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Renesas Electronics Corporation

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M16C/64 Group

Power Control Example Using Wait Mode

1. Abstract

This example shows the procedure for entering wait mode after turning the main clock off.
In the sample program, the device returns from wait mode every second and after incrementing the 1-second counter, goes to wait mode again. When an $\overline{\text{INT0}}$ interrupt is generated, the device returns from wait mode and then enters high-speed mode (main clock working).

2. Introduction

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

・MCU: M16C/64 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 program described in this application note.

3. Specification

The peripheral functions used in the sample program are listed below. Also, a power control state transition diagram is shown in Figure 1.

- Timer B2 timer mode
- $\overline{\text{INT0}}$ interrupt

A flag named "F_WIT" is used in the setup procedure. This flag is used to determine whether wait mode is to be exited.
If F_WIT = 1 in the main program, wait mode is entered; if F_WIT = 0, wait mode is not entered.

(1) A 32.768 kHz resonator is connected to XCIN and it is used as the count source for timer B2. Every time the timer counts 1 second, a timer B2 interrupt is generated. The device returns from wait mode by this timer B2 interrupt and after counting clock pulses, goes to wait mode again. In the sample program, a RAM labeled "WATCH_CNT" is used as memory to count clock pulses.
(2) When an INT0 interrupt request is generated, wait mode is exited.
In an INT0 interrupt handler, the F_WIT flag is cleared by writing 0.

