RX651 Group

Voice Recognition Demo Board

Introduction

This application note explains the hardware specifications of Renesas Electronics' voice recognition demo board RTK0EA0003D00001BJ, which uses RX651.

Target Device

RX651 Group

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1. Outline

The RTK0EA0003D00001BJ is a demo board for a voice recognition remote control using RX651. This product provides the following features.

- Compact (60mm x 40mm)
- Built-in MEMS microphone
- Easy setup (can be powered by USB connection)
- Built-in transmission interfaces (USB, Emulator interface)

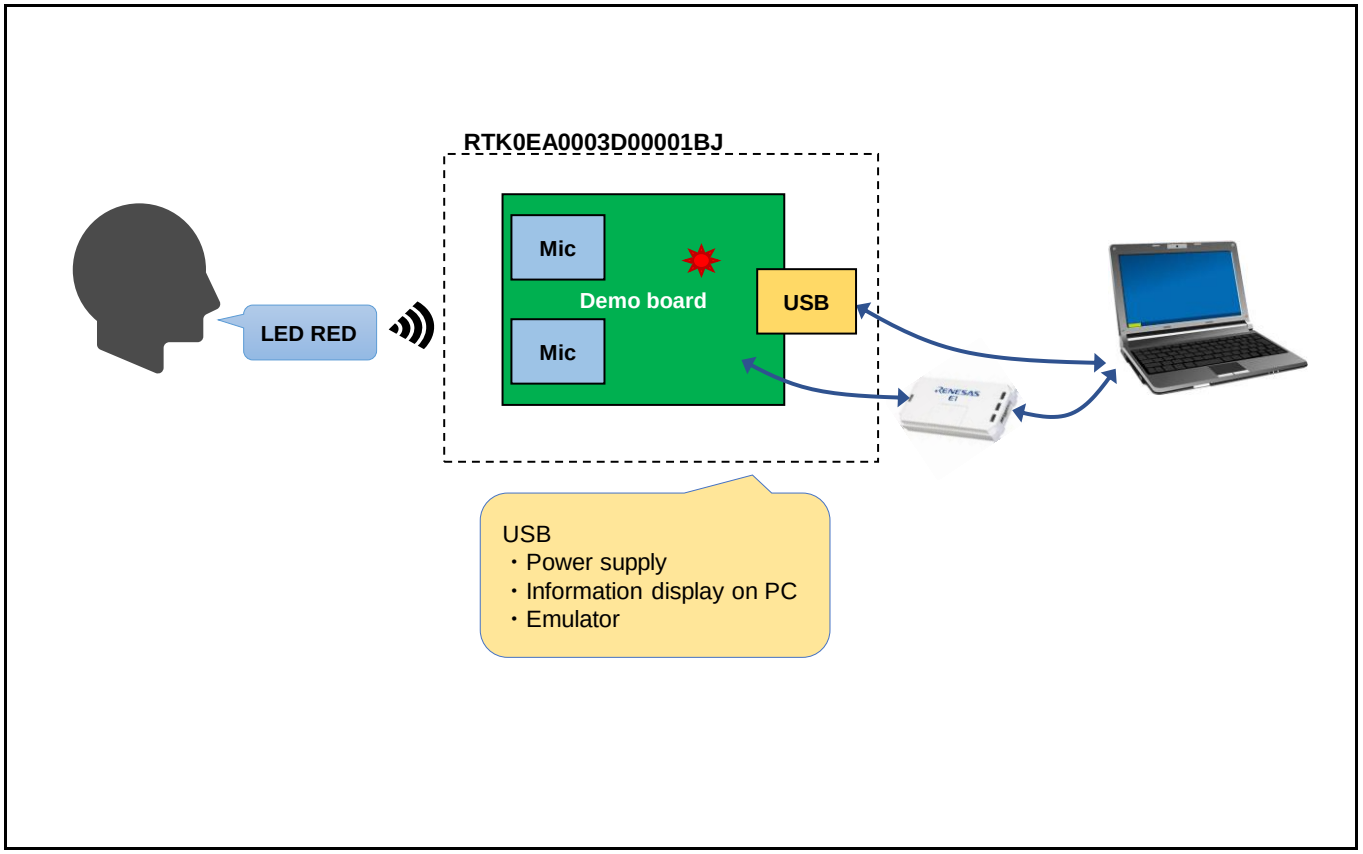


Figure 1-1 RX651 Voice Recognition Demo Set

2. Product External Appearance

Figure 2-1 shows a photo of the demo board and provides the names of the key components.

