RA6M3 Group

RA6M3 HMI Expansion Board

Introduction

This application note explains the hardware specifications of RTK0EG001BB00001BJ, which is an expansion board of RA6M3 MCU Group evaluation kit, EK-RA6M3G.

Target Device

RA6M3 Group

Related Document

1. EK-RA6M3G v1 – User's Manual (R20UT4629EU0101)

Contents

1. Outline

This product provides below features and system configuration.

(1) Voice Recognition by analog output MEMS microphone circuit

Direction forming technology (Beamforming) for voice

(2) Sound playback by D-Amp Driver® circuit(*)

(3) Built-in Temperature and Humidity sensor

(4) Built-in Gas sensor for indoor environment gas detection

- Measurement of Total Volatile Organic Compounds(TVOC)
- Measurement of equivalent CO2(eCO2)
- Measurement of Indoor Air Quality(IAQ)
- Measurement of Odor

(5) Built-in 64Mbit Serial Flash

(6) Expansion connectors (optional)

- External Analog microphone connection
- External I2C Interface device connection
- External UART Interface device connection

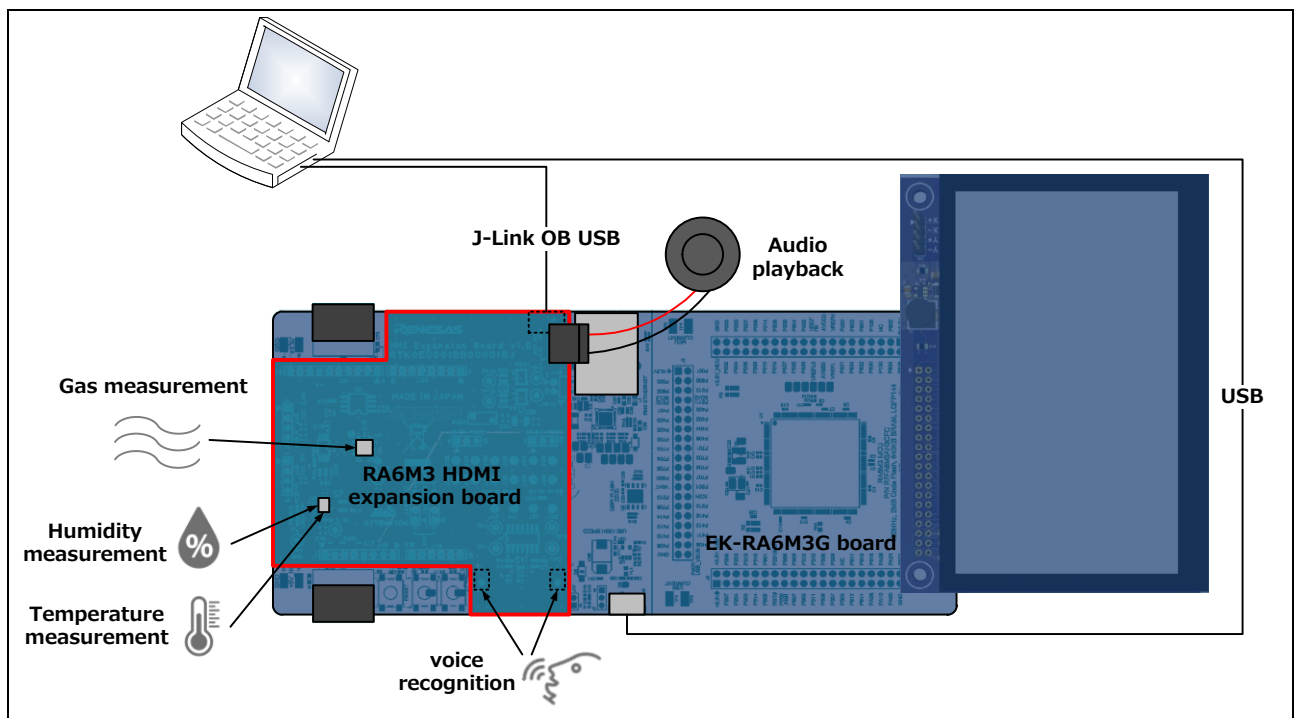(*) D-Amp Driver® is a registered trademark of CRI Middleware Co., Ltd.

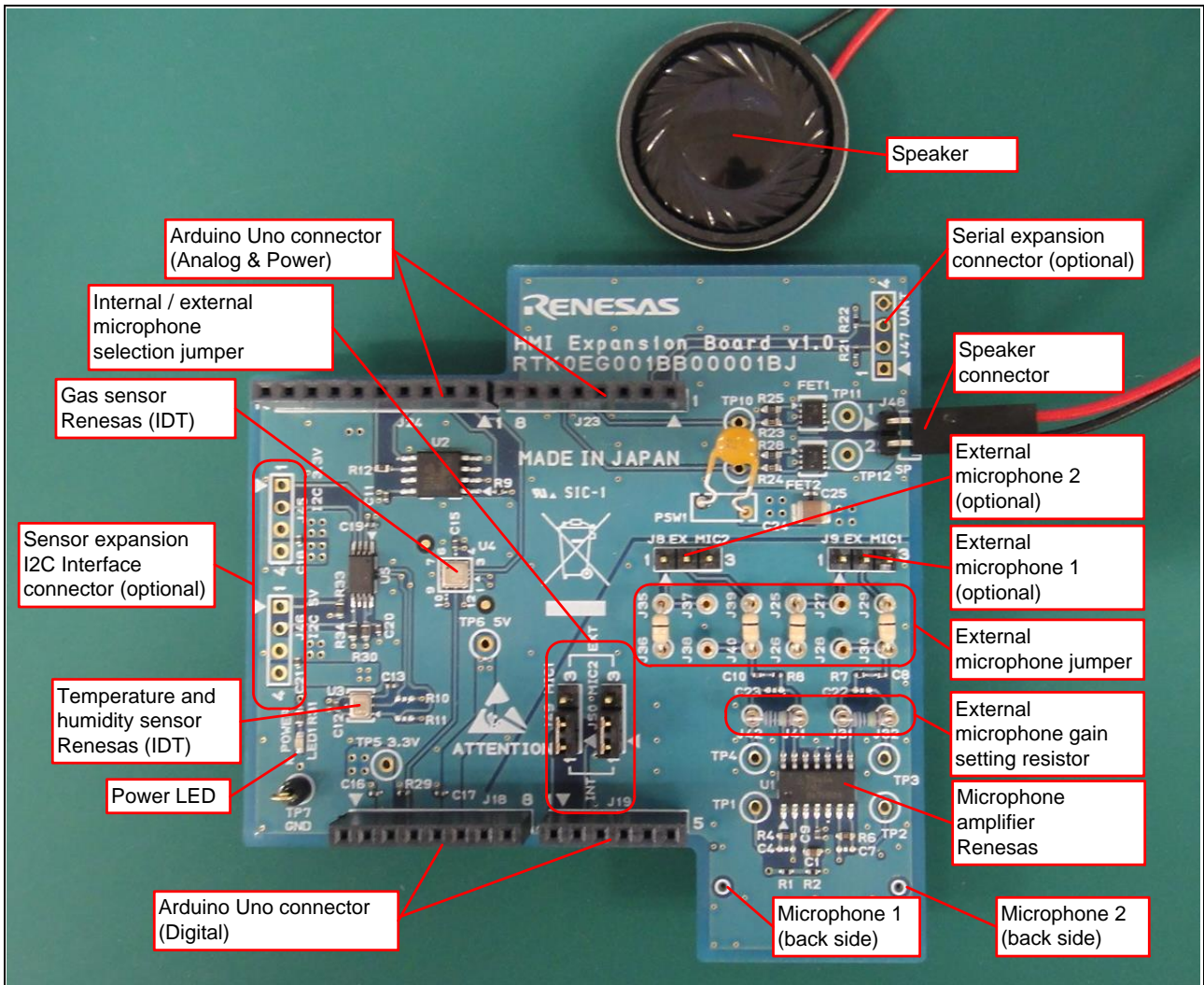Figure 1   System configuration

2. Product External Appearance

Figure 2   Product External Appearance

3.　Hardware Specifications

Table 1　Hardware Specifications

Item	Description	Remarks
Board size	78.0×80.0[mm]	max external dimension
Power	EK-RA6M3G board　J18 3.3V、5V	
Serial Flash	MACRONIX International Co., Ltd. MX25R6435FM2IL0	SPI I/F、64Mbit
LED	For Power： yellow LED 1pc	
Microphone	KNOWLES Corp SPU0410LR5H-QB　2pcs	MEMS microphone, Omnidirectional, Sensitivity: -38dBV/Pa, Analog Output Amp circuit gain 40dB(x100)
External expansion microphone (Optional)	MEMS type (Analog output) Or Electret condenser type	Omnidirectional, Amp circuit default gain 40dB(x100)
Speaker operation circuit	D-Amp Driver® support H bridge circuit	
Speaker	CUI Devices CMS-28588N-L152	dimensionsΦ28mm maximum input power 2W Impedance 8Ω Sound Presser Level 88dB SPL(2W、0.5m)
Humidity and Temperature Sensor	RENESAS(IDT) HS3001	I2C IF, 14bit resolution, Sensor Accuracy • Temperature ±0.2℃ typ (-10 to +80℃) • RH ±1.5%RH typ (10 to 90%RH, 25℃)
Gas Sensor	RENESAS(IDT) ZMOD4410AI1V	I2C IF, 10〜16bit resolution, Measurement value • TVOC measurement • eCO2 measurement • IAQ measurement • Odor measurement Measurement Accuracy • TVOC±15% typ (after calibration) • eCO2±25%typ (compared to NDIR)
I2C Expansion Interface (Optional)	5V I/F Connector　1pc 3.3V I/F Connector　1pc	
UART Expansion Interface (Optional)	3.3V I/F Connector　1pc	

