

CN299-ISL9122A

High efficiency IoT battery system

Rev.1.0
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Description

The CN299-ISL9122A for IoT Battery System is the application of optimize battery power supply. The board allows quick evaluation of the low dropout linear regulator ISL9001A and the ultra-low IQ buck-boost regulator ISL9122A, whose output voltage can be adjusted by using I2C interface bus. It is a cost-effective solution for the low-power, seamless PWM/PFM and buck/boost transition application where both stepping up and stepping down voltage capabilities are required.

Specifications

The design specifications of the CN299-ISL9122A for IoT Battery System are shown in Table 1.

TABLE 1. SPECIFICATIONS

Parameters	Values
Input Voltage (VIN)	1.8V to 5.5V
ISL9122 Output Voltage (VOUT)	1.8V to 5.375V
ISL9001A Output Voltage (VLDO)	1.8V
Max. Output Current (ISL9122A IOOUT_MAX)	500mA

Key Features

- 1300nA quiescent current
- Seamless PWM/PFM and buck/boost transition
- IIC Control and voltage adjustability
- 97% peak efficiency
- PC terminal via USB control output

References

[ISL9122A](#) Datasheet

[ISL9001A](#) Datasheet

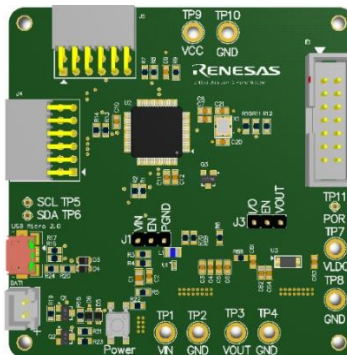


Figure1 Top View

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Functional Description

The ISL9122A is a highly integrated non-inverting buck-boost switching regulator that accepts input voltages both above or below the regulated output voltage. It features an extremely low quiescent current consumption of 1300nA in Regulation mode, 120nA in Forced Bypass mode, and 8nA in Shutdown mode. It provides 80% efficiency at 10μA load and has a peak efficiency more than 97%. It supports input voltages from 1.8V to 5.5V.

The ISL9122A supports 3.3V default output voltage at Power-On Reset (POR). After POR, the output voltage can be adjusted in the range of 1.8V to 5.375V controlled by MCU through IIC.

When the system is powered by a battery, the ISL9122A output voltage can be switched by pressing the key. There are 5 levels.

Once connecting the CN299-ISL9122A board to the PC, an ISL9122 Demo GUI is available to set the output voltage. And the output voltage and the battery voltage can be monitored in real time on the GUI.

Quick Test Setup

- ISL9122A default output 3.3V and ISL9001A fixed output 1.8V

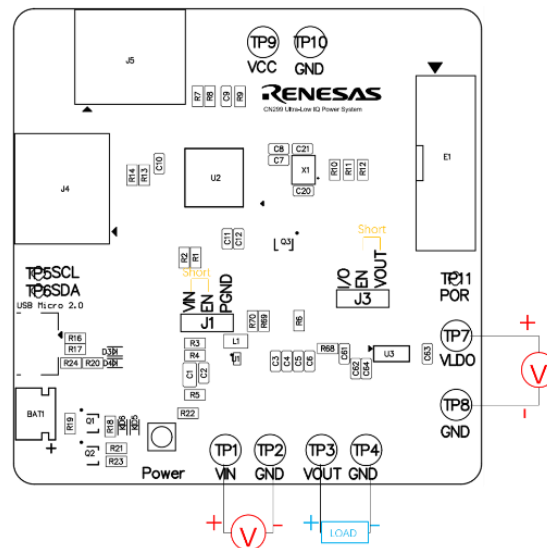


Figure 2 The Connection of the Default Output

- 1, Connect the power supply to the input terminals VIN (TP1) and GND (TP2). Connect the load to the output VOUT (TP3) and GND (TP4). Short VIN and EN on J1, and EN and VOUT on J3. Make sure the setup is correct prior to applying any power or load to the board. Refer to Figure 2.
- 2, Adjust the power supply to 1.8V to 5.5V and turn it on.
- 3, Verify the output voltage is 3.3V(VOUT) and 1.8V(VLDO). Refer to Figure 2.