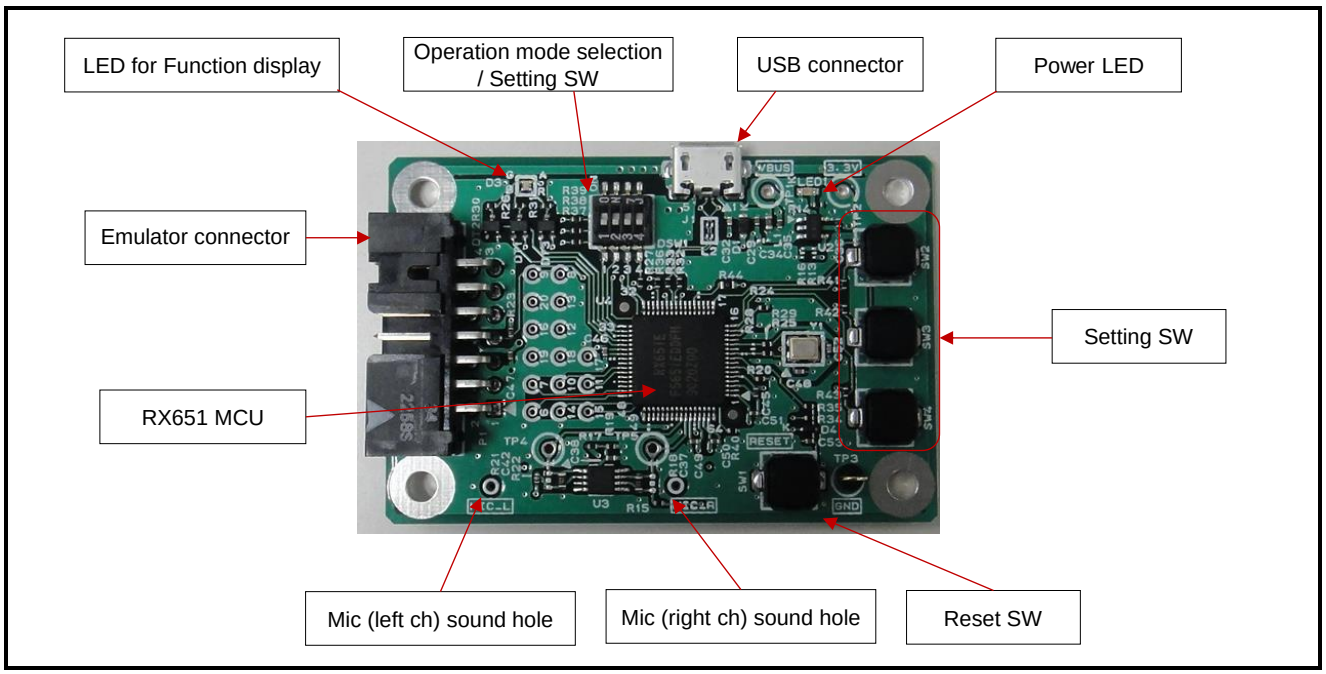


Figure 2-1 Product External Appearance

3. Hardware Specifications

Table 3-1 Hardware Specifications

Item	Description	Remarks
Board size	60.0 x 40.0[mm]	
MCU	RX651 (R5F5651EDDFM)	Code flash: 2MB, RAM: 640KB Data flash: 32KB Package: 64-pin LFQFP (0.5mm pitch) Operating ambient temperature: -40～85℃
Clock	MCU main clock: external 24MHz	Crystal unit
Microphone	KNOWLES, Inc. SPU0410LR5H-QB: 2 pcs.	MEMS Microphone, omnidirectional, Sensitivity -38dBV/Pa, Analog output
LED	Power supply: Green LED 1 pc.	
	Function display: 3-color (RGB) LED 1 pc.	MCU port control
Switch	Push switch: 4 pcs.	・MCU reset switch ・Setting switch 1 - 3(MCU port control)
	Dip switch: 1 pc.	・Operation mode selection switch Switching between single-chip mode and boot mode. * Used in single-chip mode when connected to an emulator. * Boot mode only supports USB boot. ・Setting switch 1 - 3(MCU port input)
USB interface	USB Micro B connector	Full speed transfer
Emulator interface	E1 14-pin box header	
Power supply input	USB bus power (VBUS): 5V	

