RA6M1 Group

Voice Recognition Demo Board

Introduction

This application note explains the hardware specifications of Renesas Electronics' voice recognition demo board RTK0EA0004D00001BJ, which uses RA6M1.

Target Device

RA6M Group

Contents

1. Outline

The RTK0EA0004D00001BJ is a demo board for a voice recognition remote control using RA6M1. 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)

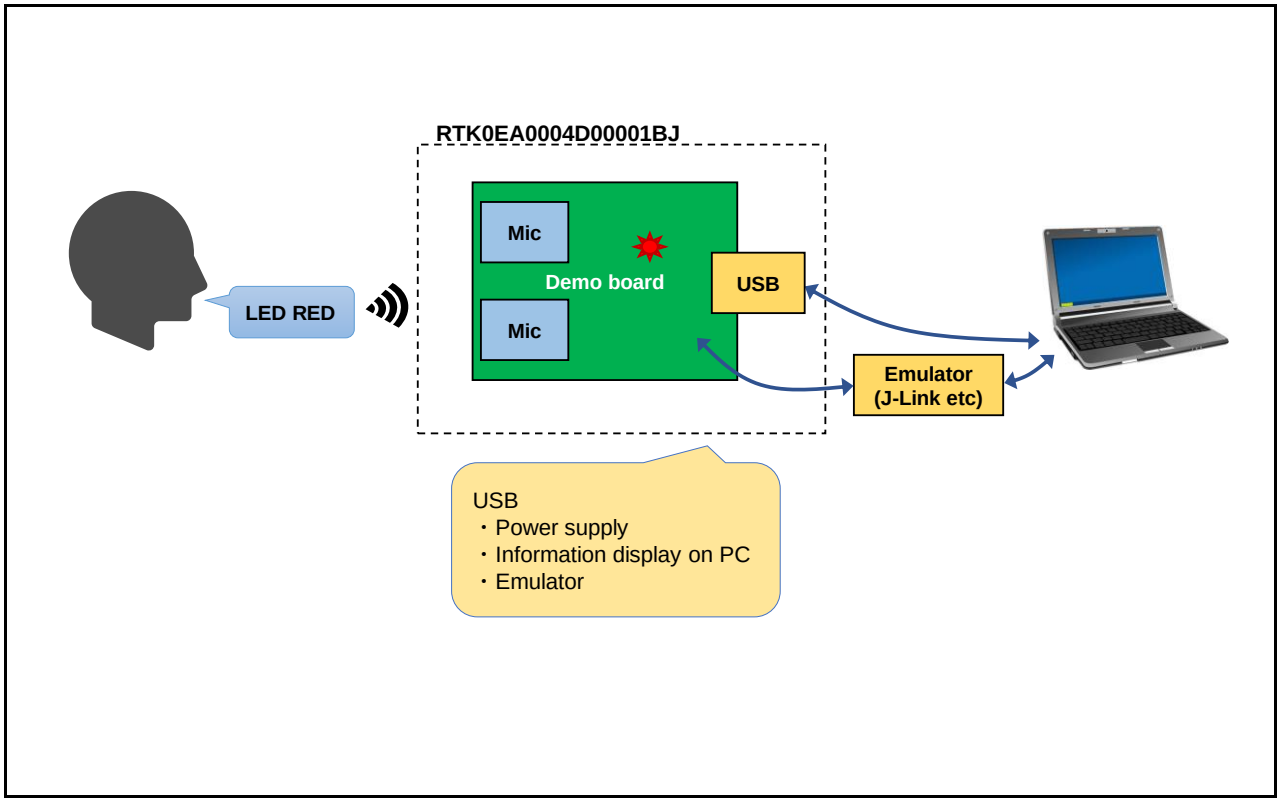

Figure 1-1 RA6M1 Voice Recognition Demo Set

2. Product External Appearance

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

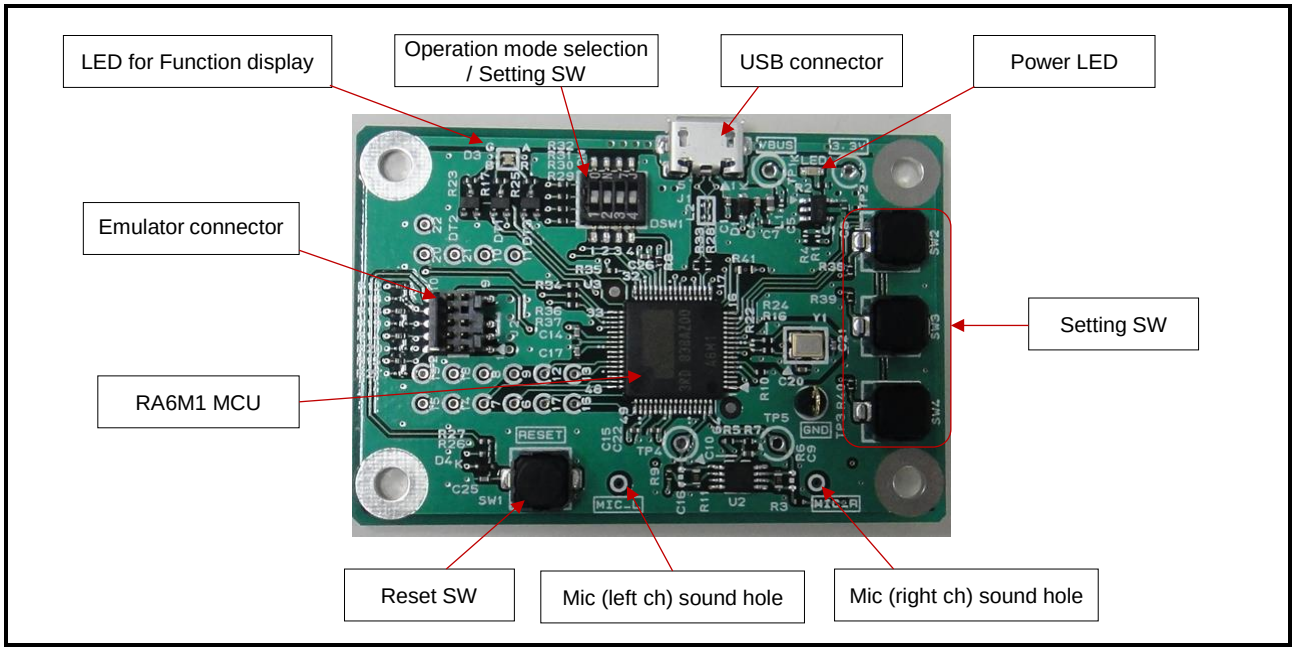

Figure 2-1 Product External Appearance

3. Hardware Specifications

Table 3-1 Hardware Specifications

Item	Description	Remarks
Board size	60.0 x 40.0[mm]	
MCU	RA6M1 (R7FA6M1AD3CFM)	Code flash: 512KB, RAM: 256KB Data flash: 8KB Package: 64-pin LQFP (0.5mm pitch) Operating ambient temperature: -40～85℃
Clock	MCU main clock: external 16MHz	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. ・Setting switch 1 - 3(MCU port input)
USB interface	USB Micro B connector	Full speed transfer
Emulator interface	1.27mm pitch 10-pin header	
Power supply input	USB bus power (VBUS): 5V	