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- Adjust the ISL9122A output by the keys and ISL9001A fixed output 1.8V

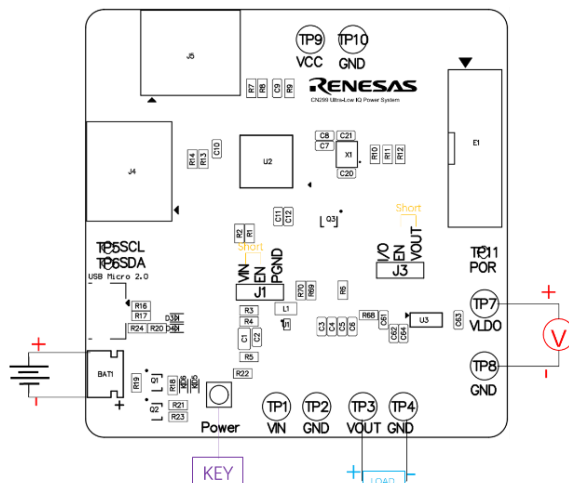


Figure 3 The Connection of Adjust the Output by keys

1. Connect the battery to BAT1. Connect the load to the output VOUT (TP3) and GND (TP4). Short VIN and EN on J1, and EN and VOUT on J3. Make sure the setup is correct prior to applying any power or load to the board. Refer to Figure 2.
2. Press and hold the KEY for 3s to power on the system power.
3. Verify the output voltage is 3.3V(VOUT) and 1.8V(VLDO). Refer to Figure 2.
4. Press the key for a short time to switch the output voltage of ISL9122A. There are 5 voltage levels.
- 5.

- Adjust the ISL9122A output by PC and ISL9001A fixed output 1.8V

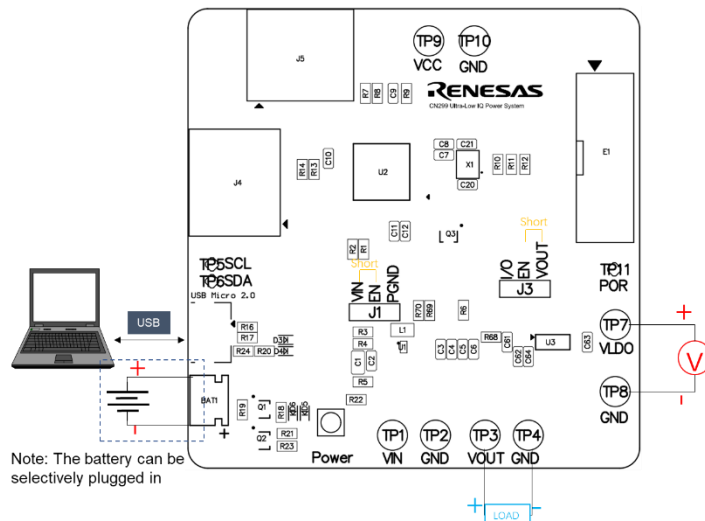


Figure 4 The Connection of Adjust the Output by PC

1. Connect PC to CN299-ISL9122A board using USB cable. Connect the load terminals to the output VOUT (TP3) and GND (TP4). Short VIN and EN on J1, and EN and VOUT on J3. Make sure the setup is correct prior to applying any power or load to the board. Refer to Figure 2.
2. Verify the output voltage is 3.3V(VOUT) and 1.8V(VLDO). Refer to Figure 2.
3. Open the GUI. Click the "Connect" button.
4. Use the GUI to adjust the output of the ISL9122A (Adjustable range from 2.0V to 5.35V).

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GUI Screenshot

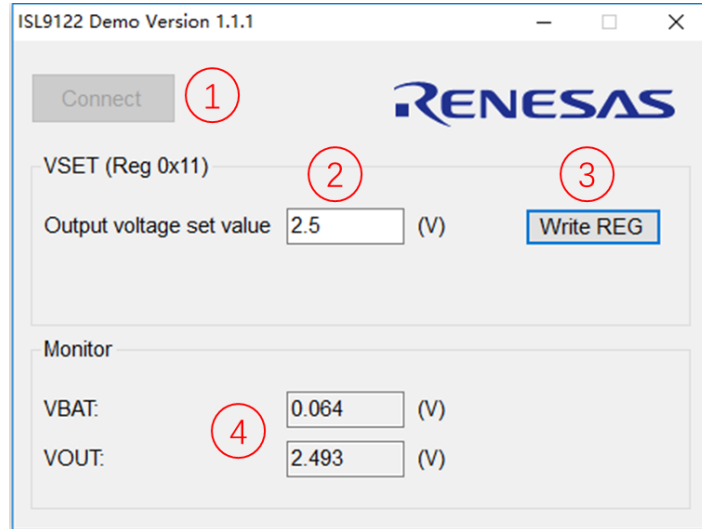


Figure 5 GUI Screenshot

1. Click the "Connect" button to connect the CN299-ISL9122A board.
2. Type the setting voltage value.
3. Click the "Write REG" button to send the setting value to MCU.
4. Display the voltage values in real time.