4. Block Diagram

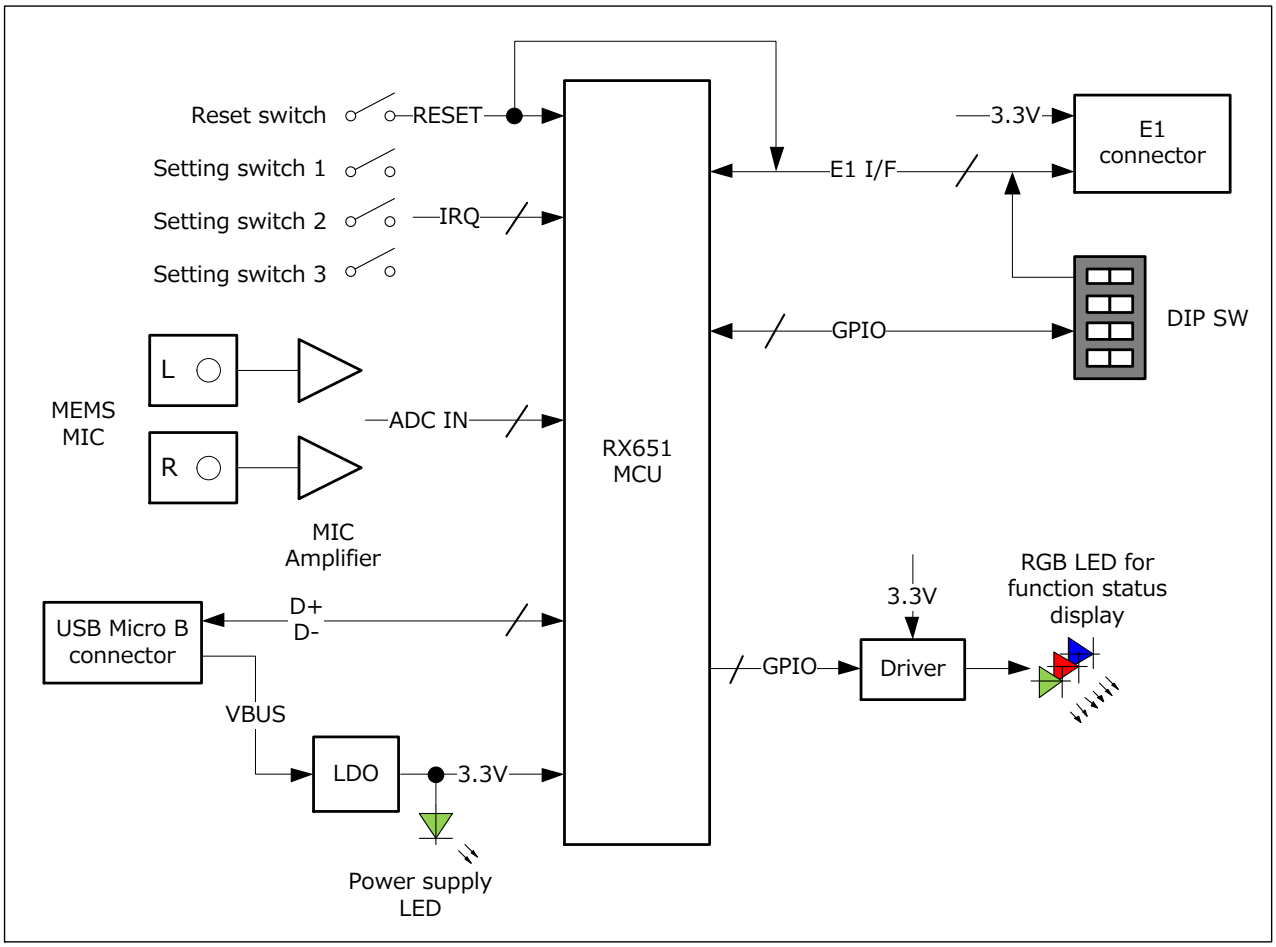


Figure 4-1 Block Diagram

5. Circuit Diagram

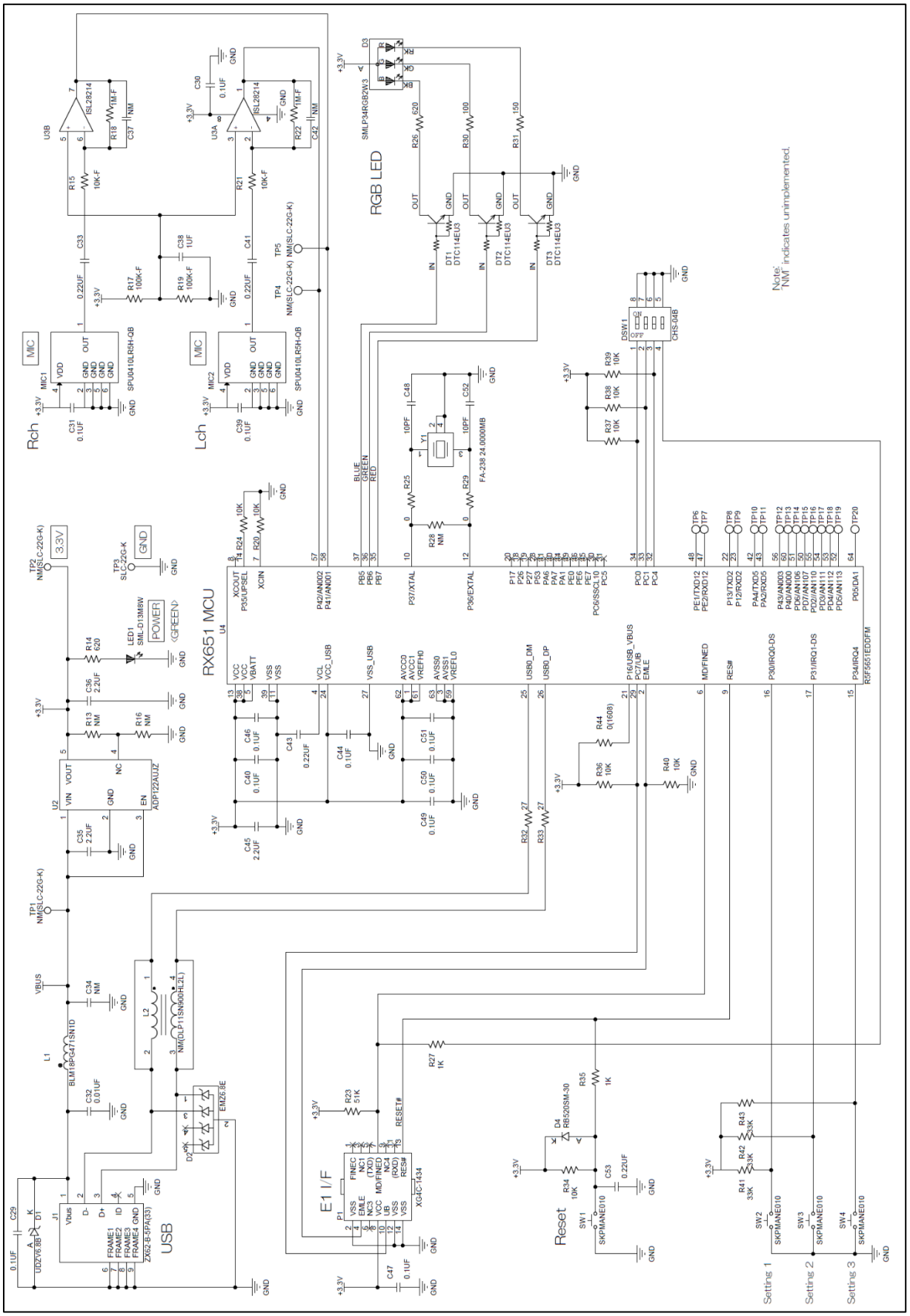


Figure 5-1 RTK0EA0003D00001BJ Circuit Diagram

