

## 1. Abstract

This document describes procedures for the following mode transitions, and setting and canceling slow read mode in the M16C/5M Group:

- Transition from 40 MHz on-chip oscillator mode (fOCO-F divided by 1) to 125 kHz on-chip oscillator mode (fOCO-S divided by 1)
- Transition from 125 kHz on-chip oscillator mode (fOCO-S divided by 1) to 40 MHz on-chip oscillator mode (fOCO-F divided by 1)
- Transition from 125 kHz on-chip oscillator mode to 125 kHz on-chip oscillator low power mode
- Transition from 125 kHz on-chip oscillator low power mode to 125 kHz on-chip oscillator mode
- Setting and canceling slow read mode

## 2. Introduction

The application example described in this document applies to the following microcomputer (MCU):

- MCU: M16C/5M Group

This application note can be used with other M16C Family MCUs which have the same special function registers (SFRs) as the above group. Check the manual for any modifications to functions. Careful evaluation is recommended before using the sample code described in this application note.

### 3. Clock Mode Transition Procedure

Figure 3.1 shows the transition procedure between 40 MHz on-chip oscillator and 125 kHz on-chip oscillator low power mode.

Figure 3.2 to Figure 3.5 show transition procedures for each mode.

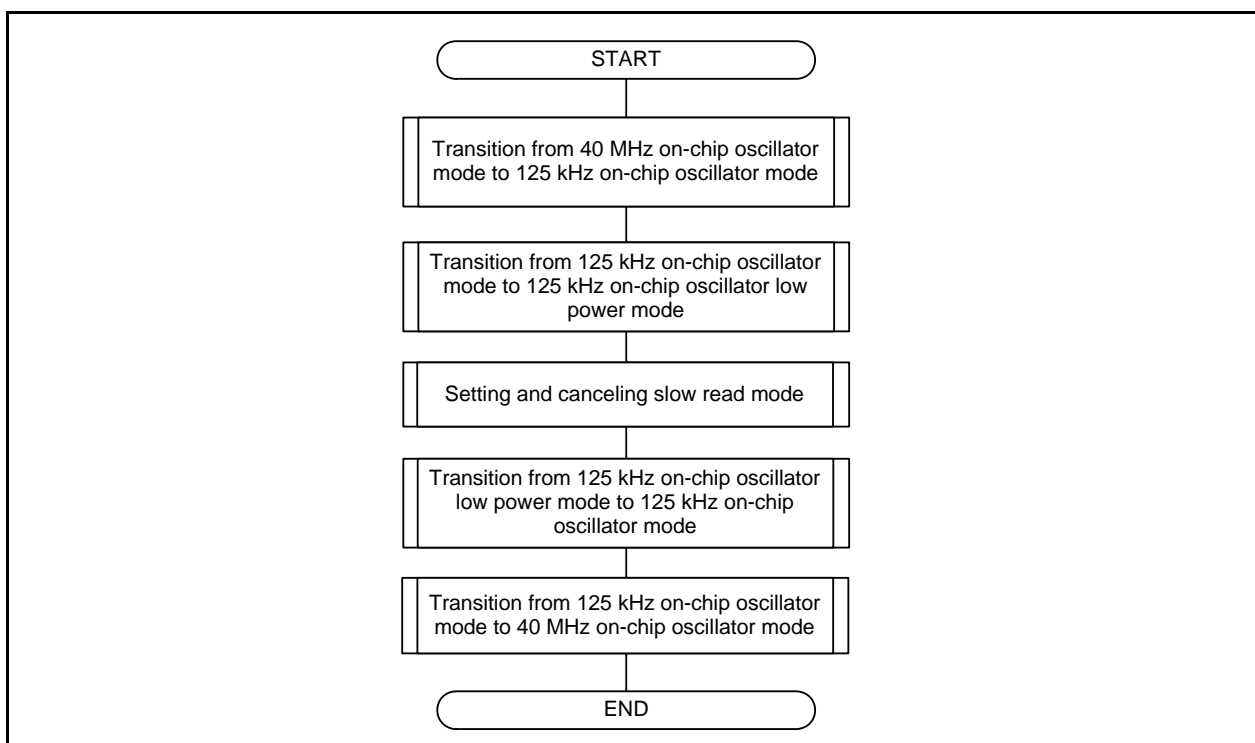
Figure 3.6 shows the procedure for setting and canceling slow read mode.

