

RX231 Group

Voice Recognition Demo Board

Introduction

This application note explains the hardware specifications of Renesas Electronics' voice recognition demo board RTK0EA0002D00001BJ, which uses RX231.

Target Device

RX231 Group

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1. Outline

The RTK0EA0002D00001BJ is a demo board for a voice recognition remote control using RX231. This product provides the following features.

- Compact, lightweight (60mm x 40mm, less than 20 grams)
- Infrared remote control which recognizes voice activity
- Remote control transmission format: can be modified by rewriting software
- Built-in MEMS microphone
- Easy setup (can be powered by USB connection)
- Multiple built-in transmission interfaces (USB, BLE, Debugging interface)

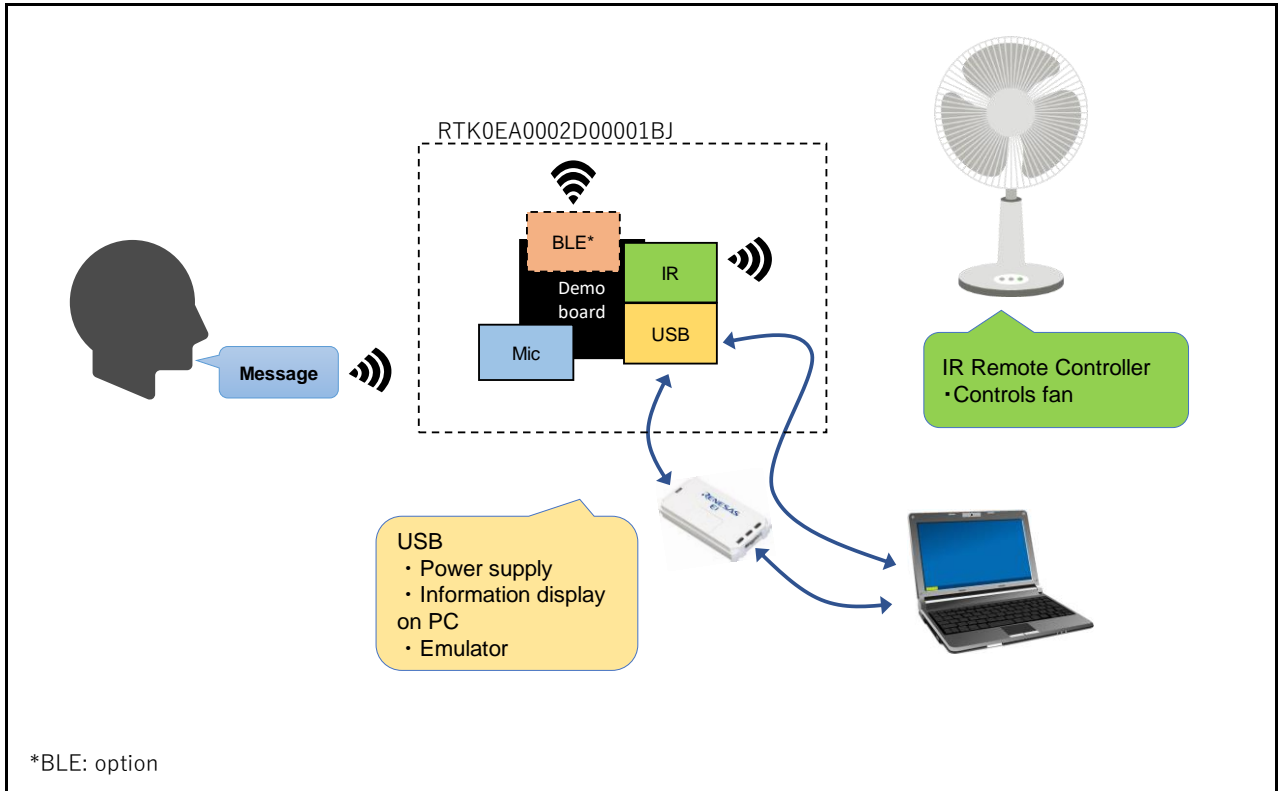


Figure 1-1 RX231 Voice Recognition Remote Control Demo Set

2. Product External Appearance

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

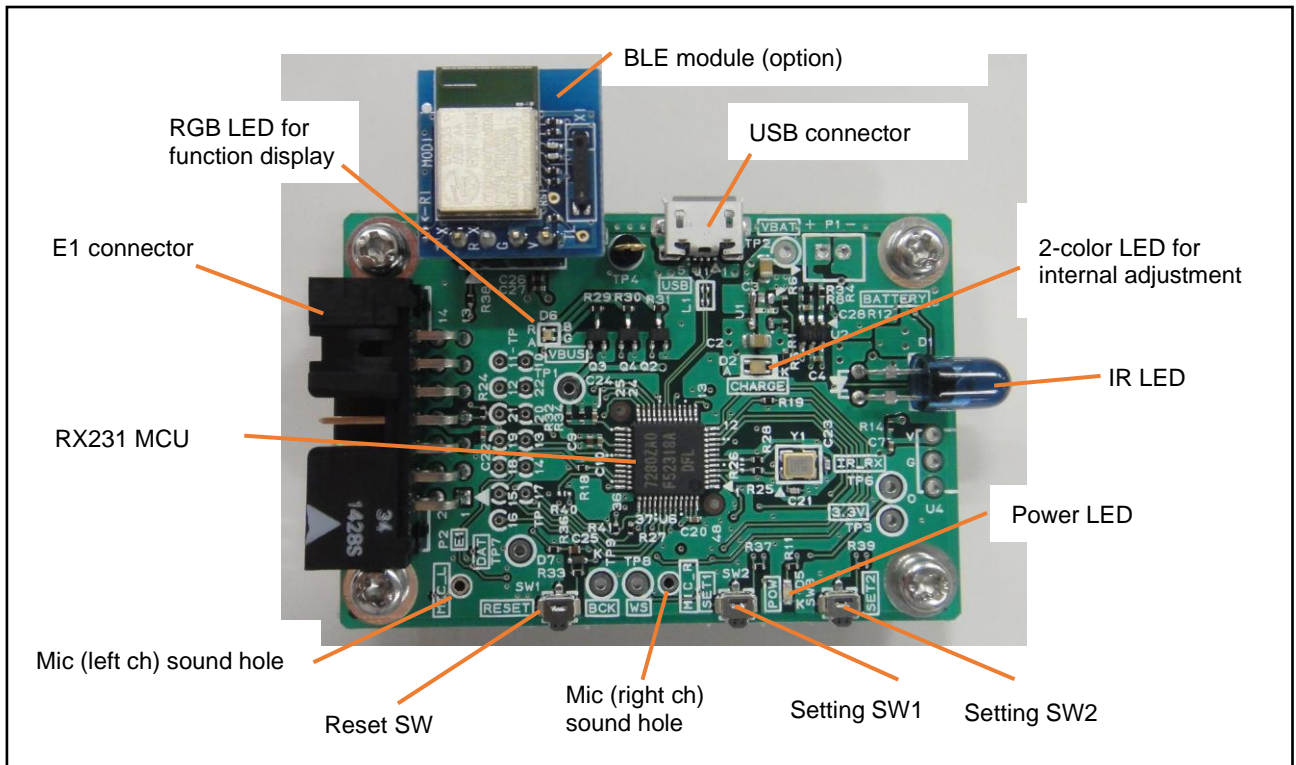


Figure 2-1 Product External Appearance

3. Hardware Specifications

Table 3-1 Hardware Specifications

Item	Description	Remarks
Board size	60.0 x 40.0[mm]	
