M16C/6C Group

Power Control

Transition between 40 MHz On-Chip Oscillator Mode and Low Power Mode (Using Low Current Consumption Read Mode)

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1. Abstract

This document describes procedures for the following mode transitions, and setting and canceling low current consumption read mode in the M16C/6C Group:

- Transition from 40 MHz on-chip oscillator mode (fOCO-F divided by 2) 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 2)
- Transition from 125 kHz on-chip oscillator mode (fOCO-S divided by 1) to low power mode
- Transition from low power mode to 125 kHz on-chip oscillator low power mode (fOCO-S divided by 1)
- Transition from low-speed mode to low power mode
- Transition from low power mode to low-speed mode
- Setting and canceling low current consumption read mode

2. Introduction

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

- MCU: M16C/6C 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 mode and low power mode.
Figure 3.2 to Figure 3.7 show transition procedures for each mode.
Figure 3.8 shows the procedure for setting and canceling low current consumption read mode.

Wait time until the main clock oscillation or sub 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
Refer to the “Electrical Characteristics” in the User's Manual: Hardware (Hardware Manual) for details on tsu(fOCO40M) and tsu(fOCO-S).

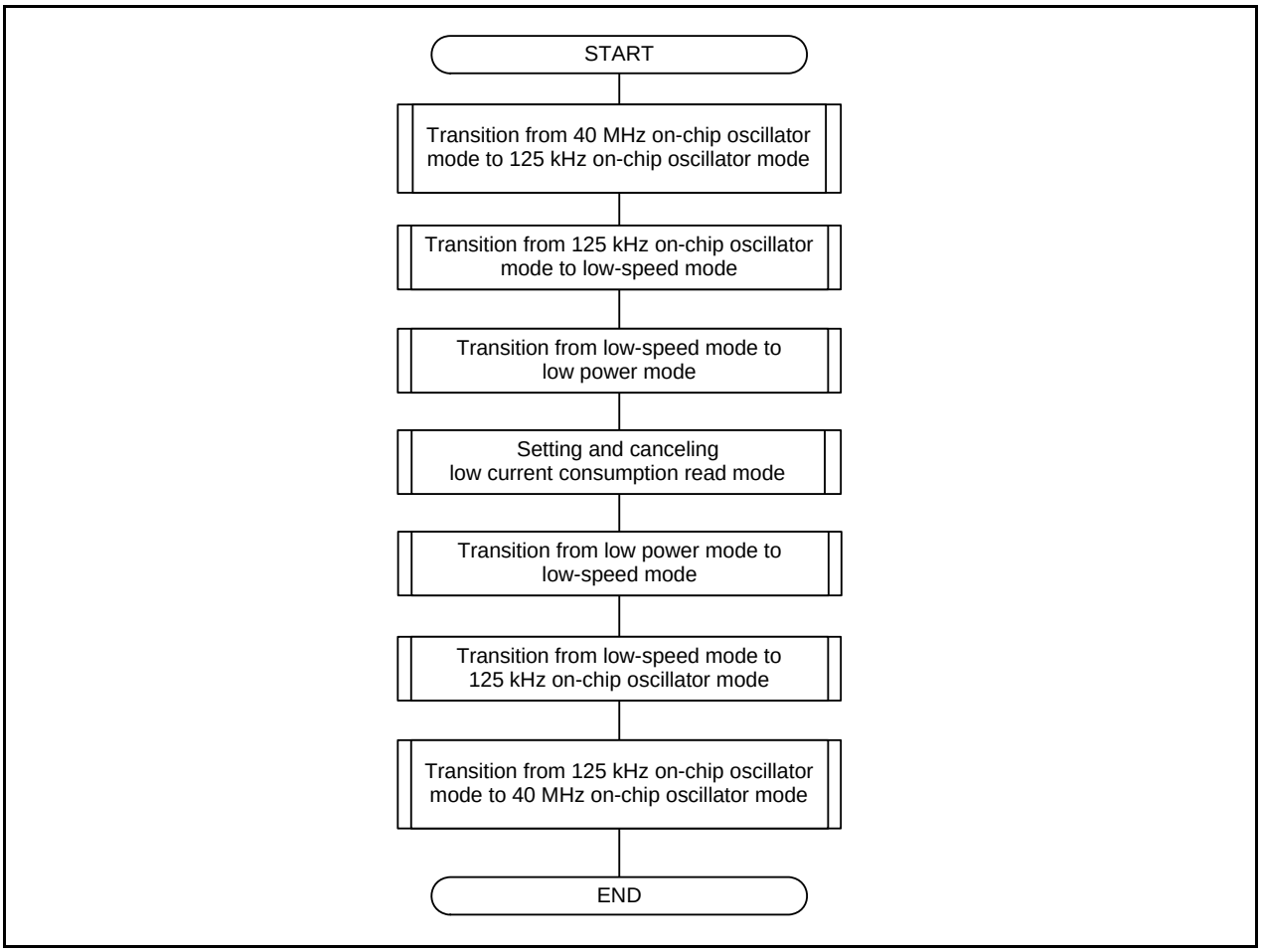


Figure 3.1 Transition between 40 MHz On-Chip Oscillator Mode and Low Power Mode

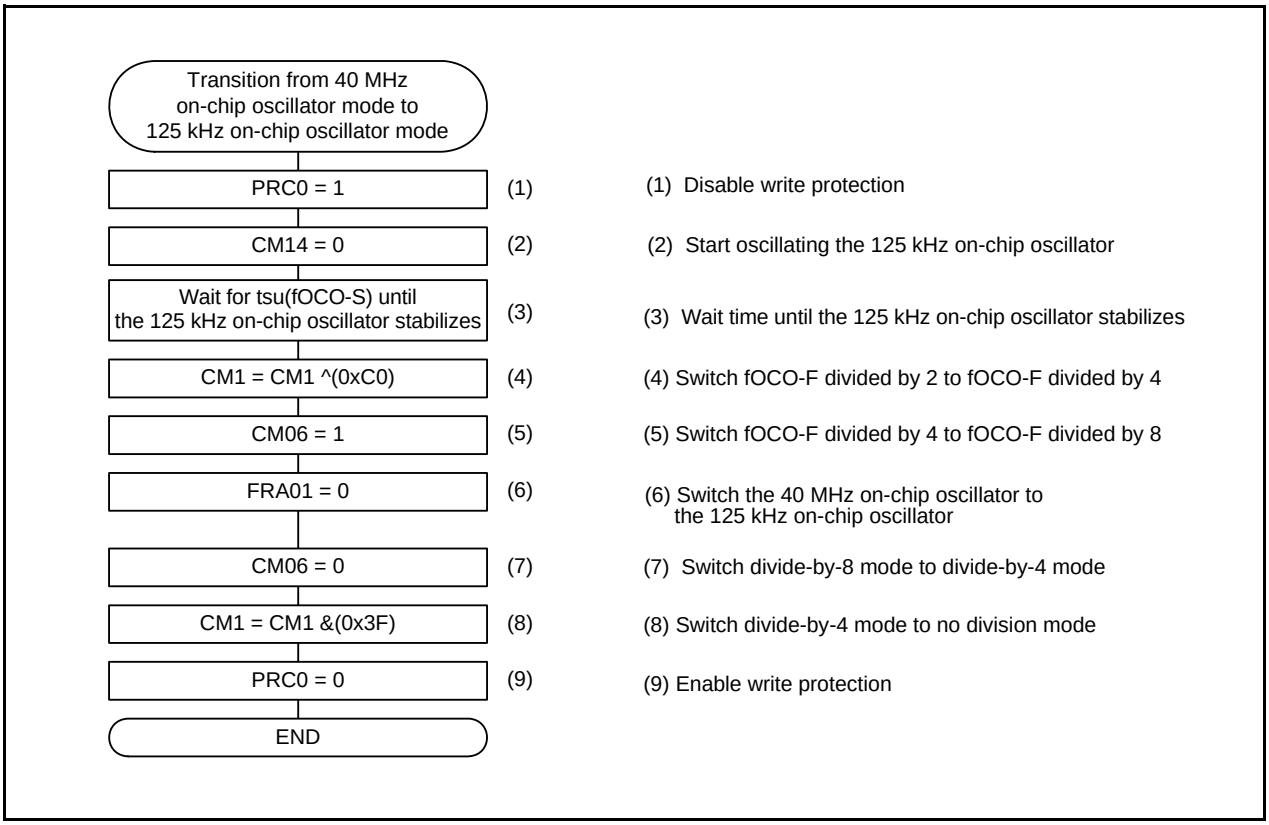


Figure 3.2 Transition from 40 MHz On-Chip Oscillator Mode (fOCO-F Divided by 2) to 125 kHz On-Chip Oscillator mode