4. Block Diagram

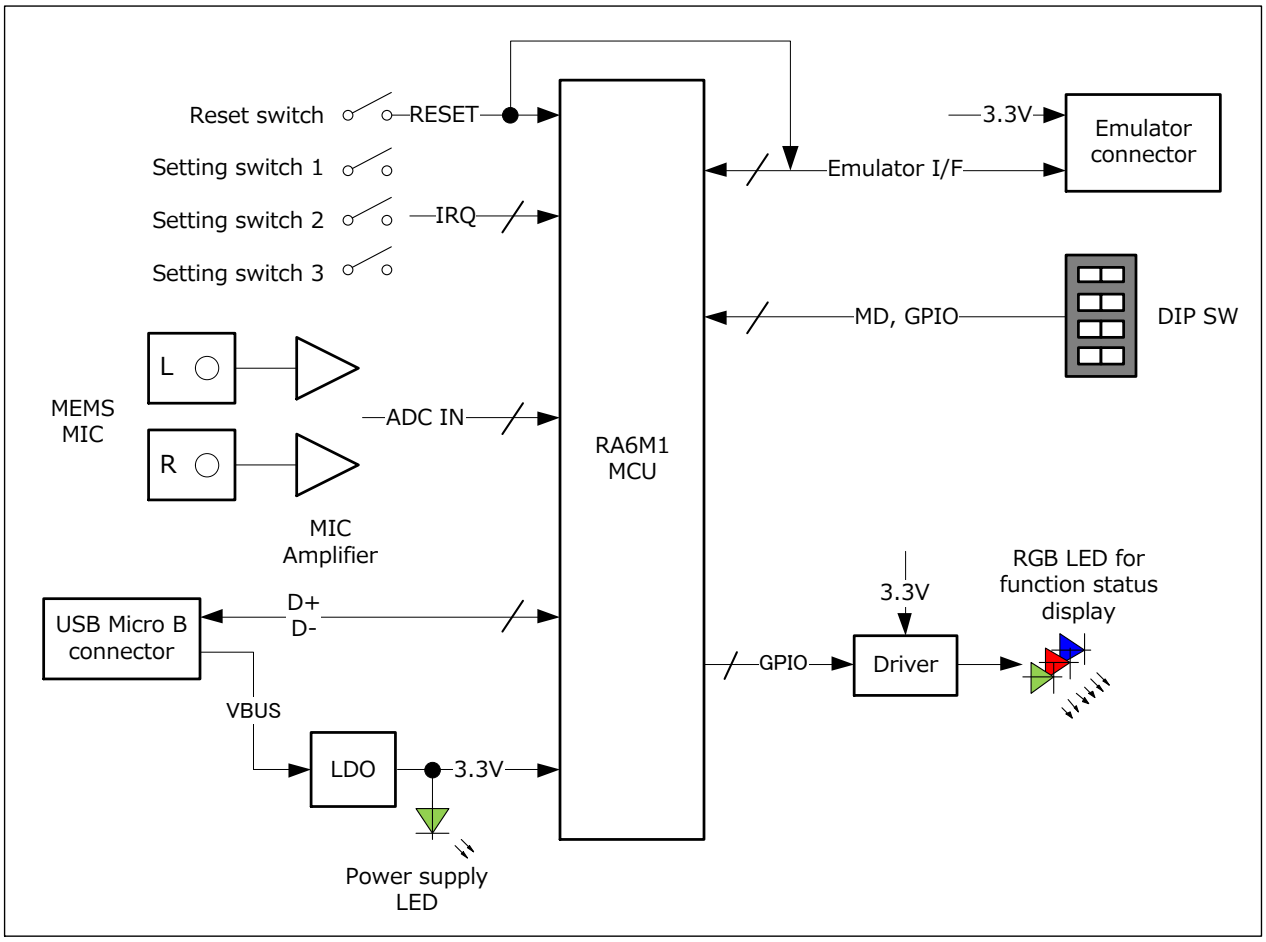

Figure 4-1 Block Diagram

5. Circuit Diagram

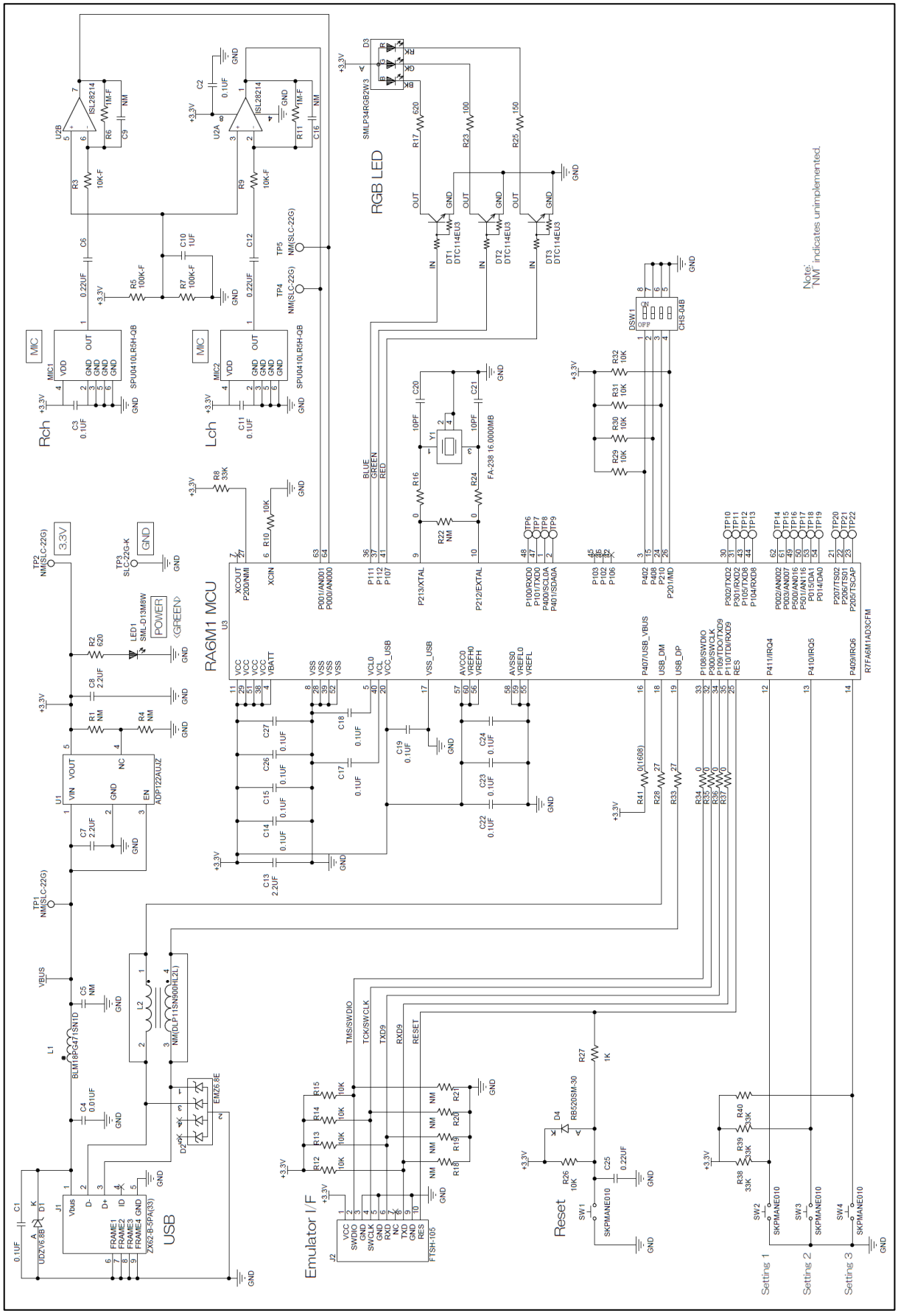