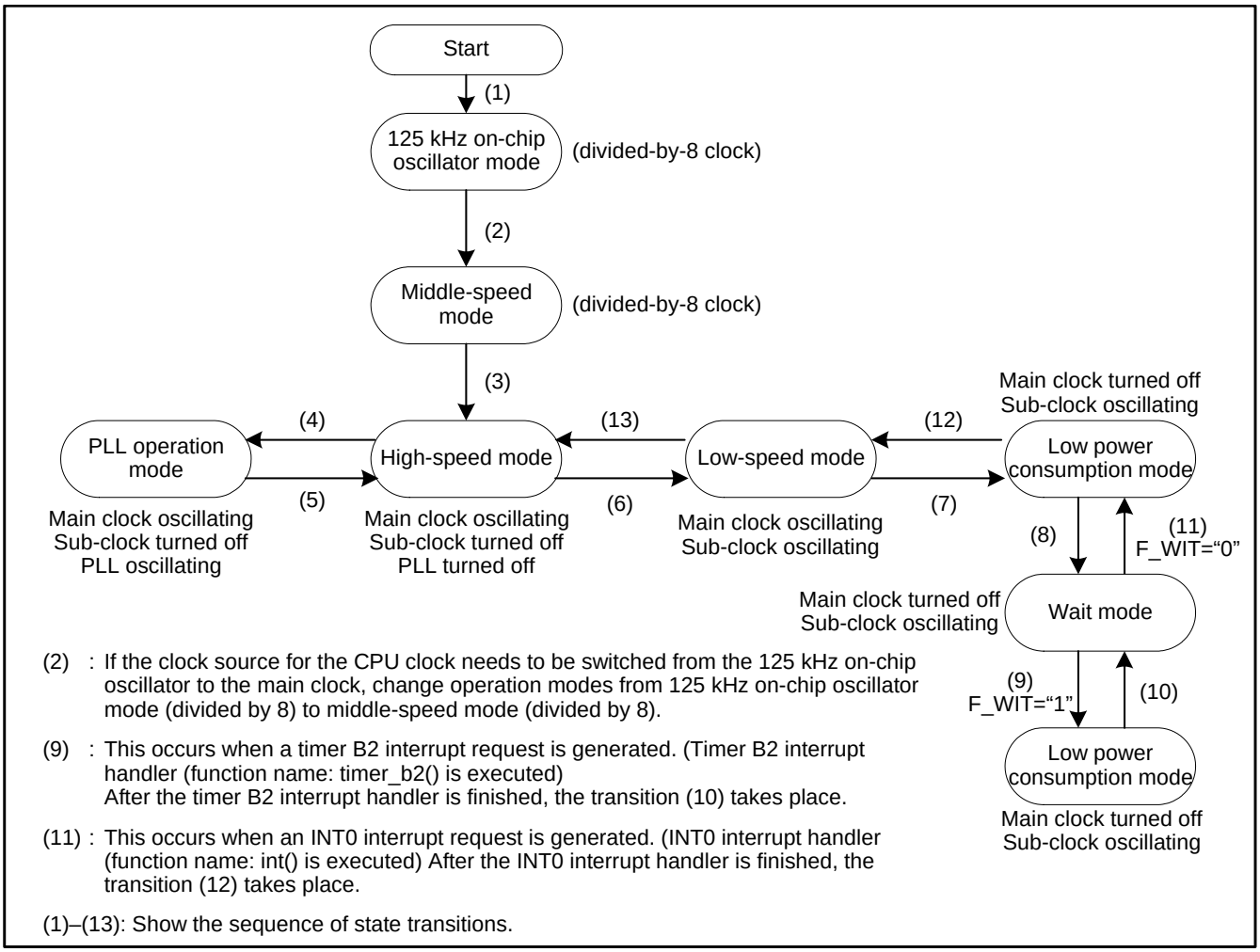
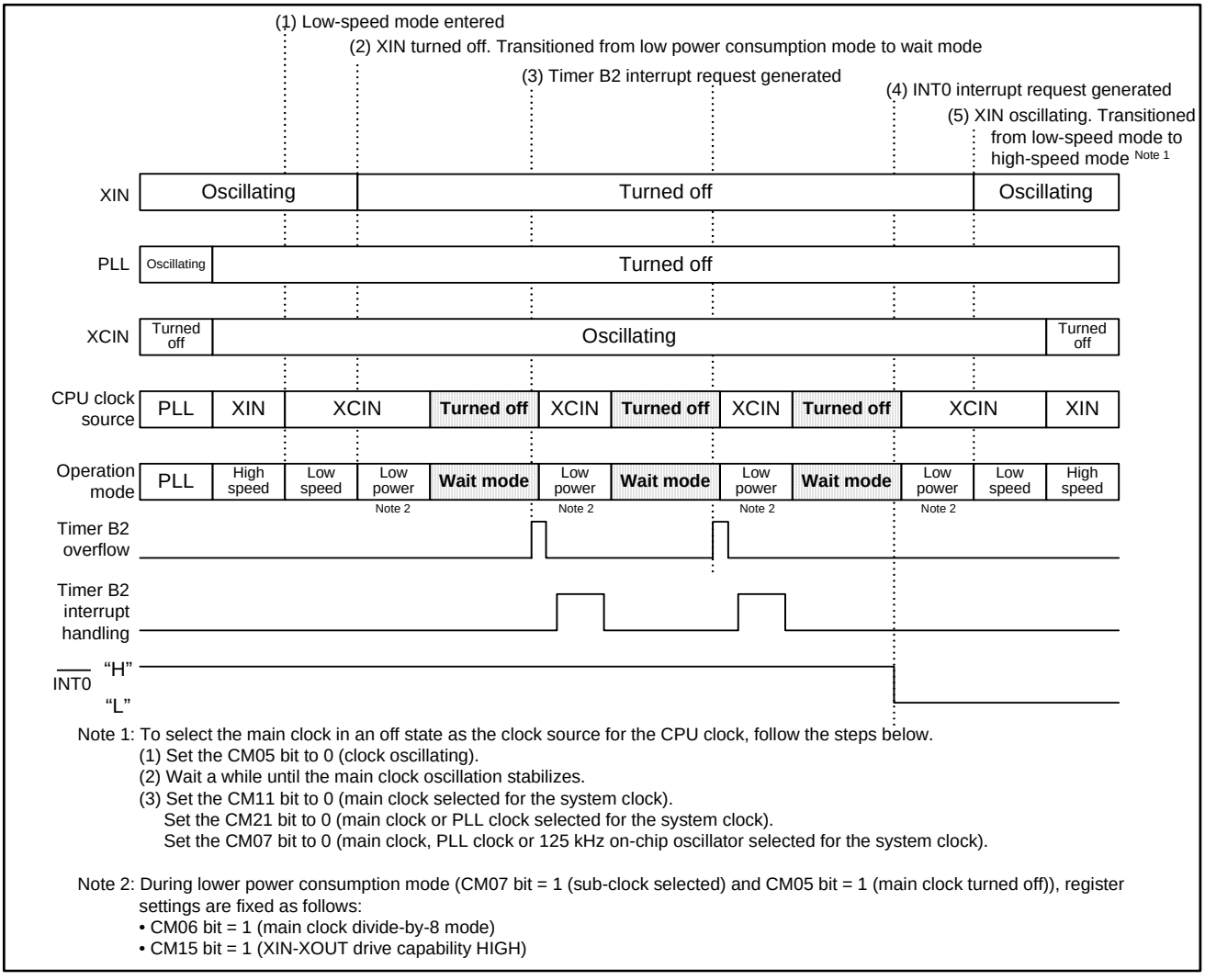