6. Board Layout Diagram

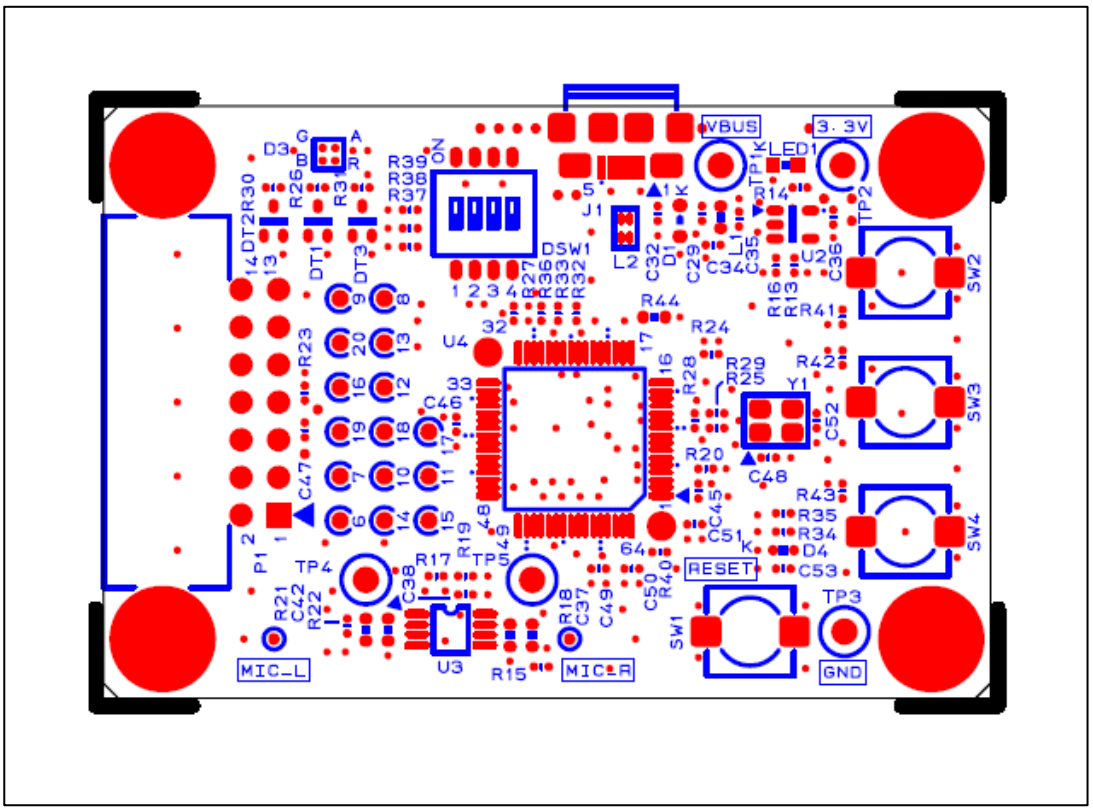


Figure 6-1 Component Side Silkscreen (top view)

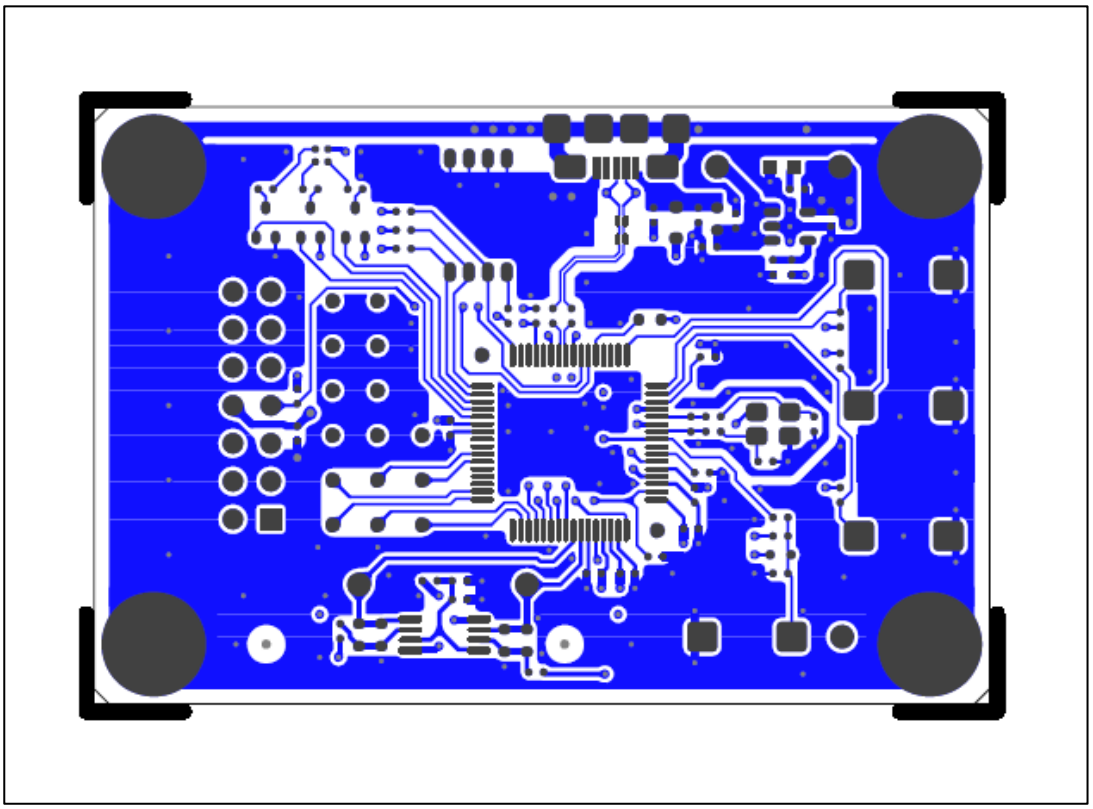


Figure 6-2 1st Layer Pattern (top view)

