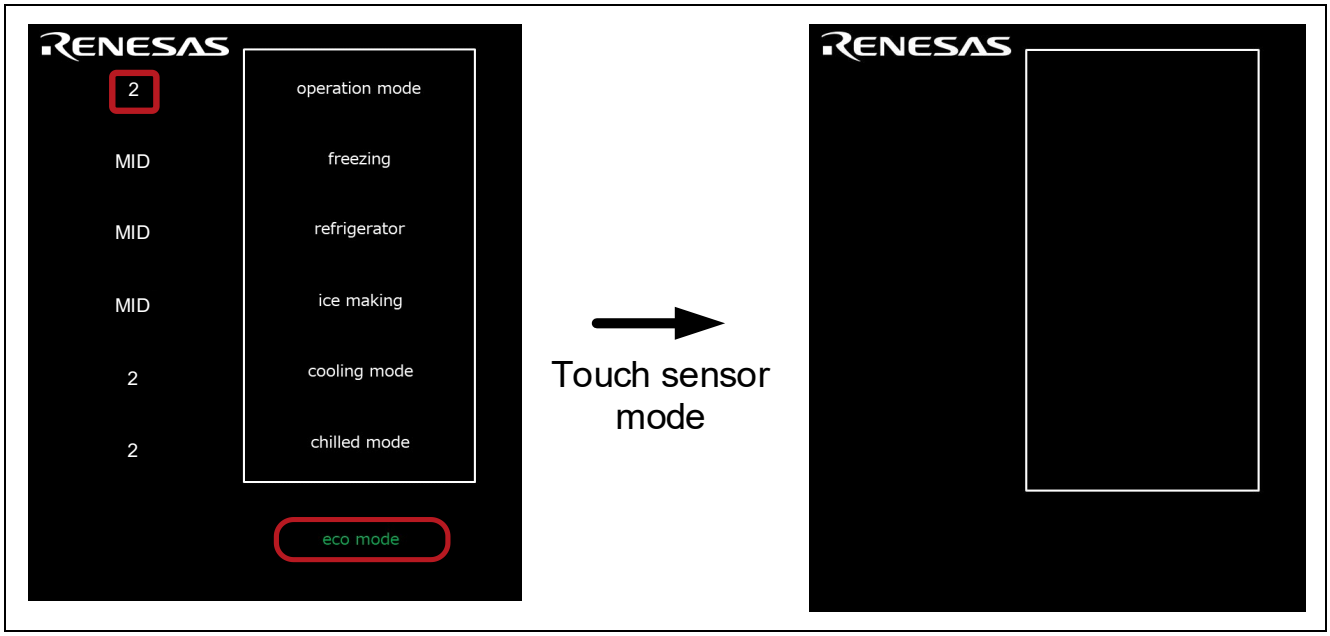

Figure 3-12 When operating mode 2 is Set, Touch eco mode

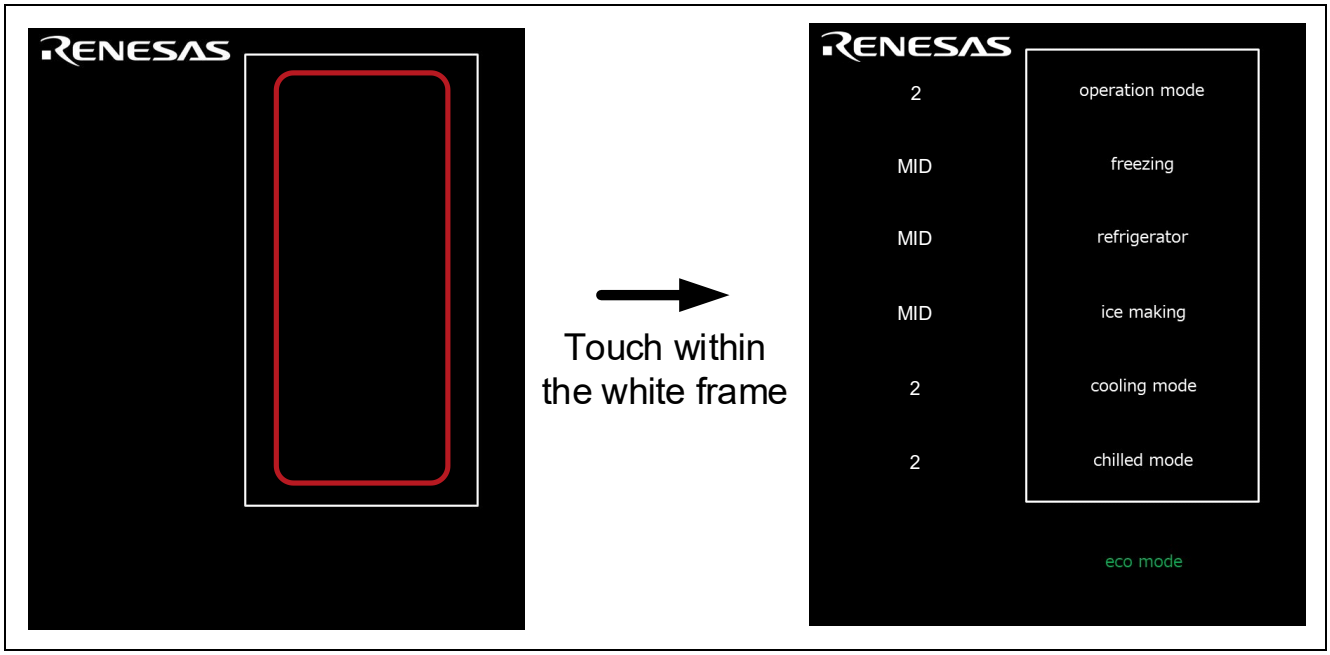

Figure 3-13 Return from Standby Mode in Touch Sensor Mode

3.3.9 eco mode (Auto Judgment (using SMS) Mode)

Touching the eco mode button when the operating mode is set to 3, the device transits the standby mode in the Auto judgment (using SMS) mode. In Auto judgment (using SMS) mode, touching the button in the white frame returns to normal mode.

SMS will make the decision to return from standby mode.

