R32C/116A, 117A, and 118A Groups

Rewriting Flash Memory Using the Suspend/Resume Function in EW1 Mode

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Abstract

This document describes how to rewrite the flash memory in the R32C/116A, 117A, and 118A Groups using the suspend/resume function while in EW1 mode of the CPU rewrite mode.

Products

R32C/116A Group
R32C/117A Group
R32C/118A Group

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

Contents

1. Specifications

This document explains how to rewrite the on-chip flash memory with the suspend/resume function enabled in EW1 mode of CPU rewrite mode.
Table 1.1 lists the Peripheral Functions and Their Applications. Figure 1.1 shows an Conceptual Diagram of the Suspend Function.

Table 1.1 Peripheral Functions and Their Applications

Peripheral Function	Application
EW1 mode of CPU rewrite mode	Rewrite the on-chip flash memory with the suspend/resume function enabled
Timer A0 of timer A	Suspend request interrupt
Timer A2 of timer A	Wait for reset to be released

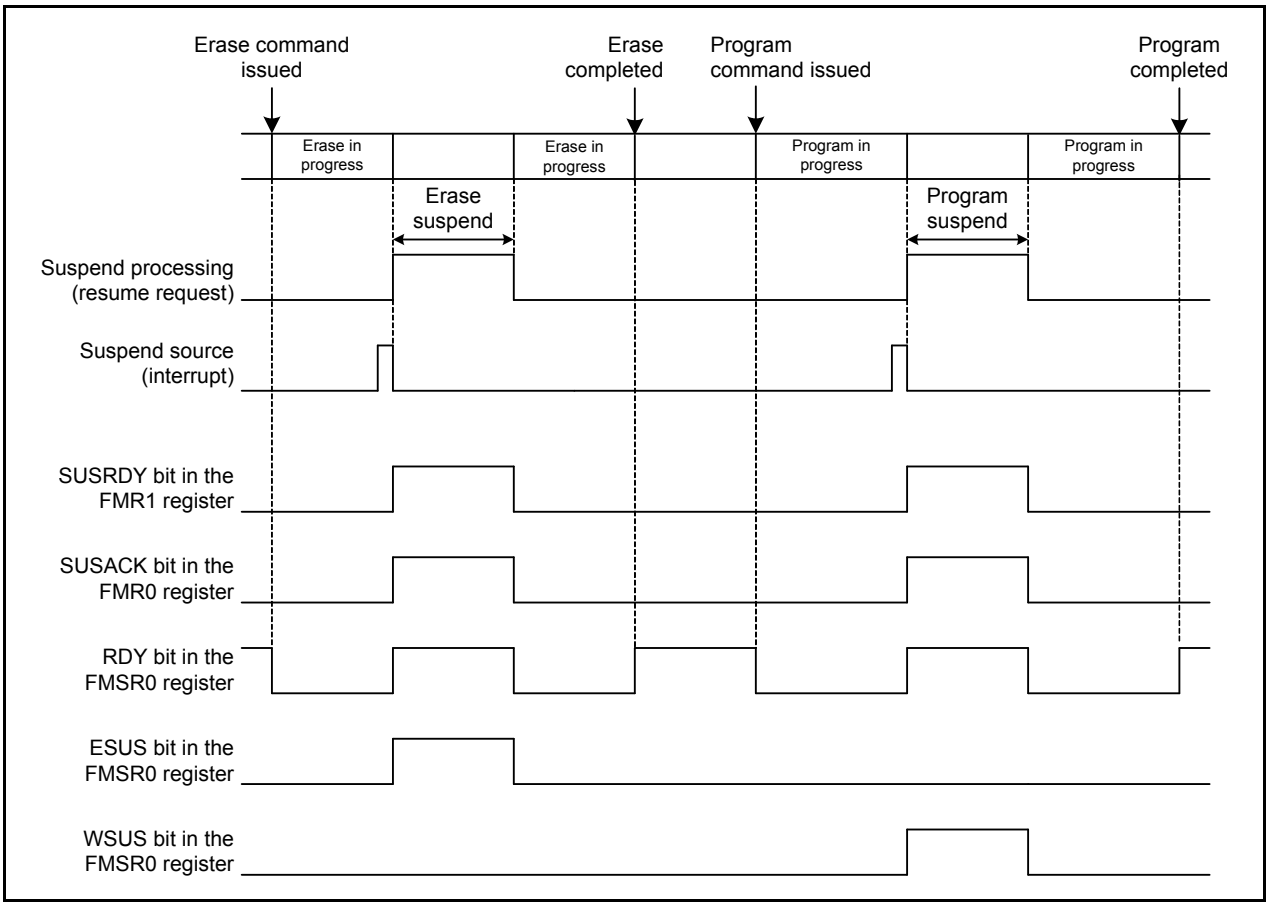

Figure 1.1 Conceptual Diagram of the Suspend Function

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	R5F6416MADFE (R32C/118A Group)
Operating frequencies	• Main clock: 16 MHz • PLL clock: 128 MHz • Base clock: 64 MHz • CPU clock: 64 MHz • Peripheral bus clock: 32 MHz • Peripheral function clock source: 32 MHz
Operating voltage	5 V
Integrated development environment	Renesas Electronics High-performance Embedded Workshop Version 4.07
C compiler	Renesas Electronics R32C/100 Series C Compiler V.1.02 Release 01
	Compile options -D__STACKSIZE__=0X300 -D__ISTACKSIZE__=0X300 -DVECTOR_ADR=0x0FFFFFBDC -c -finfo -dir “$(CONFIGDIR)” Default setting is used in the integrated development environment.