Wait time until the main clock oscillation stabilizes varies depending on the oscillation circuit used.

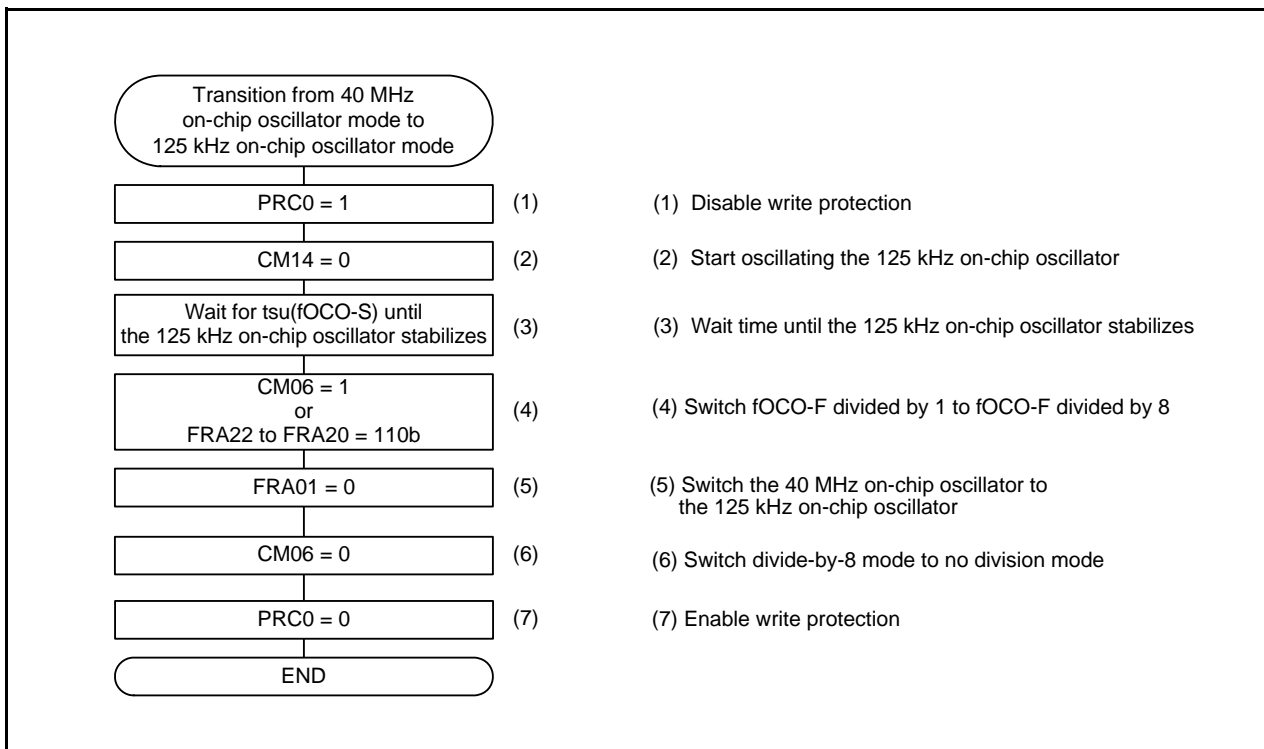
Use the wait time recommended by the crystal unit manufacturer.