MCU	RX231 (R5F52318ADFL)	ROM: 512KB, RAM: 64KB Data flash: 8KB Package: 48-pin LQFP (0.5mm pitch) Operating ambient temperature: -40~85°C
Clock	MCU main clock: external 16MHz	Crystal unit
	AUDIO_MCK: external 12.2880MHz	Crystal oscillator
Microphone	TDK InvenSense, Inc. ICS-43434: 2 pcs.	MEMS Microphone, omnidirectional Sensitivity -26dBFS (94dB SPL), I2S output
LED	Power supply: Orange LED 1 pc.	
	Function display: 3-color (RGB) LED 1 pc.	MCU port control
	For internal adjustment: 2-color (RG) LED 1 pc.	Always lit in green
Remote control transmission	Infrared LED (IR LED): 950nm, viewing angle $\pm 22^\circ$	Compliant format: NEC format
Remote control reception (option)	Infrared receiver module: 950nm, viewing angle $\pm 45^\circ$	
Switch	Push switch: 3 pcs.	<ul style="list-style-type: none"> • MCU reset switch • Setting switch 1, setting switch 2 (MCU port control)
Wireless module (option)	RL78/G1D built-in module: RY7011A0000DZ00 Conversion board: RTK0EN0013A01001BJ	Bluetooth v4.1 specification (Low Energy, Single mode)
USB interface	USB Micro B connector	Full speed transfer
Debugging interface	E1 14-pin box header	
Power supply input	USB bus power (VBUS): 5V	
Weight	Under 20g	