Figure 5-1 RTK0EA0004D00001BJ Circuit Diagram

6. Board Layout Diagram

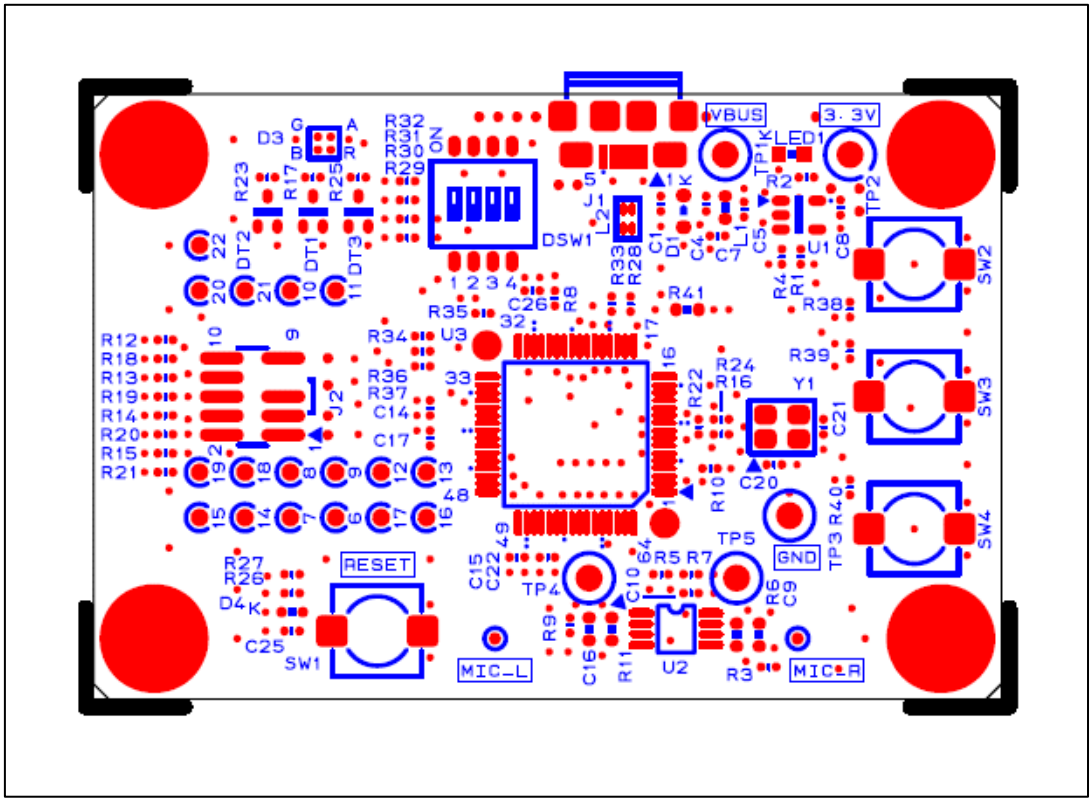

