RH850/U2B Group

Main Oscillator Application Note

R01AN6302EJ0110
Rev.1.10

Summary

This document describes precautions when using crystal Oscillator of RH850 / U2B series (after that, U2B).

It is the customer's responsibility to use the information contained in this document for designing the customer's equipment and system. We are not liable for any damages caused by these uses (including damages caused to either the customer or a third party).

Products

- RH850/U2B Group
  - RH850/U2B24
  - RH850/U2B10
  - RH850/U2B6

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1. Precautions for Crystal Oscillator Implementation

When designing the substrate around the crystal Oscillator, it is necessary to pay attention to the contents in this application note for preventing the Oscillation margin of the Oscillator from designing and to suppress the EMI level.

1.1 Recommended Circuit for Connecting Crystal Oscillator

Figure 1 shows the recommended connection circuit of the crystal Oscillator.

U2B mounts the damping resistor (Rd), load capacity (Cx1, Cx2), and oscillation amplifier.

Basically, the damping resistor (Rd) and load capacity (Cx1, Cx2) are not necessary to mount showed by Figure 1 to set the internal damping resistor (Rd), load capacity (Cx1, Cx2), and oscillation amplifier. However, the damping resistor and road capacity may be required depending on the parasitic capacity of the oscillator and board. Please consult with the crystal Oscillator manufacture before making a decision.

Since the feedback resistor is built into the microcomputer, it does not need to be mounted on the board.

Please use an AT-cut fundamental wave specification crystal Oscillator.