4. Block Diagram

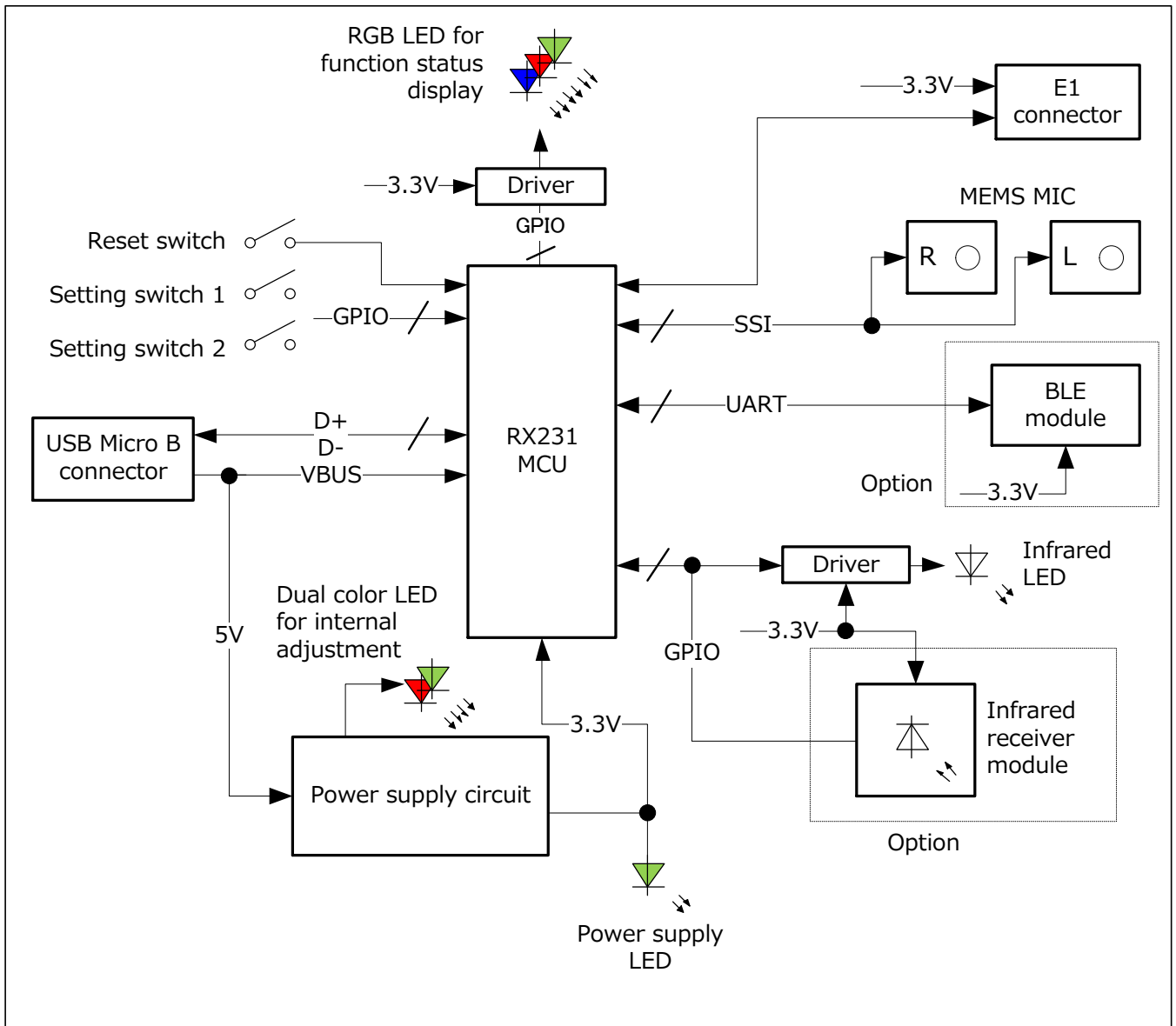


Figure 4-1 Block Diagram

5. Circuit Diagram

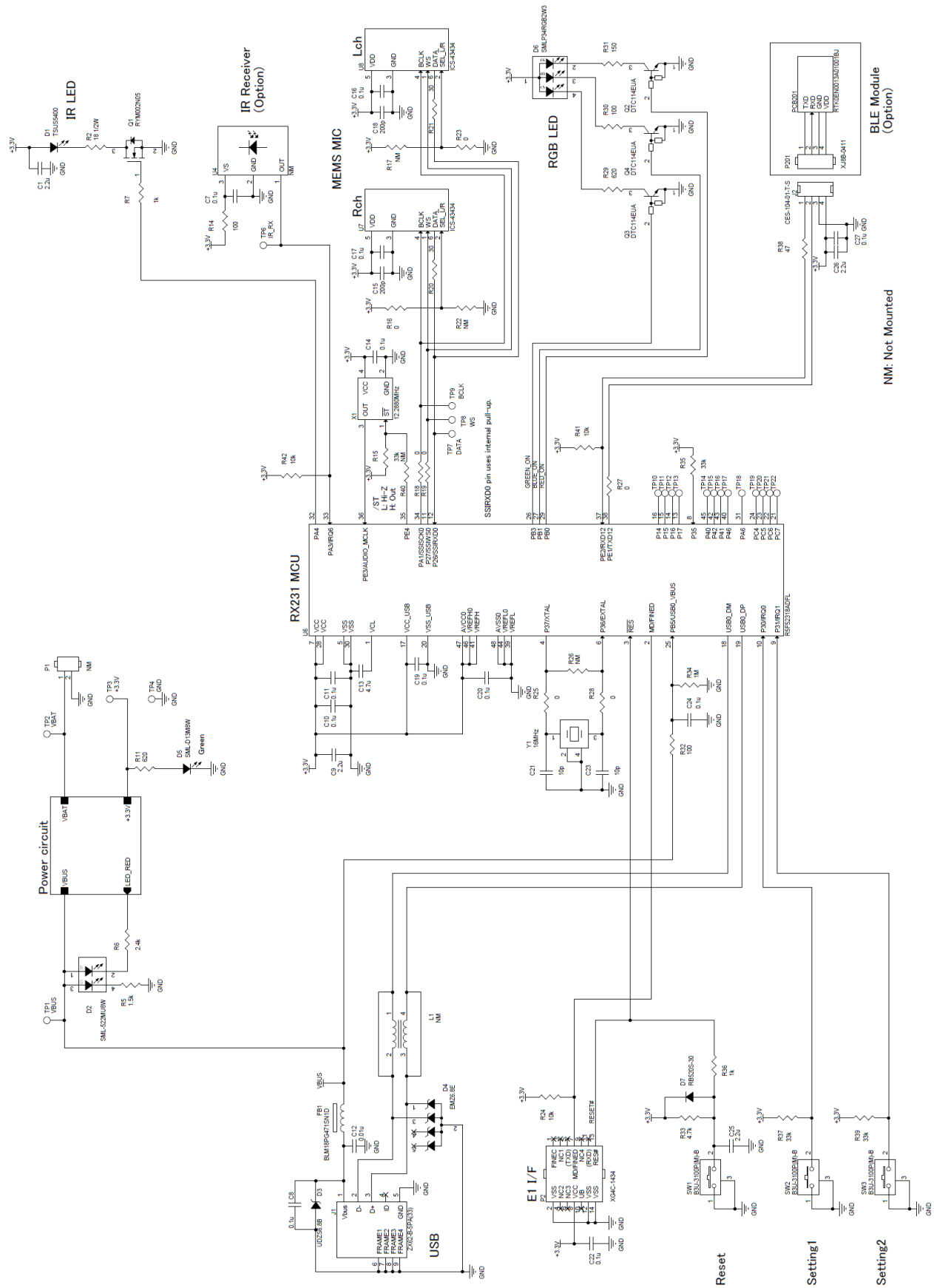