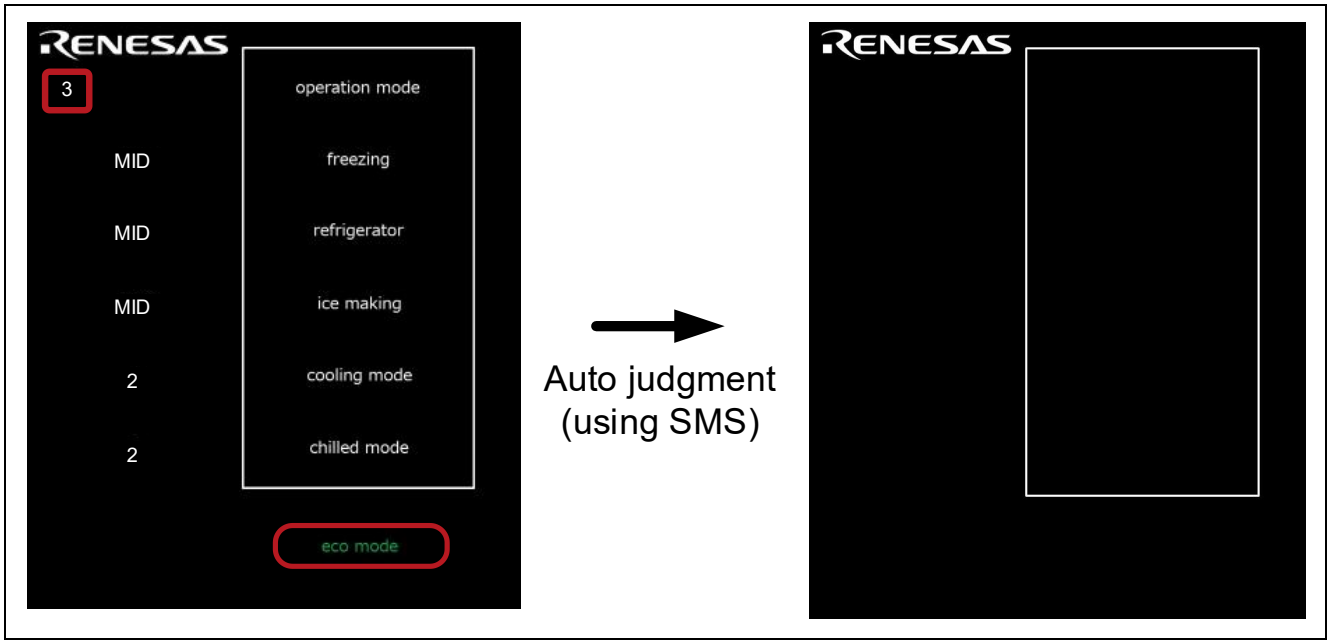

Figure 3-14 When operating mode 3 is Set, Touch eco mode

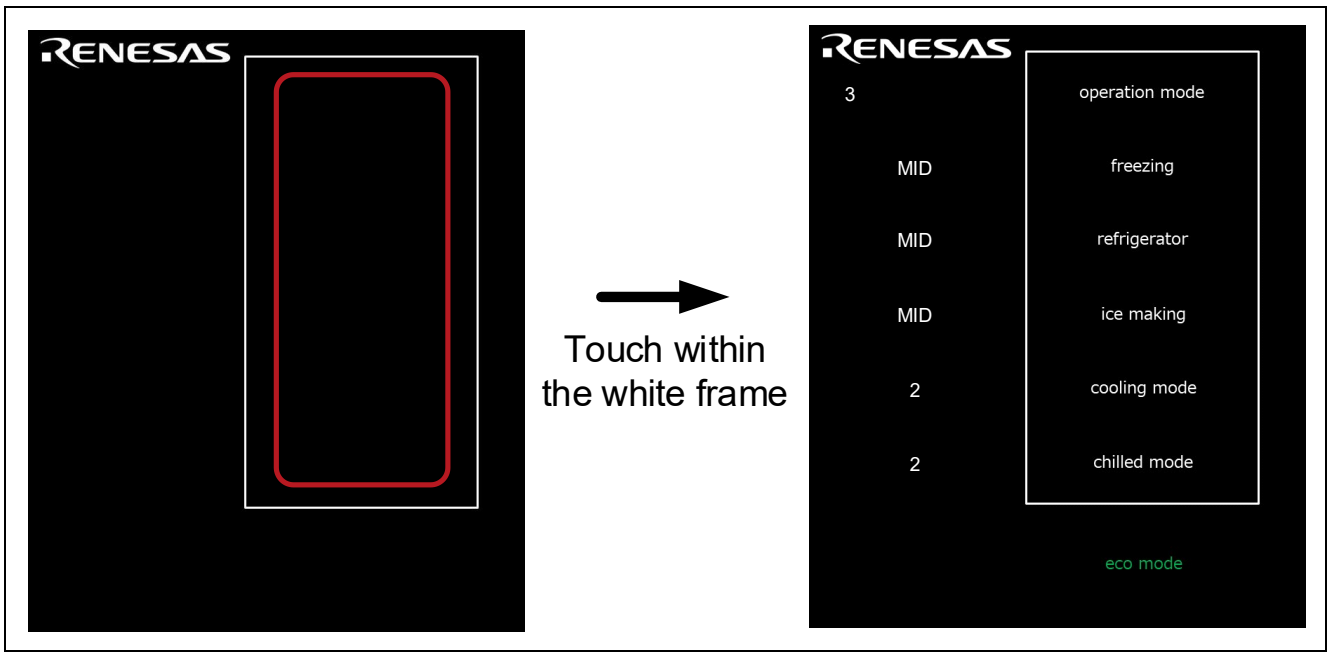

Figure 3-15 Return from Standby Mode in Auto Judgment (using SMS) Mode

4. Design Documents for Electrode Board

4.1 Schematic

The following shows a schematic of Electrode Board.