Figure 6-1 Component Side Silkscreen (top view)

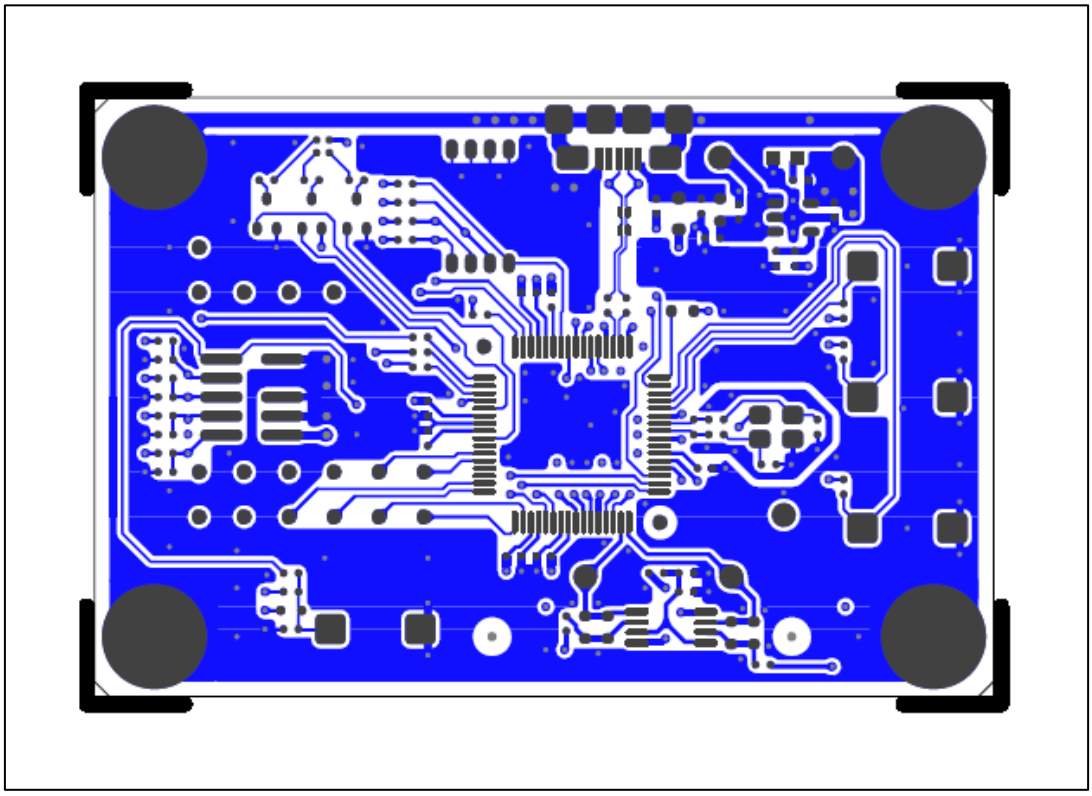

Figure 6-2 1st Layer Pattern (top view)