Figure 5-1 RTK0EA0002D0001BJ Circuit Diagram

6. Board Layout Diagram

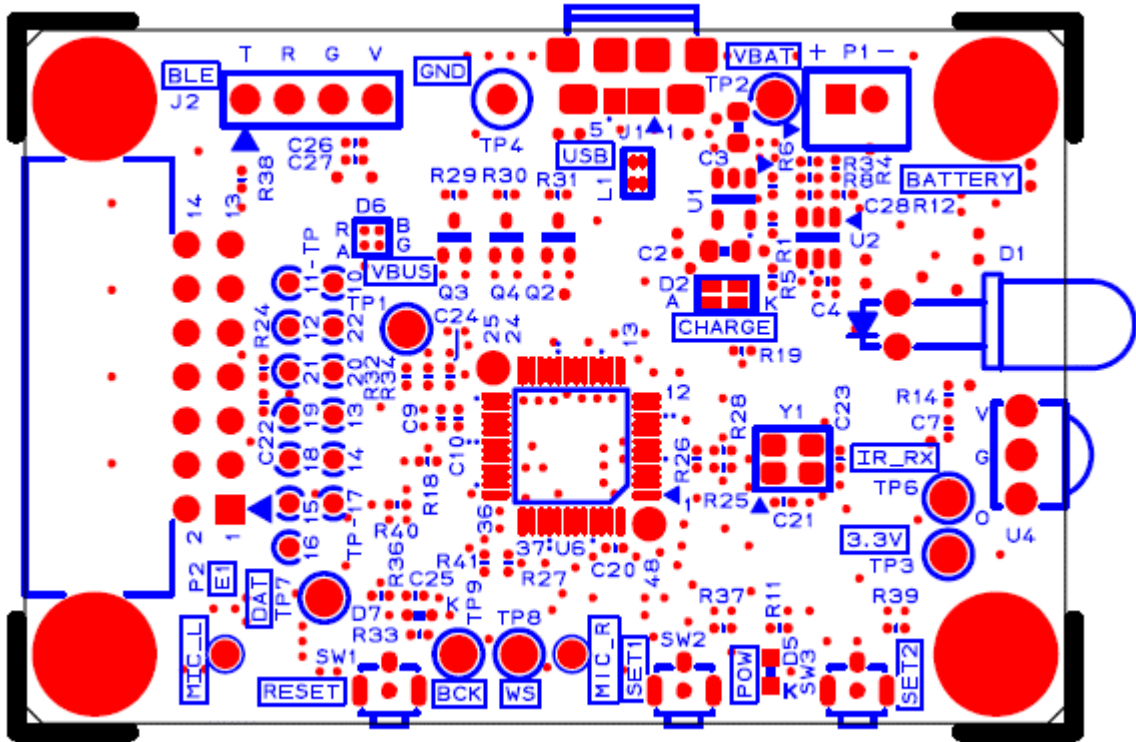


Figure 6-1 Component Side Silkscreen (top view)