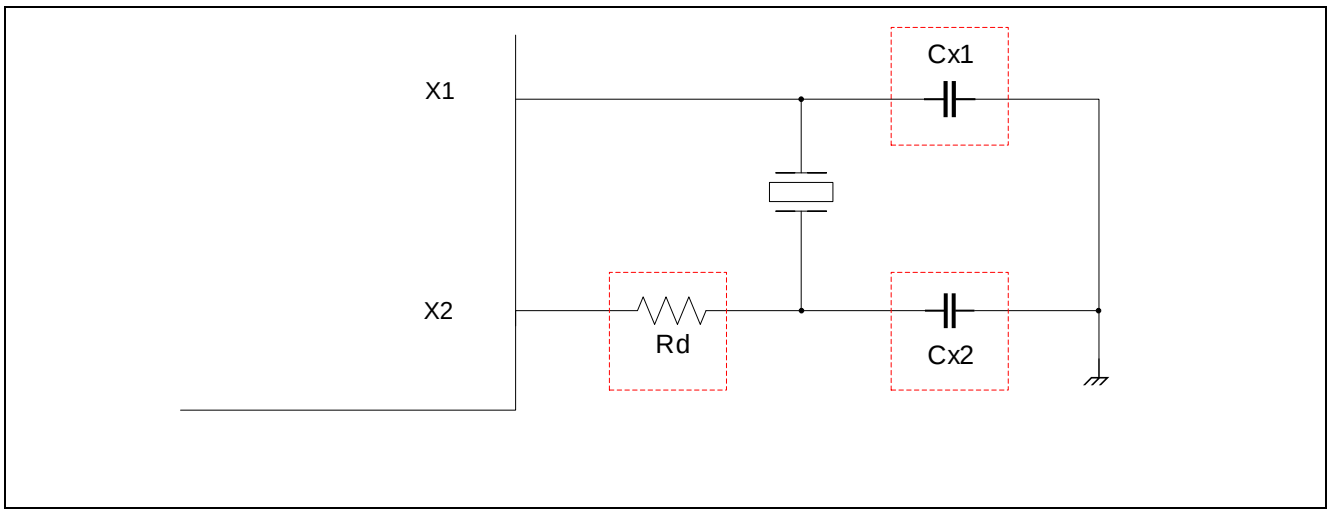


Figure 1 Recommended Connection Circuit of Crystal Oscillator

1.2 Board Pattern Example for Stable Oscillation

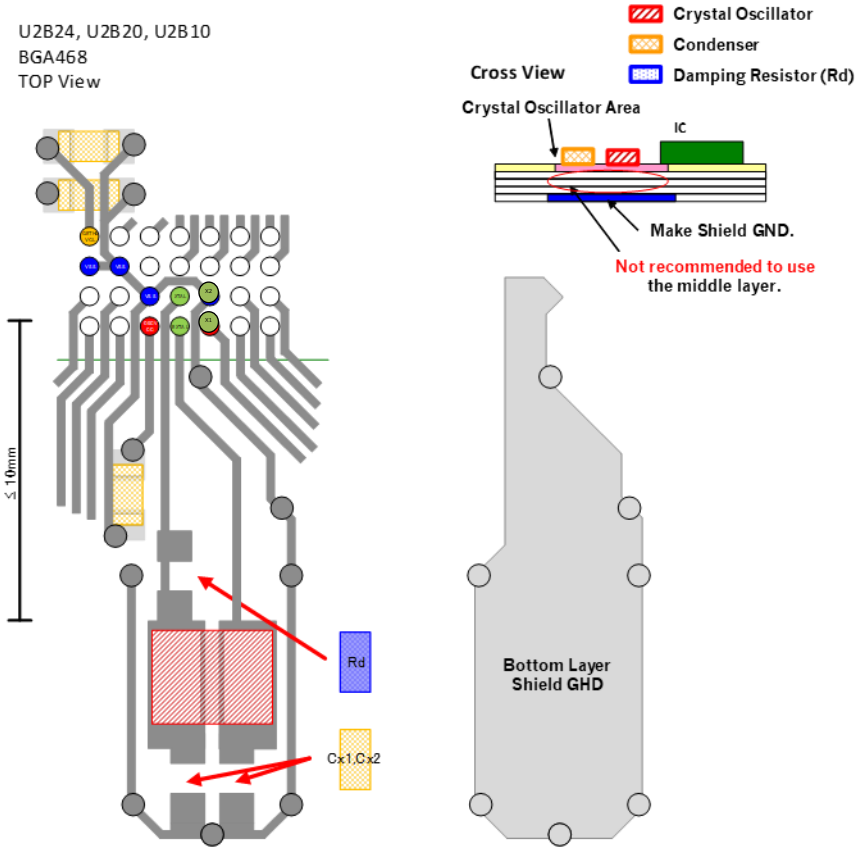


Figure 2 Bord Pattern Example for Stable Oscillation (U2B BGA468)

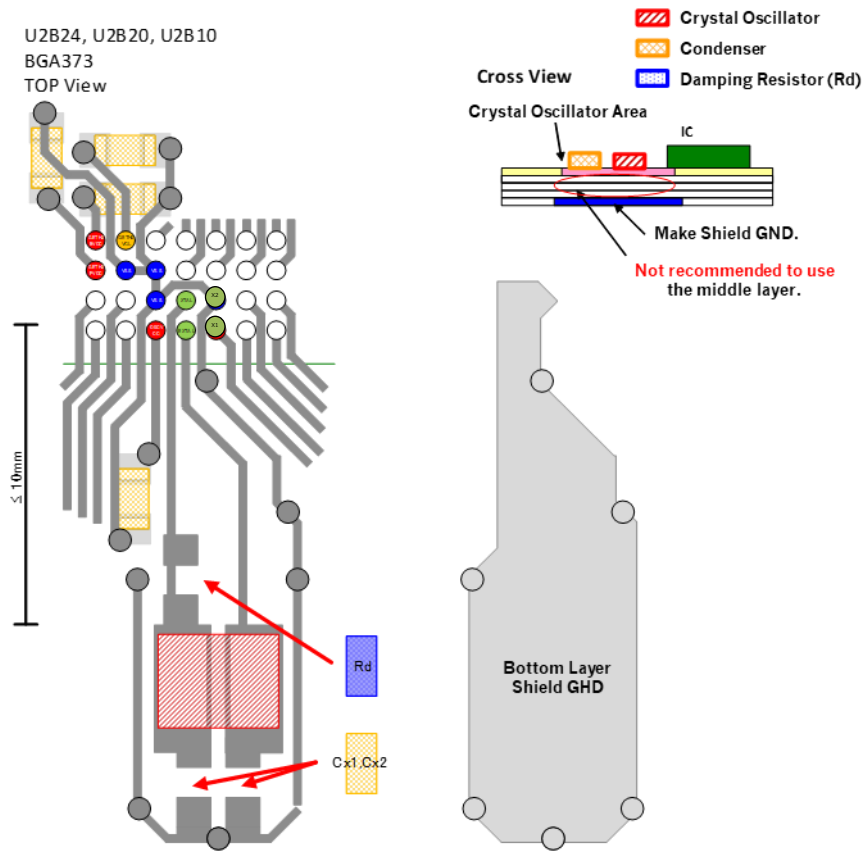


Figure 3 Bord Pattern Example for Stable Oscillation (U2B BGA373)