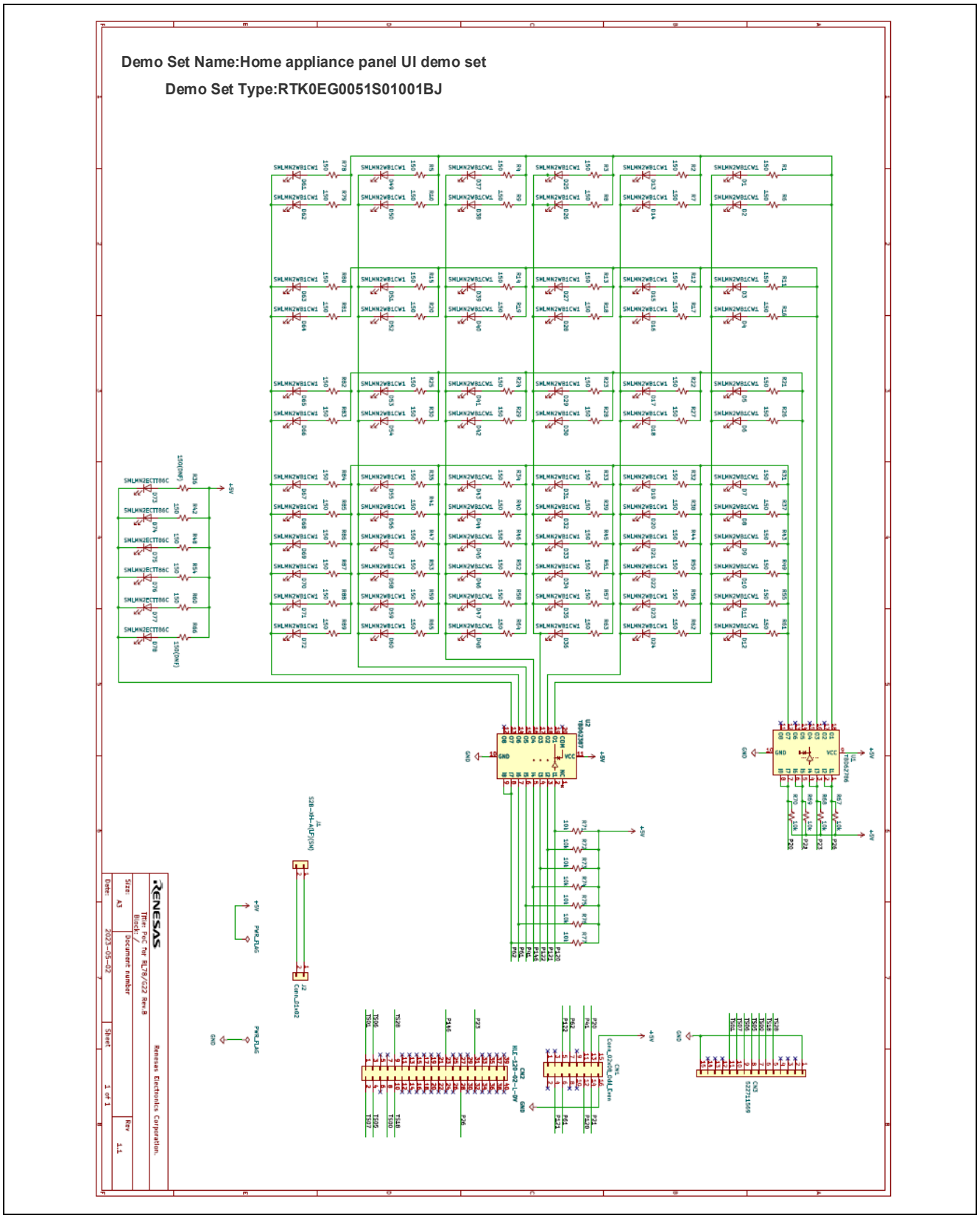

Figure 4-1 Electrode Board Schematic

4.2 Components Placement

The following shows a components placement of the Electrode Board.

