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**R8C/M12A Group**

Power Control (Entering Wait Mode Using the Wait Control Bit)

R01AN0371EJ0100

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**Abstract**

This document describes the transition to wait mode and return from wait mode using the wait control bit of the R8C/M12A Group.

**Product**

R8C/M12A Group

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

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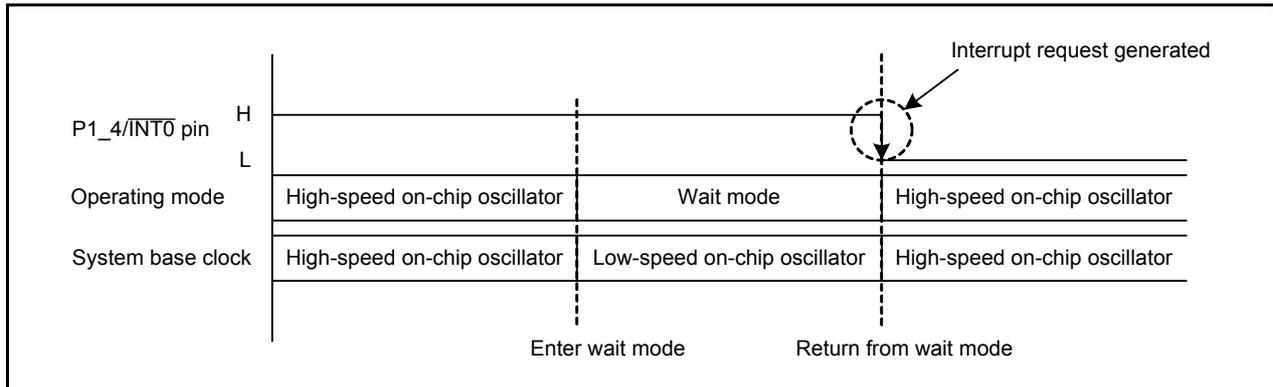
## 1. Specifications

The MCU returns from wait mode after entering wait mode. Use the  $\overline{\text{INT0}}$  interrupt request to return from wait mode.

Table 1.1 lists the Peripheral Function and Its Application. Figure 1.1 shows an Operating Example.

**Table 1.1 Peripheral Function and Its Application**

Peripheral Function	Application
$\overline{\text{INT0}}$ interrupt	Return from wait mode



**Figure 1.1 Operating Example**

## 2. Operation Confirmation Conditions

The sample code accompanying this application note has been run and confirmed under the conditions below.

**Table 2.1 Operation Confirmation Conditions**

Item	Contents
MCU used	R8C/M12A Group
Operating frequencies	<ul style="list-style-type: none"> <li>• High-speed on-chip oscillator clock: 20 MHz (typical)</li> <li>• Low-speed on-chip oscillator clock: 125 kHz (typical)</li> <li>• System clock (f): 20 MHz</li> <li>• CPU clock (fs): 20 MHz</li> </ul>
Operating voltage	5.0 V (2.7 to 5.5 V)
Integrated development environment	Renesas Electronics Corporation High-performance Embedded Workshop Version 4.07
C compiler	Renesas Electronics Corporation M16C Series, R8C Family C Compiler V.5.45 Release 01 Compile options -D __UART0__ -c -finfo -dir "\$(CONFIGDIR)" -R8C (Default setting is used in the integrated development environment.)

### 3. Hardware

#### 3.1 Pin Used

Table 3.1 lists the Pin Used and Its Function.