Test Environment

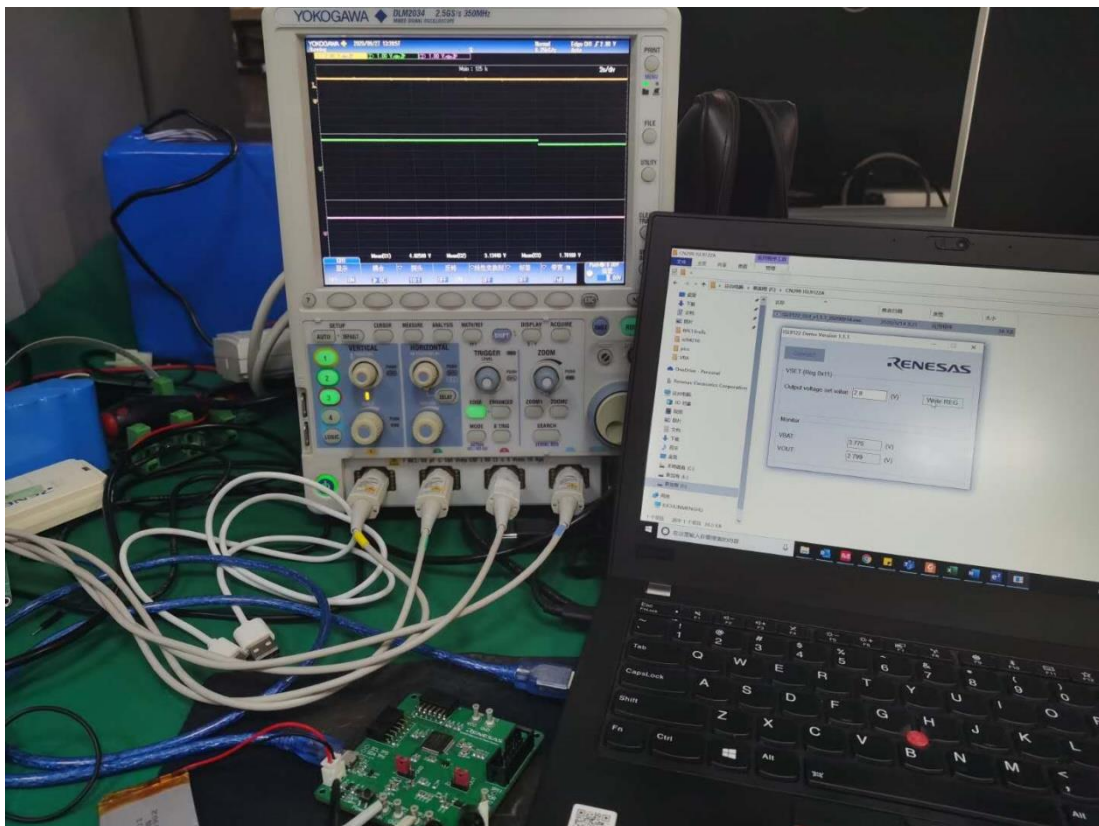


Figure 6 Test Environment

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Test Example

- **Default Output**
- Battery powered.
- ISL9122A default output 3.3V, ISL9001A fixed output 1.8V



Figure 7 Test of Default Output

- **Adjust the Output by Keys**
- Battery powered
- Adjust the ISL9122A output voltage by Keys
- ISL9001A fixed output 1.8V



Figure 8 Test of Adjust the Output by Keys

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- Adjust Output by PC
- Battery powered
- Adjust the ISL9122A output
- ISL9001A fixed output 1.8V