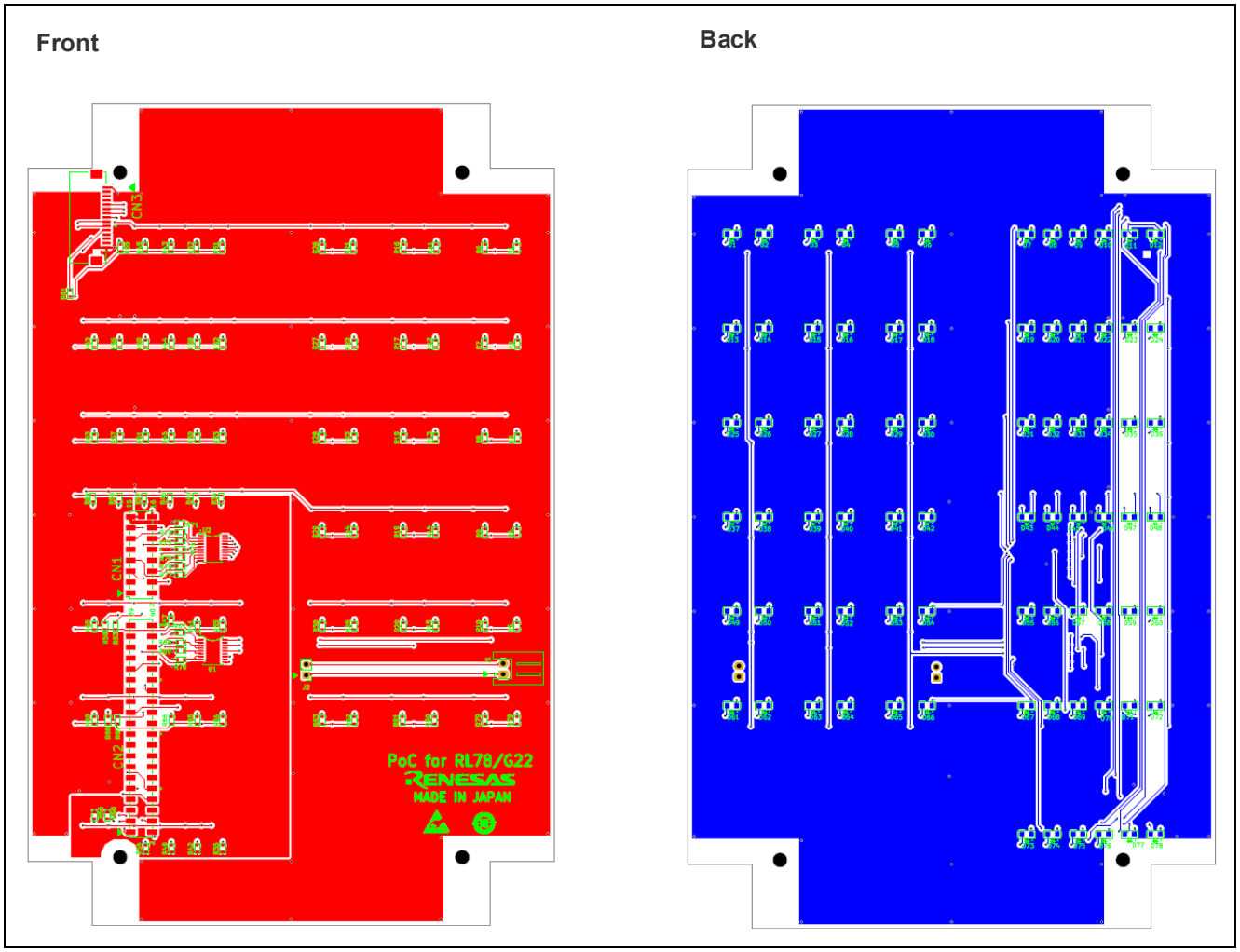

Figure 4-2 Electrode Board Components Placement

4.3 Components List

The following shows a components list of the Electrode Board.

Table 4-1 Electrode Board Components List

Comment	Description	Designator	Manufacturer	Quantity	notes
TBD62786	Transistor Array	U1	TOSHIBA	1	
TBD62387	Transistor Array	U1	TOSHIBA	1	
HLE-108-02-L-DV	Connector	CN1	Samtec	1	
HLE-120-02-L-DV	Connector	CN2	Samtec	1	
522711569	Connector	CN3	Molex	1	
SMLMN2WB1CW1	LED	D1,D2,D3,D4,D5,D6,D7, D8,D9,D10D11,D12, D13,D14,D15,D16,D17, D18,D19,D20,D21,D22, D23,D24,D25,D26,D27, D28,D29,D30,D31,D32, D33,D34,D35,D36,D37, D38,D39,D40,D41,D42, D43,D44,D45,D46,D47, D48,D49,D50,D51,D52, D53,D54,D55,D56,D57, D58,D59,D60,D61,D62, D63,D64,D65,D66,D67, D68,D69,D70,D71,D72	ROHM	72	White
SMLMN2ECTT86C	LED	D73,D74,D75,D76,D77, D78	ROHM	6	Green