Figure 1. Power Control State Transition Diagram

4. Operation

(1) The clock source for the CPU clock is switched from the main clock to a sub-clock, thereby entering low-speed mode.
(2) The main clock is turned off to enter low power consumption mode. After that, wait mode is entered by a WAIT instruction. At this time, timer B2 and $\overline{\text{INT0}}$ interrupts are enabled.
(3) When a timer B2 interrupt request (interrupt interval of 1 second) is generated, control returns from wait mode and the CPU clock is turned back on again. At the same time, clock pulses are counted in a timer B2 interrupt handler, and then wait mode is entered again. (F_WIT flag = 1)
(4) When an $\overline{\text{INT0}}$ interrupt request is generated, control returns from wait mode and the CPU clock is turned back on again. At the same time, the F_WIT flag is cleared (wait mode exited) by writing 0 in an $\overline{\text{INT0}}$ interrupt handler.
(5) The main clock is started oscillating to enter low-speed mode. After that, the clock source for the CPU clock is switched from a sub-clock to the main clock, thereby entering high-speed mode.



Note 1: To select the main clock in an off state as the clock source for the CPU clock, follow the steps below.
(1) Set the CM05 bit to 0 (clock oscillating).
(2) Wait a while until the main clock oscillation stabilizes.
(3) Set the CM11 bit to 0 (main clock selected for the system clock).
Set the CM21 bit to 0 (main clock or PLL clock selected for the system clock).
Set the CM07 bit to 0 (main clock, PLL clock or 125 kHz on-chip oscillator selected for the system clock).

Note 2: During lower power consumption mode (CM07 bit = 1 (sub-clock selected) and CM05 bit = 1 (main clock turned off)), register settings are fixed as follows:
• CM06 bit = 1 (main clock divide-by-8 mode)
• CM15 bit = 1 (XIN-XOUT drive capability HIGH)

Figure 2. Operation Timing Diagram of Wait Mode Based Power Control

5. How to Set Up

The following shows how to set up the registers to accomplish the operation described in 4, "Operation." For details about each register, see the hardware manual of the M16C/64 group.