**Table 3.1 Pin Used and Its Function**

Pin Name	I/O	Function
P1_4/ $\overline{\text{INT0}}$	Input	$\overline{\text{INT0}}$ interrupt input

### 4. Software

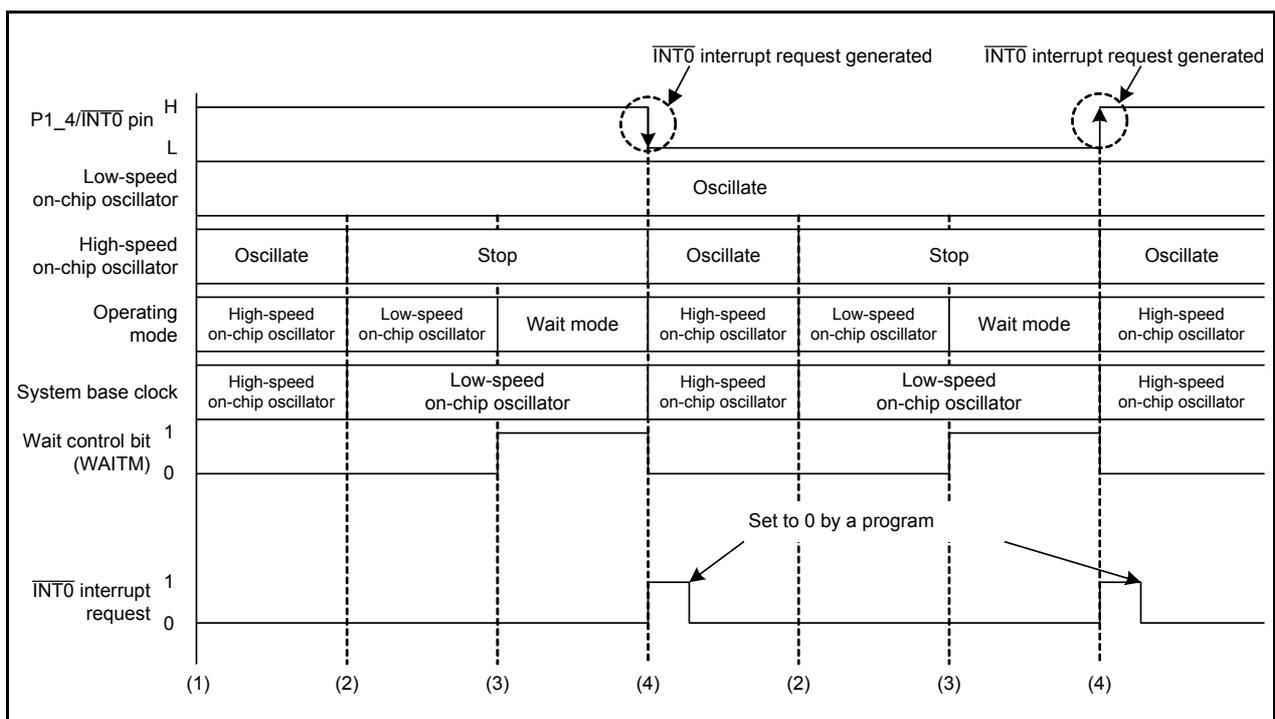
#### 4.1 Operation Overview

Enter and return from wait mode in the procedure below. The  $\overline{\text{INT0}}$  interrupt is used to return from wait mode.

- (1) Switch to the high-speed on-chip oscillator (no division) by a program after reset.
- (2) Disable maskable interrupts before entering wait mode. Enable  $\overline{\text{INT0}}$  input after enabling the  $\overline{\text{INT0}}$  interrupt. Then switch the system base clock from the high-speed on-chip oscillator to the low-speed on-chip oscillator by a program and stop the high-speed on-chip oscillator.
- (3) Enter wait mode to set the WAITM bit in the SCKCR register to 1 (enter wait mode).
- (4) The  $\overline{\text{INT0}}$  interrupt request is generated by the edge input of port P1\_4/ $\overline{\text{INT0}}$  and the MCU returns from wait mode. At this time, the  $\overline{\text{INT0}}$  interrupt is not generated since maskable interrupts are disabled. After returning from wait mode, the system base clock is automatically switched to the high-speed on-chip oscillator (no division).

Repeat steps (2) to (4).

Figure 4.1 shows the Timing Diagram.



**Figure 4.1 Timing Diagram**

## 4.2 Required Memory Size

Table 4.1 lists the Required Memory Size.