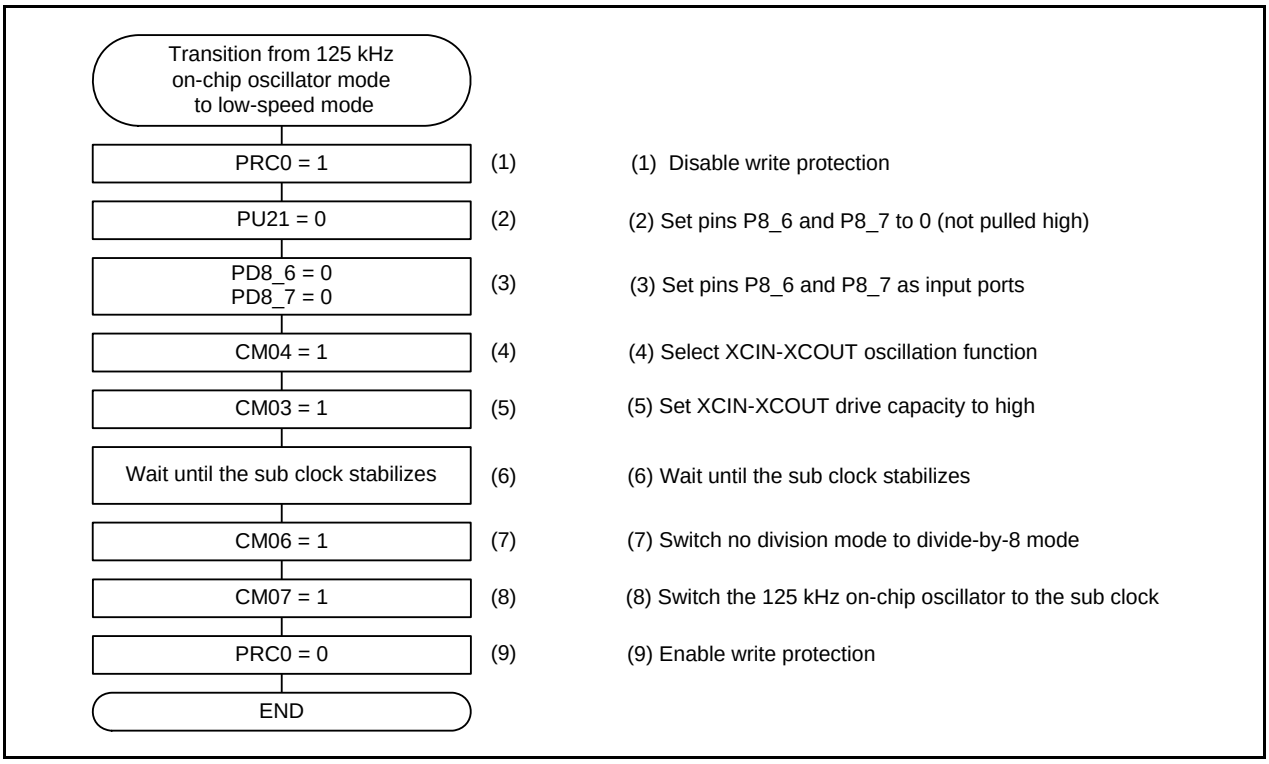


Figure 3.3 Transition from 125 kHz On-Chip Oscillator Mode to Low-Speed Mode