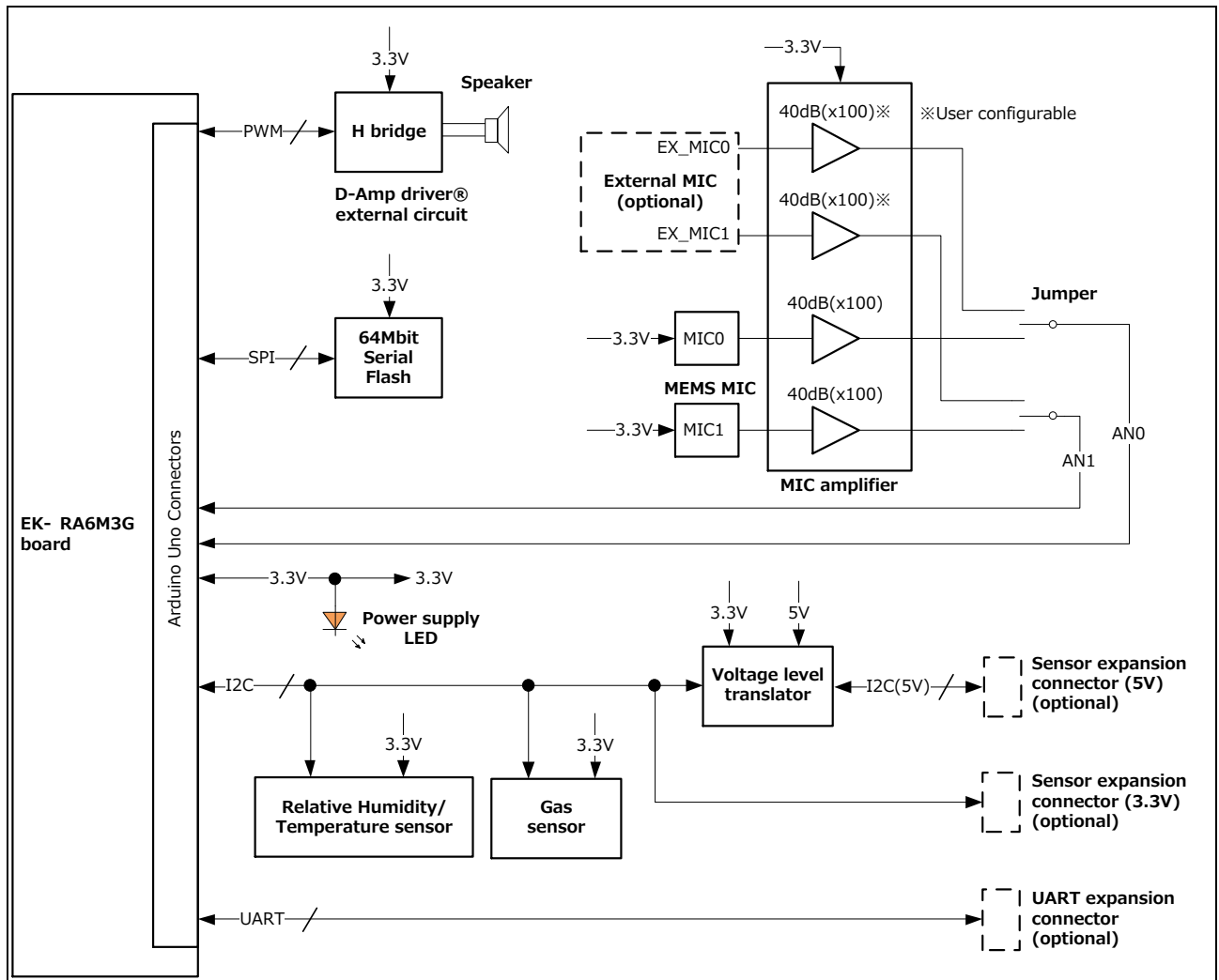## 4. Block Diagram

Figure 3   Block Diagram

5.   Settings and Connection to the board

5.1   Connects EK-RA6M3 board

As figure 4 shows below, connect RA6M3 HMI expansion board with Arduino Uno connector of EK-RA6M3G board.
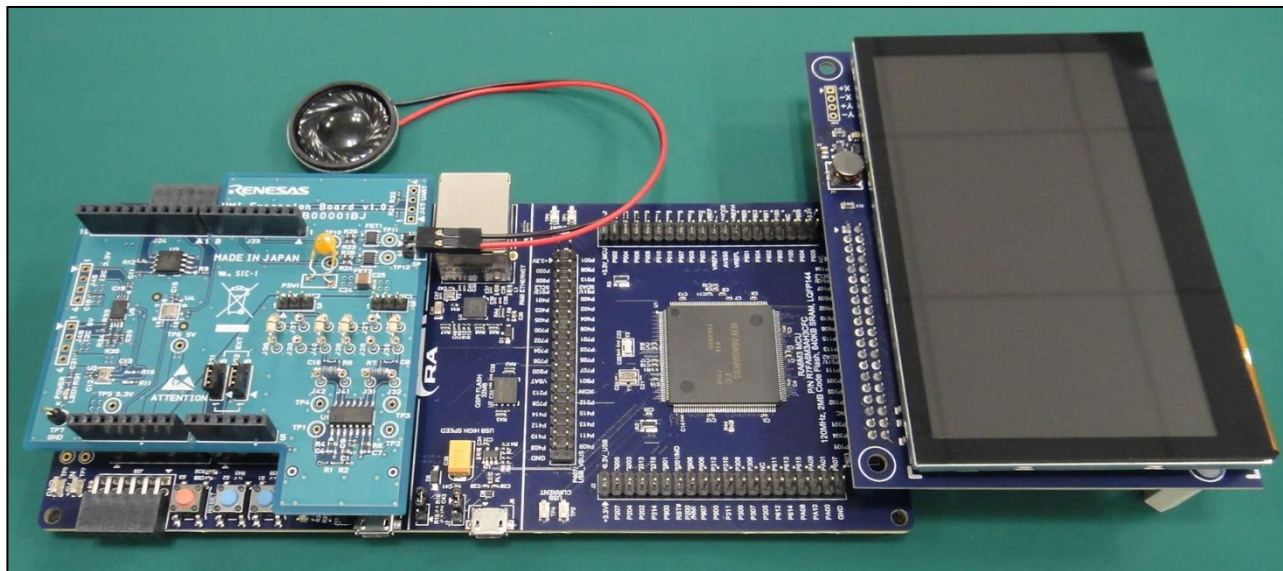
Figure 4   EK-RA6M3G board Connection

5.2   Microphone

5.2.1   Inside microphone

Table 2 and Figure 5 shows jumper settings. Figure 3 shows direction of microphone when uses beamforming.