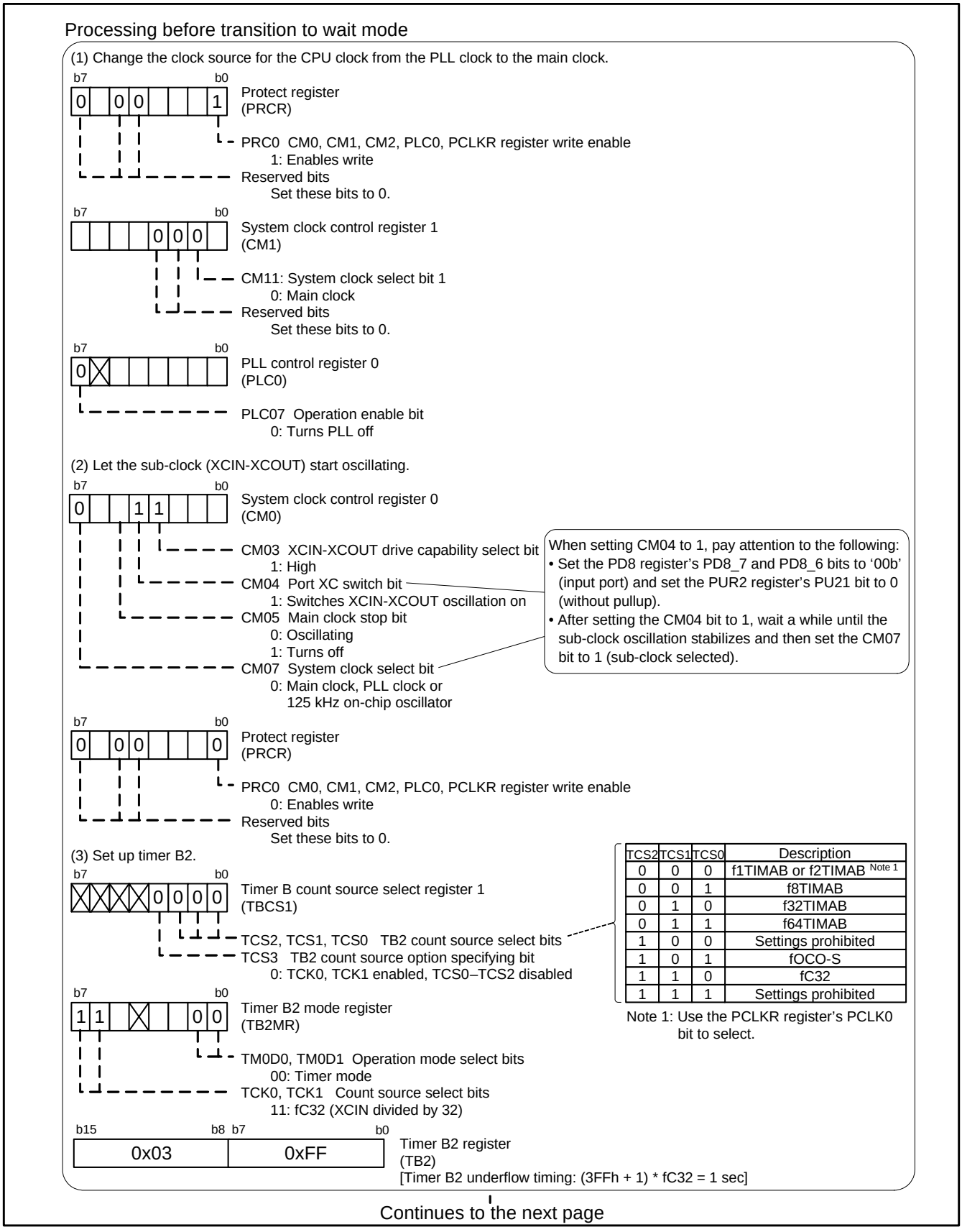


Figure 3. Procedure for Setting Up the Registers Associated with Wait Mode Based Power Control (1)