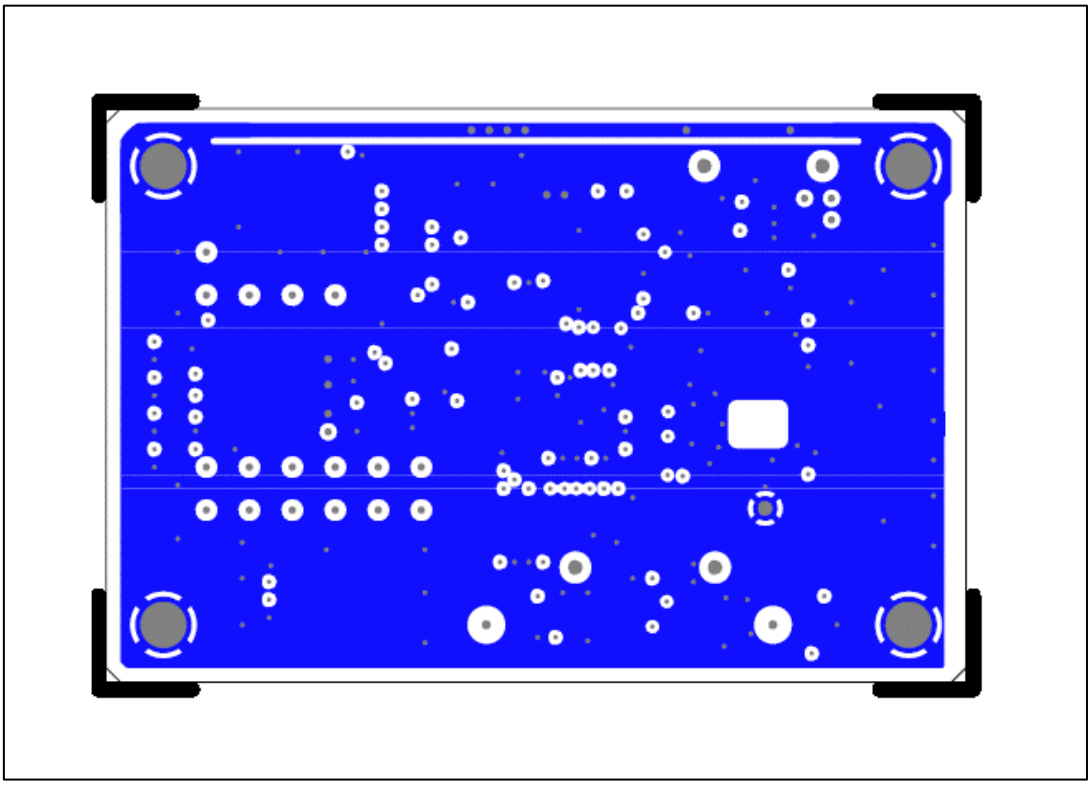

Figure 6-3 2nd Layer Pattern (top view)

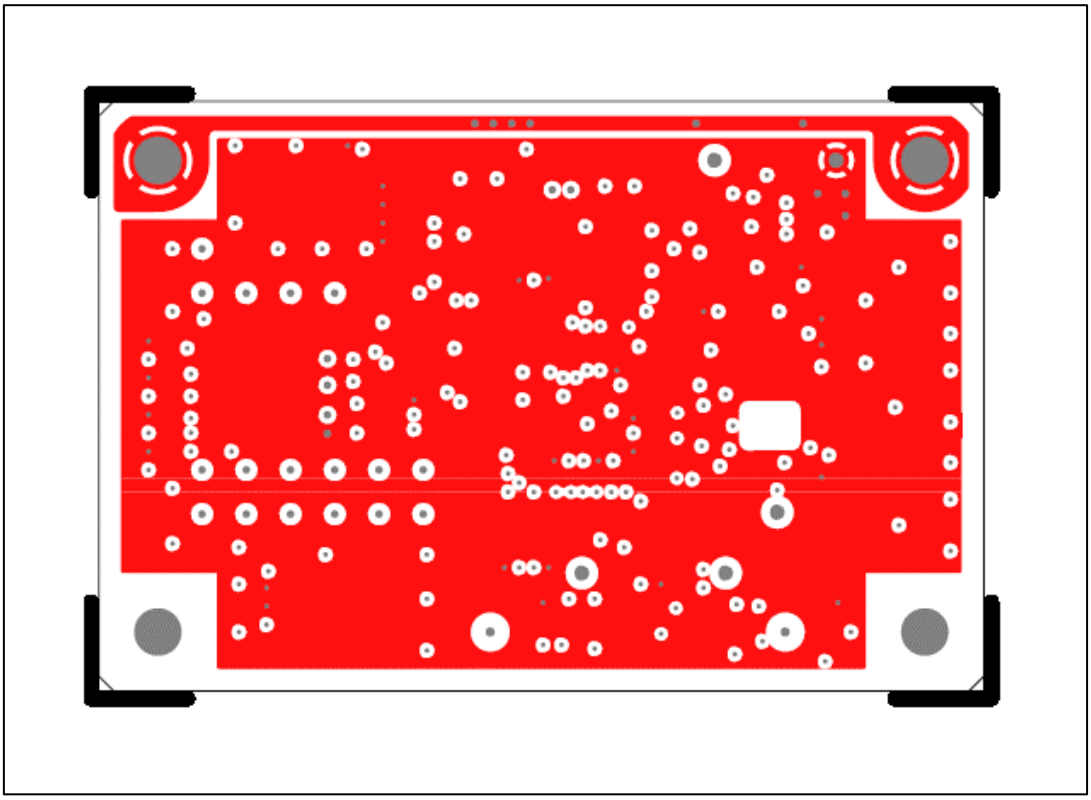

Figure 6-4 3rd Layer Pattern (top view)