Figure 9 Test of Adjust the Output by PC

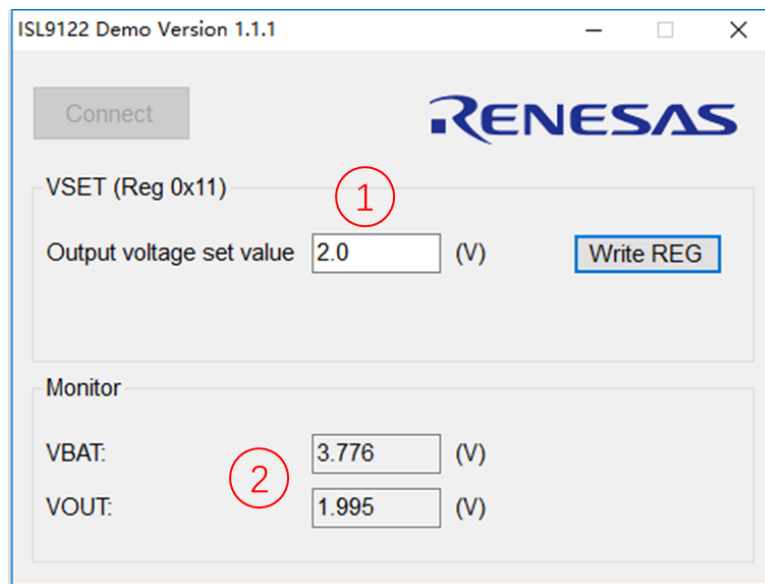


Figure 10 GUI window

1. Set output voltage.
2. Display the battery voltage and output voltage values in real time.

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CN299-ISL9122A High efficiency IoT battery system Circuit Schematic

