RL78 Family

Notes and Countermeasures Against Noise

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Abstract

This document describes notes and countermeasures against noise for the RL78 Family. The countermeasures are generally effective countermeasures against noise, however a careful system evaluation should be performed after using these countermeasures.

Product

MCU: RL78 Family

Contents

1. Notes on Noise

1.1 Shortest Wiring Length

The wiring on a printed circuit board can function as an antenna, which attracts noise into an MCU. The shorter the total wiring length (in mm units), the less the possibility of noise being attracted into the MCU.

1.1.1 Wiring for the $\overline{\text{RESET}}$ Pin

Make the length of the wiring connected to the $\overline{\text{RESET}}$ pin as short as possible. When connecting a capacitor between the $\overline{\text{RESET}}$ pin and Vss pin, and when connecting the reset IC to its corresponding pins, the wire length should be especially short (within 20 mm).

Reason:
The width of a pulse input into the $\overline{\text{RESET}}$ pin is determined by the timing requirements. If noise having a shorter pulse width than the standard is input to the $\overline{\text{RESET}}$ pin, the reset is released before the internal state of the MCU is completely initialized. This may cause a program runaway.

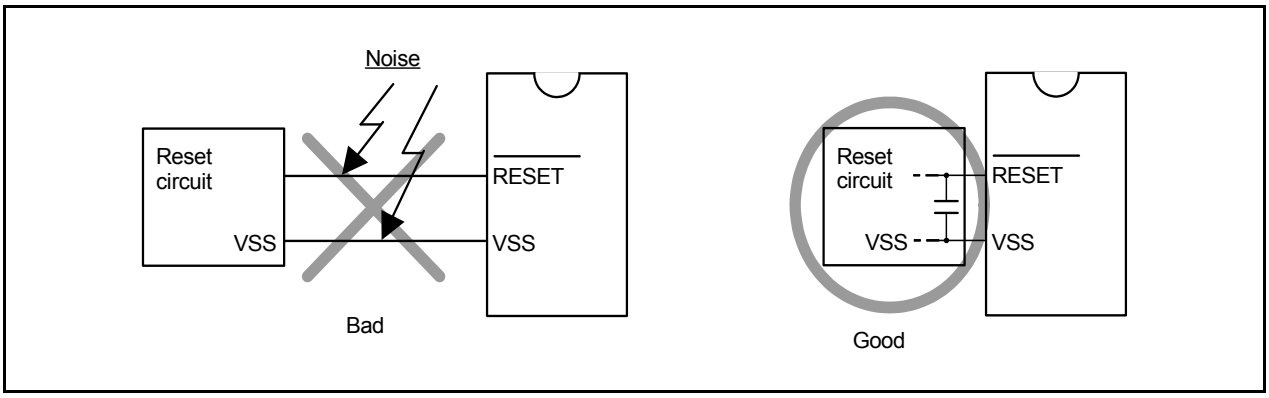


Figure 1.1 Wiring for the $\overline{\text{RESET}}$ Pin

1.1.2 Wiring for Clock Input/Output Pins

- Make the length of wiring connected to clock I/O pins as short as possible.
- Make the length of wiring (within 20 mm) across the grounding lead of a capacitor which is connected to an oscillator and the Vss pin of an MCU as short as possible.