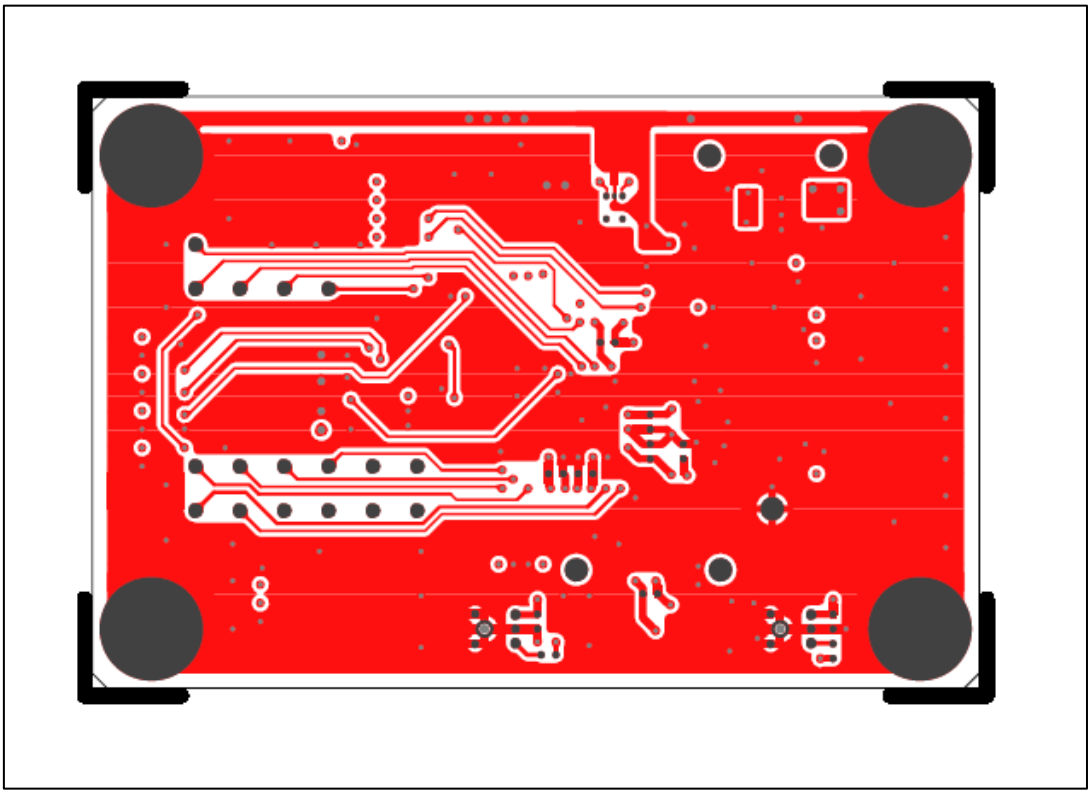

Figure 6-5 4th Layer Pattern (top view)