tsu(fOCO40M): Wait time until 40 MHz on-chip oscillator stabilizes

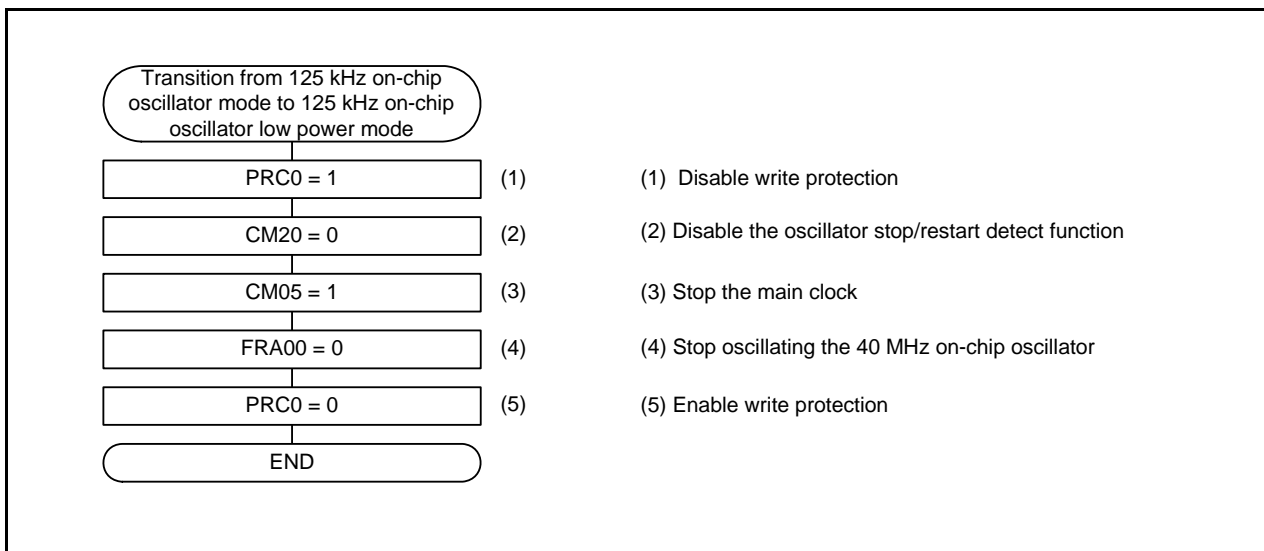
tsu(fOCO-S): Wait time until 125 kHz on-chip oscillator stabilizes



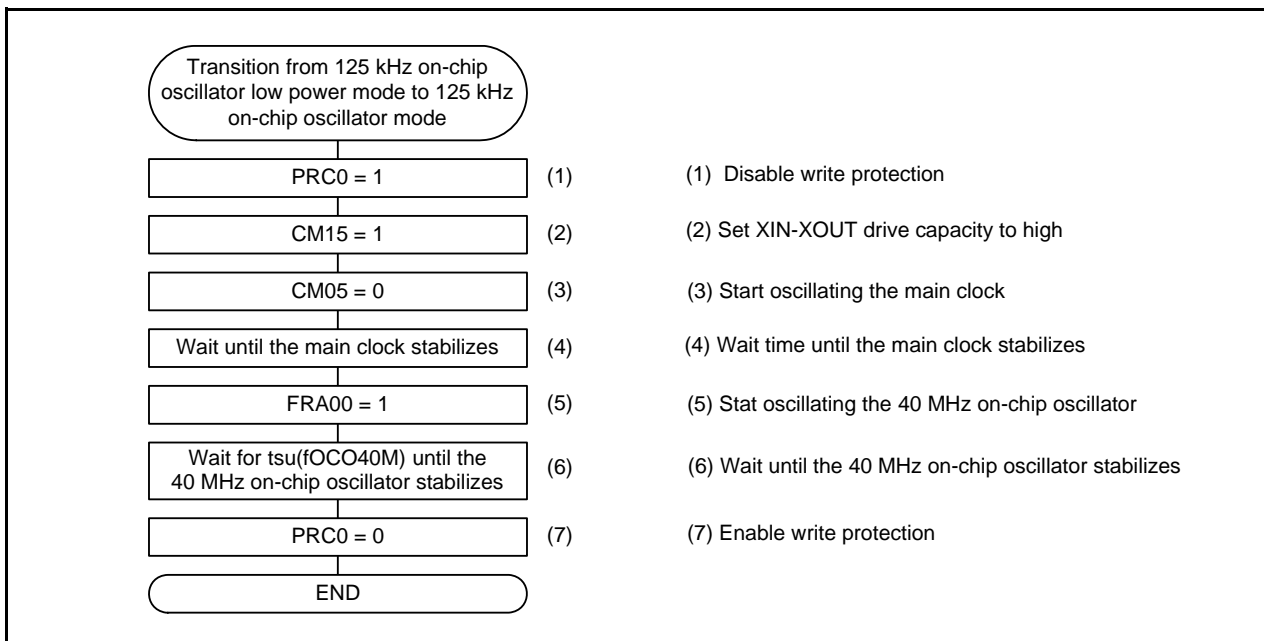
**Figure 3.1 Transition between 40 MHz On-Chip Oscillator Mode and 125 kHz On-Chip Oscillator Low Power Mode**