Operating mode	Single-chip mode
Sample code version	Version 1.00

3. Reference Application Notes

Application notes associated with this application note are listed below. Refer to these application notes for additional information.

- R32C/100 Series Configuring PLL Mode (REJ05B1221-0100)
- R32C/100 Series Timer A Operation in One-shot Timer Mode (REJ05B1200-0100)
- R32C/100 Series Rewriting ROM Area Using EW1 Mode of CPU Rewrite Mode (REJ05B1394-0100)

4. Peripheral Functions

This chapter provides supplementary information on the suspend/resume function. Refer to the User's Manual (Hardware) for general information.

4.1 Suspend/Resume Function

These groups of MCUs support program-suspend and erase-suspend operations to execute other operations with higher priority. Unlike non-maskable interrupts which abort an operation in progress, a suspended operation is able to resume on demand. The following two software commands are suspendible: block erase and program.

4.2 Suspend Request

A suspend is requested by an interrupt. Note that a fast interrupt does not trigger a suspend request. Note that all interrupt-associated registers must be set before entering CPU rewrite mode. Once the IPL is set, do not rewrite the interrupt-associated registers.

5. Hardware

5.1 Pin Used

Table 5.1 lists the Pin Used and Its Function.

Table 5.1 Pin Used and Its Function

Pin Name	I/O	Function
P0_0	Output	Verifying the timer A0 interrupt

6. Software

6.1 Operation Overview

This section shows a program example of the MCU entering EW1 mode of CPU rewrite mode, and executing the program and block erase commands in block 7 (addresses FFFA0000h to FFFAFFFFh). The timer A0 interrupt is used as the request source of the suspend/resume function.
Figure 6.1 shows the Memory Map Used in the Sample Code.