**Table 4.1 Required Memory Size**

Memory Used	Size	Remarks
ROM	166 bytes	In the r01an0371_src.c module
RAM	0 bytes	In the r01an0371_src.c module
Maximum user stack usage	10 bytes	
Maximum interrupt stack usage	0 bytes	

The required memory size varies depending on the C compiler version and compile options.

## 4.3 Functions

Table 4.2 lists the Functions.

**Table 4.2 Functions**

Function Name	Outline
mcu_init	System clock setting
int0_init	Initial setting of <u>INT0</u> interrupt
wait_control	Wait mode processing

## 4.4 Function Specifications

The following tables list the sample code function specifications.

mcu_init	
Outline	System clock setting
Header	None
Declaration	void mcu_init(void)
Description	Set the system clock.
Argument	None
Returned value	None
Remark	—

int0_init	
Outline	Initial setting of $\overline{\text{INT0}}$ interrupt
Header	None
Declaration	void int0_init(void)
Description	Perform initial setting to use the $\overline{\text{INT0}}$ interrupt.
Argument	None
Returned value	None
Remark	—

wait_control	
Outline	Wait mode processing
Header	None
Declaration	void wait_control(void)
Description	Enter wait mode.
Argument	None
Returned value	None
Remark	—

## 4.5 Flowcharts

### 4.5.1 Main Processing

Figure 4.2 shows the Main Processing.

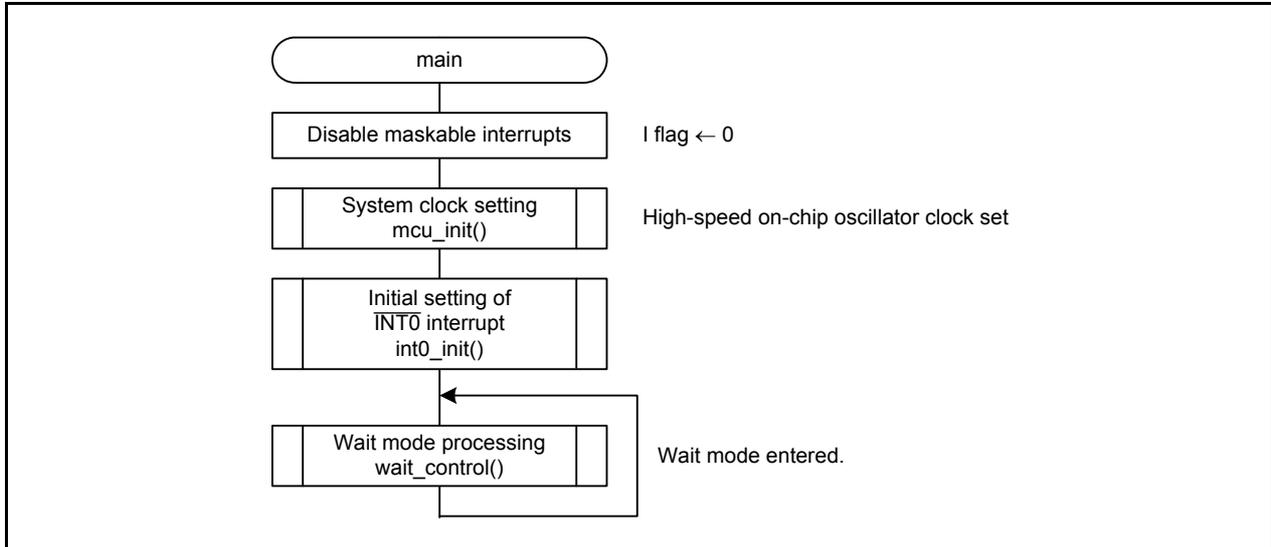


Figure 4.2 Main Processing

### 4.5.2 System Clock Setting

Figure 4.3 shows the System Clock Setting.