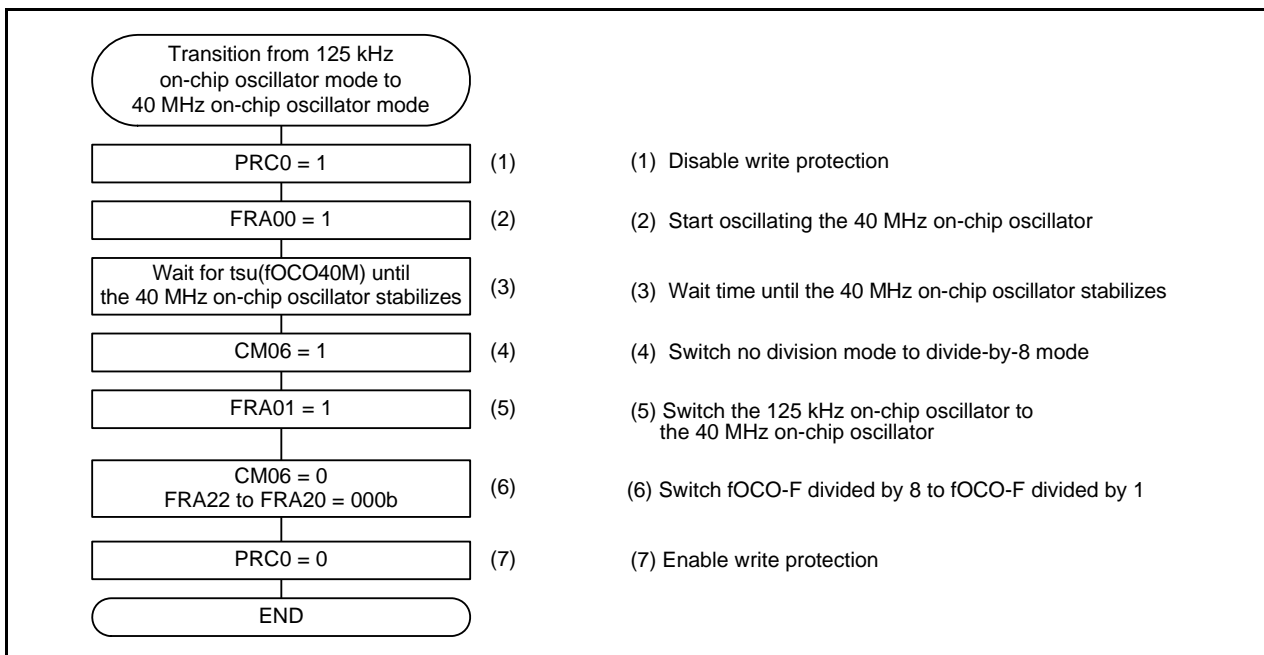
**Figure 3.2 Transition from 40 MHz On-Chip Oscillator Mode (fOCO-F Divided by 1) to 125 kHz On-Chip Oscillator Mode**