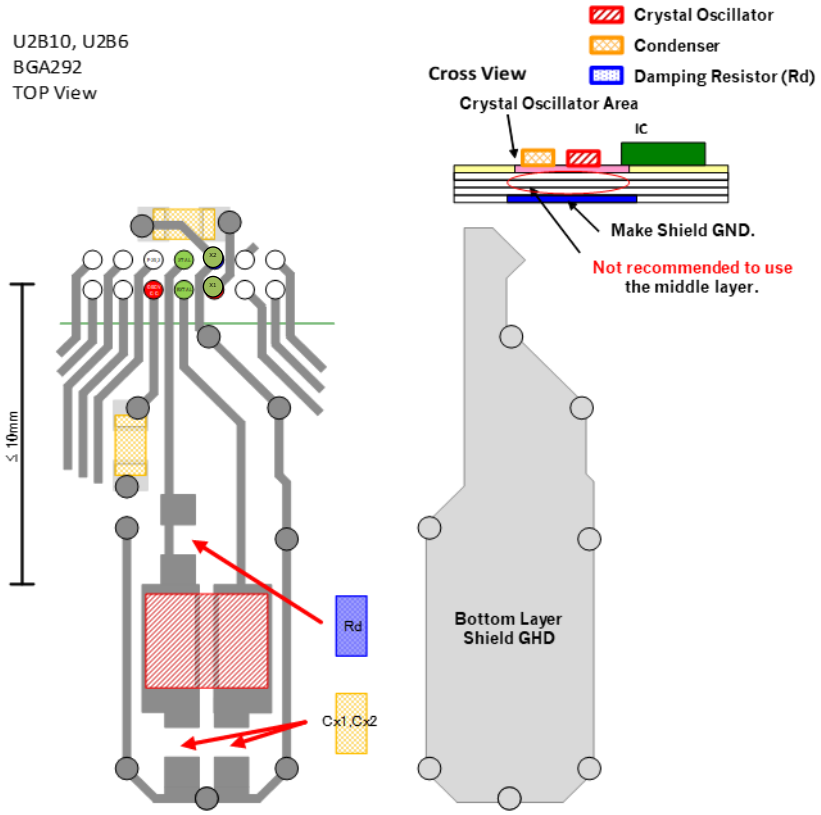


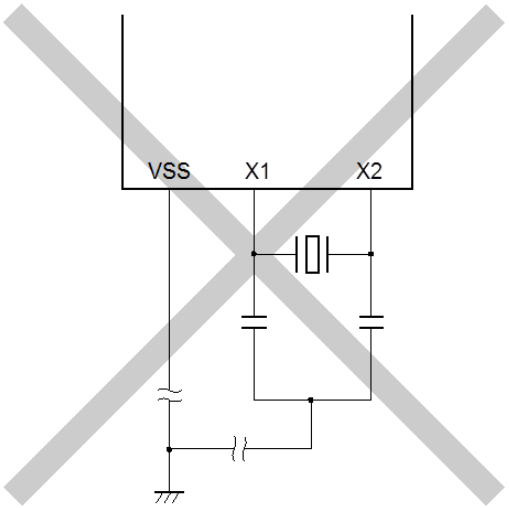
Figure 4 Bord Pattern Example for Stable Oscillation (U2B BGA292)

Recommended Wiring Structure for Stable Oscillation

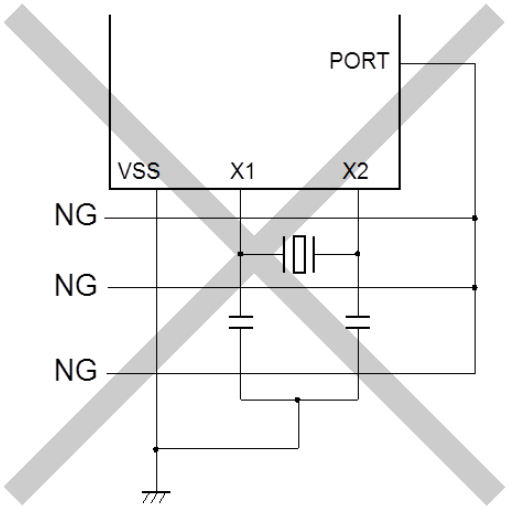
- Wire with metal of top layer board. (GND shield required)
- Place shield GND on bottom layer board.
- Not use middle layer board.
- Wiring length from pin to crystal oscillation is within 10mm.
- Signal wiring width is 0.1 to 0.3mm.
- Signal wiring should be separated from other wiring by 0.3mm or more.
  (Wiring interval between X1 and X2 should be also 03 mm or more.)
- X1 and X2 wiring resistance ＜2Ω
- X1 and X2 wiring capacity ＜2pF
- Connect about 0.1uF condenser between OSCVCC and VSS.