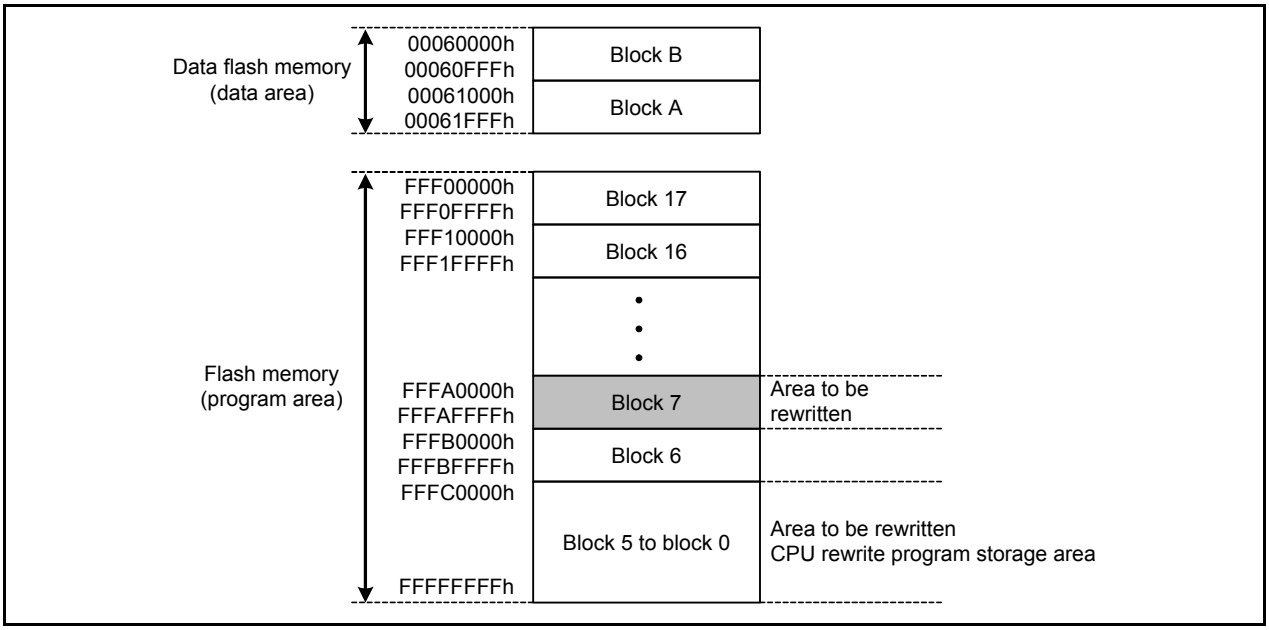

Figure 6.1 Memory Map Used in the Sample Code

6.2 Suspend/Resume Operation

The timer A0 interrupt is used as the request source of the suspend/resume function. Use timer mode of timer A to generate a timer A interrupt every 300 µs.

6.3 Constants

Table 6.1 lists the Constants Used in the Sample Code.

Table 6.1 Constants Used in the Sample Code

Constant Name	Setting Value	Contents
ADR_BLOCK_7	FFFA0000h	Start address of block 7
ADR_CMD_1ST	FFFFF800h	Start address of the first command
CMD_BLOCK_ERASE_1ST	0020h	First command data of the block erase command
CMD_BLOCK_ERASE_2ND	00D0h	Second command data of the block erase command
CMD_PROGRAM	0043h	First command data of the program command
CMD_CLEAR_STATUS	0050h	First command data of the clear status register command
PROG_SIZE_DATA	32	Program data size (64 bytes)
PROG_SIZE_UNIT	4	Program command (8 bytes)
PROG_SIZE_64K	8000h	Maximum number of times program command can be issued
RET_COMPLETE	00h	Successfully completed
RET_ERR_CMDSEQ	01h	Command sequence error
RET_ERR_ERASE	02h	Erase error
RET_ERR_PROGRAM	03h	Program error
RET_ERR_PROGCHK	04h	Program data verification error
RET_ERR_FLASH	FFh	Flash memory error
RET_SUS_COMPLETE	00h	Program/erase completed
RET_SUS_RESUME	01h	Program/erase suspended
RET_SUS_FLASH	FFh	Flash memory error

6.4 Variable

Table 6.2 lists the const Variable.

Table 6.2 const Variable

Type	Variable Name	Contents	Function Used
const unsigned short	write_data[ ]	Program data	exec_ew1_mode

6.5 Functions

Table 6.3 lists the Functions.