S2B-XH-A(LF)(SN)	Connector	J1	JST	1	
FFC-2AEMP	Connector	J2	HTK	1	
MCR03EZPJ151	Resistor	R1,R2,R3,R4,R5,R6,R7, R8,R9,R10,R11,R12, R13,R14,R15,R16,R17, R18	ROHM	76	1608m 150
RMC1/16K151FTP			KAMAYA		
MCR03EZPJ151	Resistor	R36,R66	ROHM	0	150 1608m
MCR03EZPJ103	Resistor	R67,R68,R69,R70,R71, R72,R73,R74,R75,R76, R77	ROHM	11	10k 1608m
RMC1/16K103FTP			KAMAYA		10k 1608m
PSR-420257-8	Connector	Mounted on CN1	Hirosugi-Keiki	1	
PSR-420257-10	Connector	Two mounted on CN2	Hirosugi-Keiki	2	

Revision History	RL78/G22 Group Capacitive Touch Appliance UI Reference Design Manual

Rev.	Date	Description	
		Page	Summary
1.00	May.22.26	—	First edition

RL78/G22 Group
Capacitive Touch Appliance UI Reference Design Manual

Publication Date: Rev.1.00 May.22.26

Published by: Renesas Electronics Corporation

RL78/G22 Group

Renesas Electronics Corporation

R30UZ0247EJ0100