M16C/64 Group

Power Control

Transition between High-Speed Mode and 125 kHz On-Chip Oscillator Low Power Mode (Using Slow Read Mode)

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1. Abstract

This document describes procedures for the following mode transitions, and setting and canceling slow read mode in the M16C/64 Group:

- Transition from high-speed mode to 125 kHz on-chip oscillator mode
- Transition from 125 kHz on-chip oscillator mode to high-speed mode
- 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/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 sample code described in this application note.

3. Clock Mode Transition Procedure

Figure 3.1 shows the transition procedure between high-speed mode 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(fOCO-S): Wait time until the 125 kHz on-chip oscillator stabilizes
Refer to the “Electrical Characteristics” in the User's Manual: Hardware (Hardware Manual) for details on tsu(fOCO-S).

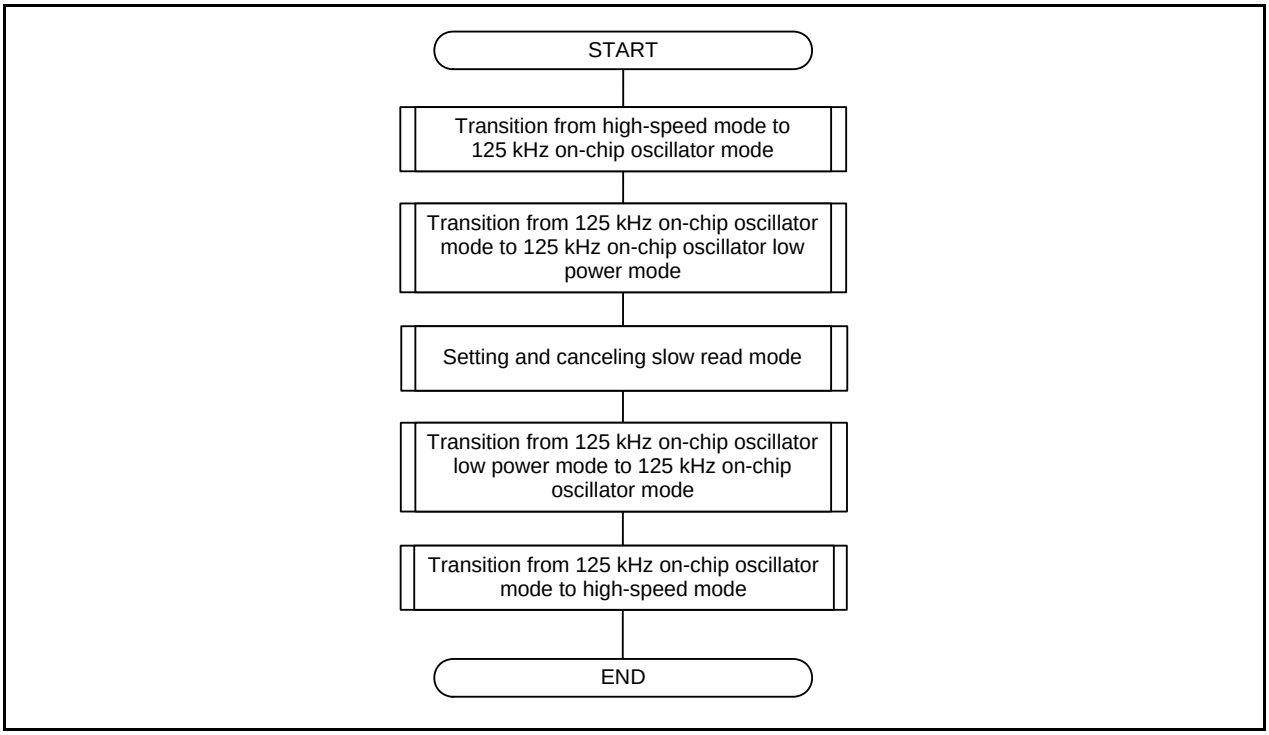

Figure 3.1 Transition between High-Speed Mode and 125 kHz On-Chip Oscillator Low Power Mode