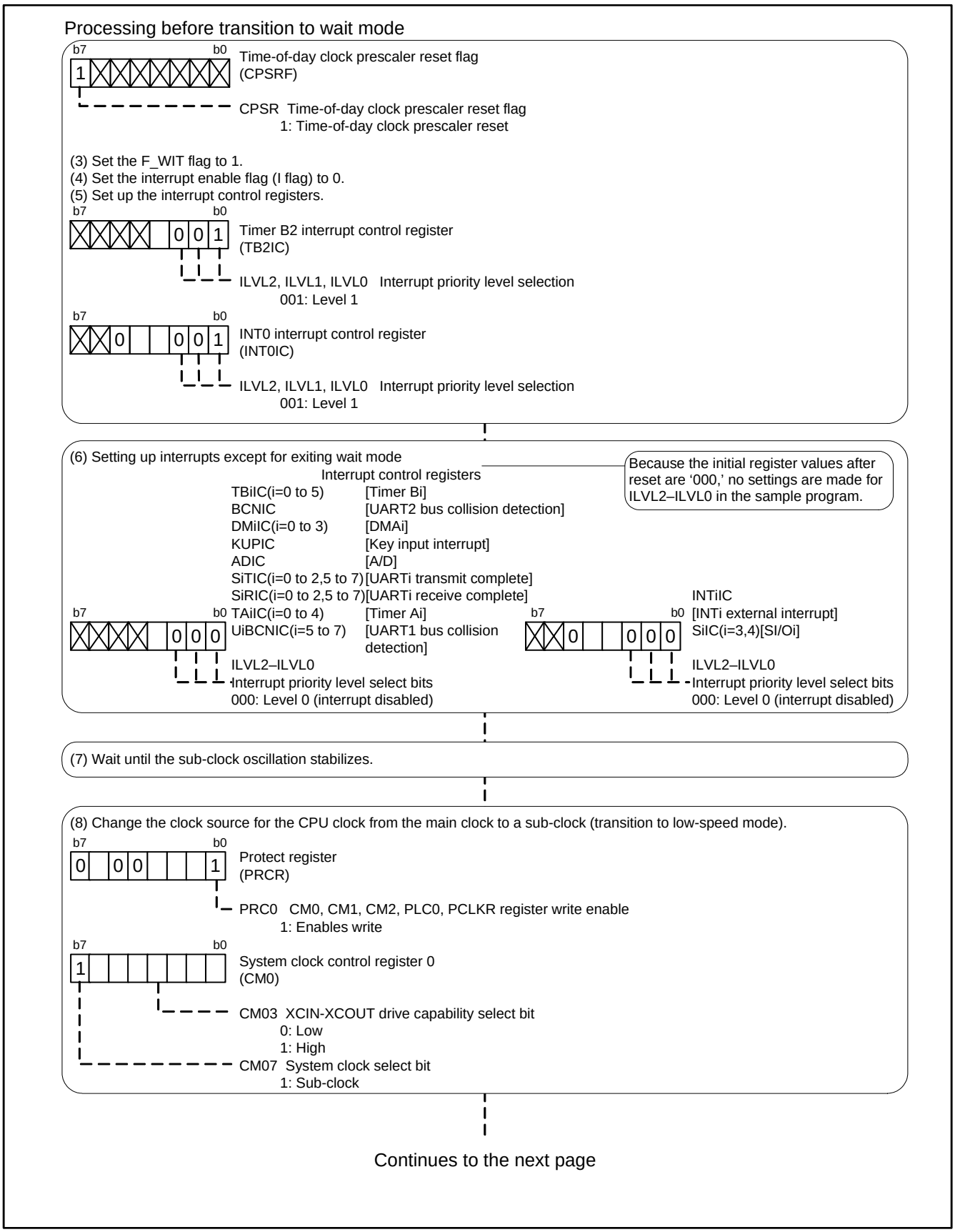


Figure 4. Procedure for Setting Up the Registers Associated with Wait Mode Based Power Control (2)