Table 2   Jumper Setting(Inside microphone)

Reference	Setting
J49	Short 1-2pin
J50	Short 1-2pin

Figure 5   Jumper setting of inside microphone

Table 3   Microphone direction of beamforming(Inside microphone)

Direction	MIC1	MIC2
Direction1	L	R
Direction2	R	L

5.2.2 External Expansion microphone

External Expansion microphone can be connected to Analog MEMS microphone and Electret condenser microphone.
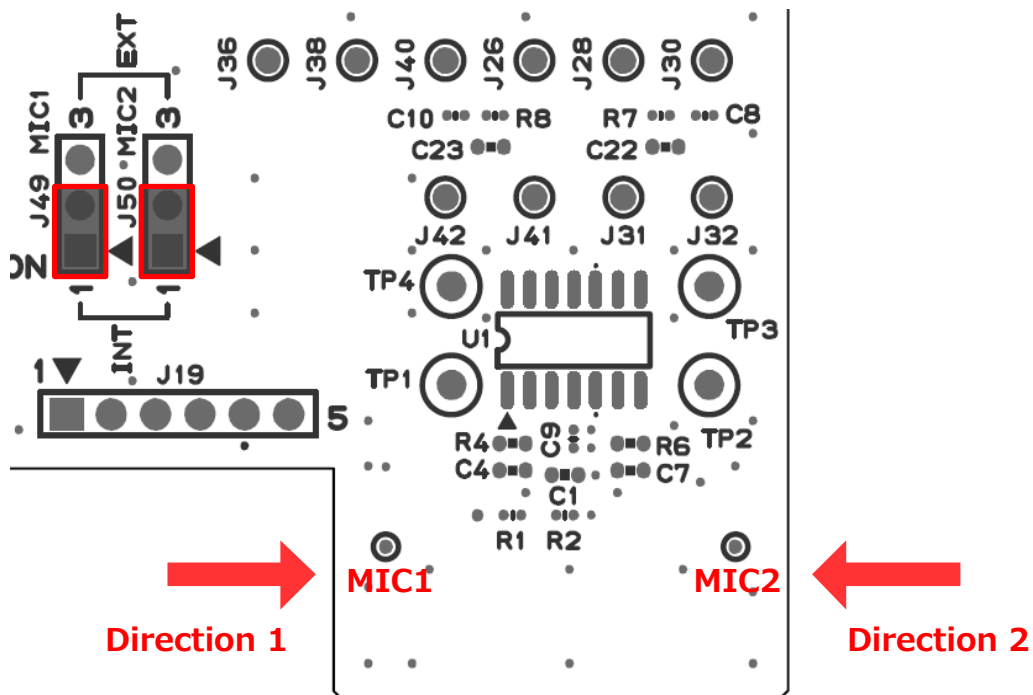
Table 4 shows signal of external microphone connector and Table 5 shows Amp gain settings.

Also ,chapter 5.2.2.1 explains Setting of analog MEMS microphone, 5.2.2.2 explains electret condenser microphone settings.

Table 4   External expansion microphone interface

J9, J8		
PIN	Signal name	Type
1	POW/ECMO	POWER/OUT
2	MEMSO	OUT
3	GND	POWER

Table 5   Amp Gain setting of External Expansion microphone

Reference	Gain
U1C	Gain = (Resistance Value J31-J32) / R7 Default：1M / 10K = 100 (40dB)
U1D	Gain = (Resistance Value J41-J42) / R8 Default：1M / 10K = 100 (40dB)

5.2.2.1   External Analog MEMS microphone

Table 6 and Figure 6 shows Jumper setting of External Analog MEMS microphone. Table 7 shows microphone direction when beamforming.

Figure 6 Ⓐ part is explained in Table 5.

Table 6   Jumper Setting(External Analog　MEMS microphone)

Reference	Settings
J49	Short PIN 2-3
J50	Short PIN 2-3
J35、J36	Implement Jumper resistance J35-J36
J37、J38	No implementation
J39、J40	Implement Jumper resistance J39-J40
J25、J26	Implement Jumper resistance J25-J26
J27、J28	No implementation
J29、J30	Implement Jumper resistance J29-J30

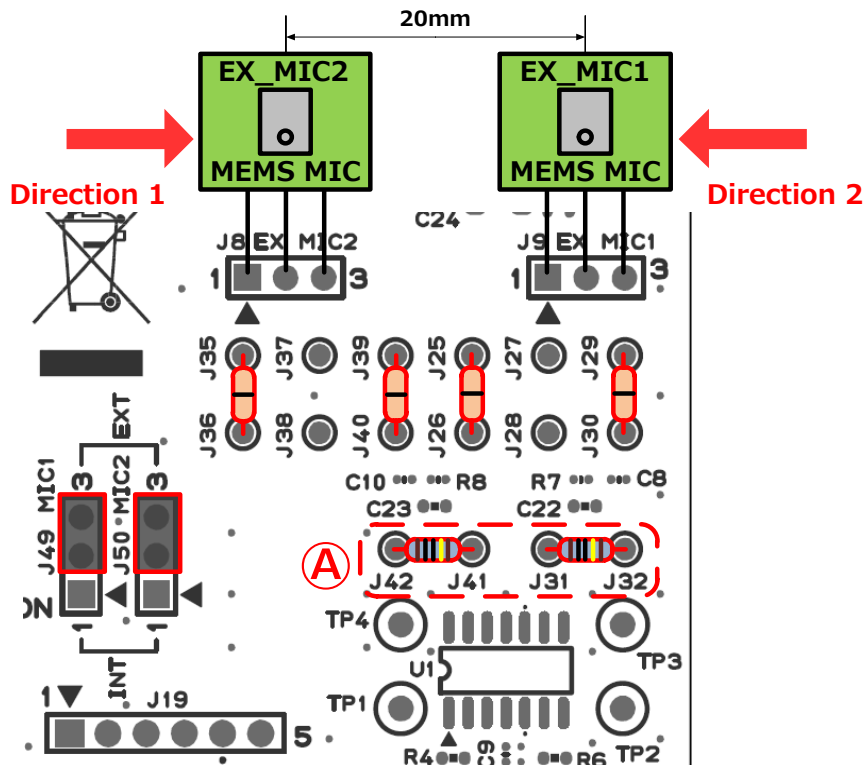

Figure 6   Jumper Settings of External MEMS microphone

Table 7   Beamforming Direction(External Expansion microphone)

Direction	EX_MIC1	EX_MIC2
Direction1	R	L
Direction2	L	R

5.2.2.2   External electret condenser microphone

Table 8 and Figure 7 shows Jumper setting of external electret condenser microphone.

Figure 7 Ⓐ part is explained in Table 5 and refer Table7 for Direction1 and 2.

Table 8   **Jumper setting of external electret condenser microphone**

| Reference	Settings
J49	Short PIN 2-3
J50	Short PIN 2-3
J35、J36	Implement resistance adopted to electret condenser microphone between J35-J33
J37、J38	Implement jumper resistance between J37-J38
J39、J40	No implementation
J25、J26	Implement resistance adopted to electret condenser microphone between J25-J26
J27、J28	Implement jumper resistance between J27-J28
J29、J30	No implementation
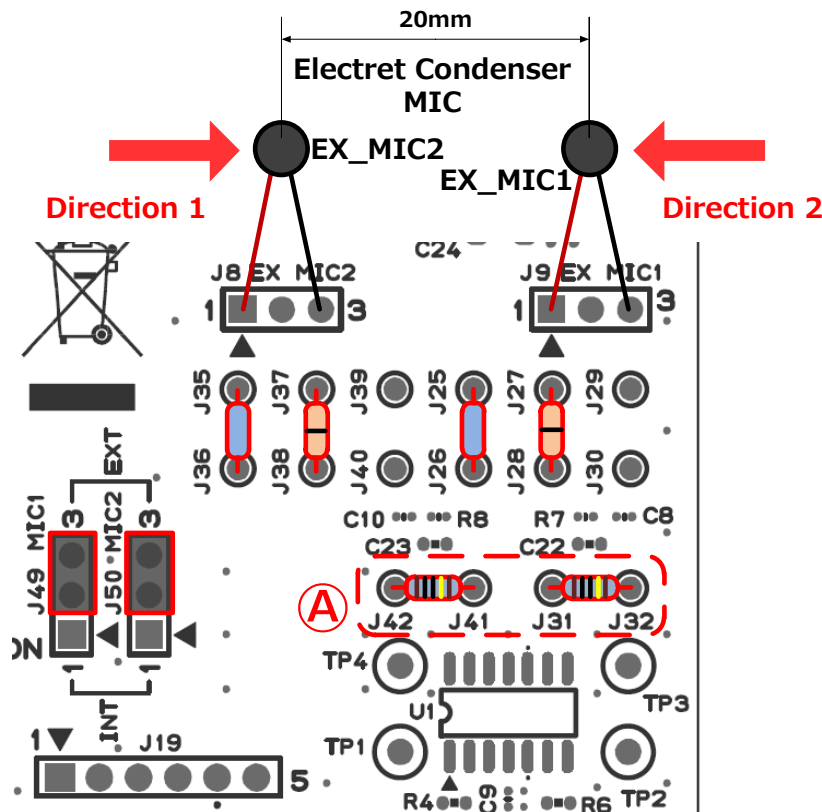
Figure 7   Jumper setting of external electret condenser microphone

5.3 Speaker

Table 9 shows speaker connector signals.

Table 9   Speaker Interface

J48		
PIN	Signal	Type
1	SPOUT1	OUT
2	SPOUT2	OUT

5.4 Sensor expansion connector(optional)

Table 10 shows sensor expansion 3.3 V I2C connector signals. Table 11 shows 5 V I2C connector signals.

Table 10   Sensor Expansion 3.3V   I2C Interface

J45		
PIN	Signal	Type
1	SCL	IN/OUT
2	SDA	IN/OUT
3	GND	POWER
4	3.3V	POWER

Table 11   Sensor Expansion 5V   I2C Interfcace

J46		
PIN	Signal	Type
1	SCL	IN/OUT
2	SDA	IN/OUT
3	GND	POWER
4	5V	POWER

5.5 Serial expansion connector(optional)

Table 12 shows serial expansion connector signals.