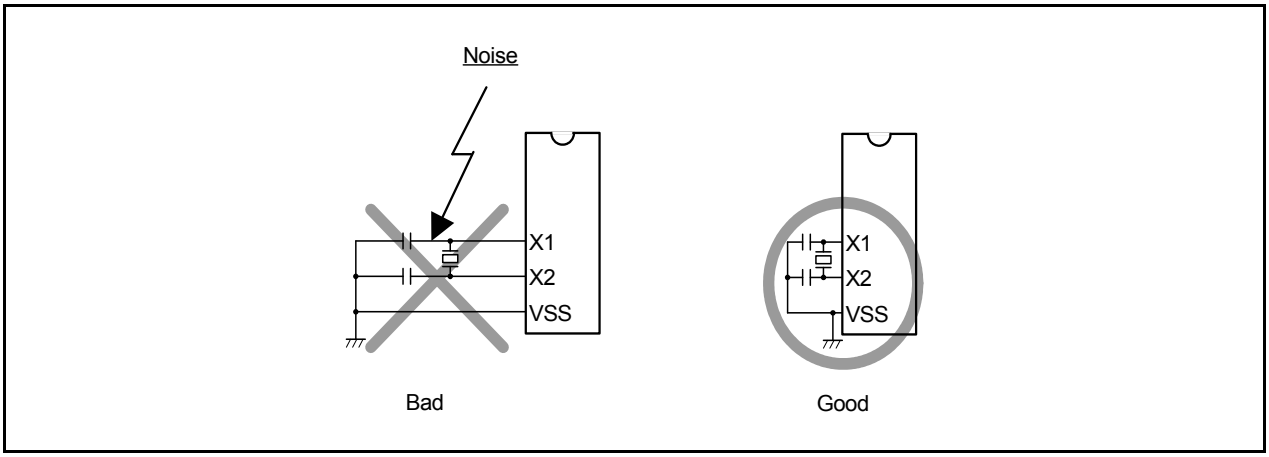


Figure 1.2 Wiring for Clock Input/Output Pins

Reason:

If noise enters clock input/output pins, clock waveforms may be unstable. This may cause a program failure or program runaway. Also, if a potential difference is caused by the noise between the Vss level of the MCU and the Vss level of an oscillator, the correct clock will not be input in the MCU.

1.2 Connection of Bypass Capacitor Across VSS Line and VDD Line

Connect a bypass capacitor that is approximately 0.1 µF across the VSS line and VDD line as follows:

- Connect a bypass capacitor across the VSS pin and VDD pin at equal length.
- Connect a bypass capacitor across the VSS pin and VDD pin with the shortest possible wiring.
- Use lines with a diameter larger than other signal lines for VSS line and VDD line.
- Connect the power source wiring via a bypass capacitor to the VSS pin and the VDD pin.

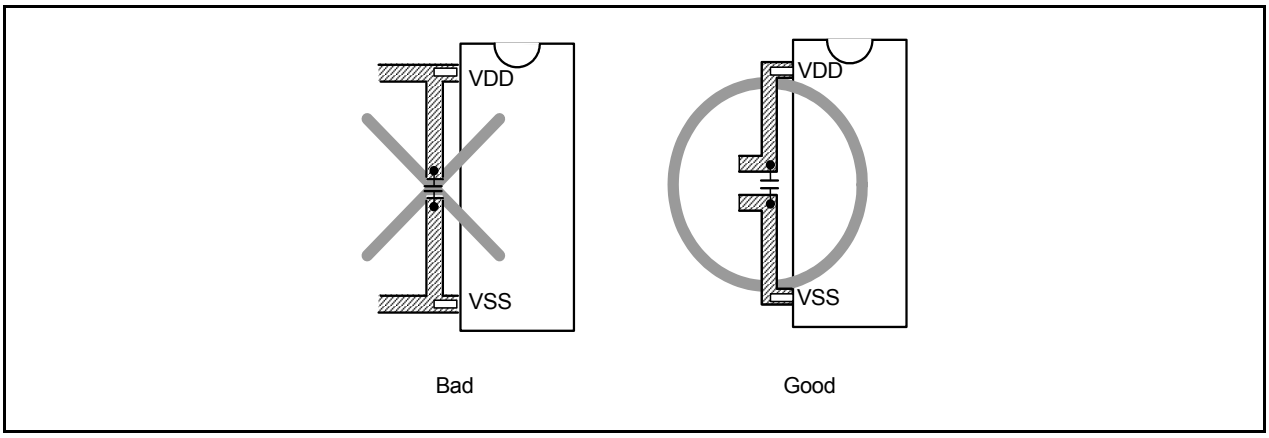
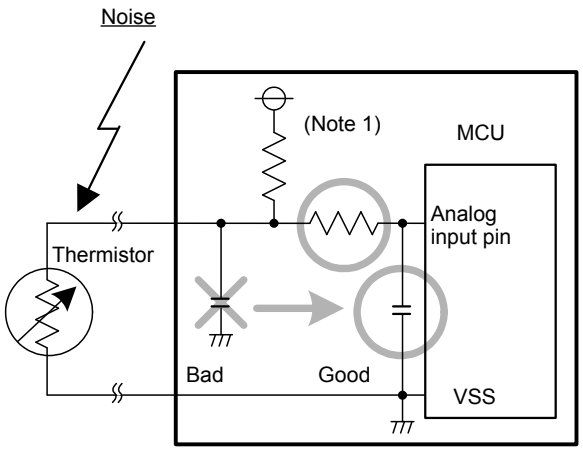