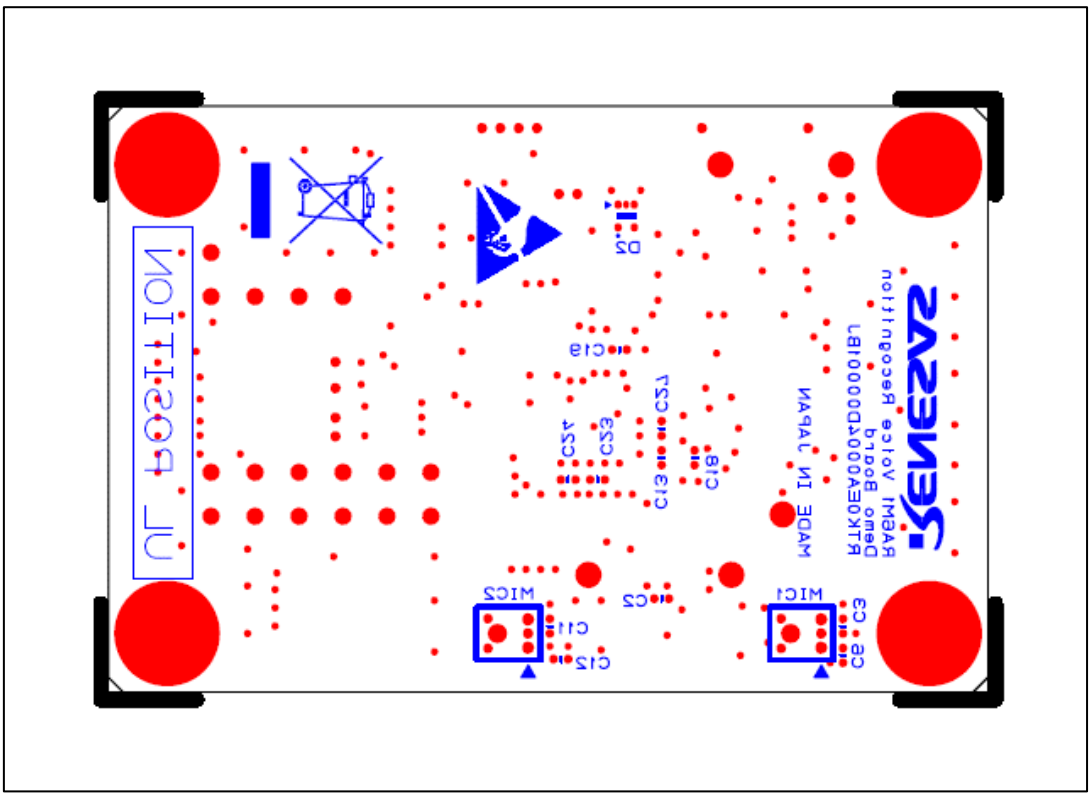

Figure 6-6 Solder Side Silkscreen (top view)

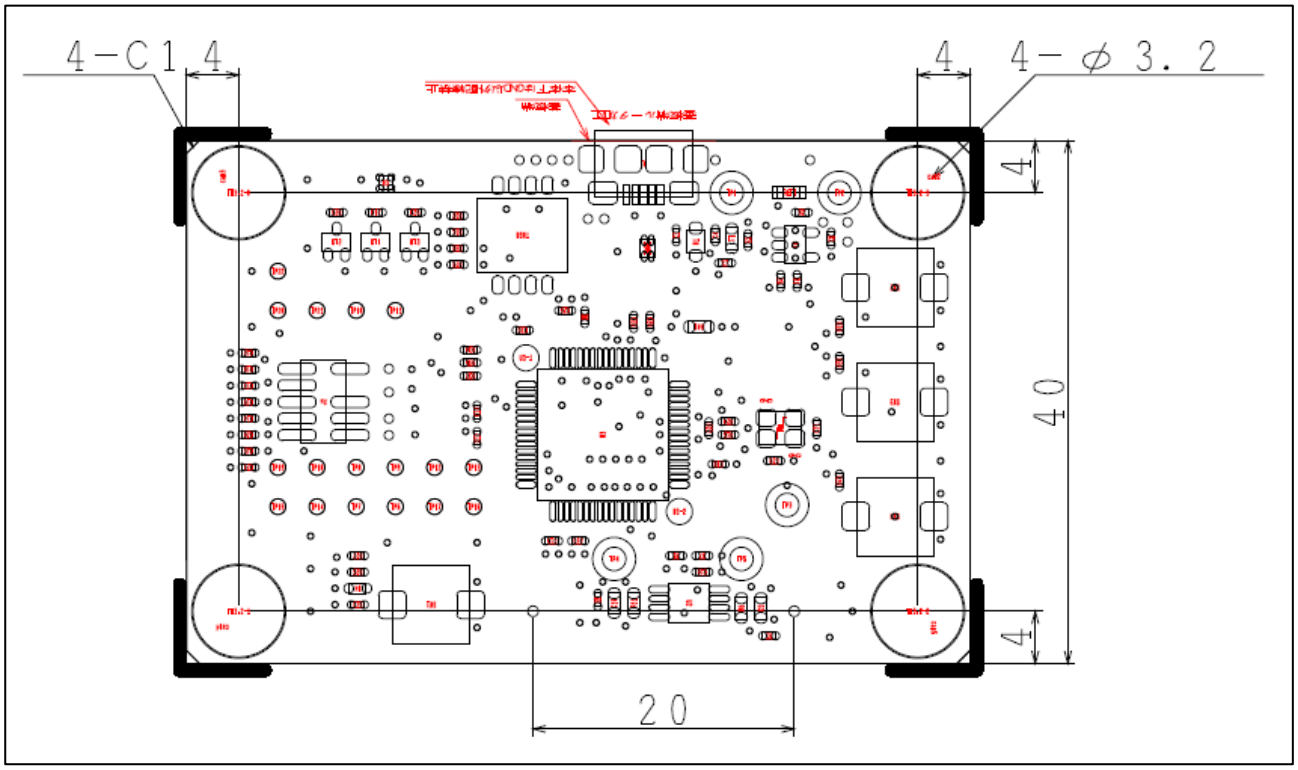

Figure 6-7 External dimensions (Unit:mm)

7. BOM (parts list)

Table 7-1 BOM (1/2)