Table 6.3 Functions

Function Name	Outline
set_ew1_mode	EW1 mode of CPU rewrite mode is set
set_normal_mode	Normal mode is set
exec_ew1_mode	Flash memory rewrite
command_block_erase	Block erase command processing
command_program	Program command processing
status_check	Status check
suspend_state_check	Suspend verification
block_erase_error	Block erase error processing
programdata_check	Program data verification
suspend_flash_error	Processing a flash memory error that occurs during suspend
timerA0_init	Timer A0 initial setting
timerA2_wait	Timer A2 processing
_timer_a0	Timer A0 interrupt handling

6.6 Function Specifications

The following tables list the sample code function specifications.

set_ew1_mode	
Outline	Setting EW1 mode of CPU rewrite mode
Header	None
Declaration	void set_ew1_mode(void)
Description	Enter EW1 mode and enable the suspend/resume function.
Argument	None
Returned value	None
Remarks	

set_normal_mode	
Outline	Normal mode setting
Header	None
Declaration	void set_normal_mode(void)
Description	Disable the suspend/resume function and enter normal mode.
Argument	None
Returned value	None
Remarks	

exec_ew1_mode	
Outline	Flash memory rewrite
Header	None
Declaration	void exec_ew1_mode(void)
Description	The program and block erase commands are issued for block 7 of the on-chip flash memory.
Argument	None
Returned value	None
Remarks	

command_block_erase	
Outline	Block erase command processing
Header	None
Declaration	int command_block_erase(unsigned short *ers_addr)
Description	The block erase command is issued.
Argument	• First argument: *ers_addr Block address where the block erase command is issued
Returned values	• Successfully completed: RET_COMPLETE • Command sequence error: RET_ERR_CMDSEQ • Erase error: RET_ERR_ERASE • Program error: RET_ERR_PROGRAM • Flash memory error: RET_ERR_FLASH
Remarks	A resume request is issued while suspended. When a flash memory error occurs, the corresponding block is erased.

command_program	
Outline	Program command processing
Header	None
Declaration	int command_program(unsigned short *prg_addr, unsigned short *prg_data)
Description	Issues a program command.
Arguments	• First argument: *prg_addr Address where program command is issued • Second argument: *prg_data Start address for the write data
Returned value	• Completed successfully: RET_COMPLETE • Command sequence error: RET_ERR_CMDSEQ • Erase error: RET_ERR_ERASE • Program error: RET_ERR_PROGRAM • Flash memory error: RET_ERR_FLASH
Remarks	Programming is performed in 64-bit (4 word) units. A resume request is issued while suspended. When a flash memory error occurs, the corresponding block is erased.

status_check	
Outline	Status check
Header	None
Declaration	int status_check(void)
Description	Verify if a software command was issued successfully.
Argument	None
Returned value	• Completed successfully: RET_COMPLETE • Command sequence error: RET_ERR_CMDSEQ • Erase error: RET_ERR_ERASE • Program error: RET_ERR_PROGRAM
Remarks	

suspend_state_check	
Outline	Suspend verification
Header	None
Declaration	int suspend_state_check(void)
Description	Verify if the suspend was executed successfully.
Argument	None
Returned value	• Program/erase complete: RET_SUS_COMPLETE • Program/erase suspended: RET_SUS_RESUME • Flash memory error: RET_SUS_FLASH
Remarks	

block_erase_error	
Outline	Block erase error processing
Header	None
Declaration	void block_erase_error(unsigned short *ers_addr)
Description	Processing when a block erase error occurs.
Argument	• First argument: *ers_addr Block address where the block erase command is issued
Returned value	None
Remarks	The clear status register command is issued. The block erase command is issued four times.