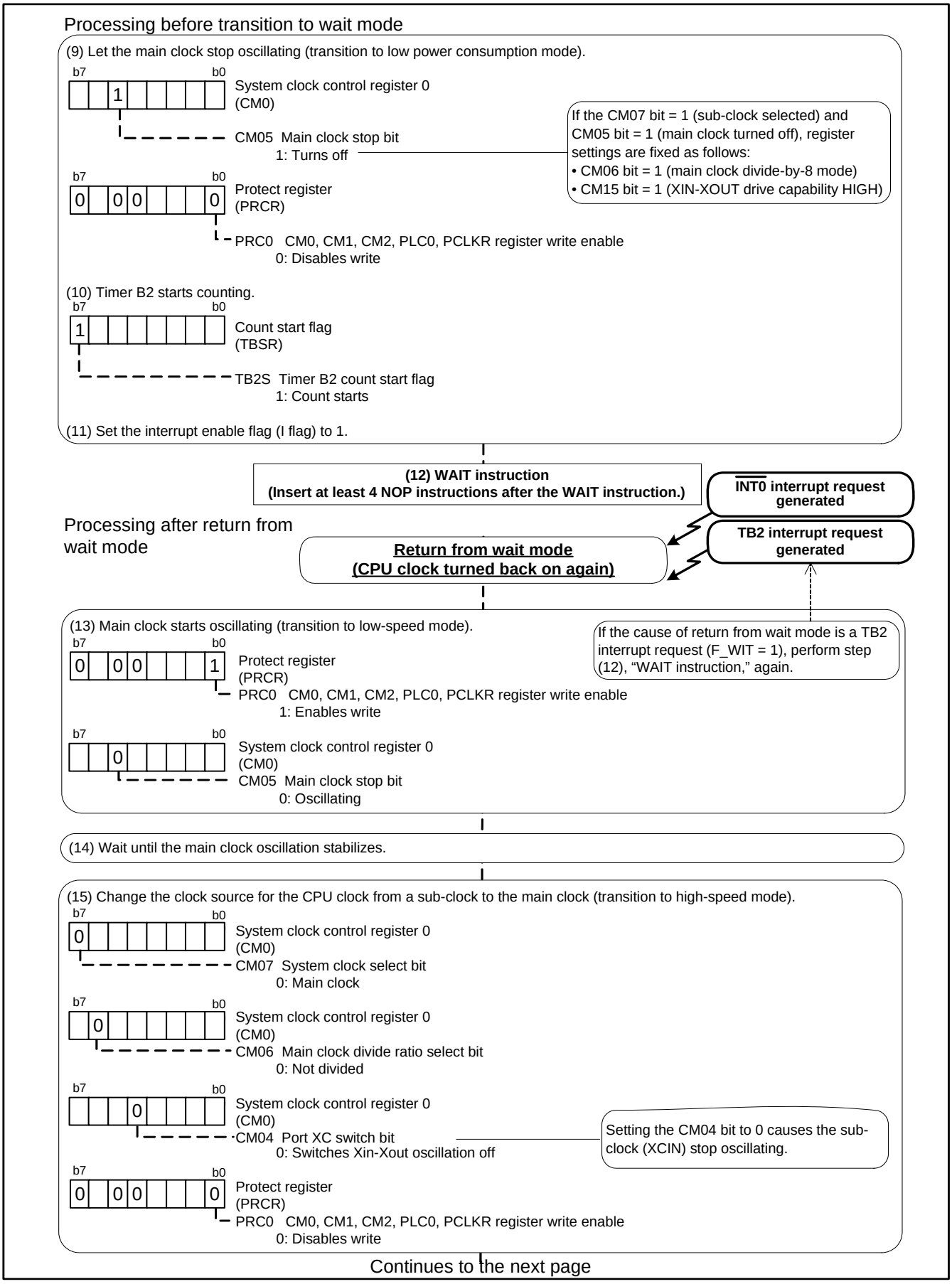


Figure 5. Procedure for Setting Up the Registers Associated with Wait Mode Based Power Control (3)