1.3 Bad Example of Crystal Oscillator Connection

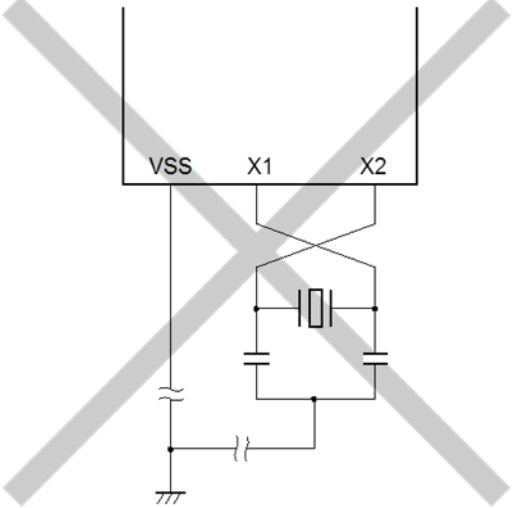
Figure 6 and Figure 7 show the bad example of crystal oscillator connections.



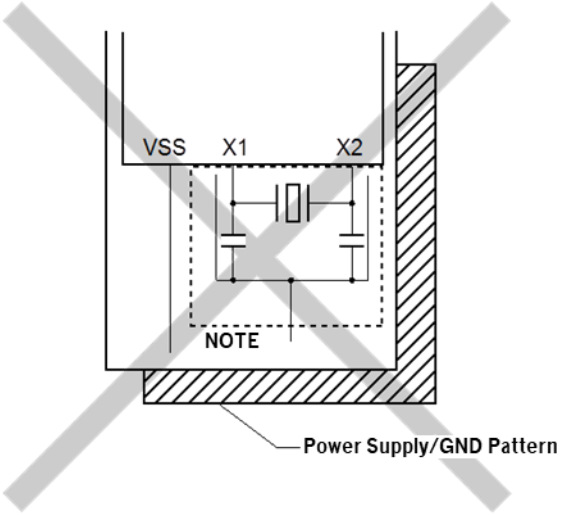
（a）Wiring of connection circuit is too long.



（b）Signal line is intersecting.



（c）Wirings of X1 and X2 signal lines are intersecting.

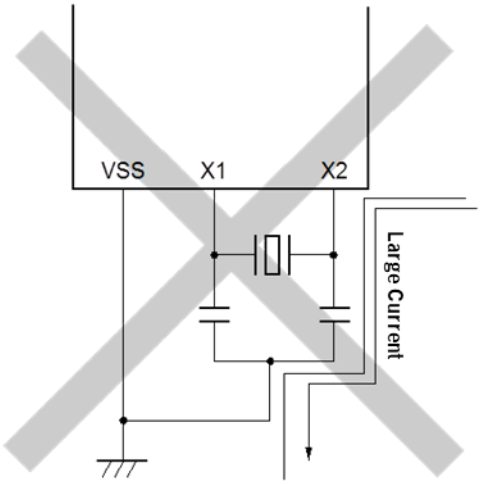


（d）There is power/GND pattern in the middle layer under the X1 and X2 wirings.

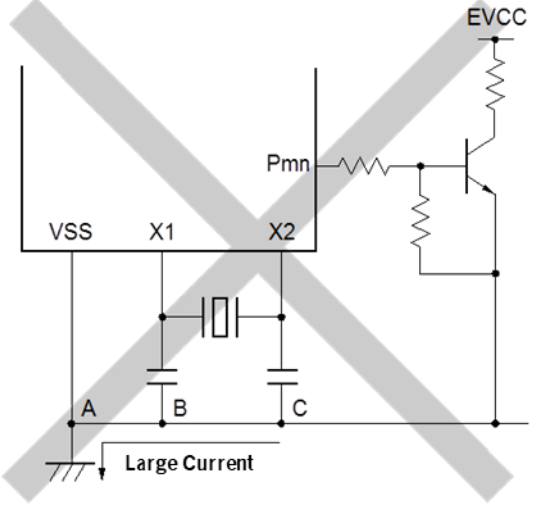
Note The capacitance between PINs between X1 and X2 may deteriorate the oscillation characteristics. Therefore, please avoid signal crossings. Also, when the wiring runs in parallel, pay attention to the wiring interval and parallel running distance so that the capacity during this period does not increase.