Table 12   Serial expansion interface

J47		
PIN	Signal	Type
1	3.3V	POWER
2	RXD	IN
3	TXD	OUT
4	GND	POWER

6. Circuit diagram
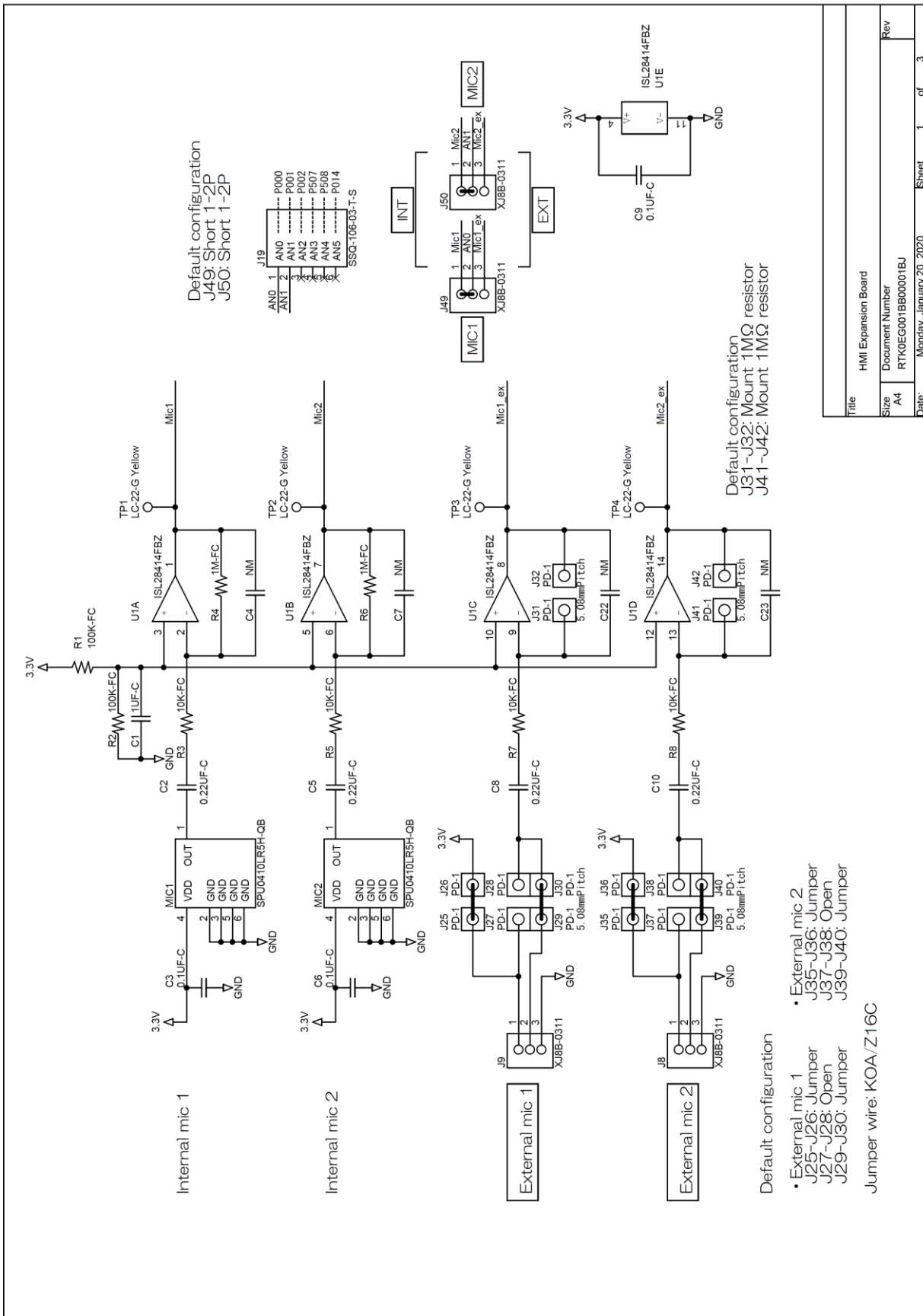
Figure 8   circuit diagram(1/3)

【*】 "NM" shows no implementation
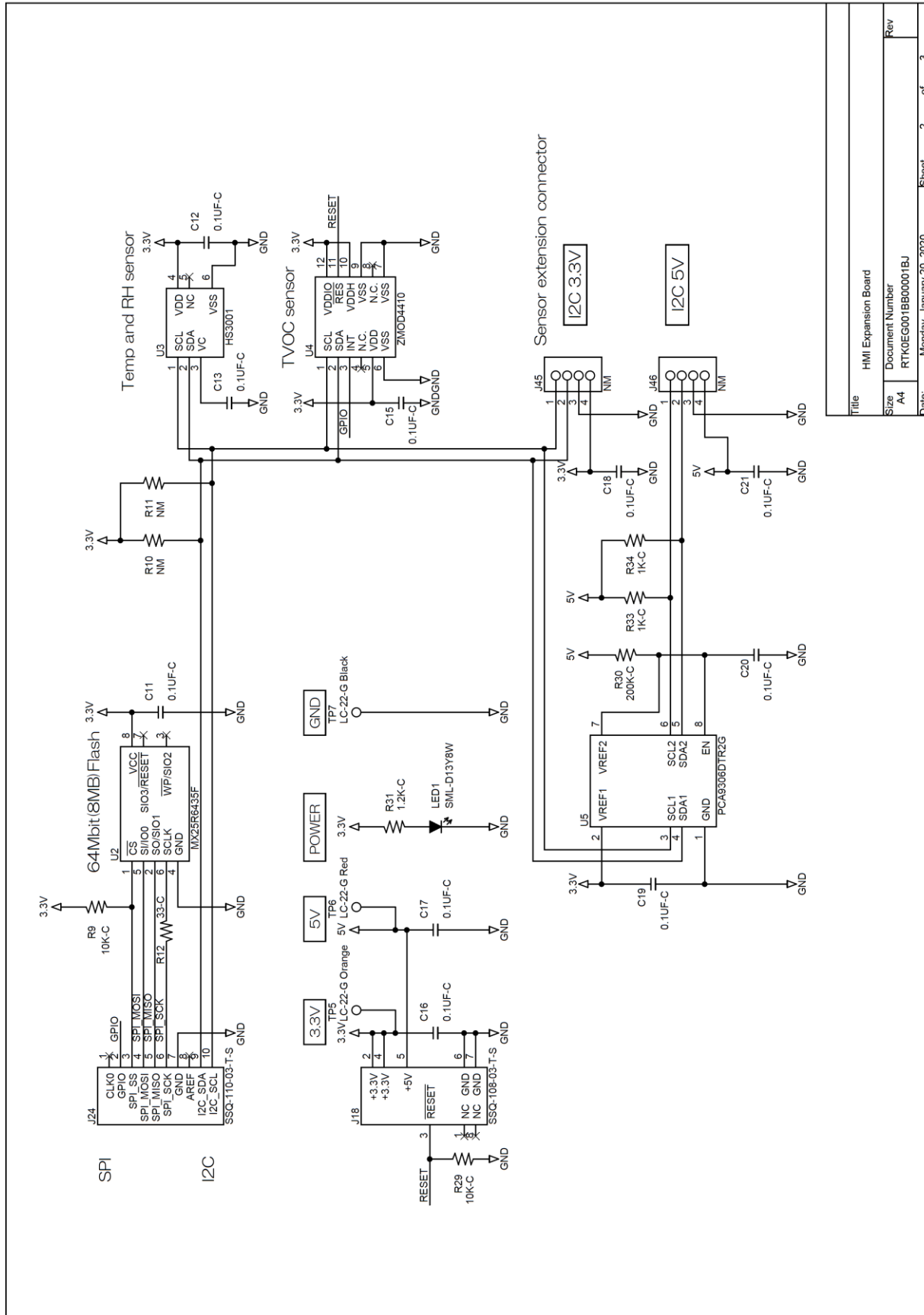
Figure 8   circuit diagram(2/3)
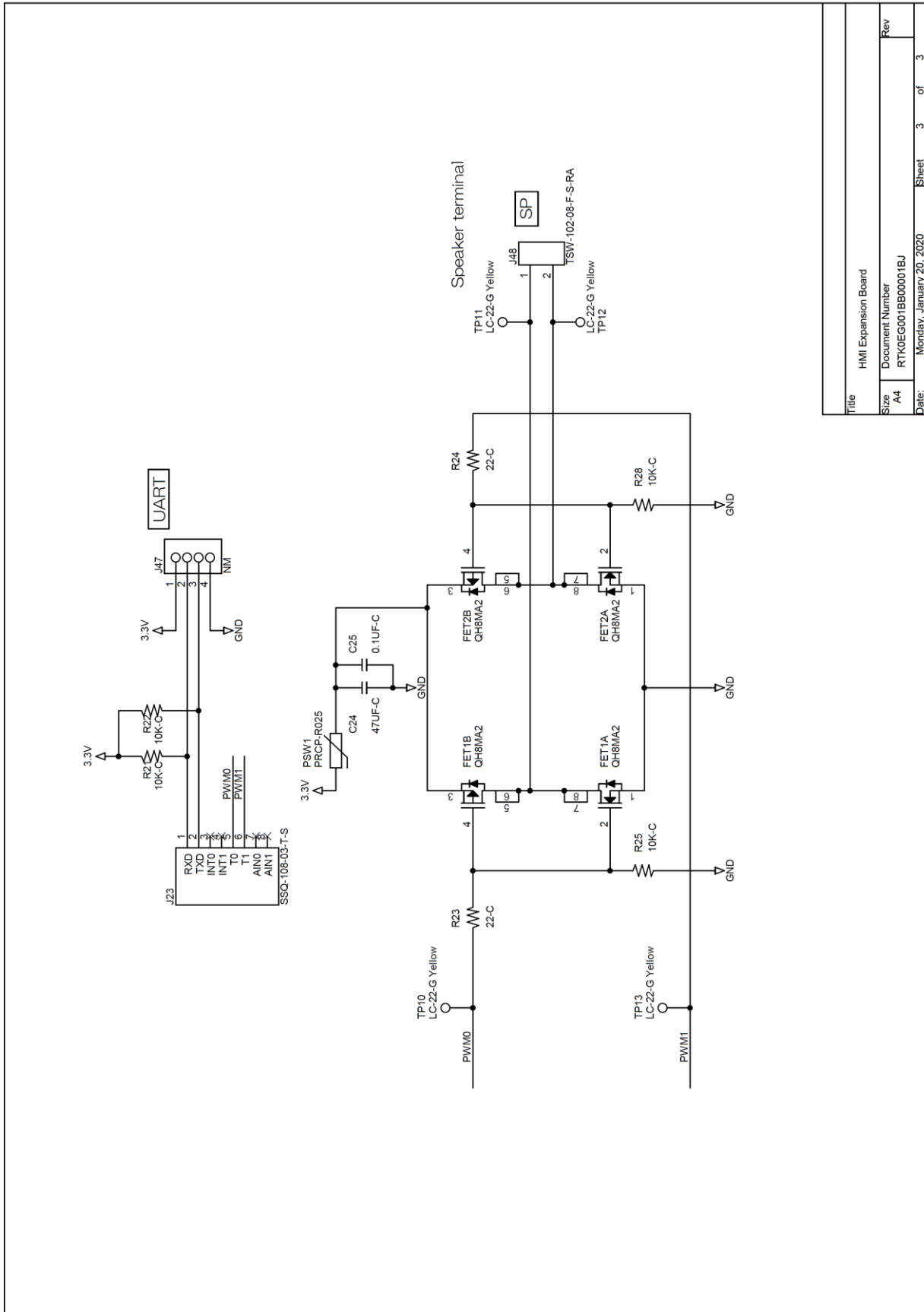
Figure 8   circuit diagram(3/3)