programdata_check	
Outline	Program data verification
Header	None
Declaration	int programdata_check(unsigned short *prg_addr, unsigned short *prg_data)
Description	Verify if data was written successfully.
Argument	• First argument: *prg_addr Start address of the on-chip flash memory where data is written • Second argument: *prg_data Start address of the write data
Returned value	• Completed successfully: RET_COMPLETE • Program data verification error: RET_ERR_PROGCHK
Remarks	

suspend_flash_error	
Outline	Flash memory error occurs during suspend
Header	None
Declaration	void suspend_flash_error(unsigned short *ers_addr)
Description	Corresponding blocks are erased.
Argument	• First argument: *ers_addr Block address where the block erase command is issued
Returned value	None
Remarks	

timerA0_init	
Outline	Timer A0 initial setting
Header	None
Declaration	void timerA0_init(void)
Description	Sets a 300 µs period timer.
Argument	None
Returned value	None
Remarks	

timerA2_wait	
Outline	Timer A2 processing
Header	None
Declaration	void timerA2_wait(void)
Description	Operates a 20 µs period one-shot timer.
Argument	None
Returned value	None
Remarks	

_timer_a0	
Outline	Timer A0 interrupt handling
Header	none
Declaration	void _timer_a0(void)
Description	Inverts the output from port P0_0.
Argument	None
Returned value	None
Remarks	

6.7 Flowcharts

6.7.1 Main Processing

Figure 6.2 shows the Main Processing.