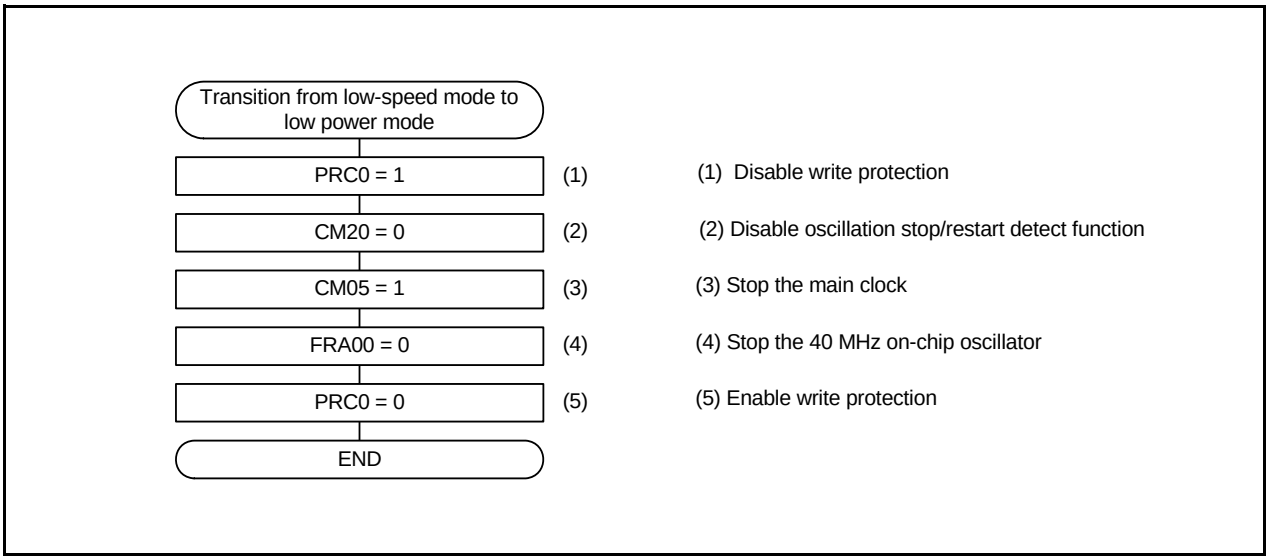


Figure 3.4 Transition from Low-Speed Mode to Low Power Mode