7.   Board Layout Diagram

Figure 9   Component Side Silkscreen (top view)

Figure 10   1st Layer Pattern (top view)

Figure 11   2nd Layer Pattern (top view)

Figure 12   3rd Layer Pattern (top view)

Figure 13   4th Layer Pattern (top view)

Figure 14   Solder Side Silkscreen (top view)

Figure 15   External dimensions (Unit:mm)

8. BOM (parts list)

Table 13   BOM List (1/2)

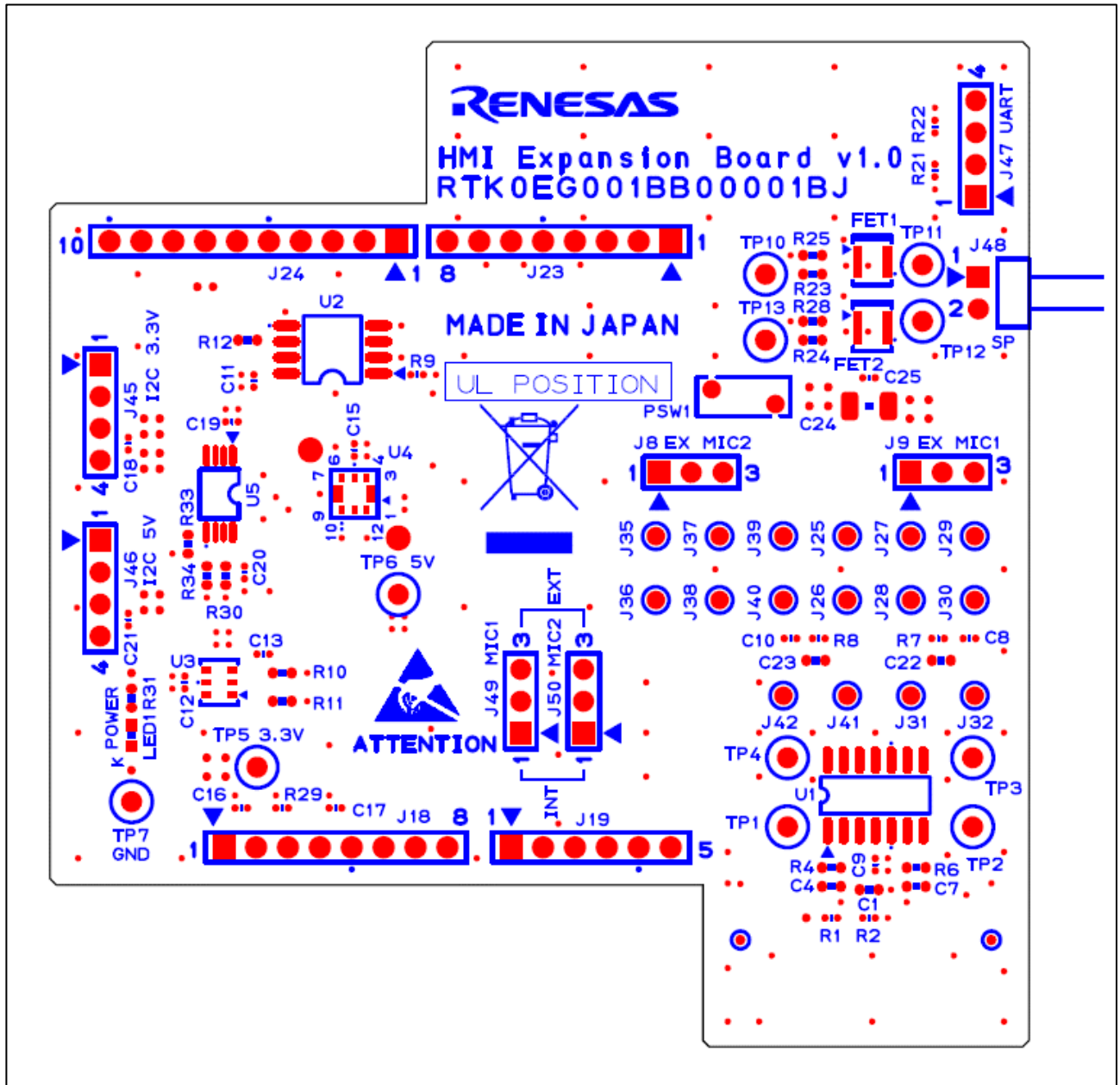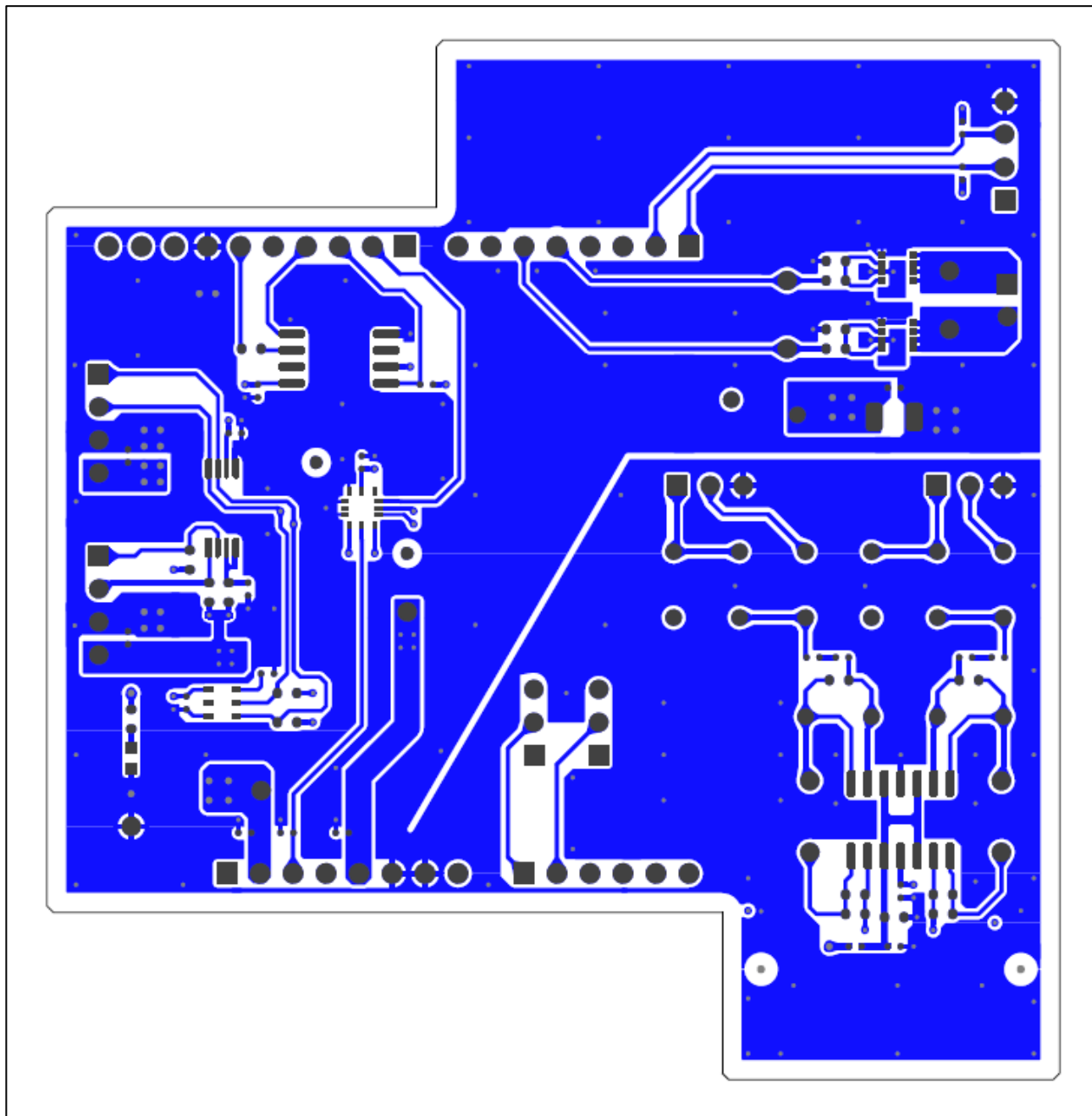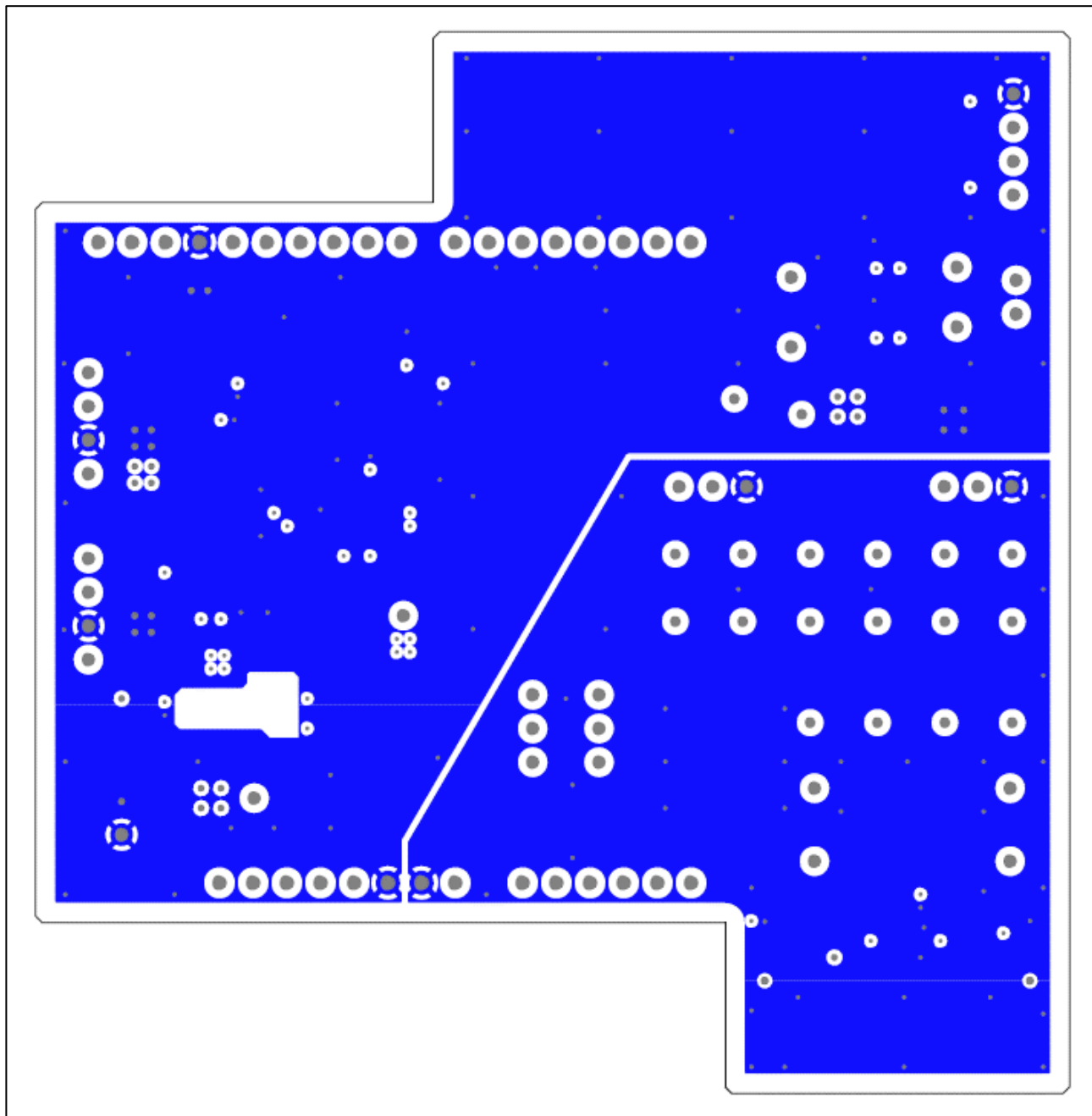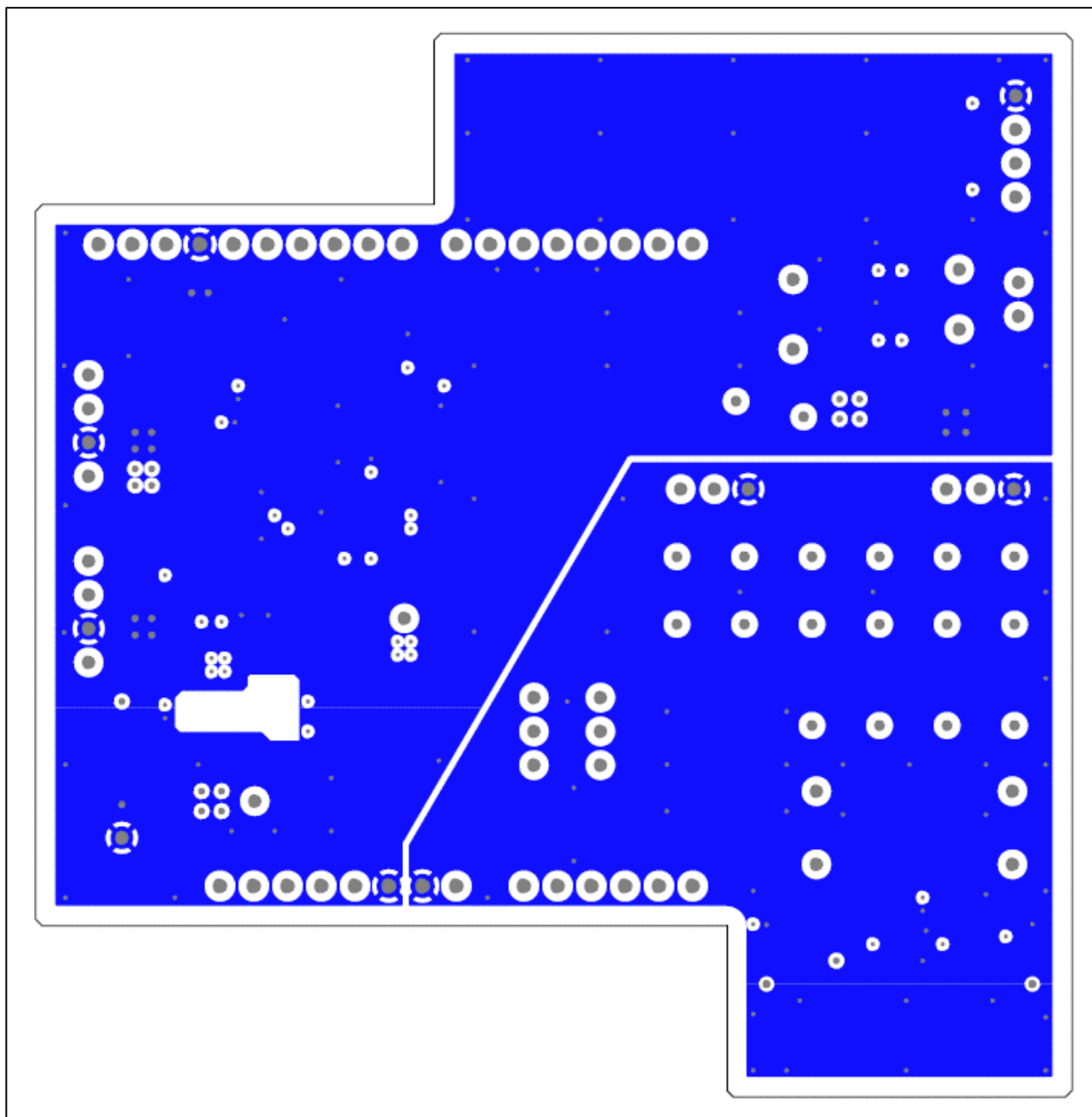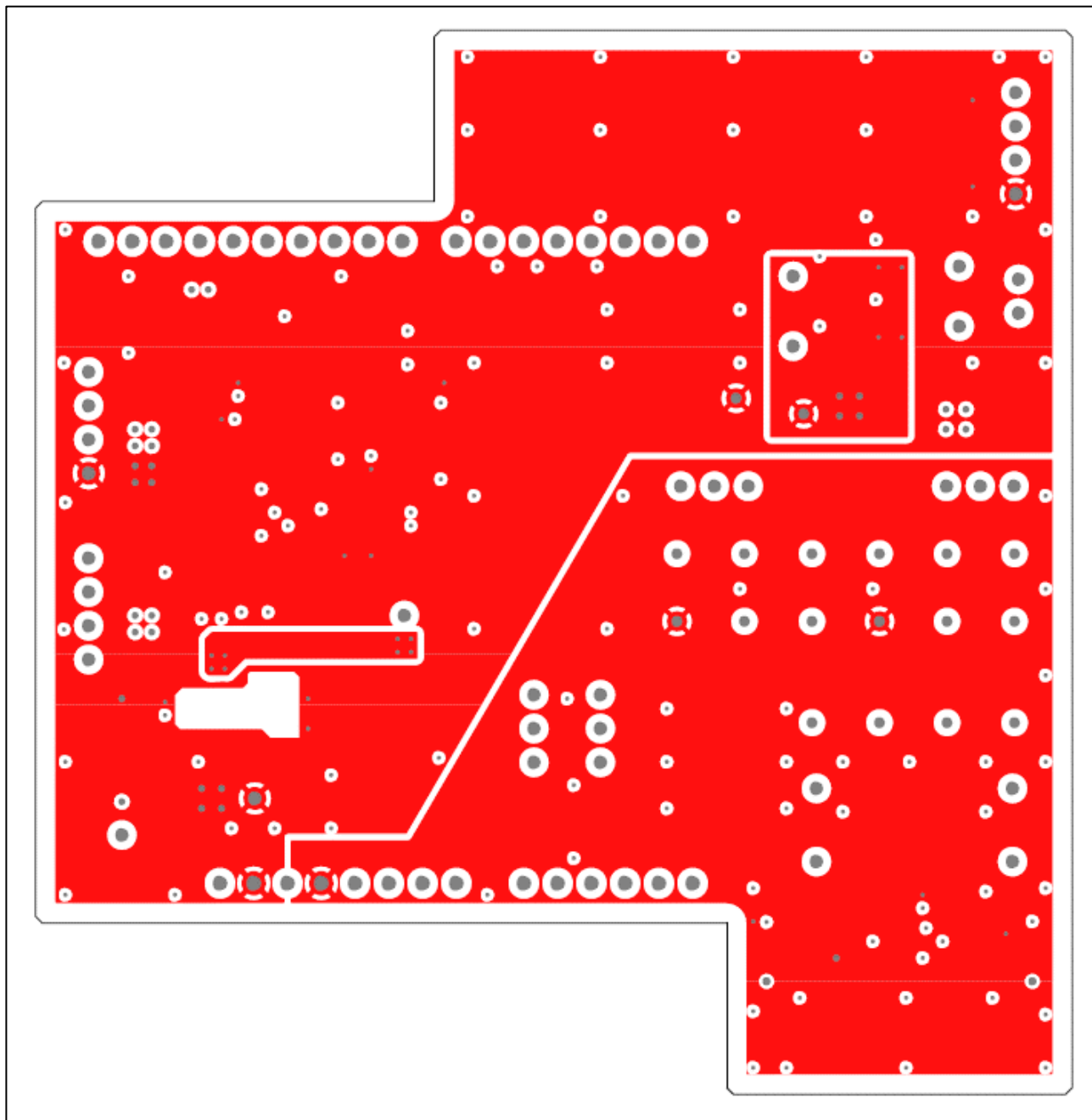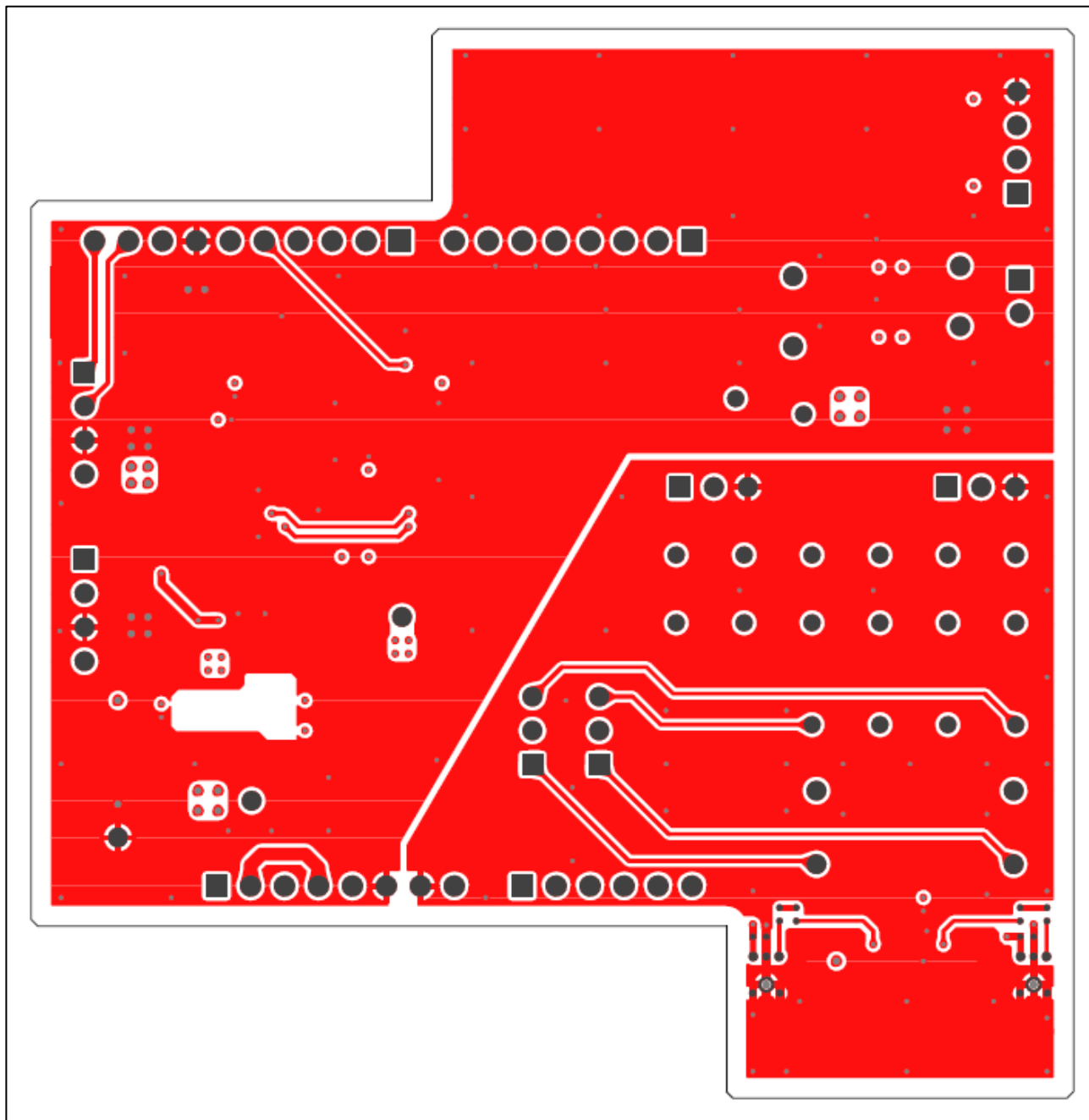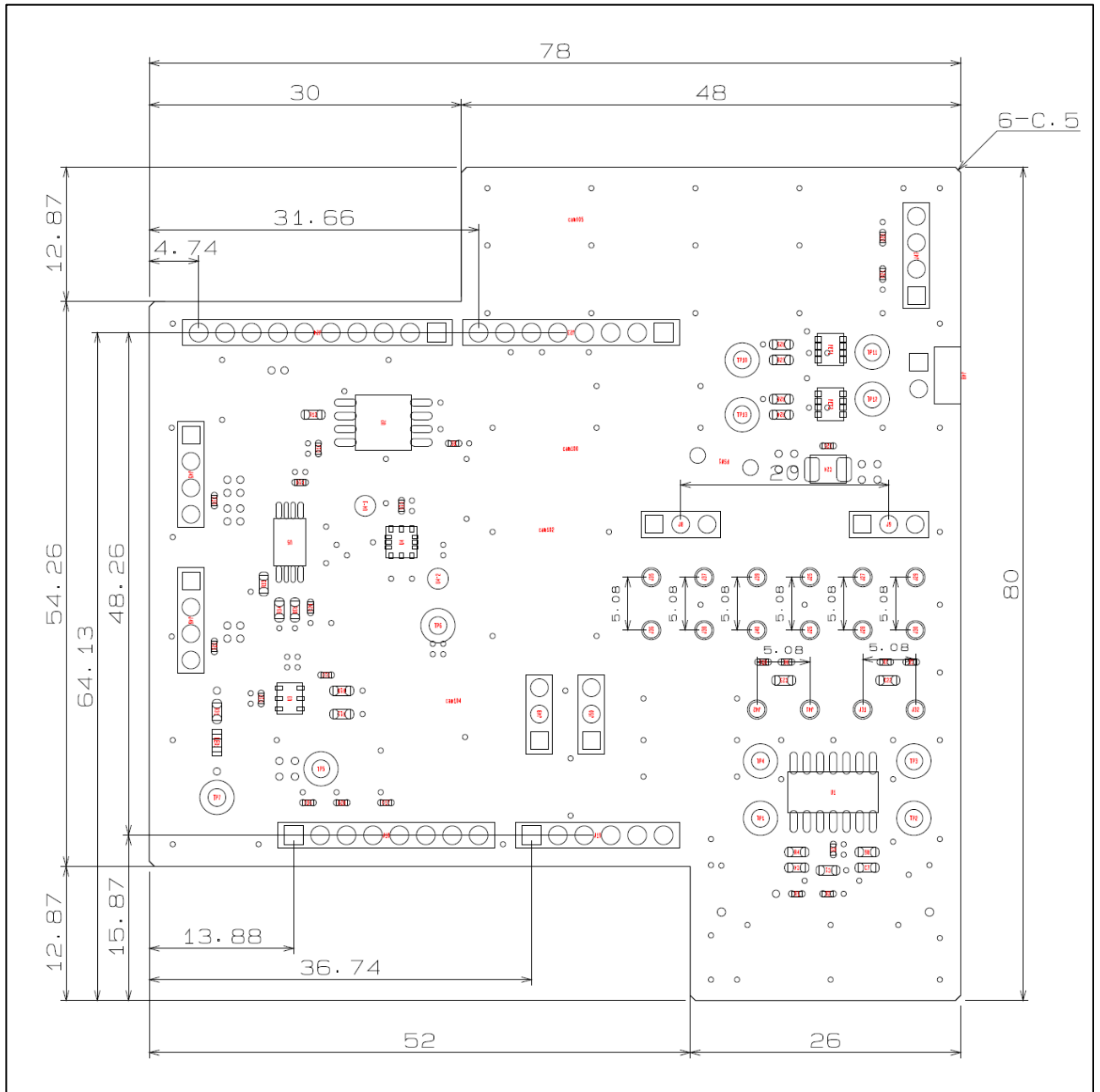| Item	Parts Type	Reference	PartNo.	Manufacture	Impl	Qty	Remarks
1	64Mbit Flash Memory	U2	MX25R6435FM2IL0	MACRONIX	Mount	1	8-SOIP
2	Temp and RH sensor	U3	HS3001	Renesas (IDT)	Mount	1	
3	TVOC sensor	U4	ZMOD4410AI1V	Renesas (IDT)	Mount	1	
4	I2C level converter	U5	PCA9306DTR2G	ON Semiconductor	Mount	1	8-TSSOP