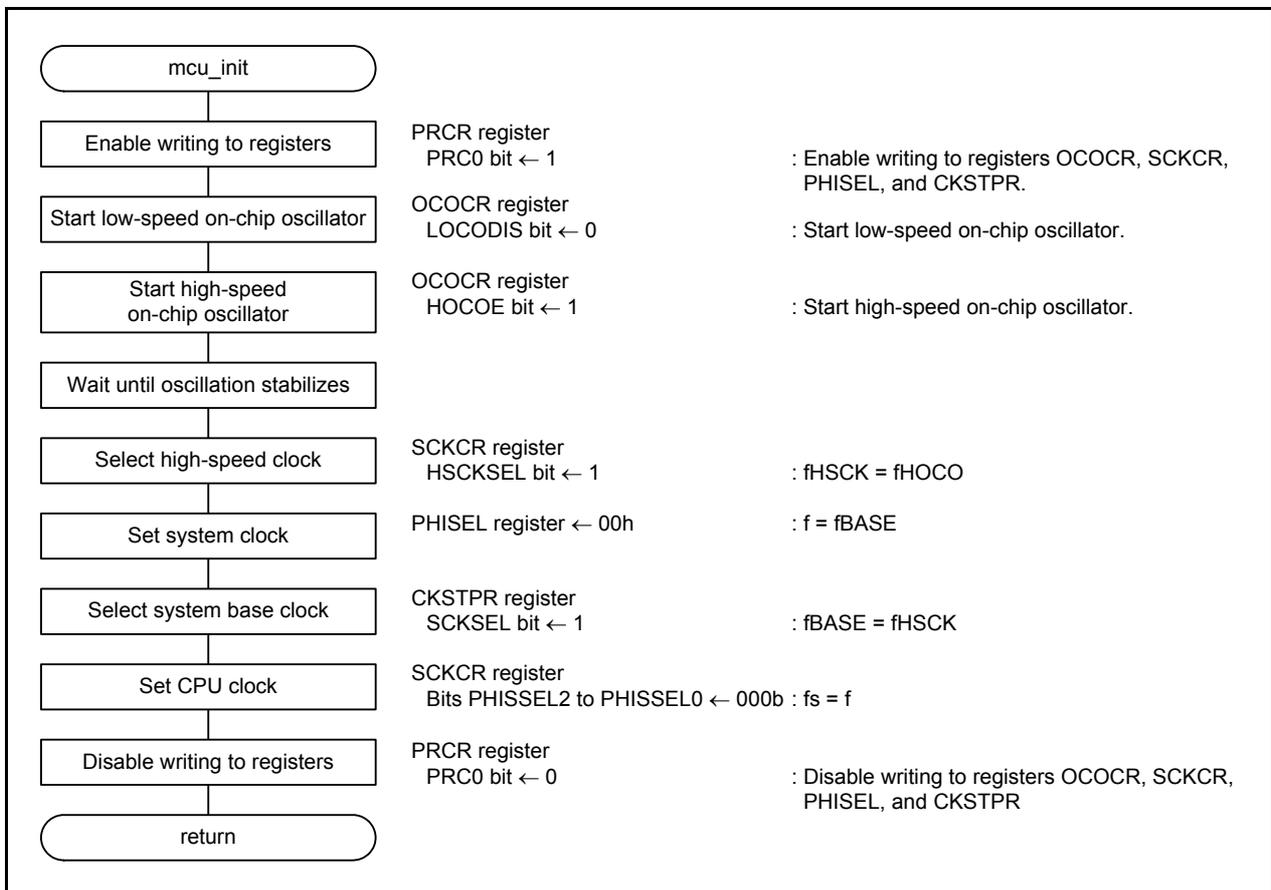


Figure 4.3 System Clock Setting

### 4.5.3 Initial Setting of the $\overline{\text{INT0}}$ Interrupt

Figure 4.4 shows the Initial Setting of  $\overline{\text{INT0}}$  Interrupt.