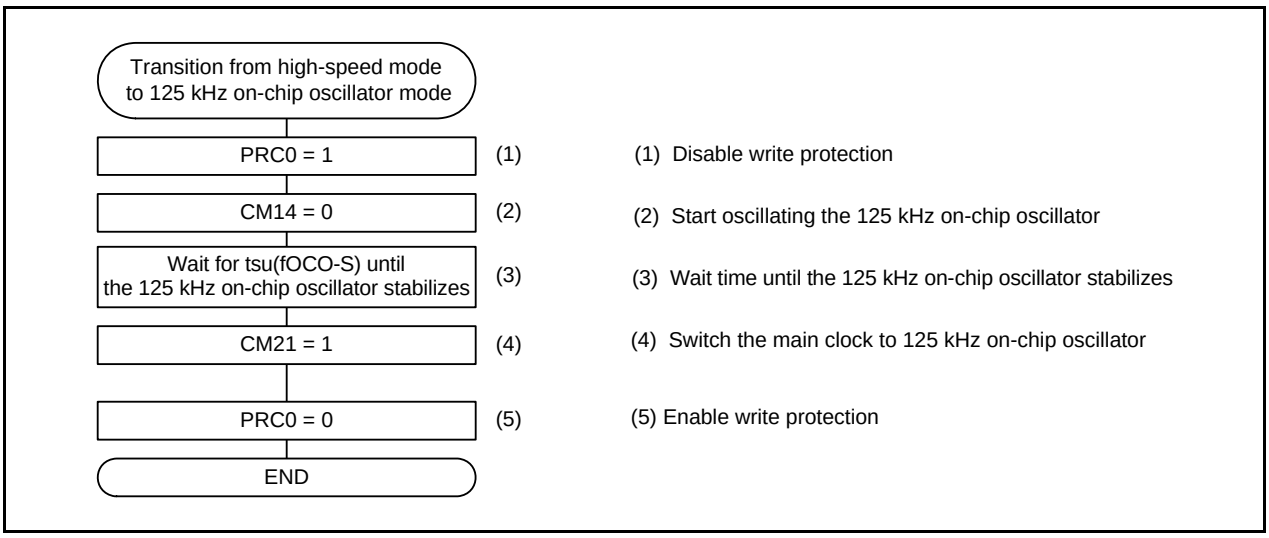

Figure 3.2 Transition Procedure from High-Speed Mode to 125 kHz On-Chip Oscillator Mode

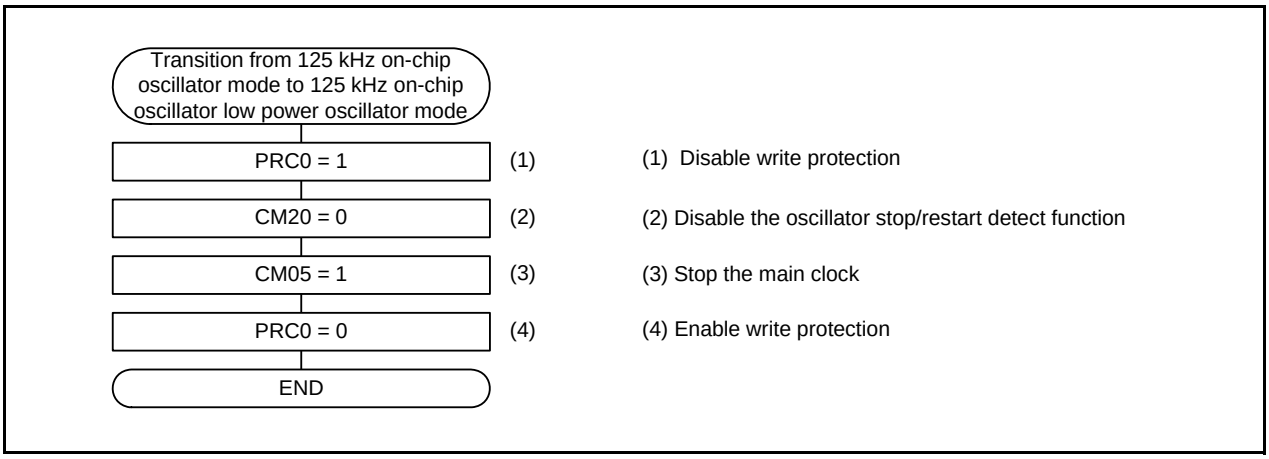

Figure 3.3 Transition Procedure from 125 kHz On-Chip Oscillator Mode to 125 kHz On-Chip Oscillator Low Power Mode