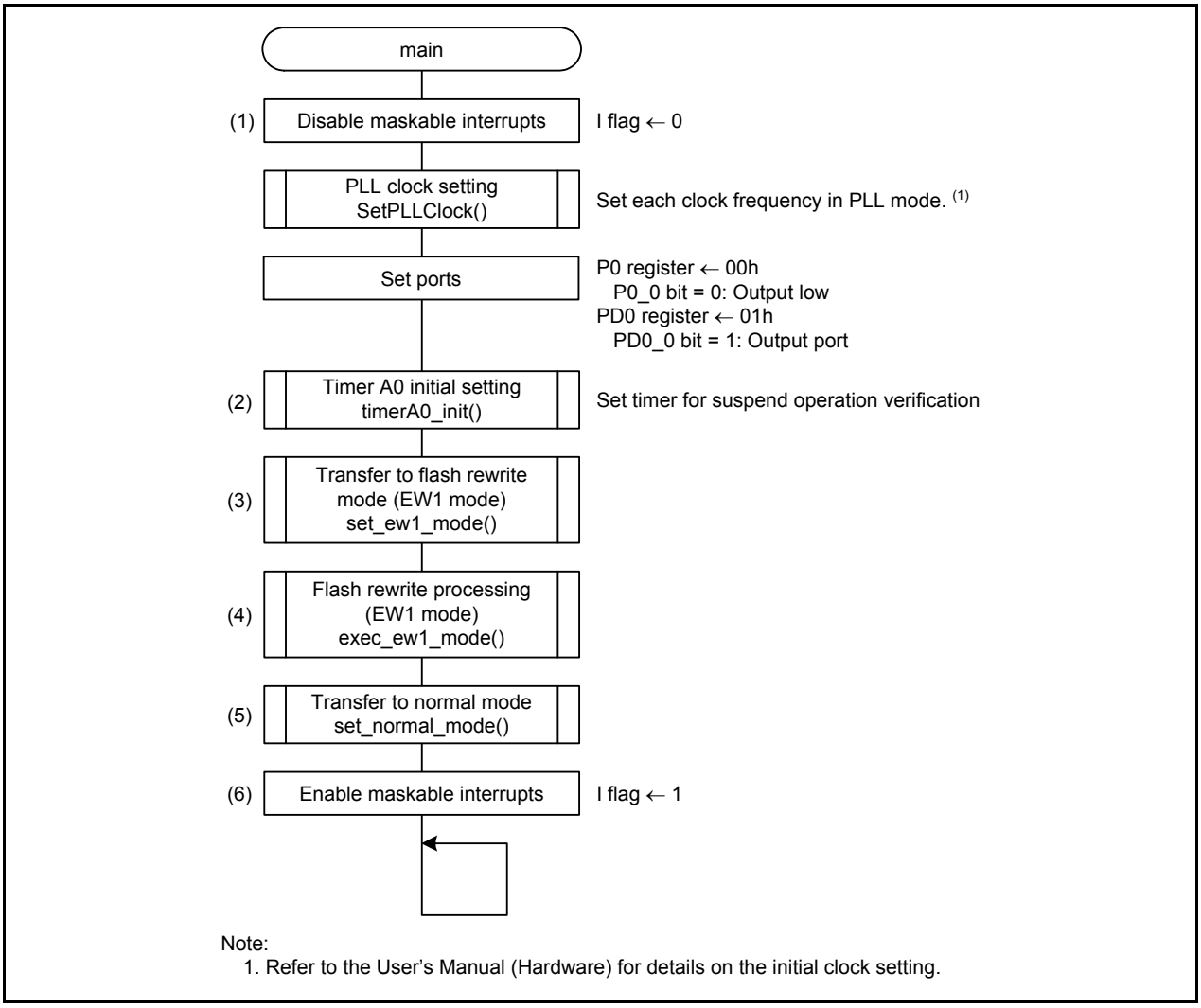

Figure 6.2 Main Processing

6.7.2 CPU Rewrite Mode (EW1 Mode) Setting

Figure 6.3 show the CPU Rewrite Mode (EW1 Mode) Setting.