**Figure 3.3 Transition from 125 kHz On-Chip Oscillator Mode to 125 kHz On-Chip Oscillator Low Power Mode**



**Figure 3.4 Transition from 125 kHz On-Chip Oscillator Low Power Mode to 125 kHz On-Chip Oscillator Mode**



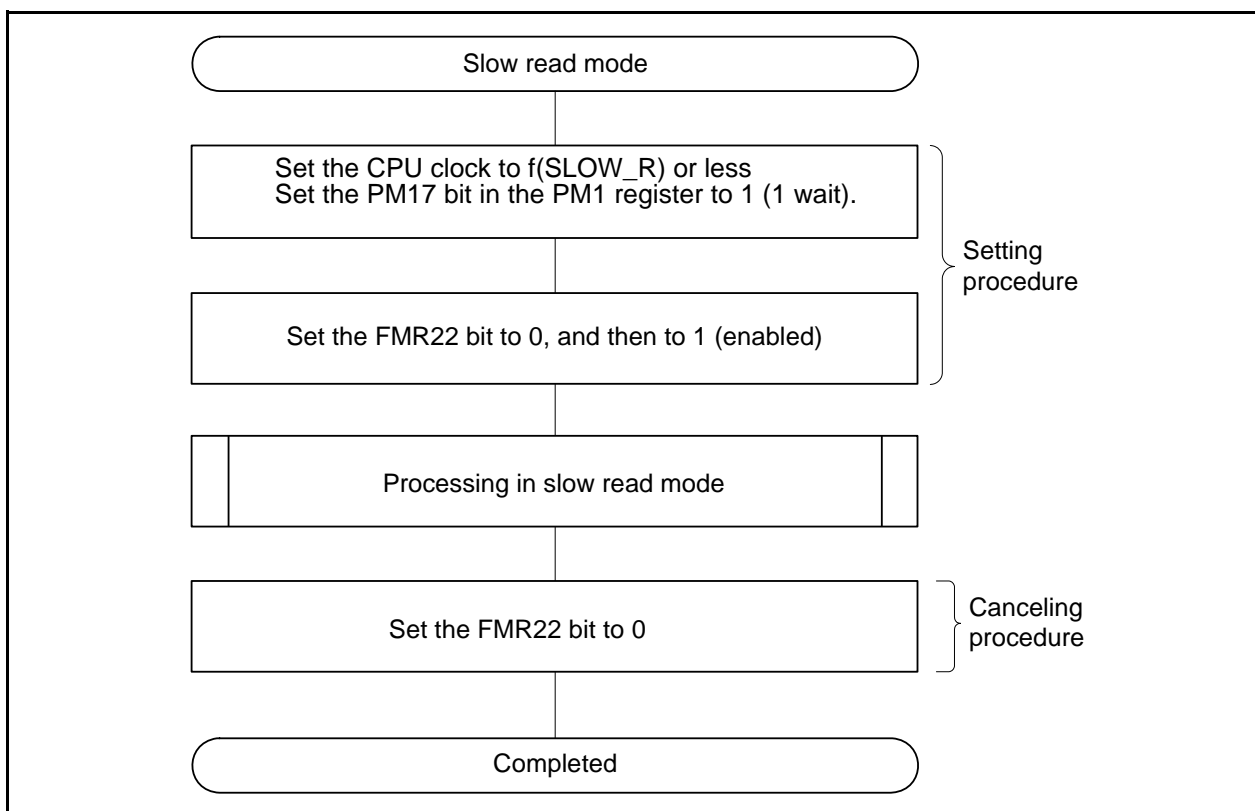
**Figure 3.5 Transition from 125 kHz On-Chip Oscillator Mode to 40 MHz On-Chip Oscillator Mode (fOCO-F Divided by 1)**

Slow read mode can be used when  $f(\text{BCLK})$  is less than or equal to  $f(\text{SLOW\_R})$ , and the PM17 bit in the PM1 register is 1 (one wait).

$f(\text{SLOW\_R})$ : Operation frequency in slow read mode

Refer to the “Electric Characteristics” in the User's Manual: Hardware (Hardware Manual) for the maximum standard value of the operation frequency in slow read mode.

No wait time is required when the CPU clock source is the 125 kHz on-chip oscillator clock or the sub clock.



**Figure 3.6** Setting and Canceling Slow Read Mode

## 4. Sample Code

A sample code can be downloaded from the Renesas Electronics website.  
To download, click “Application Notes” in the left-hand side menu of the M16C Family page.

### 4.1 Sample Code Operation

The sample code executes functions (1) to (6) below in order. Refer to 4.2 Function Tables for details of each function.

- (1) CPU initialization
- (2) Transition from 125 kHz on-chip oscillator mode to 40 MHz on-chip oscillator mode
- (3) Transition from 40 MHz on-chip oscillator mode to 125 kHz on-chip oscillator mode
- (4) Transition from 125 kHz on-chip oscillator mode to 125 kHz on-chip oscillator low power mode
- (5) Setting and canceling slow read mode
- (6) Transition from 125 kHz on-chip oscillator low power mode to 125 kHz on-chip oscillator mode

The settings in the sample code are as follows:

- Operation frequency is approximately 20 MHz in 40 MHz on-chip oscillator mode.
- Wait time until the 40 MHz on-chip oscillator stabilizes is approximately 5 ms when the CPU clock is 125 kHz.
- Wait time until the 125 kHz on-chip oscillator stabilizes is approximately 50  $\mu$ s when the CPU clock is 20 MHz.
- Wait time until the main clock stabilizes is approximately 100 ms when the CPU clock is 125 kHz.

In the sample code, the 125 kHz on-chip oscillator is used as the CPU clock source when entering slow read mode and the PM17 bit remains 0 (no wait state).

## 4.2 Function Tables

### Function Tables for This Document

Declaration	void foco125k_from_foco40m(void)
Outline	Transition from 40 MHz on-chip oscillator mode to 125 kHz on-chip oscillator mode
Argument	None
Variable	None
Returned value	None
Function	Switch the CPU clock from 40 MHz on-chip oscillator mode (fOCO-F divided by 1) to 125 kHz on-chip oscillator mode (fOCO-S divided by 1).

