
RA0E3 Group

Supplement of EMI (Electromagnetic Interference) design

Introduction

This application note serves as supplemental material for EMI (Electromagnetic Interference) design when developing hardware equipped with the RA0E3.

When hardware equipped with RA0E3 must meet the BISS Class-1 standard under the 150Ω method specified in IEC 61967-4, the conductive emission standard defined by the International Electrotechnical Commission (IEC), implementing a snubber circuit on the VCL terminal is effective.

This application note provides examples of snubber circuit implementation, design considerations, and precautions for application.

This application note is intended exclusively for RA0E3 and must not be applied to other microcontrollers.

Target Device

RA0E3

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1. Example of Snubber Circuit Implementation

As shown in Figure 1, connect a capacitor with a value between 0.47 and 1 μ F and a 1 Ω resistor in series between the VCL terminal and the VSS terminal.

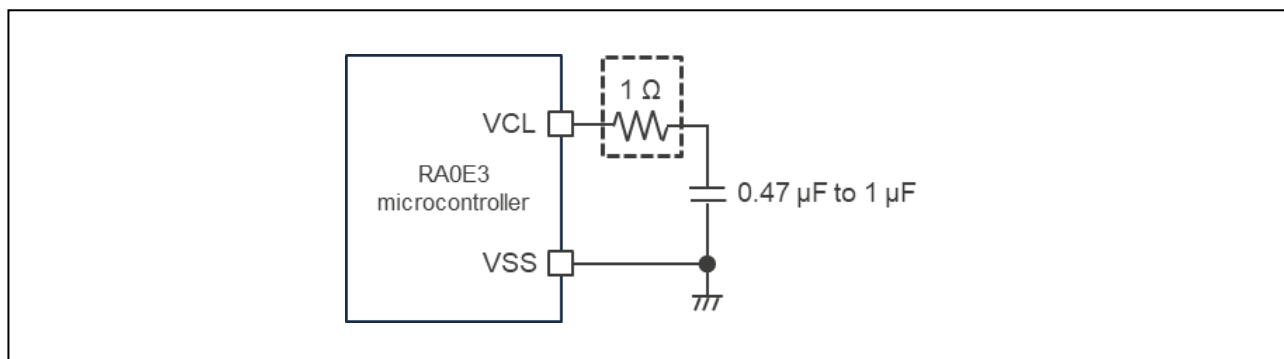


Figure 1. Example of Snubber Circuit Implementation

2. Design Considerations

- (1) The resistor used in the snubber circuit should be 1 Ω (Typ.).
- (2) When implementing the snubber circuit, place the resistor and capacitor as close as possible to the VCL terminal to minimize parasitic inductance.

3. Precautions for Application

The voltage applied to the VCL terminal is extremely important for the internal circuitry.

If a resistor larger than 1 Ω (Typ.) is inserted between the VCL terminal and the capacitor, the voltage supplied to the internal circuitry may become unstable, affecting device performance. Therefore, this application note is limited to EMI countermeasures specifically for RA0E3.

4. Reference Documents

RA0E3 User's Manual: Hardware (R01UH1165EJ0100)

(Please obtain the latest version from the Renesas Electronics website.)

Technical Updates / Technical News

(Please obtain the latest version from the Renesas Electronics website.)

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Oct.31.2025	-	Initial version

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.

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