On multi-layer bord, do not place the power supply/GND pattern under the wiring part between X1/X2 and crystal oscillation. (dotted line part in Figures) Also, secure a space of 0.5mm or more with the ground shield. If the space is not secured, the oscillation characteristics may be affected by the parasitic capacitance increase.

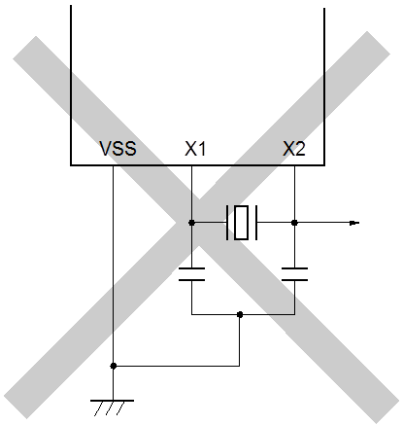
Figure 5 Bad Example of Crystal Oscillator Connection（1/2）



（e） Large changing current is close To signal line.



（f） Current flows on ground line of oscillation circuit part.
（Potentials at points A, B, and C fluctuate.）



（g）Taking out the signal.

Figure 6 Bad Example of Crystal Oscillator Connection（2/2）

1.4 Target Oscillator and Reference Oscillator Circuit Constants

The crystal currently the design target and its reference oscillation circuit constants are shown. This reference oscillation circuit constant was examined by our circuit simulation. To confirm that there is no problem with the oscillation characteristics in the actual application, ask the oscillator manufacturer to evaluate the actual product board.

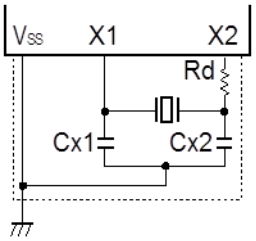


Figure 7 External Circuit Example

Table 1 Target Crystal Oscillator, Ceramic Oscillator and Its Reference Oscillation Circuit Constants*1

Manufacture	Name	CL (pF)	SMD/ Read	Frequency (MHz)	External Oscillator Circuit Constants (Reference)*2			OSCVCC Power Voltage (V)	OPBT10 Setting (Reference)								
					C_{x1} (pF)	C_{x2} (pF)	R_d (kΩ)		MOSC_EXCLKINPUT	MOSC_FREQ[2:0]	MOSC_CAP_SEL[3:0]	MOSC_SHTSTBY_A	MOSC_SHTSTBY_B	MOSC_AMP_SEL_A[2:0]	MOSC_AMP_SEL_B[2:0]	MOSC_RD_SEL_A[2:0]	MOSC_RD_SEL_B[2:0]
KDS	DSX320GE	8	SMD	16	–	–	–	3.0~5.5V	1	000	0000	1	0	111	111	000	000
		8	SMD	20	–	–	–	3.0~5.5V	1	001	0000	1	0	111	111	000	000
		8	SMD	24	–	–	–	3.0~5.5V	1	010	0000	1	0	111	111	000	000
		8	SMD	25	–	–	–	3.0~5.5V	1	1??	0000	1	0	100	111	000	000
		8	SMD	40	–	–	–	3.0~5.5V	1	011	0000	1	0	100	111	000	000
	DSX210GE	8	SMD	20	–	–	–	3.0~5.5V	1	001	0000	1	0	111	111	000	011
		8	SMD	24	–	–	–	3.0~5.5V	1	010	0000	1	0	111	111	000	100
		8	SMD	25	–	–	–	3.0~5.5V	1	1??	0000	1	0	100	111	000	000
		8	SMD	40	–	–	–	3.0~5.5V	1	011	0000	1	0	100	111	000	000
Kyocera	CX3225GA	8	SMD	16	–	–	–	3.0~5.5V	1	000	0010	1	0	000	001	001	000
		8	SMD	20	–	–	–	3.0~5.5V	1	001	0010	1	0	000	010	010	000
		8	SMD	24	–	–	–	3.0~5.5V	1	010	0010	1	0	010	011	000	000
		8	SMD	25	–	–	–	3.0~5.5V	1	1??	0010	1	0	100	101	000	000
		8	SMD	40	–	–	–	3.0~5.5V	1	011	0010	1	0	100	101	000	000
	CX2016GR	8	SMD	16	–	–	–	3.0~5.5V	1	000	0010	1	0	110	100	100	000
		8	SMD	20	–	–	–	3.0~5.5V	1	001	0010	1	0	001	011	010	000
		8	SMD	24	–	–	–	3.0~5.5V	1	010	0010	1	0	111	100	100	000
		8	SMD	25	–	–	–	3.0~5.5V	1	1??	0010	1	0	101	101	000	000
		8	SMD	40	–	–	–	3.0~5.5V	1	011	0010	1	0	101	101	000	000
NDK	NX3225GB	8	SMD	16	–	–	–	3.0~5.5V	1	000	0101	1	0	000	011	000	000
		8	SMD	20	–	–	–	3.0~5.5V	1	001	0101	1	0	011	100	000	000