5	Operational amplifier	U1	ISL28414FBZ	Renesas	Mount	1	14-SOIC
6	MEMS microphone	MIC1,MIC2	SPU0410LR5H-QB-7	Knowles	Mount	2	
7	Composite FET	FET1,FET2	QH8MA2TCR	Rohm	Mount	2	Nch+Pch
8	LED	LED1	SML-D13Y8WT86	Rohm	Mount	1	Golden Yellow
9	Chip Resistor	R23,R24	MCR03EZPJ220	Rohm	Mount	2	22Ω 5%
10	Chip Resistor	R12	MCR03EZPJ330	Rohm	Mount	1	33Ω 5%
11	Chip Resistor	R33,R34	MCR03EZPJ102	Rohm	Mount	2	1KΩ 5%
12	Chip Resistor	R31	MCR03EZPJ122	Rohm	Mount	1	1.2kΩ 5%
13	Chip Resistor	R9,R21,R22,R29	MCR01MZPJ103	Rohm	Mount	4	10kΩ 5%
14	Chip Resistor	R25,R28	MCR03EZPJ103	Rohm	Mount	2	10kΩ 5%
15	Chip Resistor	R30	MCR03EZPJ204	Rohm	Mount	1	200kΩ 5%
16	Chip Resistor	R3,R5,R7,R8	MCR01MZPF1002	Rohm	Mount	4	10kΩ 1%
17	Chip Resistor	R1,R2	MCR01MZPF1003	Rohm	Mount	2	100kΩ 1%
18	Chip Resistor	R4,R6	MCR03EZPFX1004	Rohm	Mount	2	1MΩ 1%
19	Chip Capacitor	C3,C6,C9,C11,C12,C13,C15,C16,C17,C18,C19,C20,C21,C25	EMK105B7104KV-F	Taiyo Yuden	Mount	15	Ceramic 0.1uF/16V