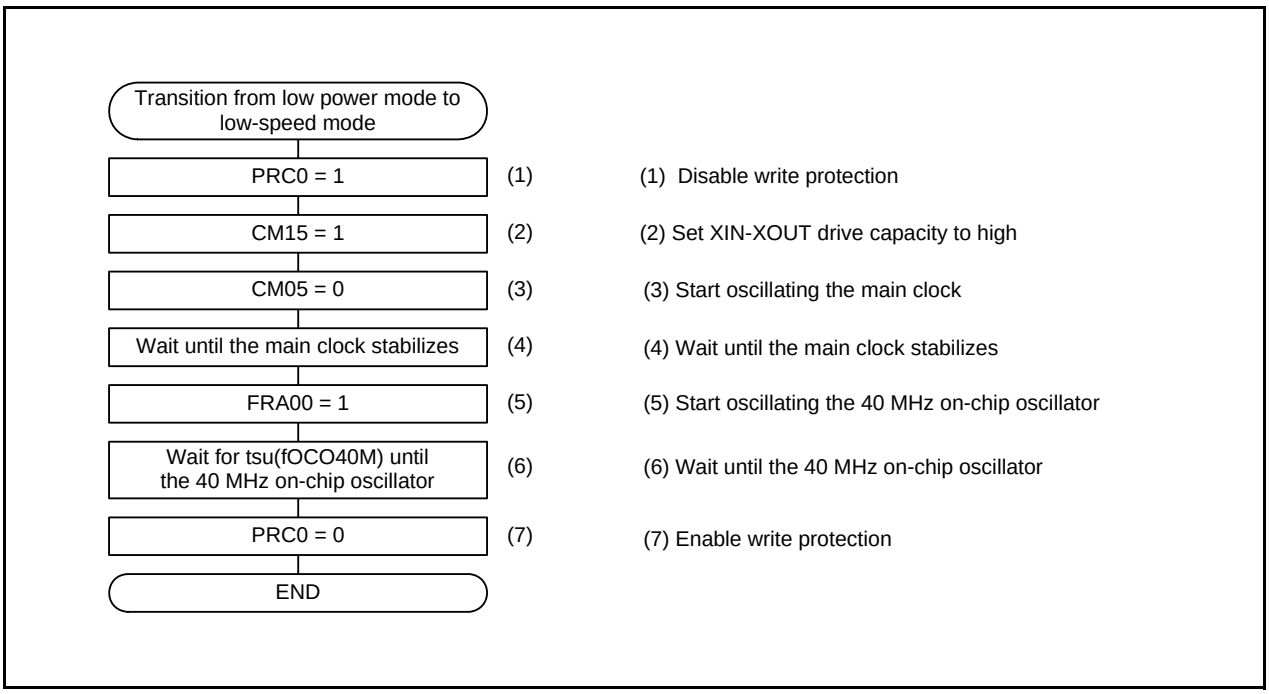


Figure 3.5 Transition from Low Power Mode to Low-Speed Mode