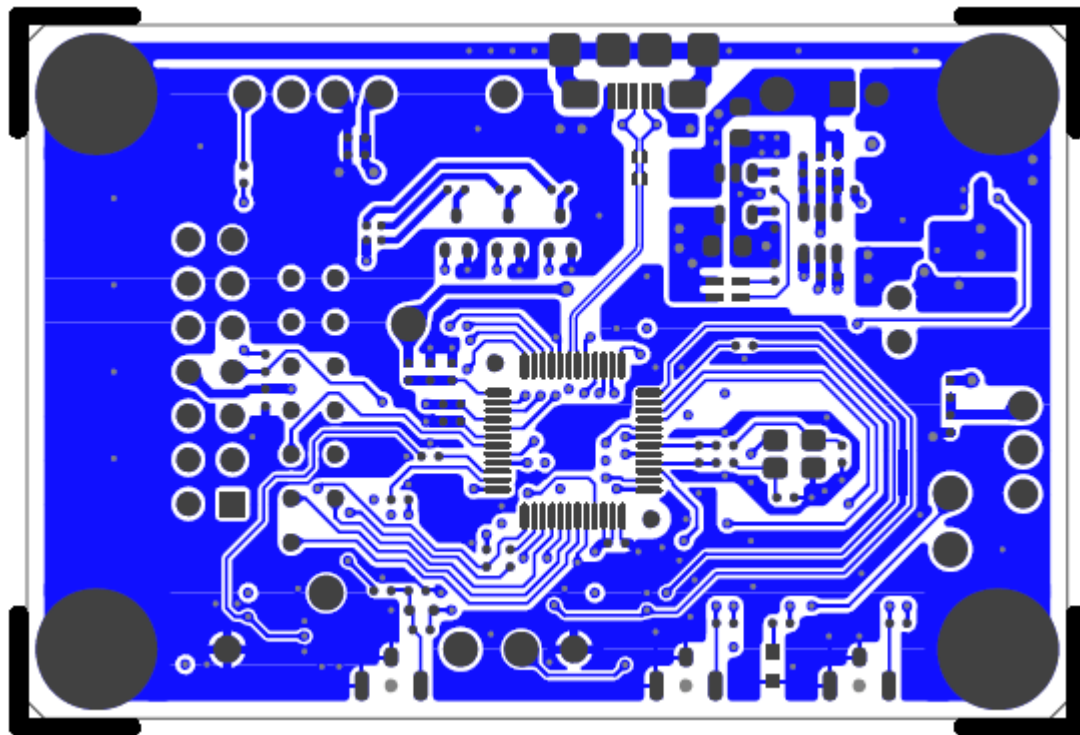


Figure 6-2 1st Layer Pattern (top view)

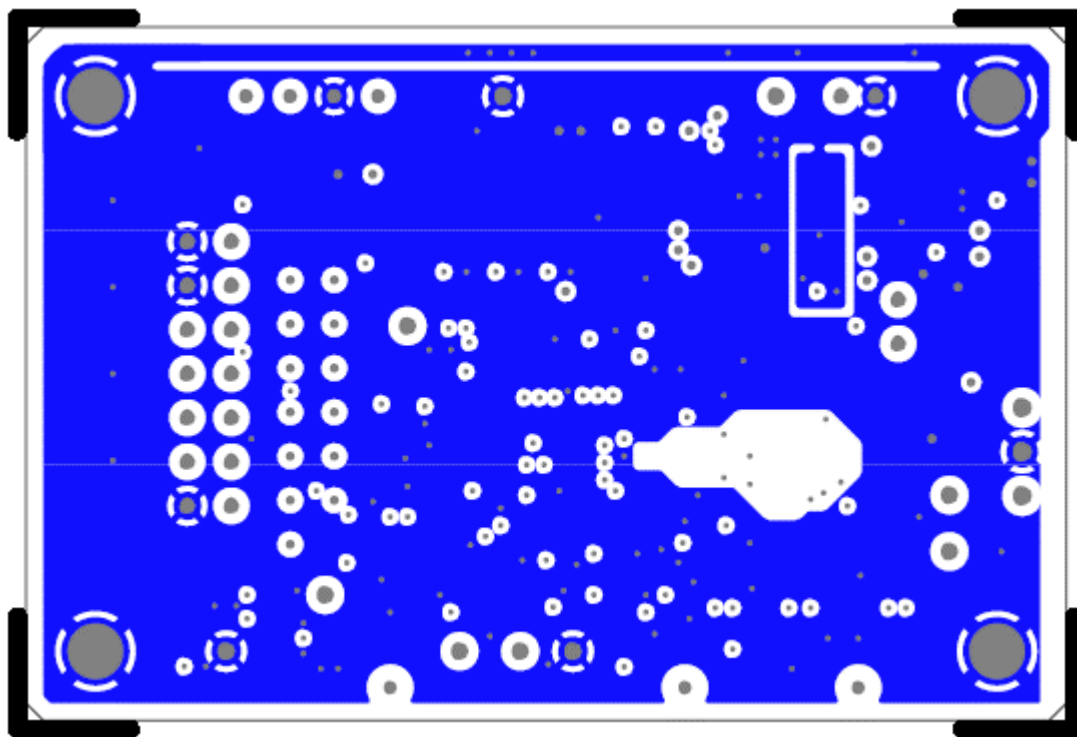


Figure 6-3 2nd Layer Pattern (top view)