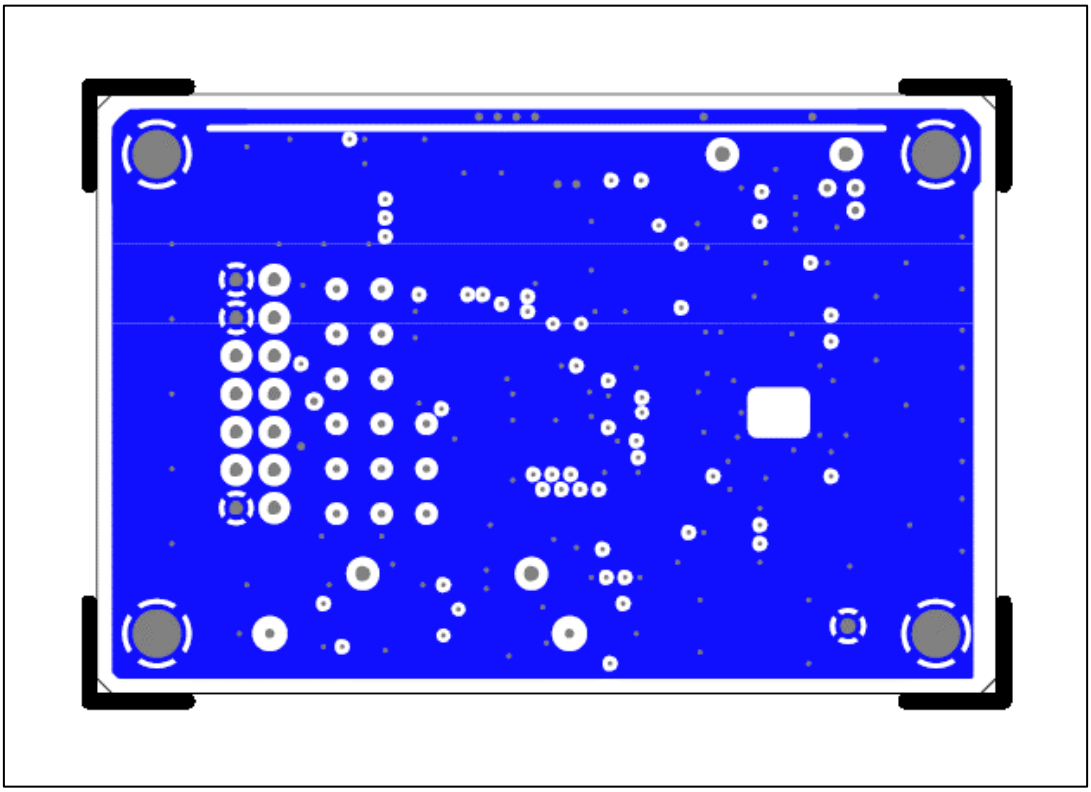


Figure 6-3 2nd Layer Pattern (top view)

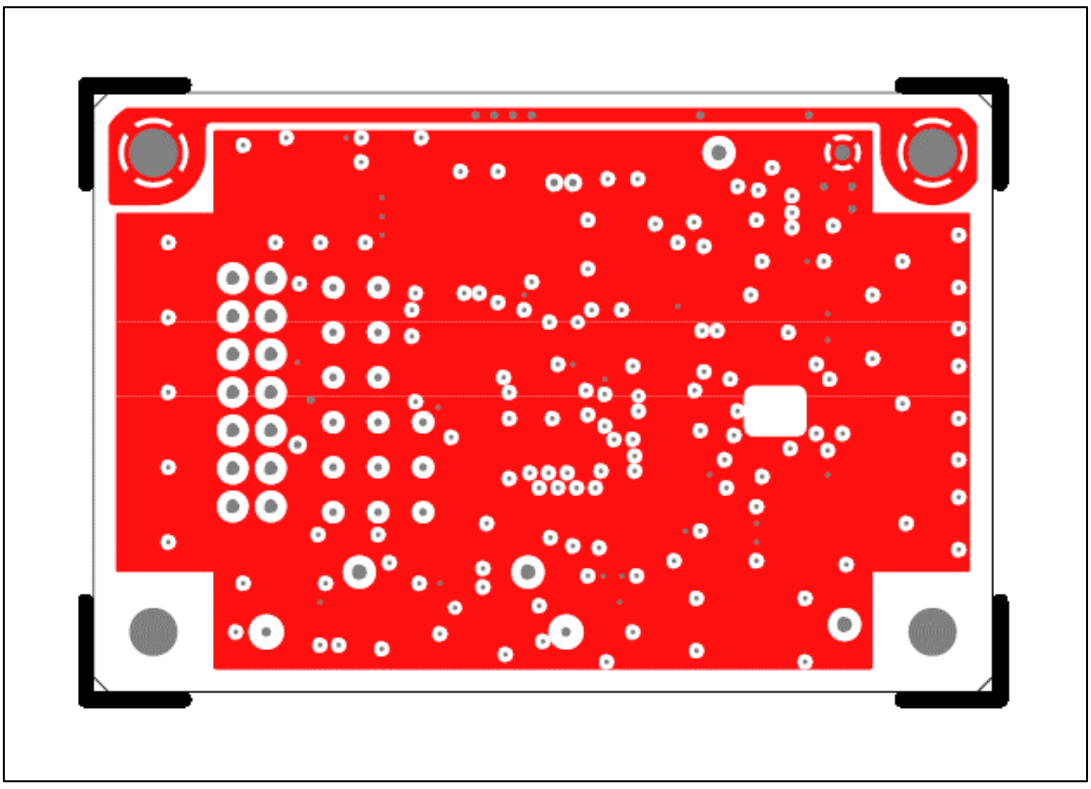


Figure 6-4 3rd Layer Pattern (top view)