20	Chip Capacitor	C2,C5,C8,C10	EMK105BJ224KV-F	Taiyo Yuden	Mount	4	Ceramic 0.22uF/16V
21	Chip Capacitor	C1	EMK107B7105KA-T	Taiyo Yuden	Mount	1	Ceramic 1uF/16V
22	Chip Capacitor	C24	EMK325AC6476MM-P	Taiyo Yuden	Mount	1	Ceramic 47uF/16V
23	Check Terminal	TP1,TP2,TP3,TP4,TP10,TP11,TP12,TP13	LC-22G(Yellow)	Mac-Eight	UnMount	8	
24	Check Terminal	TP5	LC-22G(Orange)	Mac-Eight	UnMount	1	
25	Check Terminal	TP6	LC-22G(Red)	Mac-Eight	UnMount	1	
26	Check Terminal	TP7	LC-22G(Black)	Mac-Eight	Mount	1	
27	Connector	J8,J9,J49,J50	XJ8B-0311	OMRON	Mount	4	Header 3 position
28	Connector	J19	SSQ-106-03-T-S	Samtec	Mount	1	Receptacle 6 position
29	Connector	J18,J23	SSQ-108-03-T-S	Samtec	Mount	2	Receptacle 8 position
30	Connector	J24	SSQ-110-03-T-S	Samtec	Mount	1	Receptacle 10 position
31	Connector	J48	22-28-6020	MOLEX	Mount	1	Right Angle Header 2 position
32	Connector	J25,J26,J27,J28,J29,J30,J31,J32,J35,J36,J37,J38,J39,J40,J41,J42	PD-1	Mac-Eight	Mount	16	Socket pin