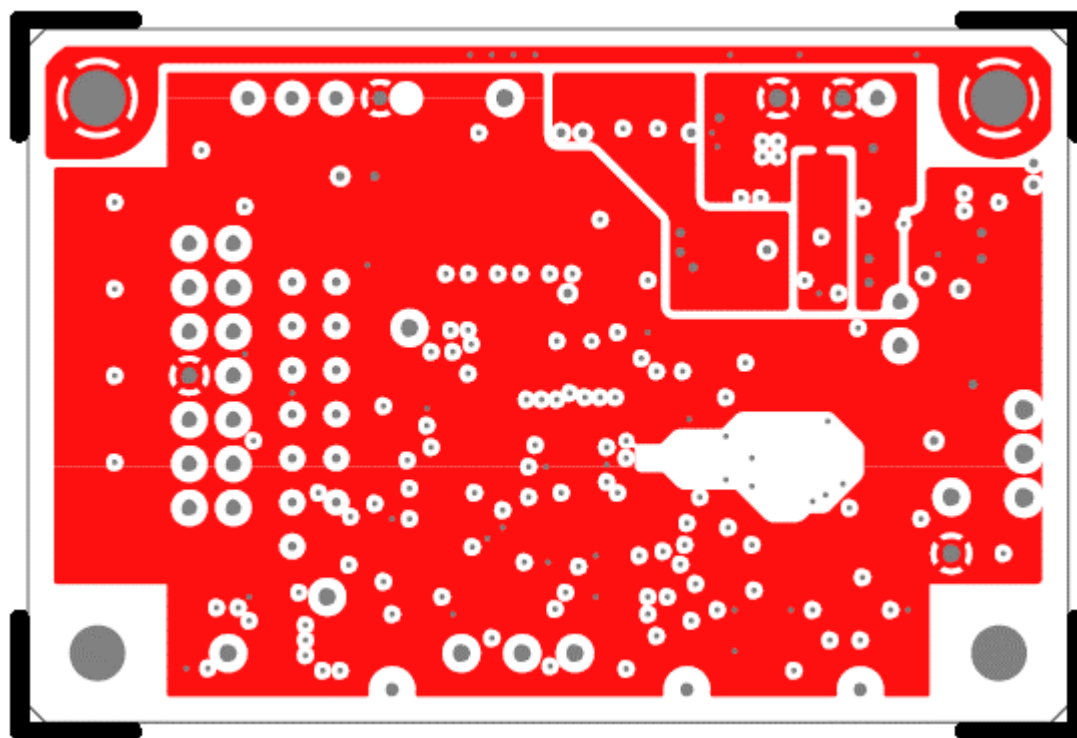


Figure 6-4 3rd Layer Pattern (top view)

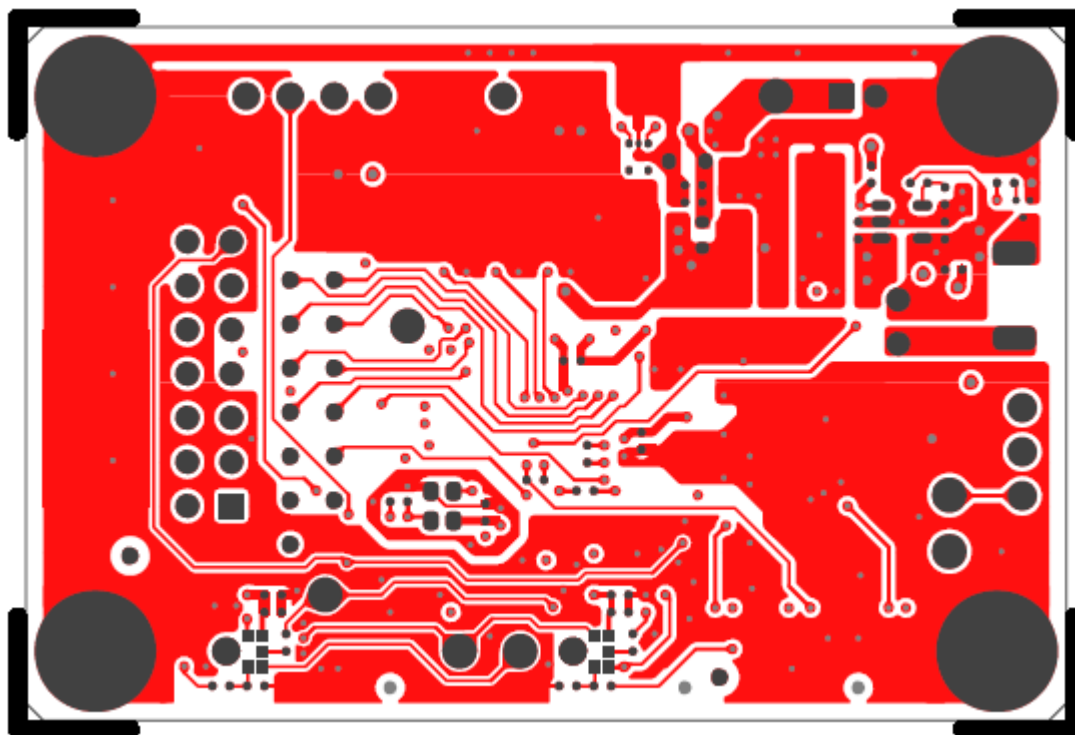


Figure 6-5 4th Layer Pattern (top view)