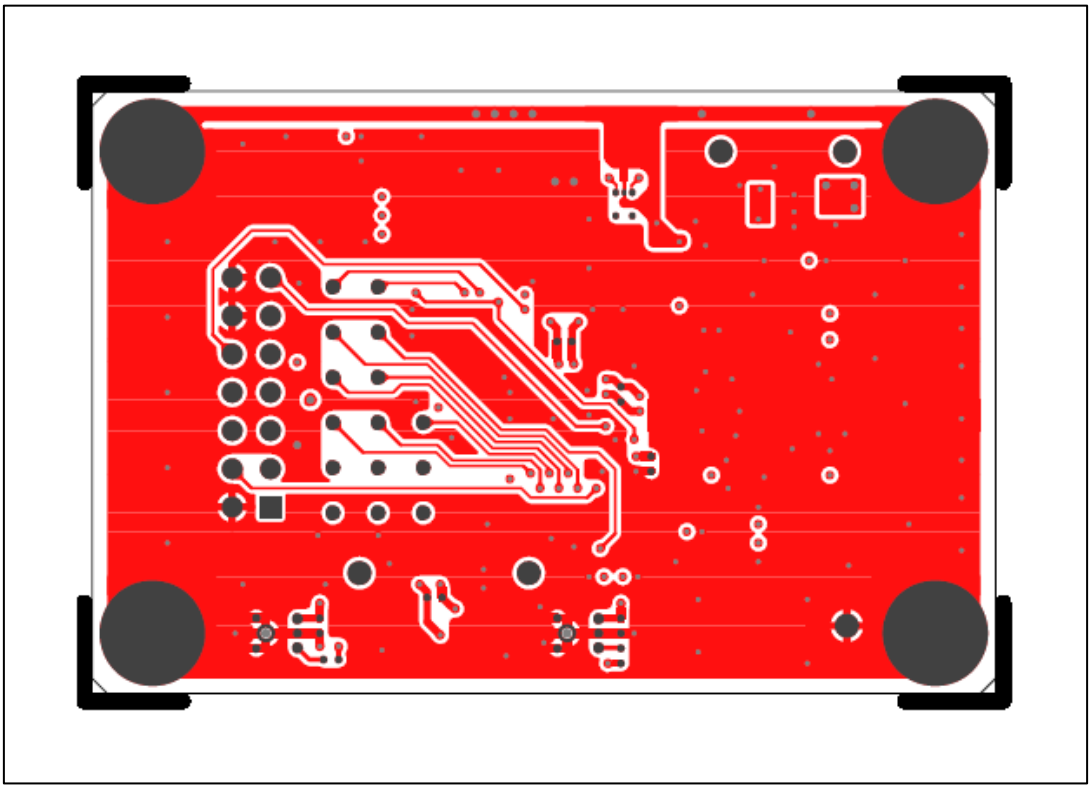


Figure 6-5 4th Layer Pattern (top view)

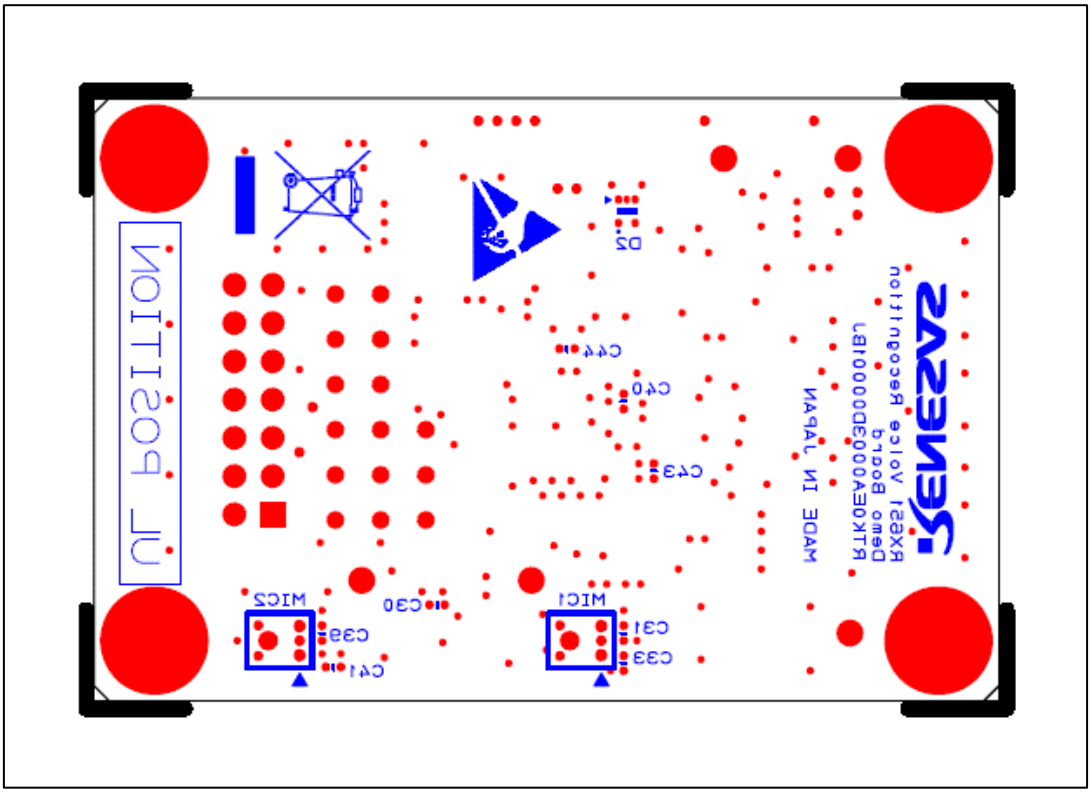


Figure 6-6 Solder Side Silkscreen (top view)