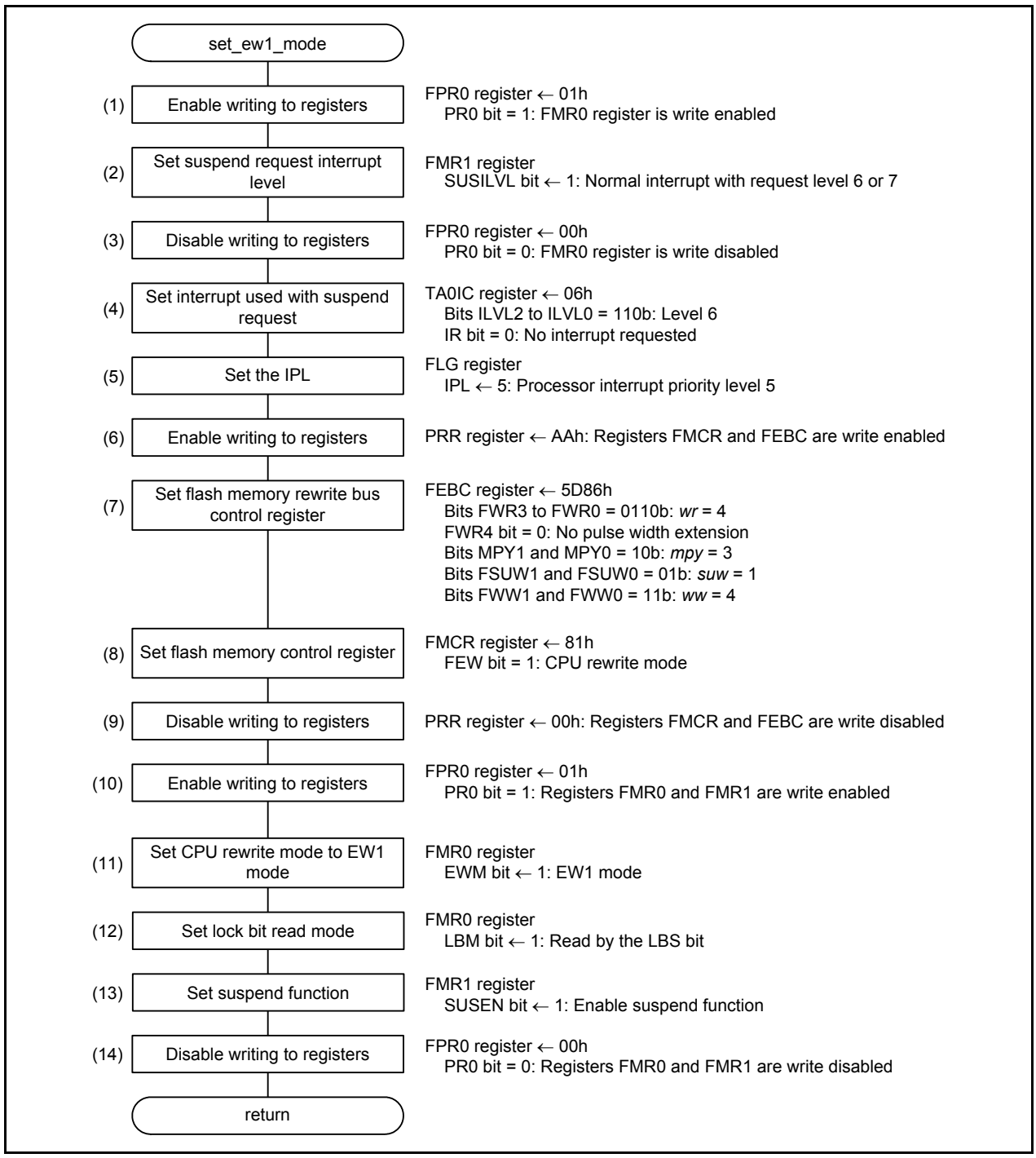

Figure 6.3 CPU Rewrite Mode (EW1 Mode) Setting

6.7.3 Normal Mode Setting

Figure 6.4 shows the Normal Mode Setting.

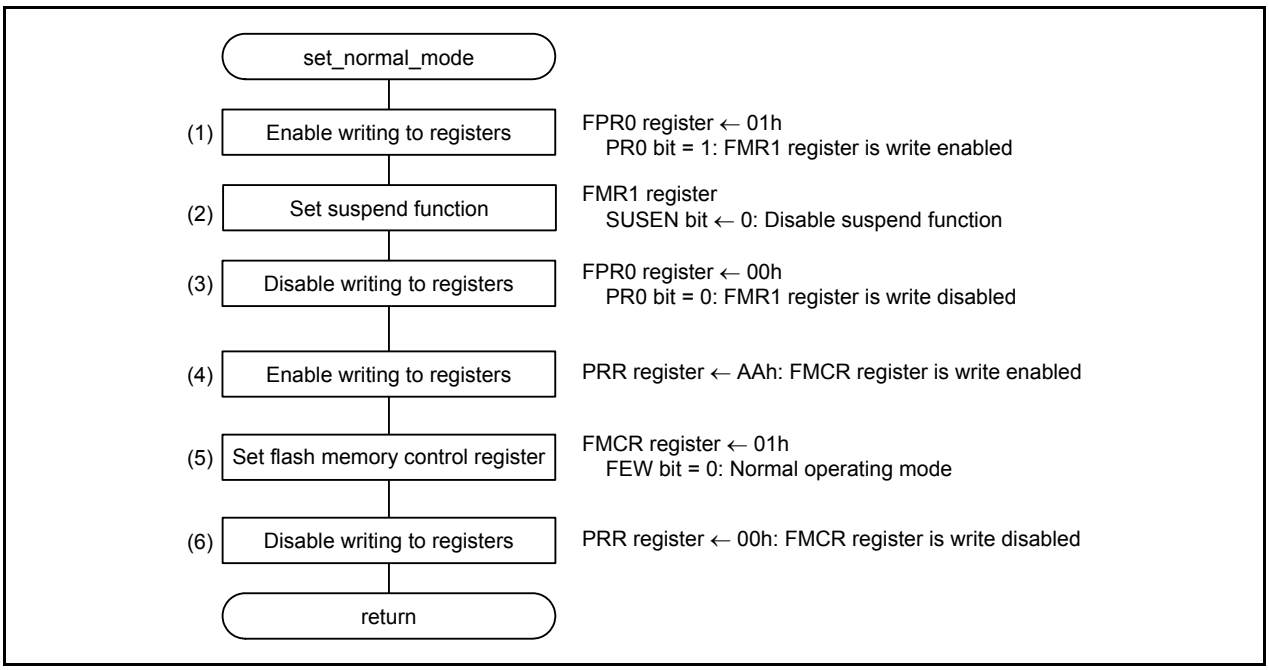

Figure 6.4 Normal Mode Setting

6.7.4 Rewriting the Flash Memory

Figure 6.5 shows rewriting of the flash memory.