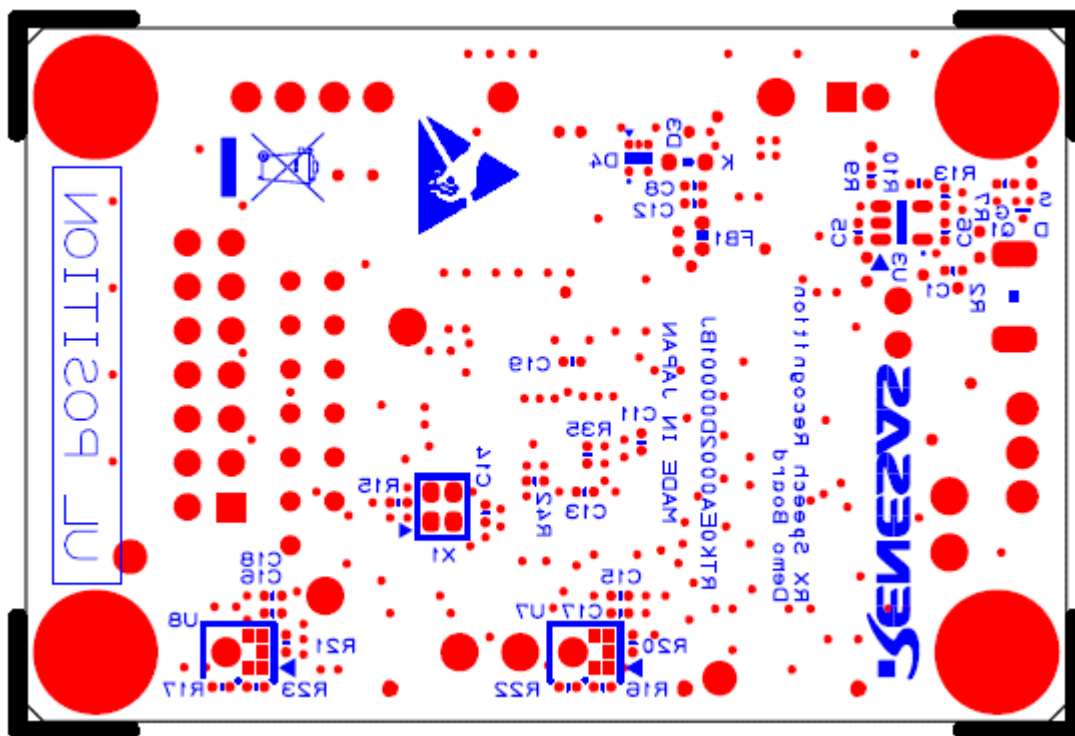


Figure 6-6 Solder Side Silkscreen (top view)

7. BOM (parts list)

Table 7-1 BOM (1/3)

Item	Qty	Reference	Part	Manufacture	Part number	Remarks
1	4	C1,C9,C25,C26	2.2u	MURATA	GRM155C81E225ME11D	CAP CER 2.2UF 20% 25V X6S 0402(1005MM)
2	12	C7,C8,C10,C11,C14,C16,C17,C19,C20,C22,C24,C27	0.1u	MURATA	GRM155R61H104ME14D	CAP CER 0.1UF 20% 50V X5R 0402(1005MM)
3	1	C12	0.01u	MURATA	GRM155R71H103KA88J	CAP CER 0.01UF 10% 50V X7R 0402(1005MM)
4	1	C13	4.7u	TDK	C1005JB1A475K050BC	CAP CER 4.7UF 10% 10V JB 0402(1005MM)
5	2	C15,C18	200p	MURATA	GRM1555C1H201JA01D	CAP CER 200PF 5% 50V C0G 0402(1005MM)
6	2	C21,C23	10p	MURATA	GRM1555C1H100JA01J	CAP CER 10PF 5% 50V C0G 0402(1005MM)
7	1	D1	TSUS5400	VISHAY	TSUS5400	EMITTER IR 950NM 150MA RADIAL
8	1	D2	SML-522MU8W	ROHM	SML-522MU8WT86	LED GREEN/RED 0605(1513MM)
9	1	D3	UDZS6.8B	ROHM	UDZSTE-176.8B	DIODE ZENER 6.8V 200MW UMD2
10	1	D4	EMZ6.8E	ROHM	EMZ6.8ET2R	DIODE ZENER ARRAY 6.8V EMD5
11	1	D5	SML-D13M8W	ROHM	SML-D13M8W	LED GREEN 0603(1608MM)
12	1	D6	SMLP34RGB2W3	ROHM	SMLP34RGB2W3	LED RGB 0404(1010MM)
13	1	D7	RB520S-30	ROHM	RB520S-30TE61	DIODE SCHOTTKY 30V 200MA EMD2
14	1	FB1	BLM18PG471SN1D	MURATA	BLM18PG471SN1D	FERRITE BEAD 470 OHM 0603(1608MM)
15	1	J1	ZX62-B-5PA(33)	HIROSE	ZX62-B-5PA(33)	MICRO USB B CONNECTOR SMD RIGHT ANGLE
16	1	J2	CES-104-01-T-S	SAMTEC	CES-104-01-T-S	CONN RCPT 4POS 2.54MM SIP
17	1	L1	NM	MURATA	DLP11SN900HL2L	COMMON MODE CHOKE COIL 150MA 90 OHM SMD
18	1	PCB201	RTK0EN0013A01001BJ	RENESAS	RTK0EN0013A01001BJ	RL78/G1D CONVERSION BOARD
19	1	P1	NM	JST	B2B-PH-K-S	CONN HEADER PH TOP 2POS 2MM SIP
20	1	P2	XG4C-1434	OMRON	XG4C-1434	CONN PLUG 14POS 2.54MM RIGHT ANGLE DIP
21	1	P201	XJ8B-0411	OMRON	XJ8B-0411	JUMPER PLUG 4POS 2.54MM SIP, BLE MODULE
22	1	Q1	RYM002N05	ROHM	RYM002N05	MOSFET N-CH 50V 0.2A VMT3
23	3	Q2,Q3,Q4	DTC114EUA	ROHM	DTC114EUAT106	DTR 200MW UMT3
24	1	R2	18 1/2W	ROHM	MCR50JZHJ180	RES SMD 18 OHM 5% 1/2W 2010(5025MM)
25	1	R5	1.5k	ROHM	MCR01MZPJ152	RES SMD 1.5K OHM 5% 1/16W 0402(1005MM)