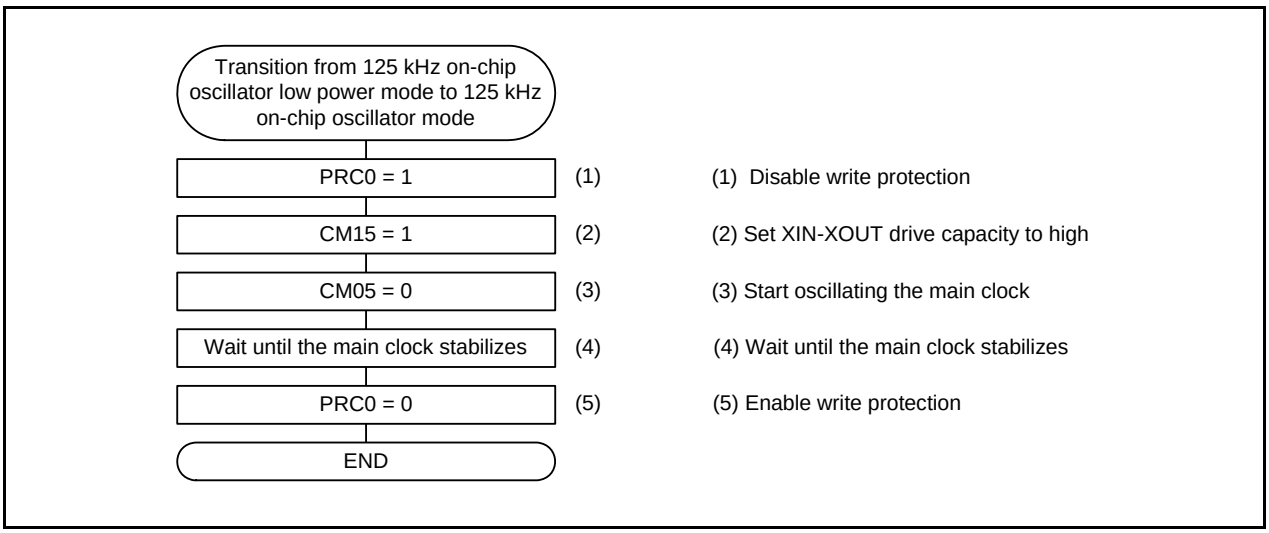

Figure 3.4 Transition Procedure from 125 kHz On-Chip Oscillator Low Power Mode to 125 kHz On-Chip Oscillator Mode

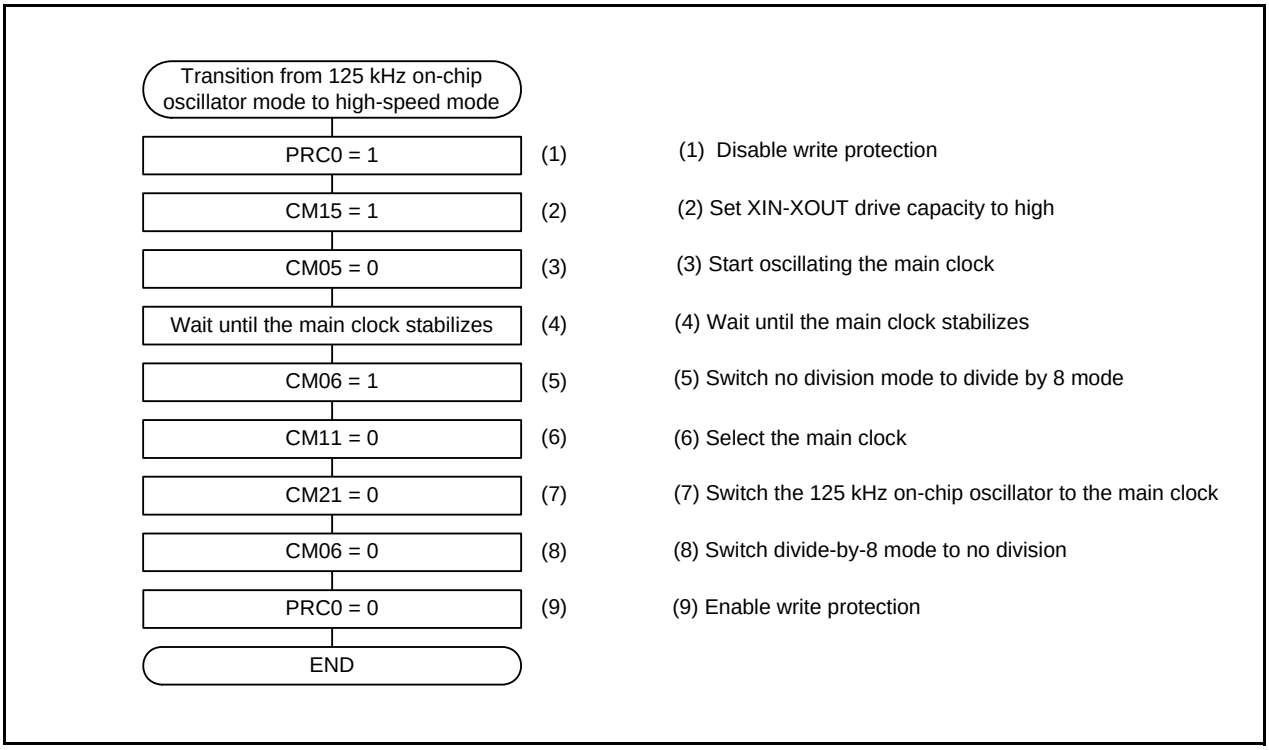

Figure 3.5 Transition Procedure from 125 kHz On-Chip Oscillator Mode to High-Speed Mode

Slow read mode can be used when f(BCLK) is less than or equal to f(SLOW_R) and the PM17 bit in the PM1 register is 1 (one wait).
f(SLOW_R): Operation frequency in slow read mode
Refer to the “Electrical 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 sub clock.