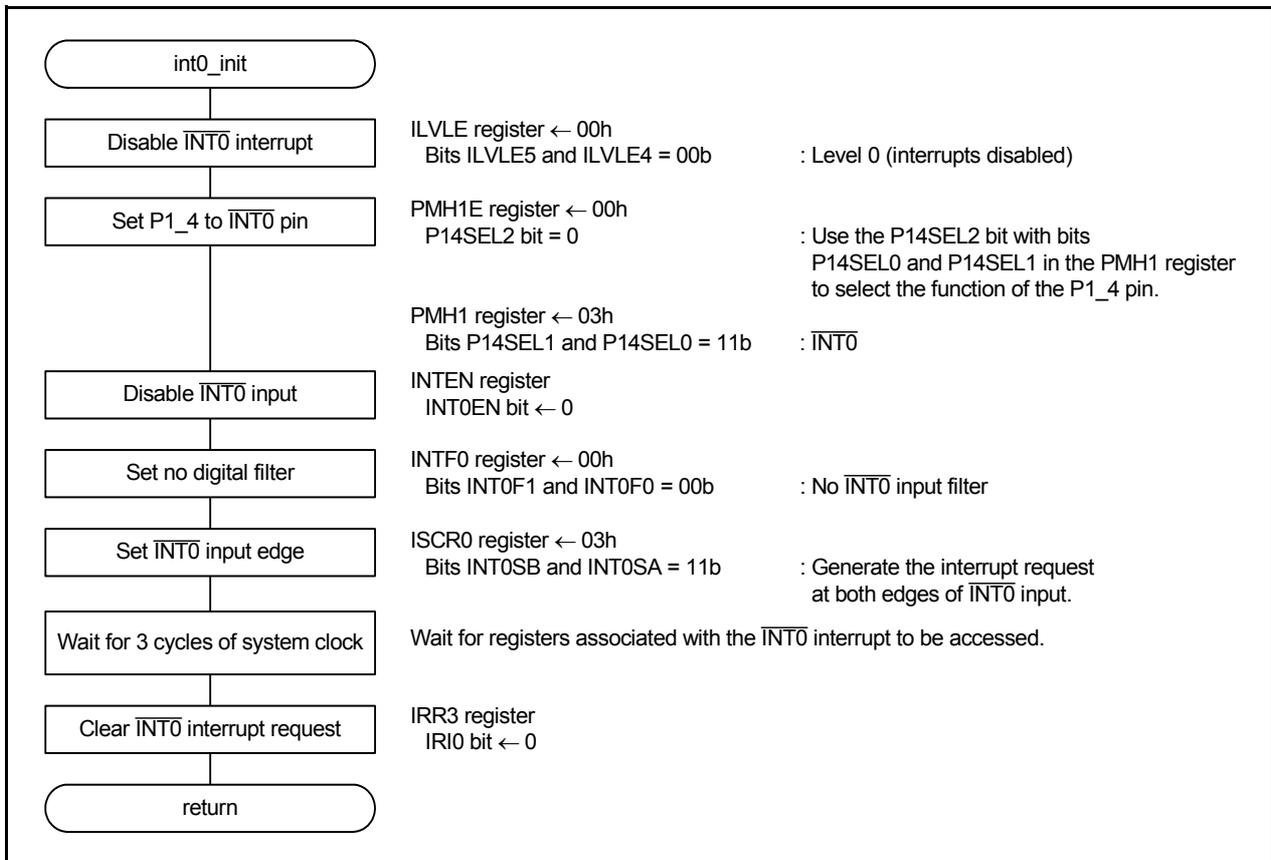


Figure 4.4 Initial Setting of the  $\overline{\text{INT0}}$  Interrupt

#### 4.5.4 Wait Mode Processing

Figure 4.5 shows the Wait Mode Processing.