Table 7-2 BOM (2/3)

Item	Qty	Reference	Part	Manufacture	Part number	Remarks
26	1	R6	2.4k	ROHM	MCR01MZPJ242	RES SMD 2.4K OHM 5% 1/16W 0402(1005MM)
27	2	R7,R36	1k	ROHM	MCR01MZPJ102	RES SMD 1K OHM 5% 1/16W 0402(1005MM)
28	2	R11,R29	620	ROHM	MCR01MZPJ621	RES SMD 620 OHM 5% 1/16W 0402(1005MM)
29	3	R14,R30,R32	100	ROHM	MCR01MZPJ101	RES SMD 100 OHM 5% 1/16W 0402(1005MM)
30	4	R15,R35,R37,R39	33k	ROHM	MCR01MZPJ333	RES SMD 33K OHM 5% 1/16W 0402(1005MM)
31	7	R16,R18,R19,R23,R25 ,R27,R28	0	ROHM	MCR01MZPJ000	RES SMD 0 OHM JUMPER 1/16W 0402(1005MM)
32	4	R17,R22,R26,R40	NM	-	-	0402(1005MM) RES PAD
33	2	R20,R21	30	ROHM	MCR01MZPJ300	RES SMD 30 OHM 5% 1/16W 0402(1005MM)
34	3	R24,R41,R42	10k	ROHM	MCR01MZPJ103	RES SMD 10K OHM 5% 1/16W 0402(1005MM)
35	1	R31	150	ROHM	MCR01MZPJ151	RES SMD 150 OHM 5% 1/16W 0402
36	1	R33	4.7k	ROHM	MCR01MZPJ472	RES SMD 4.7K OHM 5% 1/16W 0402(1005MM)
37	1	R34	1M	ROHM	MCR01MZPJ105	RES SMD 1M OHM 5% 1/16W 0402(1005MM)
38	1	R38	47	ROHM	MCR01MZPJ470	RES SMD 47 OHM 5% 1/16W 0402(1005MM)
39	3	SW1,SW2,SW3	B3U-3100P(M)-B	OMRON	B3U-3100P(M)-B	SWITCH TACT RIGHT ANGLE SMD
40	1	TP1	VBUS	-	-	1mm DIA TH, SILK"VBUS"
41	1	TP2	VBAT	-	-	1mm DIA TH, SILK"VBAT"
42	1	TP3	+3.3V	-	-	1mm DIA TH, SILK"3.3V"
43	1	TP4	GND	SUNHAYATO	SLC-22G-K	TEST POINT, SILK"GND"
44	1	TP6	IR_RX	-	-	1mm DIA TH, SILK"RX"
45	1	TP7	DATA	-	-	1mm DIA TH, SILK"D"
46	1	TP8	WS	-	-	1mm DIA TH, SILK"WS"
47	1	TP9	BCLK	-	-	1mm DIA TH, SILK"BK"
48	13	TP10,TP11,TP12,TP1 3,TP14,TP15,TP16,T P17,TP18,TP19,TP20, TP21,TP22	TP	-	-	0.5mm DIA TH
49	1	U4	NM	VISHAY	TSOP4138	Remote Receiver Sensor, 38kHz Through Hole
50	1	U6	R5F52318ADFL	RENESAS	R5F52318ADFL#30	RX231 MCU 32BIT 512KB FLASH 48LFQFP
51	2	U7,U8	ICS-43434	TDK InvenSense	ICS-43434	MIC MEMS DIGITAL I2S OMNI -26DB
52	1	X1	12.2880MHz	SEIKO EPSON	SG-210STF 12.2880ML	OSC XO 12.288MHZ CMOS SMD
53	1	Y1	16MHz	SEIKO EPSON	FA-238 16.0000MB	CRYSTAL 16.00 MHZ 10PF SMD

Table 7-3 BOM (3/3)

Item	Qty	Reference	Part	Manufacturer	Part number	Remarks
54	1	-	RTK0EA0002D00 001BJ	-	-	PCB
55	4	-	-	Hirosugi-Keiki	AS-306	Hexagonal spacer, female-female, Duracon, length 6mm
56	4	-	-	Hirosugi-Keiki	UM-0306	Stainless steel screw, M3, screw length 6 mm

NM: Not Mounted

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Revision History

Rev.	Date	Description	
		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.).

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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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(Rev.4.0-1 November 2017)

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