Item	Parts Type	Reference	PartNo.	Manufacture	Impl	Qty	Remarks
1	IC MCU	U3	R7FA6M1AD3CFM	RENESAS	Mount	1	64pin LQFP
2	CRYSTAL OSCILLATOR	Y1	FA-238 16.0000MB-K3	EPSON	Mount	1	16MHz, 50ppm, 10pF, 4-SMD
3	IC OPAMP	U2	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	U1	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	R41	MCR03EZPJ000	ROHM	Mount	1	0 ohm, 5%, 1/10W, 0603"(1608mm)
15	CHIP RESISTOR	R16,R24,R34,R35,R36,R37	MCR01MZPJ000	ROHM	Mount	6	0 ohm, 5%, 1/16W, 0402"(1005mm)
16	CHIP RESISTOR	R28,R33	MCR01MZPJ270	ROHM	Mount	2	27 ohm, 5%, 1/16W, 0402"(1005mm)
17	CHIP RESISTOR	R23	MCR01MZPJ101	ROHM	Mount	1	100 ohm, 5%, 1/16W, 0402"(1005mm)
18	CHIP RESISTOR	R25	MCR01MZPJ151	ROHM	Mount	1	150 ohm, 5%, 1/16W, 0402"(1005mm)
19	CHIP RESISTOR	R2,R17	MCR01MZPJ621	ROHM	Mount	2	620 ohm, 5%, 1/16W, 0402"(1005mm)
20	CHIP RESISTOR	R27	MCR01MZPJ102	ROHM	Mount	1	1k ohm, 5%, 1/16W, 0402"(1005mm)
21	CHIP RESISTOR	R10,R12,R13,R14,R15,R26,R29,R30,R31,R32	MCR01MZPJ103	ROHM	Mount	10	10k ohm, 5%, 1/16W, 0402"(1005mm)
22	CHIP RESISTOR	R8,R38,R39,R40	MCR01MZPJ333	ROHM	Mount	4	33k ohm, 5%, 1/16W, 0402"(1005mm)
23	CHIP RESISTOR	R3,R9	MCR01MZPF1002	ROHM	Mount	2	10k ohm, 1%, 1/16W, 0402"(1005mm)
24	CHIP RESISTOR	R5,R7	MCR01MZPF1003	ROHM	Mount	2	100k ohm, 1%, 1/16W, 0402"(1005mm)
25	CHIP RESISTOR	R6,R11	MCR03EZPFX1004	ROHM	Mount	2	1M ohm, 1%, 1/10W, 0603"(1608mm)
26	CERAMIC CAPACITOR	C20,C21	04025A100JAT2A	AVX	Mount	2	10pF, 5%, 50V, C0G, 0402"(1005mm)
27	CERAMIC CAPACITOR	C4	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
28	CERAMIC CAPACITOR	C1,C2,C3,C11, C14,C15,C17,C 18,C19,C22,C2 3,C24,C26,C27	CGA2B3X5R1H1 04M050BB	TDK	Mount	14	0.1uF, 20%, 50V, X5R, 0402"(1005mm)
29	CERAMIC CAPACITOR	C6,C12,C25	CGA2B3X7R1E2 24K050BB	TDK	Mount	3	0.22uF, 10%, 25V, X7R, 0402"(1005mm)
30	CERAMIC CAPACITOR	C10	CGB2A1X5R1E1 05M033BC	TDK	Mount	1	1uF, 20%, 25V, X5R, 0402"(1005mm)
31	CERAMIC CAPACITOR	C7,C8,C13	C1005X5R1E225 M050BC	TDK	Mount	3	2.2uF, 20%, 25V, X5R, 0402"(1005mm)
32	DIP SW	DSW1	CHS-04TB	NIDEC COPAL	Mount	1	4 Position, SMD, 100mA, 6VDC
33	TACTILE SWITCH	SW1,SW2,SW3 ,SW4	SKPMANE010	ALPS	Mount	4	50mA, 16VDC, SPST, SMD
34	USB CONNECTO R	J1	ZX62-B-5PA(33)	HIROSE	Mount	1	Micro-B, SMD, Right Angle, Non-reverse type
35	TEST POINT	TP3	SLC-22G-K	SUNHAYATO	Mount	1	1mm DIA TH
36	TEST POINT	TP1,TP2, TP4,TP5	SLC-22G	SUNHAYATO	UnMoun t	4	1mm DIA TH
37	HEADER CONNECTO R	J2	FTSH-105-01-L-DV-007-K	SAMTEC	Mount	1	SMD, 10 position, 0.050" (1.27mm)
38	TEST POINT	TP6,TP7,TP8,T P9,TP10,TP11, TP12,TP13,TP1 4,TP15,TP16,T P17,TP18,TP19 ,TP20,TP21,TP 22	-	-	-	17	0.5mm DIA TH
39	CHIP RESISTOR	R1,R4,R18,R19 ,R20,R21,R22	-	-	UnMoun t	7	0402"(1005mm) Resistor Pad
40	CERAMIC CAPACITOR	C5	-	-	UnMoun t	1	0402"(1005mm) Capacitor Pad
41	CERAMIC CAPACITOR	C9,C16	-	-	UnMoun t	2	0603"(1608mm) Capacitor Pad
42	PCB	-	RTK0EA0004D00 001BJ rev.A	-	-	1	
43	RESIN SPACER	-	AS-306	HIROSUGI-KEIKI	-	4	Hexagon both female screw, Duracon, M3
44	SCREW		UM-0306	HIROSUGI-KEIKI	-	4	Flat head, stainless steel, M3

NM: Not Mounted

8. Website and Support

Renesas Electronics Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/contact/

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.
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 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. 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.4.0-1 November 2017)

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/.