33	Resetable Fuse	PSW1	PRCP-R025-0-99	Nidec Copal Electronics	Mount	1	
34	Chip Capacitor	C4,C7,C22,C23	-	-	UnMount	4	1608 Pad
35	Chip Resistor	R10,R11	-	-	UnMount	2	1608 Pad

Table 13   BOM List (2/2)

Item	Parts Type	Reference	PartNo.	Manufacture	Impl	Qty	Remarks
36	Connector	J45,J46,J47	XJ8B-0411	OMRON	UnMount	3	
37	Resistor	(J31-J32,J41-J42)	MFS1/4CC1004F	KOA	Mount	2	1MΩ 1%
38	Jumper Resistor	(J25-J26,J29-J30,J35-J36,J39-J40)	Z16C	KOA	Mount	4	Jumper Resistor
39	Shunt Connector	(J49,J50)	XJ8A-0211	OMRON	Mount	2	
40	PCB	-	RTK0EG001BB00001BJ	-	-	1	
41	Speaker	-	CMS-28588N-L152	CUI inc	Mount	1	8Ω 2W Wire leads
42	Housing connector	-	2226A-02	Neltron	Mount	1	Speaker harness
43	Crimp terminal	-	2226TG	Neltron	Mount	2	Speaker harness

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr 30, 2020	-	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 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/.