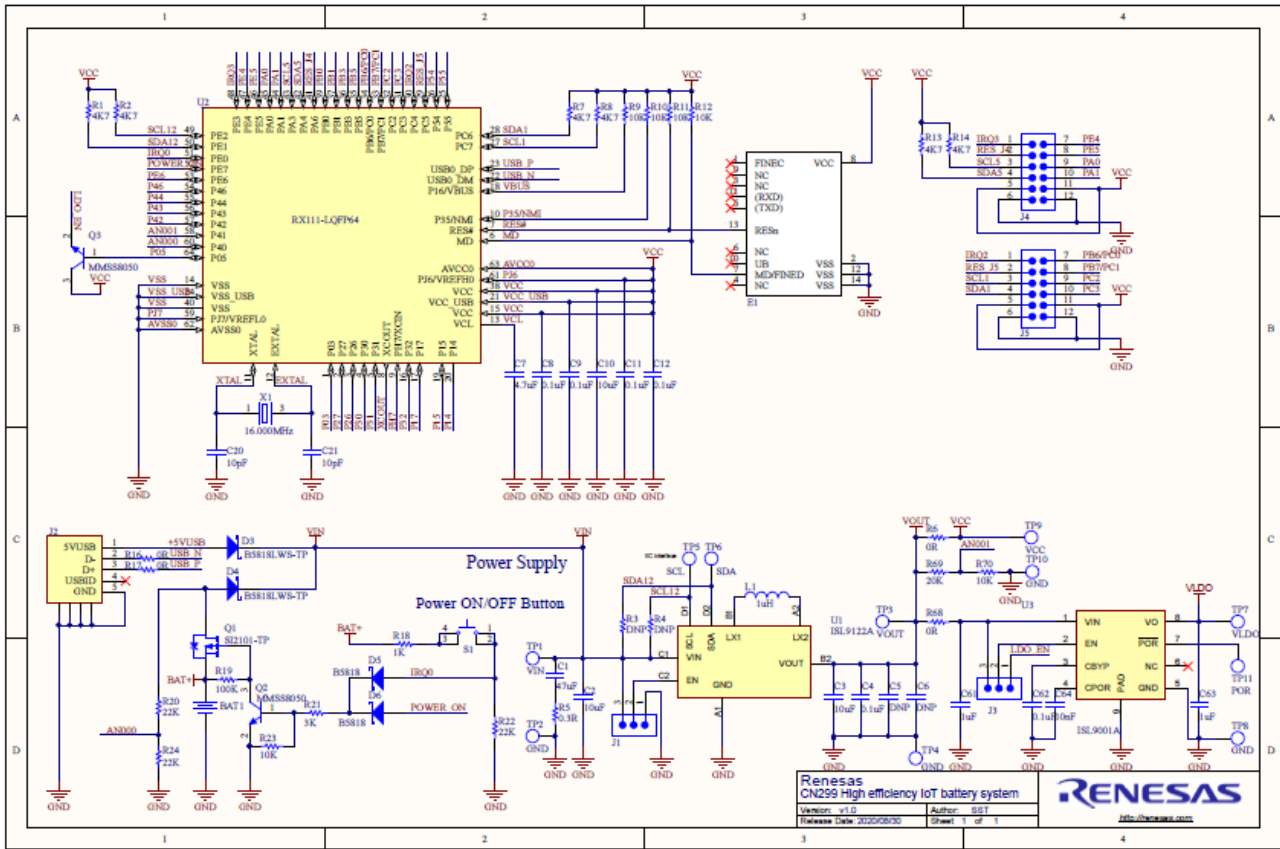


Figure 11 Circuit Schematic

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Bill of Materials

TABLE 2. BOM List

Designator	Mfg Part Number	Qty	Description	Manufacturer
BAT1	B2B-XH-A(LF)(SN)	1	CONN HEADER VERT 2POS 2.5MM	JST
C1	C2012X5R1A476M125AC	1	Ceramic Chip Capacitor 0805 47uF 10V	TDK
C2, C3, C10	CL10A106MQ8NNNC	3	Ceramic Chip Capacitor 0603 10uF 6.3V	Samsung
C4, C8, C9, C11, C12, C62	GCM188L81H104KA57D	6	Ceramic Chip Capacitor 0603 0.1uF 50V	MURATA
C5, C6		2	Ceramic Chip Capacitor 0603	
C7	CGA3E1X5R0J475K080AC	1	Ceramic Chip Capacitor 0603 4.7uF 6.3V	TDK
C20, C21	GRM1885C1H100JA01J	2	Ceramic Chip Capacitor 0603 10pF 50V	Murata
C61, C63	GRT188R61H105KE13D	2	Ceramic Chip Capacitor 0603 1uF 50V	MURATA
C64	GCD188R71H103KA01D	1	Ceramic Chip Capacitor 0603 10nF 50V	MURATA
D3, D4, D5, D6	B5818LWS-TP	4	Schottky Diode 30V 1A SC-76	Micro
E1	SBH11-PBPC-D07-ST-BK	1	CONN HEADER VERT 14POS 2.54MM	Sullins
J1, J3	77311-818-03LF	2	Header 0.1" pitch 3pos 1x3	FCI
J2	10118192-0001LF	1	Connector, Micro-USB B port,5 Position, Right Angle, Gold Flash 1u, black, SMD	FCI
J4, J5	PPTC062LFBN-RC	2	Female Header 0.1" pitch 2x6 Male	Sullins
L1	LQM2MPN1R0MEHL	1	FIXED IND 1UH 1.5A 125MOHM 0806	Murata
Q1	SI2101-TP	1	MOSFET, P-Channel,20V,1.4A, SOT-23, SMD	Micro
Q2, Q3	MMSS8050-H-TP	2	TRANS NPN 25V 1.5A SOT23	Micro
R1, R2, R7, R8, R13, R14	RC0603FR-074K7L	6	Chip Resistor Thick Film 0603 4K7 1% 1/10W	YAGEO
R3, R4		2	Chip Resistor Thick Film 0603	
R5	RL0603FR-070R3L	1	Chip Resistor Thick Film 0603 R30 1% 1/10W	YAGEO
R6, R16, R17, R68	RC0603FR-070RL	4	Chip Resistor Thick Film 0603 0R 1% 1/10W	YAGEO
R9, R10, R11, R12, R23, R70	RC0603FR-0710KL	6	Chip Resistor Thick Film 0603 10K 1% 1/10W	YAGEO
R18	RC0603FR-071KL	1	Chip Resistor Thick Film 0603 1K 1% 1/10W	YAGEO
R19	RC0603FR-07100KL	1	Chip Resistor Thick Film 0603 100K 1% 1/10W	YAGEO
R20, R22, R24	RC0603FR-0722KL	3	Chip Resistor Thick Film 0603 22K 1% 1/10W	YAGEO
R21	RC0603FR-103KL	1	Chip Resistor Thick Film 0603 3K 1% 1/10W	YAGEO
R69	RC0603FR-0720KL	1	Chip Resistor Thick Film 0603 20K 1% 1/10W	YAGEO
S1	PTS645SM43SMTR92 LFS	1	Push Button Switch 6 x 6mm 4.3mm High	C&K
TP1, TP2, TP3, TP4, TP7, TP8, TP9, TP10,		8	High current test terminal Hole 2.5mm	
TP5, TP6, TP11		3	Header 0.1" pitch 1pos	
U1		1	Ultra-Low IQ Buck-Boost Regulator With Bypass	Renesas
U2	R5F1111	1	Renesas RX111 32-Bit 32MHz MCU LQFP64	Renesas
U3	ISL9001A	1	LDO with Low ISUPPLY, High PSRR 8 LD DFN	Renesas
X1	7V16070008	1	TXC 7V Crystal 16MHz 10pF	TXC Corp