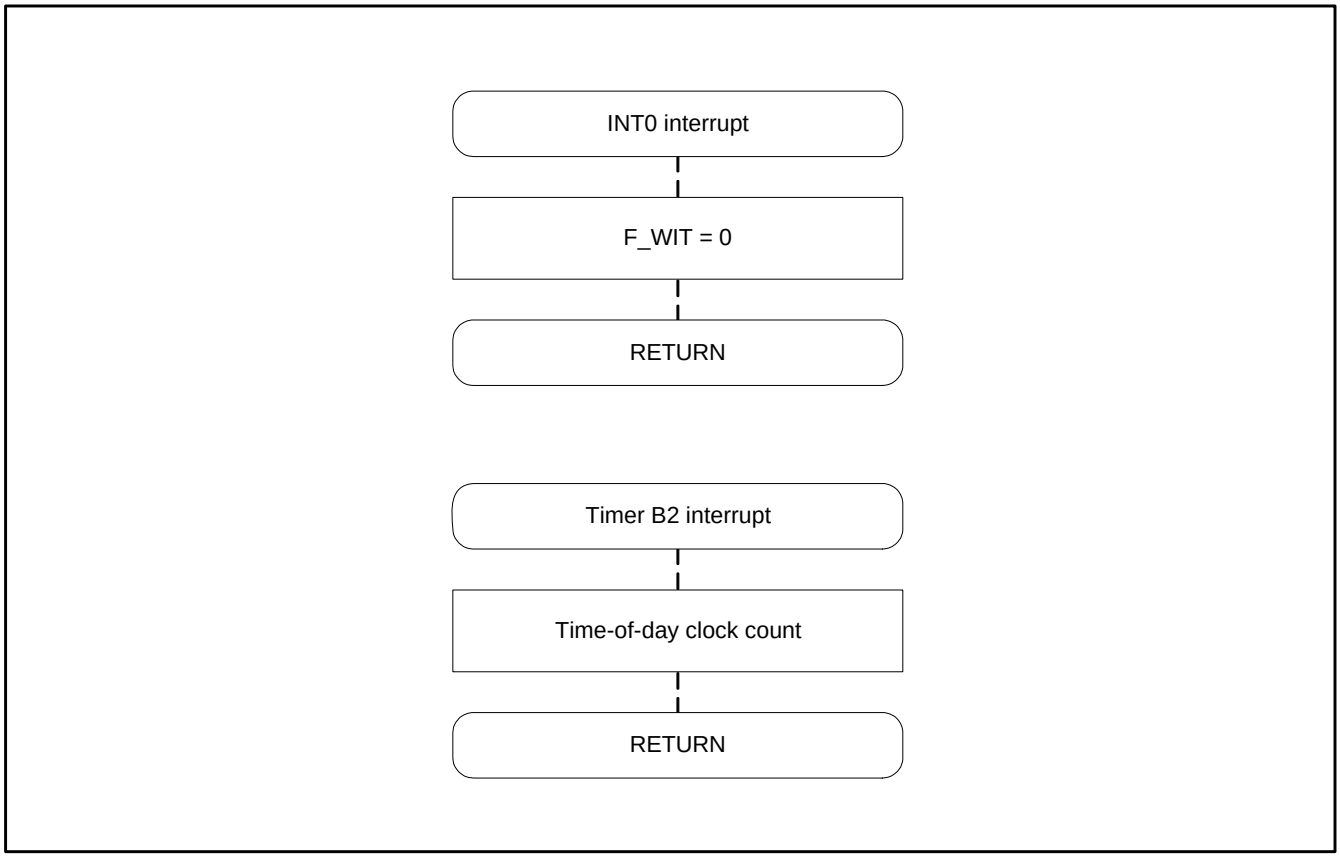


Figure 6. Procedure for Setting Up the Registers Associated with Wait Mode Based Power Control (4)

6. Sample Programming Code

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

7. Reference Documents

Hardware manual

M16C/64 Group Hardware Manual
(Get the latest version from the Renesas Technology website.)

Technical updates and technical news

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