		8	SMD	24	–	–	–	3.0~5.5V	1	010	0101	1	0	110	101	000	000
		8	SMD	25	–	–	–	3.0~5.5V	1	1??	0000	1	0	110	111	000	000
		6	SMD	40	–	–	–	3.0~5.5V	1	011	0000	1	0	110	111	000	000
	NX2016GC	8	SMD	16	–	–	–	3.0~5.5V	1	000	0010	1	0	111	111	100	100
		8	SMD	20	–	–	–	3.0~5.5V	1	001	0001	1	0	101	110	100	100
		8	SMD	24	–	–	–	3.0~5.5V	1	010	0000	1	0	100	111	000	100
		8	SMD	25	–	–	–	3.0~5.5V	1	1??	0000	1	0	111	111	000	010
		6	SMD	40	–	–	–	3.0~5.5V	1	011	0000	1	0	111	111	000	010

Note1. The target crystal oscillator, reference oscillation circuit constants, and OPBT settings are described as reference values based on information from the crystal oscillator manufacturer, and the contents are not guaranteed at all. Reference The oscillation circuit constants are measured and investigated by the oscillator manufacturer using our evaluation board under certain conditions. Since the oscillation operation depends on the oscillator and board, be sure to ask the oscillator manufacturer to evaluate the mounted circuit even in the actual system. In addition, the above conditions are conditions for the oscillator connected to the microcomputer to oscillate, and do not indicate the operating conditions of the microcomputer. For the operating conditions of the microcomputer, use it within the standards of DC and AC characteristics.

Note 2. Since the feedback resistor is built into the microcomputer, it does not need to be mounted on the board.

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	2021.4.26	-	Initial Edition
1.10	2025.4.7	1	Corrected the product list

Precautions for use of the product

This section describes the "Precautions" that apply to all microcontroller products. Please refer to this document and the Technical Update for precautions on individual products.

1. Treatment of unused pins

[Caution] Please dispose of unused pins according to "Handling of unused pins" in the text.

The impedance of the input pins of CMOS products is generally high impedance. If the unused pins are operated in an open state, noise around the LSI may be applied due to the induction phenomenon, a through current may flow inside the LSI, or it may be recognized as an input signal and malfunction may occur. Dispose of unused pins according to the instructions given in "Disposal of unused pins" in the text.

2. Treatment at power-on

[Caution] The state of the product is undefined when the power is turned on.

When the power is turned on, the state of the internal circuits of the LSI is indeterminate and the state of register settings and pins is undefined.

For products that are reset using the external reset pin, the pin state cannot be guaranteed from the time the power is supplied until the reset becomes valid.

Similarly, in the case of products that are reset using the built-in power-on reset function, the pin states cannot be guaranteed from the time the power is turned on until the voltage reaches a certain level.

3. Prohibition of Access to Reserved Addresses

[Caution] Access to reserved addresses is prohibited.

The address area has a reserved address allocated for future function expansion. The operation when these addresses are accessed cannot be guaranteed, so do not access them.

4. About clock

[Caution] When resetting, release the reset after the clock has stabilized.

When switching the clock during program execution, switch the clock after the switching destination clock is stable.

In a system that starts operating with a clock that uses an external oscillator (or external oscillator circuit) at reset, release the reset after the clock is sufficiently stable. Also, when switching to a clock that uses an external oscillator (or external oscillator circuit) in the middle of a program, make sure that the clock to be switched to is sufficiently stable before switching.

5. Differences between products

[Caution] When changing to a product with a different model name, perform a system evaluation test for each product model name.

Even if the MCUs in the same group have different model numbers, the characteristic values, operating margins, noise immunity, noise radiation, etc. may differ within the range of electrical characteristics due to differences in internal ROM and layout patterns. When changing to a product with a different model name, perform a system evaluation test for each individual product.

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