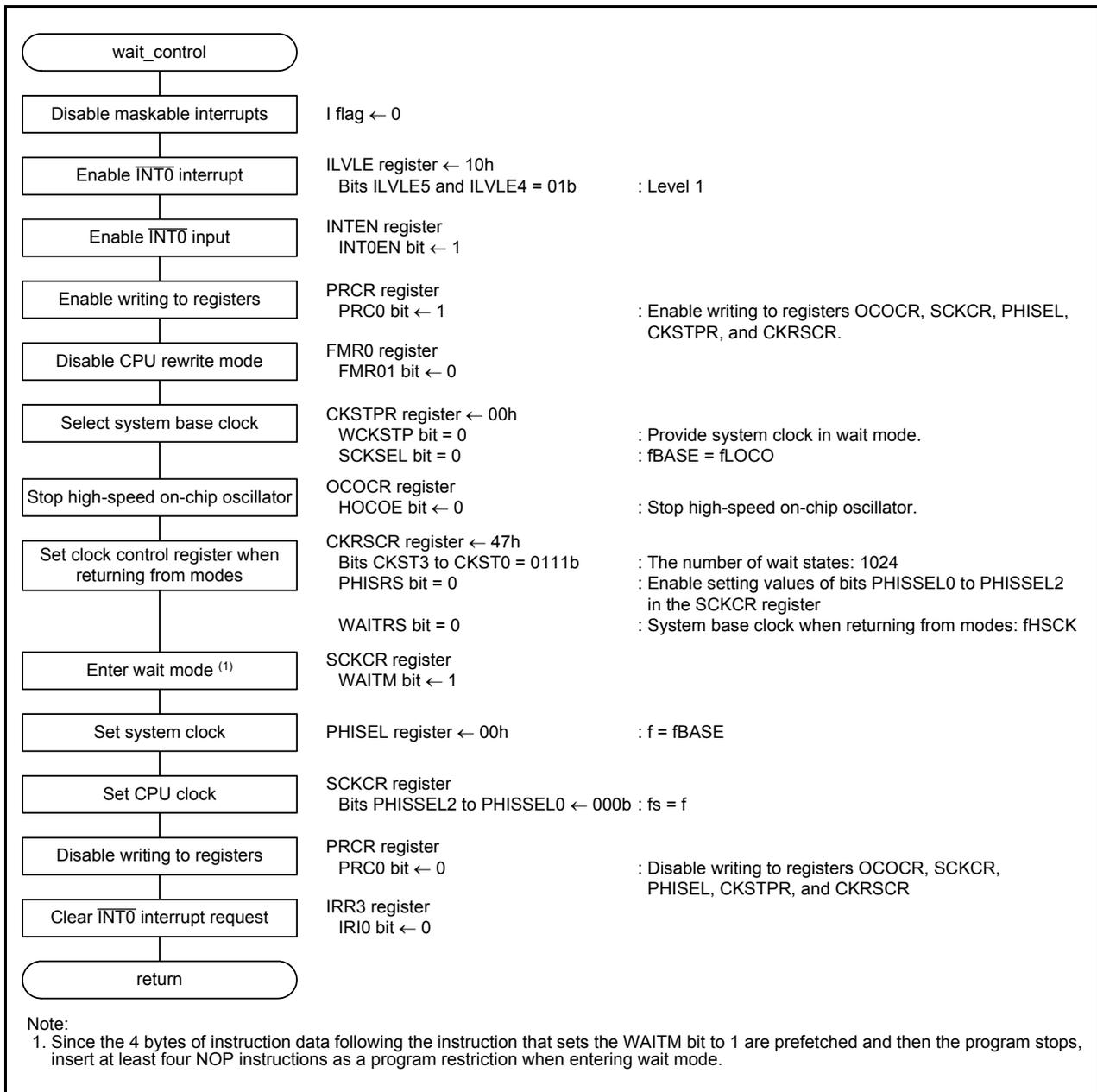


Figure 4.5 Wait Mode Processing

## 5. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

## 6. Reference Documents

R8C/M12A Group User's Manual: Hardware Rev.1.00

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.

C Compiler Manual

M16C Series, R8C Family C Compiler Package V.5.45

C Compiler User's Manual Rev.2.00

The latest version can be downloaded from the Renesas Electronics website.

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Revision History	R8C/M12A Group Power Control (Entering Wait Mode Using the Wait Control Bit)
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Rev.	Date	Description	
		Page	Summary
1.00	July 26, 2011	—	First edition issued

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## 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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