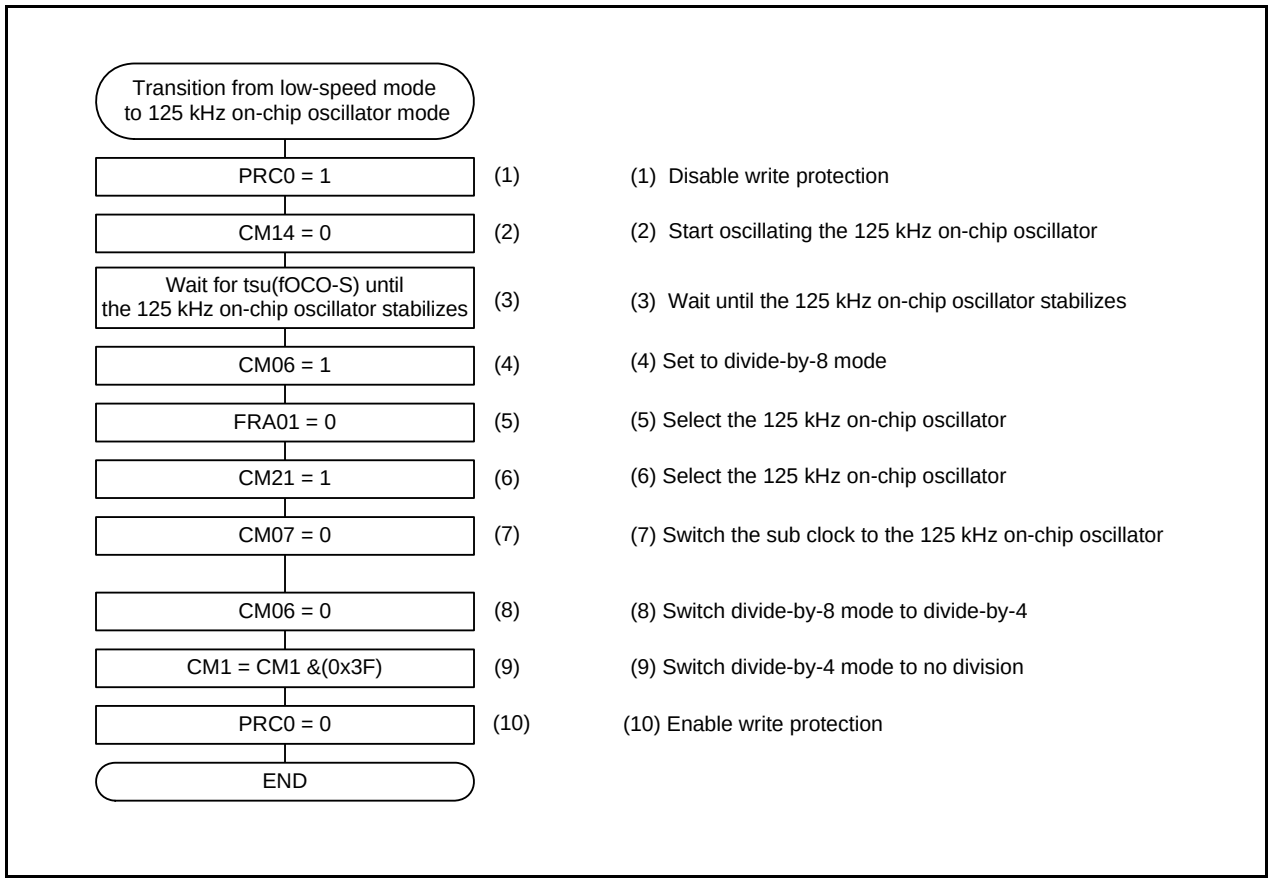


Figure 3.6 Transition from Low-Speed Mode to 125 kHz