Figure 1.3 Bypass Capacitor Across the VSS Line and VDD Line

1.3 Wiring to Analog Input Pins

- Connect a resistor that is approximately 100 Ω to 1 kΩ to an analog signal line which is connected to an analog input pin in series. Connect the resistor to the MCU as close as possible.
- Insert a capacitor that is approximately 1000 pF, between the analog input pin and Vss pin, placing it as close to the Vss pin as possible. The wire between the analog input pin and the capacitor, and the wire between the Vss pin and the capacitor should be equal length.

Reason:
Signals input to an analog input pin are usually output signals from a sensor. Most sensors that detect events are placed further away from boards that have mounted MCUs. Wiring to analog input pins is inevitably longer. This long wiring functions as an antenna which attracts noise into the MCU, which causes noise to the analog input pin.



Note:
1. The resistor is used for dividing resistance with a thermistor.

Figure 1.4 Analog Signal Line, a Resistor, and a Capacitor

1.4 Oscillator Concerns

Oscillators that generate clocks for the main operation of the MCU need special attention as to not be affected by other signals.

1.4.1 Avoid Large Current Signal Lines

Place the MCU (and especially the oscillator) as far away as possible from signal lines where a current larger than the tolerance of current value flows.

Reason:
In a system using an MCU, there are signal lines for controlling things such as motors, LEDs, and thermal heads. When a large current flows through those signal lines, noise occurs because of mutual inductance.

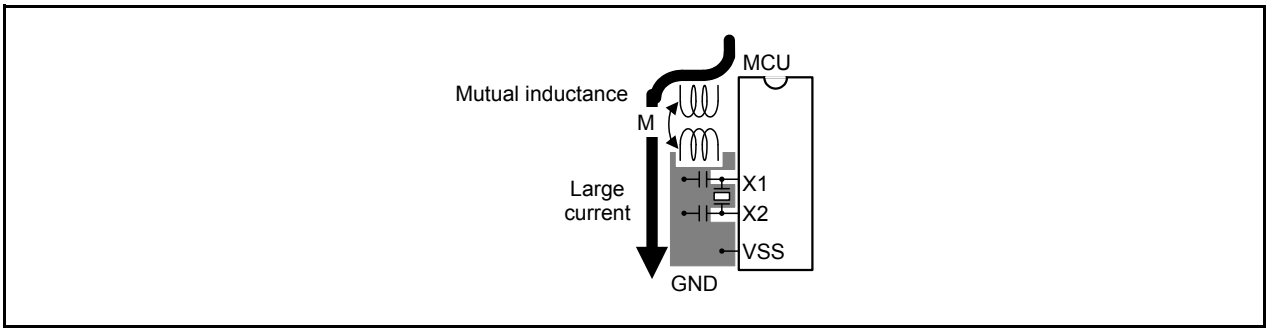


Figure 1.5 Wiring of a Large Current Signal Line

1.4.2 Avoid Signal Lines Where Potential Levels Change Frequently

Place an oscillator and a connecting pattern of an oscillator away from signal lines where potential levels change frequently. The layout for signal lines where potential levels change frequently should not cross signal lines such as clock related signal lines and other signal lines that are easily affected by noise; and the signal lines should not run long in parallel.

Reason:
Signal lines where potential levels change frequently (such as the TO01 pin signal line) may affect other lines at the rising edge or falling edge of a signal. If such lines cross over a clock line, clock waveforms may be unstable, which causes an MCU failure or a program runaway.