Board Layout

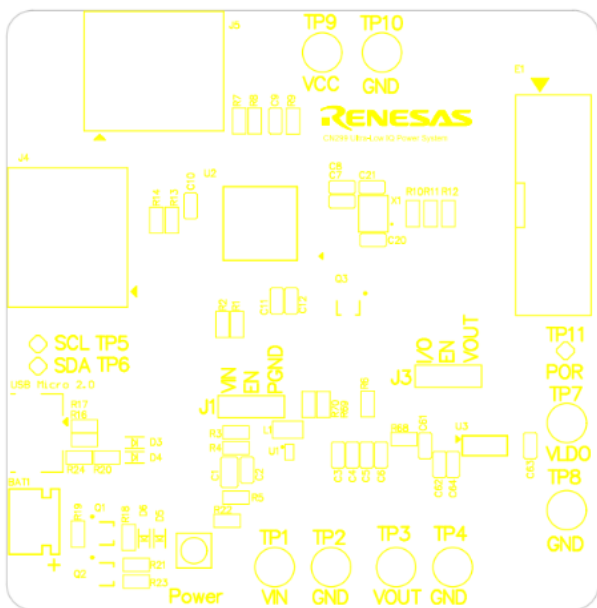


Figure 12 Silkscreen TOP

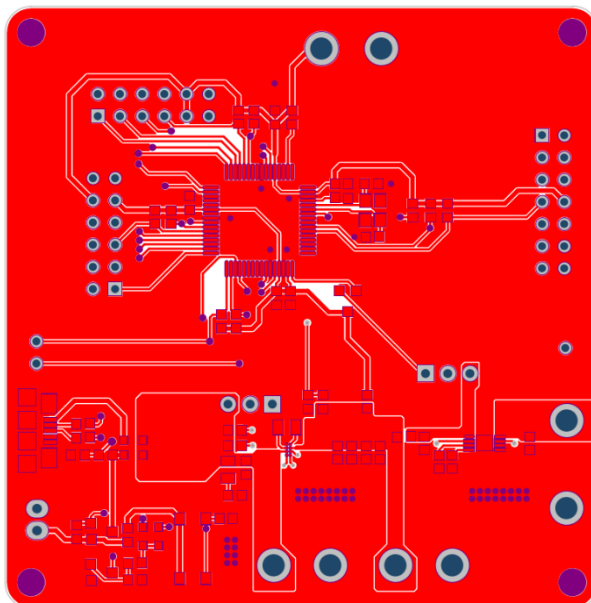


Figure 13 Top Layer

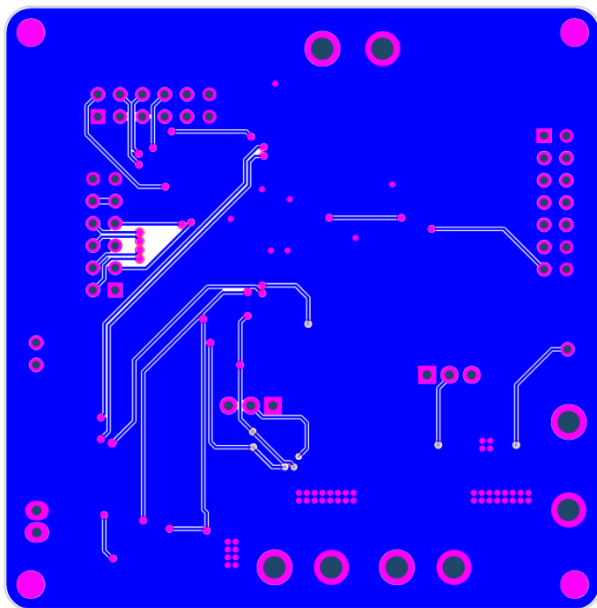


Figure 14 Bottom Layer

Revision History

Rev.	Date	Description	
		Page	Summary
0.1	Sep. 24, 2020	—	First edition issued

General Precautions in the Handling of Micro processing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Micro processing 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 near 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 micro processing 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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