On-Chip Oscillator Mode

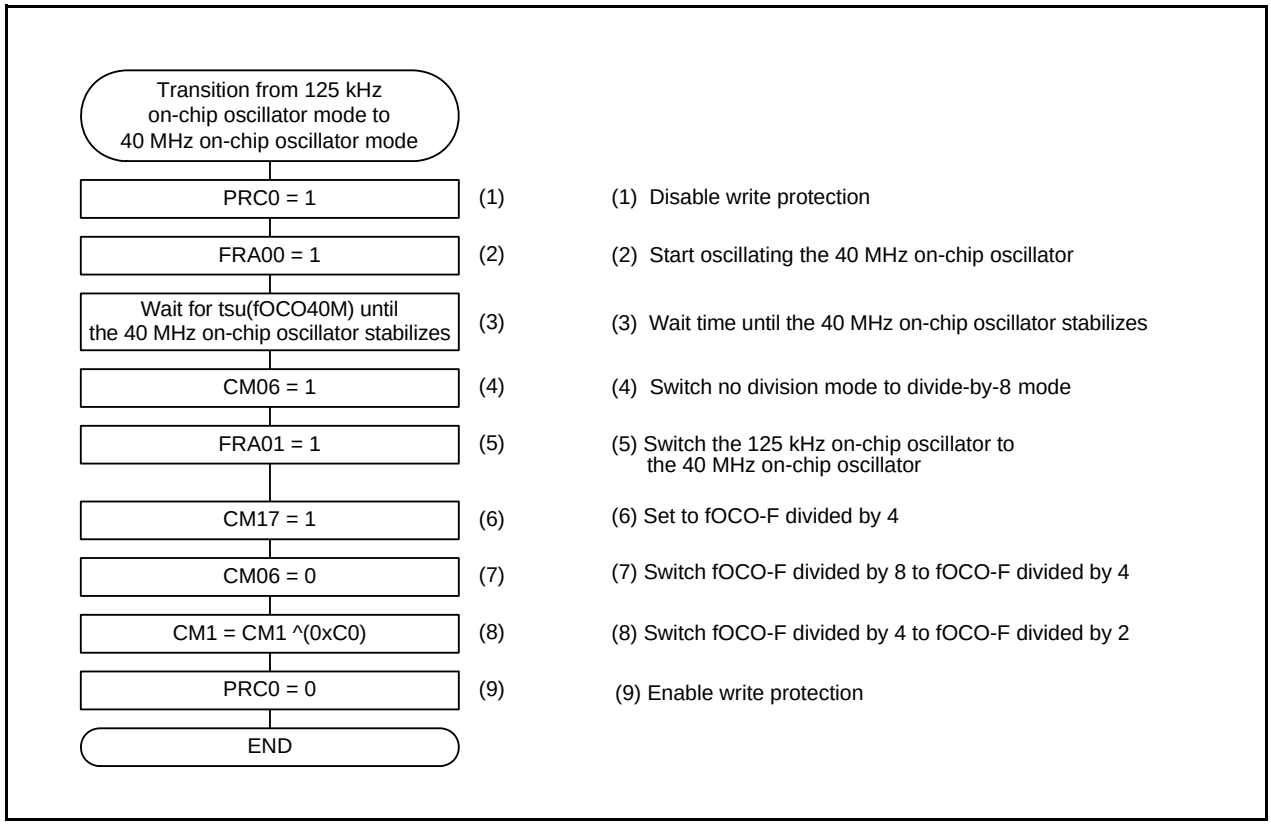
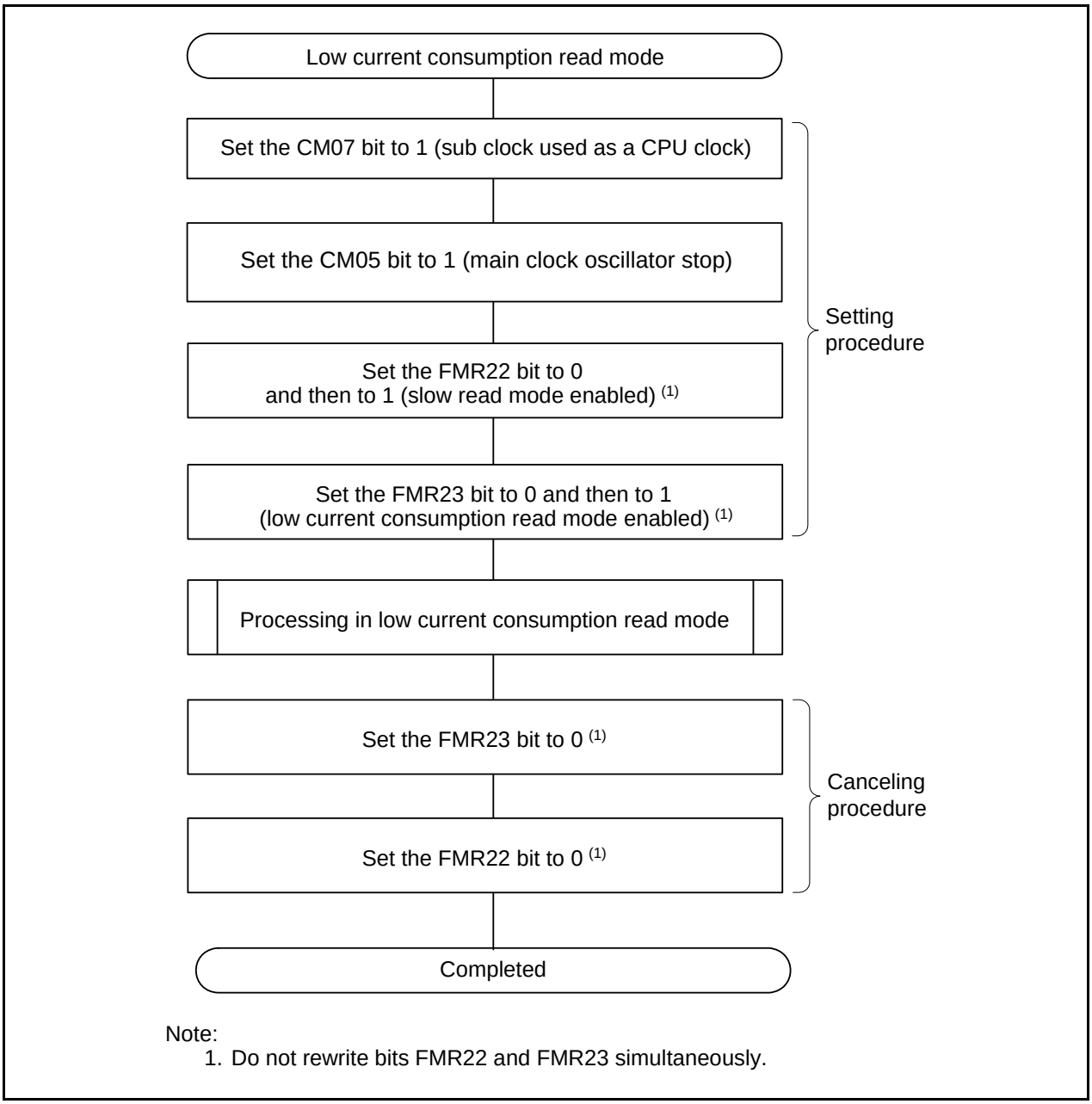