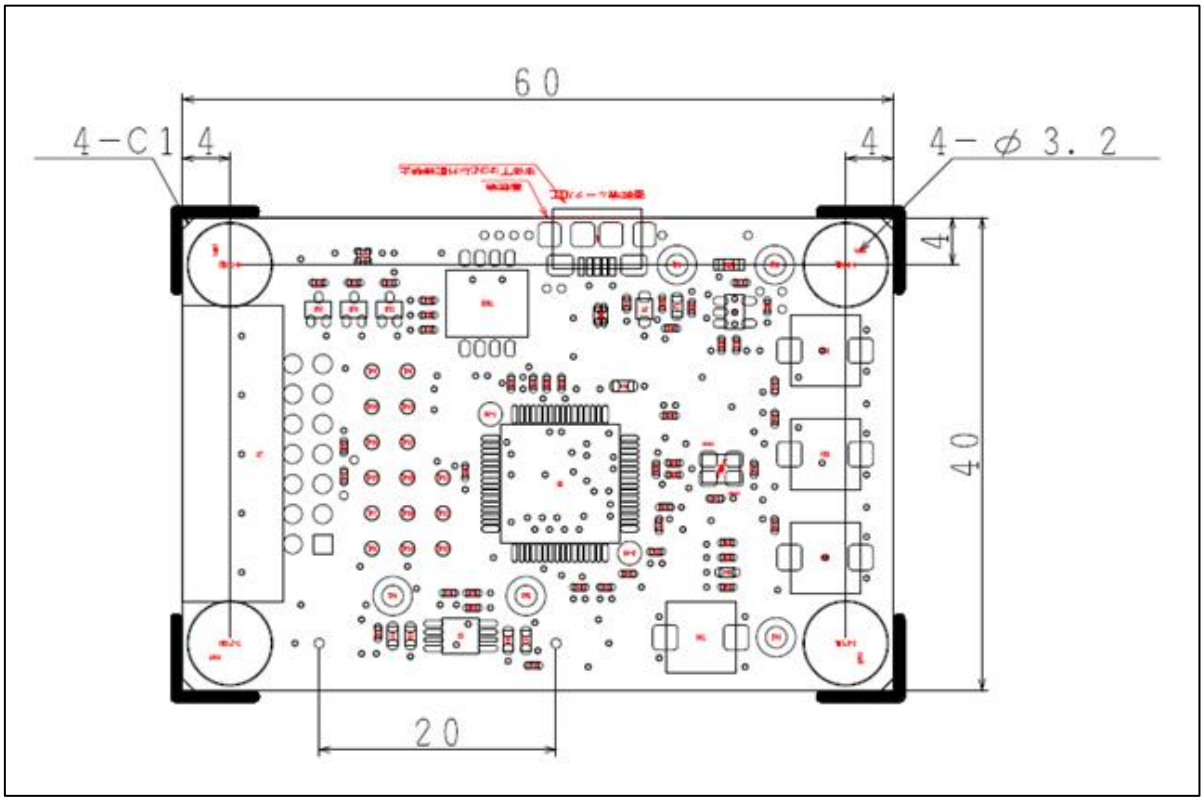


Figure 6-7 External dimensions (Unit:mm)

7. BOM (parts list)

Table 7-1 BOM (1/2)