Declaration	void foco40m_from_foco125k(void)
Outline	Transition from 125 kHz on-chip oscillator mode to 40 MHz on-chip oscillator mode
Argument	None
Variable	None
Returned value	None
Function	Switch the CPU clock from 125 kHz on-chip oscillator mode (fOCO-S divided by 1) to 40 MHz on-chip oscillator mode (fOCO-F divided by 1).

Declaration	void lowpower125k_from_foco125k(void)
Outline	Transition from 125 kHz on-chip oscillator mode to 125 kHz on-chip oscillator low power mode
Argument	None
Variable	None
Returned value	None
Function	Stop the main clock and 40 MHz on-chip oscillator, and switch the CPU clock from 125 kHz on-chip oscillator mode to 125 kHz on-chip oscillator low power mode.

Declaration	void foco125k_from_lowpower125k(void)
Outline	Transition from 125 kHz on-chip oscillator low power mode to 125 kHz on-chip oscillator mode
Argument	None
Variable	None
Returned value	None
Function	Start oscillating the main clock and 40 MHz on-chip oscillator, and switch the CPU clock from 125 kHz on-chip oscillator low power mode to 125 kHz on-chip oscillator mode.

Declaration	void slow_read_setup(void)
Outline	Setting and canceling slow read mode
Argument	None
Variable	None
Returned value	None
Function	Configure settings for slow read mode, execute slow_read(), and cancel slow read mode. This function does not include processes to set the CPU clock to f(SLOW_R) or less, or restore the CPU clock. Execute this function after setting the CPU clock to f(SLOW_R) or less. Then restore the CPU clock. When this function is executed, the PM17 bit remains 0 (no wait state). Set the PM17 bit to 1 (wait state (1 wait)) as required.

Declaration	void slow_read(void)
Outline	Processing in slow read mode
Argument	None
Variable	None
Returned value	None
Function	Called from slow_read_setup(). Add a program to be processed in slow read mode.

#### Function Tables for the Sample Code

Declaration	void mcu_init(void)
Outline	CPU initialization
Argument	None
Variable	None
Returned value	None
Function	Set to single-chip mode. Switch the CPU clock from 125 kHz on-chip oscillator mode divided-by-8 to 125 kHz on-chip oscillator mode divided-by-1.



---

## 5. Reference Documents

M16C/5M Group User's Manual: Hardware (Hardware Manual) Rev.1.01

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.

M16C Series/R8C Family C Compiler Package V.5.45 C Compiler User Manual Rev.2.00

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

## Website and Support

Renesas Electronics website

<http://www.renesas.com/>

Inquiries

<http://www.renesas.com/inquiry>

Revision History	M16C/5M Group Transition between 40 MHz On-Chip Oscillator Mode and 125 kHz On-Chip Oscillator Low Power Mode (Using Slow Read Mode)
------------------	--

Rev.	Date	Description	
		Page	Summary
1.00	2010.07.01	—	First edition issued

All trademarks and registered trademarks are the property of their respective owners.
---

## 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.

## Notice

- All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
- Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
- You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
- Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
- When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
- Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
- Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.  
"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.  
"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.  
"Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
- You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
- Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
- Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
- This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
- Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.  
(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.  
(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.



### SALES OFFICES

### Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

**Renesas Electronics America Inc.**  
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.  
Tel: +1-408-588-6000, Fax: +1-408-588-6130

**Renesas Electronics Canada Limited**  
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada  
Tel: +1-905-898-5441, Fax: +1-905-898-3220

**Renesas Electronics Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K  
Tel: +44-1628-585-100, Fax: +44-1628-585-900

**Renesas Electronics Europe GmbH**  
Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-65030, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**  
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**  
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China  
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2886-9318, Fax: +852-2886-9022/9044

**Renesas Electronics Taiwan Co., Ltd.**  
7F, No. 363 Fu Shing North Road Taipei, Taiwan  
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

**Renesas Electronics Singapore Pte. Ltd.**  
1 HarbourFront Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: +65-6213-0200, Fax: +65-6278-8001

**Renesas Electronics Malaysia Sdn.Bhd.**  
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

**Renesas Electronics Korea Co., Ltd.**  
11F., Samik Laviel' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5141