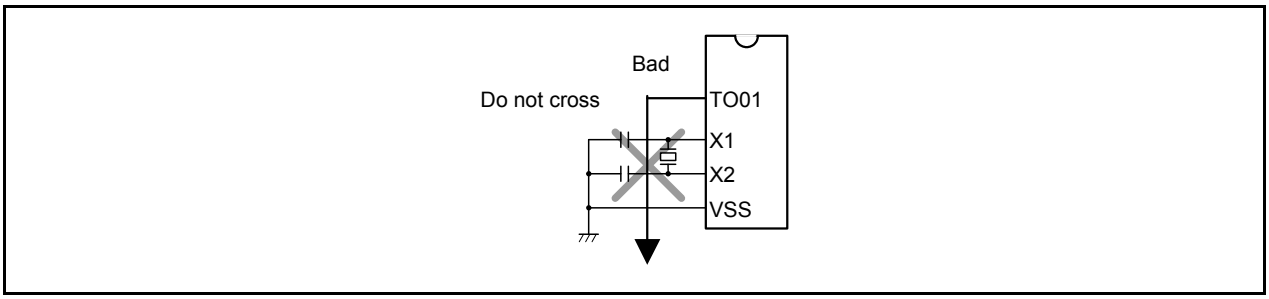


Figure 1.6 Wiring of Signal Lines Where Potential Levels Change Frequently

1.5 Setup for I/O Ports

Setup I/O ports using hardware and software as described below:

Hardware

- Connect a resistor that is 100 Ω or more to a signal line which is connected to an I/O port in series. Connect the resistor as close to the MCU as possible.

Software

- For input ports, read data several times by a program to check whether input levels are equal or not.
- For output ports, since the output data may inverse due to noise, rewrite data to its port register at fixed periods.
- Rewrite data to the register that controls port functions at fixed periods.

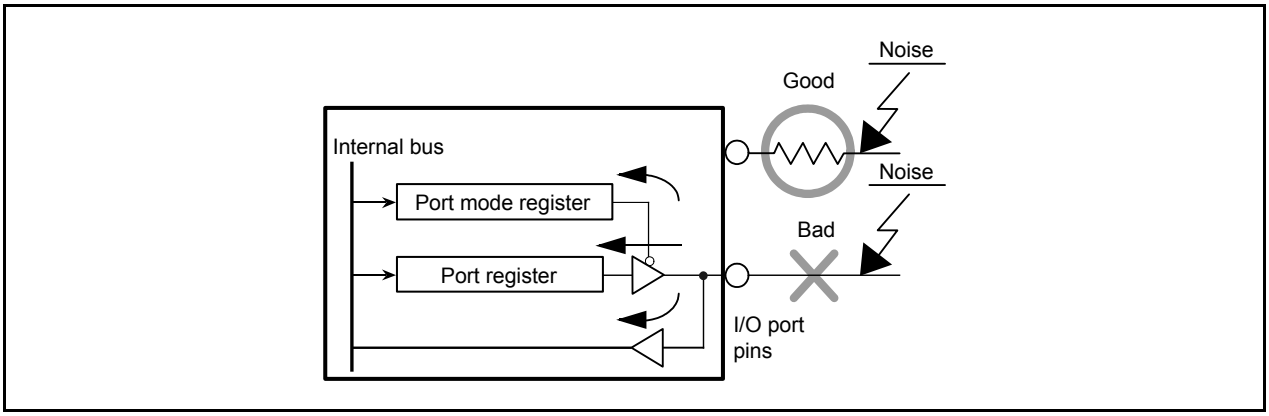


Figure 1.7 Setup for I/O Ports

2. Reference Documents

Each product User's Manual: Hardware
The latest version can be downloaded from the Renesas Electronics website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Electronics website.

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Revision History	RL78 Family Notes and Countermeasures Against Noise

Rev.	Date	Description	
		Page	Summary
1.00	Oct. 4, 2011	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins

   Handle unused pins in accord 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.

5. Differences between Products

   Before changing from one product to another, i.e. to one with a different part number, confirm that the change will not lead to problems.

   — The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.

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