Figure 3.7 Transition from 125 kHz On-Chip Oscillator Mode to 40 MHz On-Chip Oscillator Mode

Low current consumption read mode can be used when the CM07 bit in the CM0 register is 1 (sub clock used as CPU clock).



Note:
1. Do not rewrite bits FMR22 and FMR23 simultaneously.

Figure 3.8 Setting and Canceling Low Current Consumption 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 (8) 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 low-speed mode
(5) Transition from low-speed mode to low power mode
(6) Setting and canceling low current consumption read mode
(7) Transition from low power mode to low-speed mode
(8) Transition from low-speed mode to 125 kHz on-chip oscillator mode

The settings in the sample code are as follows:

- Operation frequency is approximately 10 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 µs when the CPU clock is 10 MHz and approximately 60 µs when the CPU clock is 32.768 kHz.
- Wait time until the sub clock stabilizes is approximately 1 sec. when the CPU clock is 125 kHz.

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 2) 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 2).

Declaration	void slowspeed_from_foco125k(void)
Outline	Transition from 125 kHz on-chip oscillator mode to low-speed mode
Argument	None
Variable	None
Returned value	None
Function	Switch the CPU clock from 125 kHz on-chip oscillator mode to low-speed mode.

Declaration	void foco125k_from_slowspeed(void)
Outline	Transition from low-speed mode to 125 kHz on-chip oscillator mode
Argument	None
Variable	None
Returned value	None
Function	Switch the CPU clock from low-speed mode to 125 kHz on-chip oscillator mode.

Declaration	void lowpower_from_lowspeed(void)
Outline	Transition from low-speed mode to low power mode
Argument	None
Variable	None
Returned value	None
Function	Switch the CPU clock from low-speed mode to low power mode.

Declaration	void lowspeed_from_lowpower(void)
Outline	Transition from low power mode to low-speed mode
Argument	None
Variable	None
Returned value	None
Function	Switch the CPU clock from low power mode to low-speed mode.

Declaration	void low_current_consumption_read_setup(void)
Outline	Setting and canceling low current consumption read mode
Argument	None
Variable	None
Returned value	None
Function	Configure settings for low current consumption read mode, execute low_current_consumption_read(), and cancel low current consumption read mode. This function does not include processes to set the CPU clock to low power mode, or restore the CPU clock. Execute this function after setting the CPU clock to low power mode. Then restore the CPU clock.

Declaration	void low_current_consumption_read(void)
Outline	Processing in low current consumption read mode
Argument	None
Variable	None
Returned value	None
Function	Called from low_current_consumption_read_setup(). Add a program to be processed in low current consumption 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/6C Group User's Manual: Hardware (Hardware Manual) 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.

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.

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Revision History	M16C/6C Group Transition between 40 MHz On-Chip Oscillator Mode and Low Power Mode (Using Low Current Consumption Read Mode)

Rev.	Date	Description	
		Page	Summary
1.00	2010.07.01	—	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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