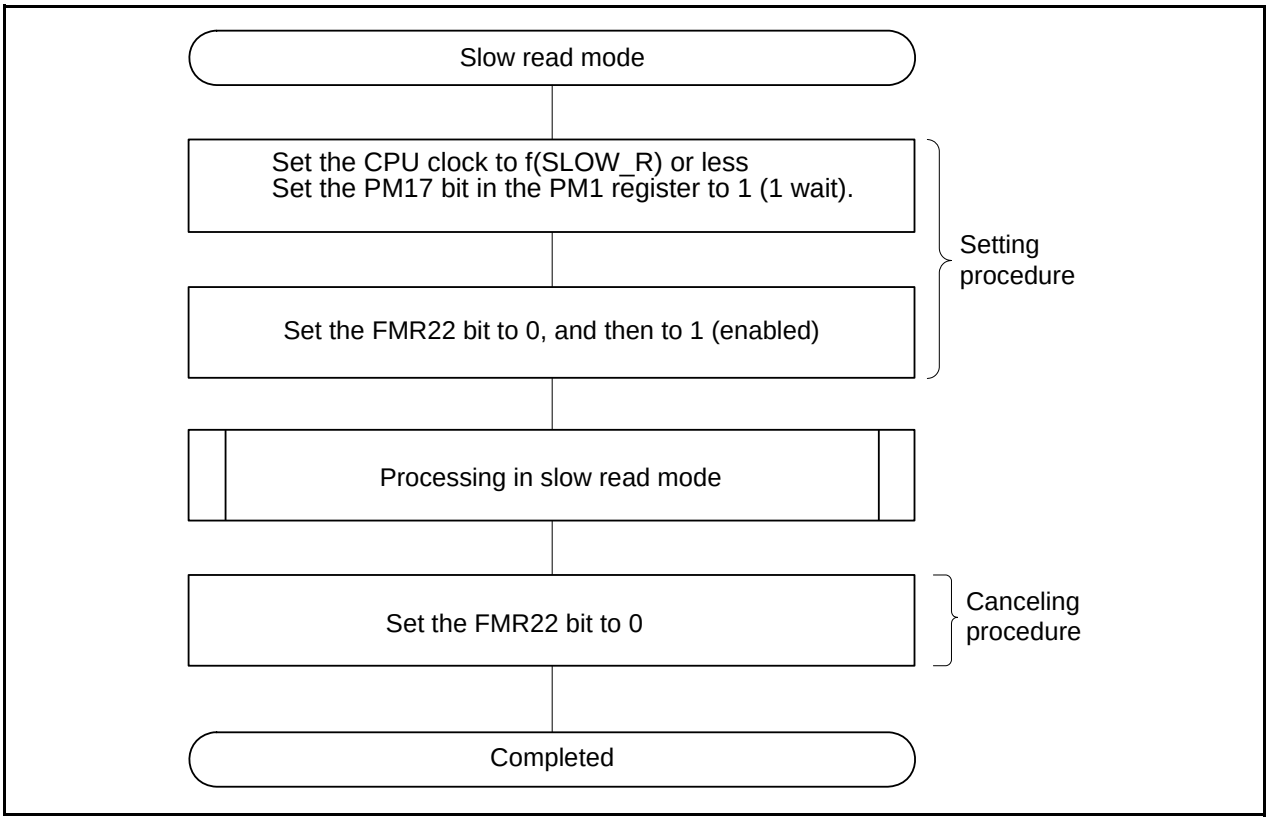

Figure 3.6 Setting and Canceling Slow Read Mode

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 (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 high-speed mode
(3) Transition from high-speed 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: Wait time until the main clock stabilizes is approximately 100 ms when the CPU clock is 125 kHz, and wait time until the 125 kHz on-chip oscillator stabilizes is approximately 50 µs when the CPU clock is 4 MHz.
In the sample code, since the 125 kHz on-chip oscillator is used as the CPU clock source when entering slow read mode, the PM17 bit remains 0 (no wait state).

4.2 Function Tables

Function Tables for This Document

Declaration	void foco125k_from_highspeed(void)
Outline	Transition from high-speed mode to 125 kHz on-chip oscillator mode
Argument	None
Variable	None
Returned value	None
Function	Switch the CPU clock from high-speed mode to 125 kHz on-chip oscillator mode (fOCO-S divided by 1).

Declaration	void highspeed_from_foco125k(void)
Outline	Transition from 125 kHz on-chip oscillator mode to high-speed 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 high-speed mode.

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 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 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/64 Group User's Manual: Hardware (Hardware Manual) Rev.1.05
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/64 Group Transition between High-Speed 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

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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