Item	Parts Type	Reference	PartNo.	Manufacture	Impl	Qty	Remarks
1	IC MCU	U4	R5F5651EDDFM	RENESAS	Mount	1	64LFQFP
2	CRYSTAL OSCILLATOR	Y1	FA-238 24.0000MB50X	EPSON	Mount	1	24MHz, 50ppm, 10pF, 4-SMD
3	IC OPAMP	U3	ISL28214FUZ	RENESAS	Mount	1	Rail-to-Rail, 8-MSOP
4	MICROPHONE	MIC1,MIC2	SPU0410LR5H-QB	KNOWLES	Mount	2	Analog, MEMS, Omnidirectional, -38dB, Solder Pads
5	DIGITAL TRANSISTOR	DT1,DT2,DT3	DTC114EU3T106	ROHM	Mount	3	NPN, 100mA, 200mW, UMT3
6	SCHOTTKY DIODE	D4	RB520SM-30T2R	ROHM	Mount	1	30V, 200mA, EMD2
7	ZENER DIODE	D1	UDZVTE-176.8B	ROHM	Mount	1	6.8V, 200mW, UMD2
8	ZENER DIODE ARRAY	D2	EMZ6.8ET2R	ROHM	Mount	1	Common Anode, 6.8V, 150mW, EMD5
9	IC LDO	U2	ADP122AUJZ-3.3-R7	ANALOG DEVICES	Mount	1	3.3V, 300mA, TSOT-5
10	LED	LED1	SML-D13M8WT86	ROHM	Mount	1	Green, 0603" (1608mm)
11	LED	D3	SMLP34RGB2W3	ROHM	Mount	1	RGB, 0404"(1010mm)
12	INDUCTOR	L2	DLP11SN900HL2L	MURATA	UnMount	1	Common Mode Choke, 150mA, 90ohm, SMD
13	FERRITE BEAD	L1	BLM18PG471SN1D	MURATA	Mount	1	470 ohm, 0603"(1608mm)
14	CHIP RESISTOR	R44	MCR03EZPJ000	ROHM	Mount	1	0 ohm, 5%, 1/10W, 0603"(1608mm)
15	CHIP RESISTOR	R25,R29	MCR01MZPJ000	ROHM	Mount	2	0 ohm, 5%, 1/16W, 0402"(1005mm)
16	CHIP RESISTOR	R32,R33	MCR01MZPJ270	ROHM	Mount	2	27 ohm, 5%, 1/16W, 0402"(1005mm)
17	CHIP RESISTOR	R30	MCR01MZPJ101	ROHM	Mount	1	100 ohm, 5%, 1/16W, 0402"(1005mm)
18	CHIP RESISTOR	R31	MCR01MZPJ151	ROHM	Mount	1	150 ohm, 5%, 1/16W, 0402"(1005mm)
19	CHIP RESISTOR	R14,R26	MCR01MZPJ621	ROHM	Mount	2	620 ohm, 5%, 1/16W, 0402"(1005mm)
20	CHIP RESISTOR	R27,R35	MCR01MZPJ102	ROHM	Mount	2	1k ohm, 5%, 1/16W, 0402"(1005mm)
21	CHIP RESISTOR	R20,R24,R34,R36,R37,R38,R39,R40	MCR01MZPJ103	ROHM	Mount	8	10k ohm, 5%, 1/16W, 0402"(1005mm)
22	CHIP RESISTOR	R41,R42,R43	MCR01MZPJ333	ROHM	Mount	3	33k ohm, 5%, 1/16W, 0402"(1005mm)
23	CHIP RESISTOR	R23	MCR01MZPJ513	ROHM	Mount	1	51k ohm, 5%, 1/16W, 0402"(1005mm)
24	CHIP RESISTOR	R15,R21	MCR01MZPF1002	ROHM	Mount	2	10k ohm, 1%, 1/16W, 0402"(1005mm)
25	CHIP RESISTOR	R17,R19	MCR01MZPF1003	ROHM	Mount	2	100k ohm, 1%, 1/16W, 0402"(1005mm)
26	CHIP RESISTOR	R18,R22	MCR03EZPFX1004	ROHM	Mount	2	1M ohm, 1%, 1/10W, 0603"(1608mm)
27	CERAMIC CAPACITOR	C48,C52	04025A100JAT2A	AVX	Mount	2	10pF, 5%, 50V, C0G, 0402"(1005mm)
28	CERAMIC CAPACITOR	C32	04025C103KAT2A	AVX	Mount	1	0.01uF, 10%, 50V, X7R, 0402"(1005mm)

Table 7-2 BOM (2/2)

Item	Parts Type	Reference	PartNo.	Manufacture	Impl	Qty	Remarks
29	CERAMIC CAPACITOR	C29,C30,C31,C39,C40,C44,C46,C47,C49,C50,C51	CGA2B3X5R1H104M050BB	TDK	Mount	11	0.1uF, 20%, 50V, X5R, 0402"(1005mm)
30	CERAMIC CAPACITOR	C33,C41,C43,C53	CGA2B3X7R1E224K050BB	TDK	Mount	4	0.22uF, 10%, 25V, X7R, 0402"(1005mm)
31	CERAMIC CAPACITOR	C38	CGB2A1X5R1E105M033BC	TDK	Mount	1	1uF, 20%, 25V, X5R, 0402"(1005mm)
32	CERAMIC CAPACITOR	C35,C36,C45	C1005X5R1E225M050BC	TDK	Mount	3	2.2uF, 20%, 25V, X5R, 0402"(1005mm)
33	DIP SW	DSW1	CHS-04TB	NIDEC COPAL	Mount	1	4 Position, SMD, 100mA, 6VDC
34	TACTILE SWITCH	SW1,SW2,SW3,SW4	SKPMANE010	ALPS	Mount	4	50mA, 16VDC, SPST, SMD
35	HEADER CONNECTOR	P1	XG4C-1434	OMRON	Mount	1	Through Hole, Right Angle, 14 position, 0.100"(2.54mm)
36	USB CONNECTOR	J1	ZX62-B-5PA(33)	HIROSE	Mount	1	Micro-B, SMD, Right Angle, Non-reverse type
37	TEST POINT	TP3	SLC-22G-K	SUNHAYATO	Mount	1	1mm DIA TH
38	TEST POINT	TP1,TP2, TP4,TP5	SLC-22G	SUNHAYATO	UnMount	4	1mm DIA TH
39	TEST POINT	TP6,TP7,TP8,TP9,TP10,TP11, TP12,TP13,TP14,TP15,TP16,TP17,TP18,TP19,TP20	-	-	-	15	0.5mm DIA TH
40	CHIP RESISTOR	R13,R16,R28	-	-	UnMount	3	0402"(1005mm) Resistor Pad
41	CERAMIC CAPACITOR	C34	-	-	UnMount	1	0402"(1005mm) Capacitor Pad
42	CERAMIC CAPACITOR	C37,C42	-	-	UnMount	2	0603"(1608mm) Capacitor Pad
43	PCB	-	RTK0EA0003D00001BJ rev.A	-	-	1	
44	RESIN SPACER	-	AS-306	HIROSUGI-KEIKI	-	4	Hexagon both female screw, Duracon, M3
45	SCREW		UM-0306	HIROSUGI-KEIKI	-	4	Flat head, stainless steel, M3

NM: Not Mounted

8. Website and Support

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Sep 26, 2019	-	First edition issued.
1.01	Mar 31, 2020	3	Revised outline.

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.
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   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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