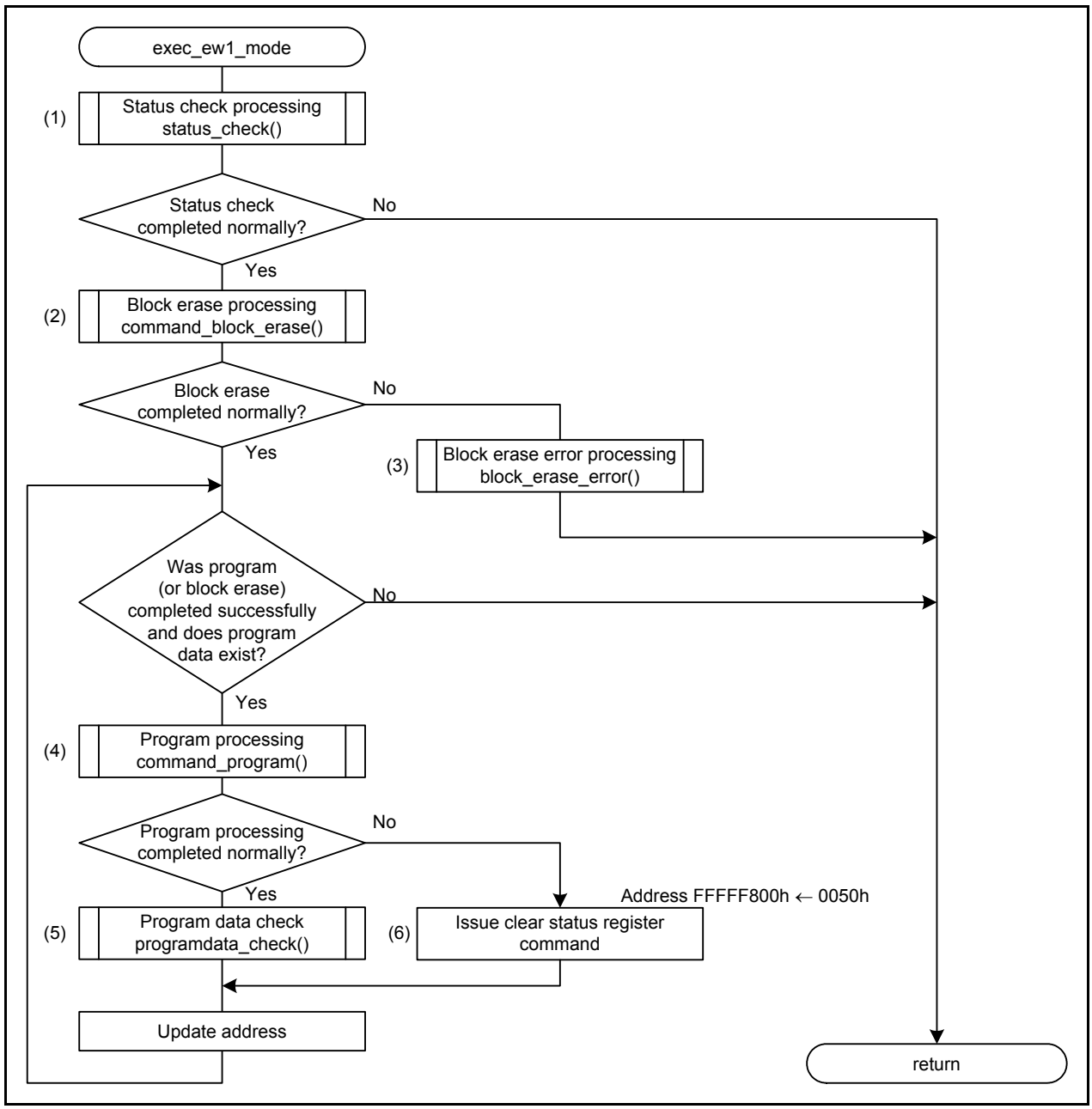

Figure 6.5 Rewriting the Flash Memory

6.7.5 Block Erase Command Processing

Figure 6.6 shows Block Erase Command Processing.

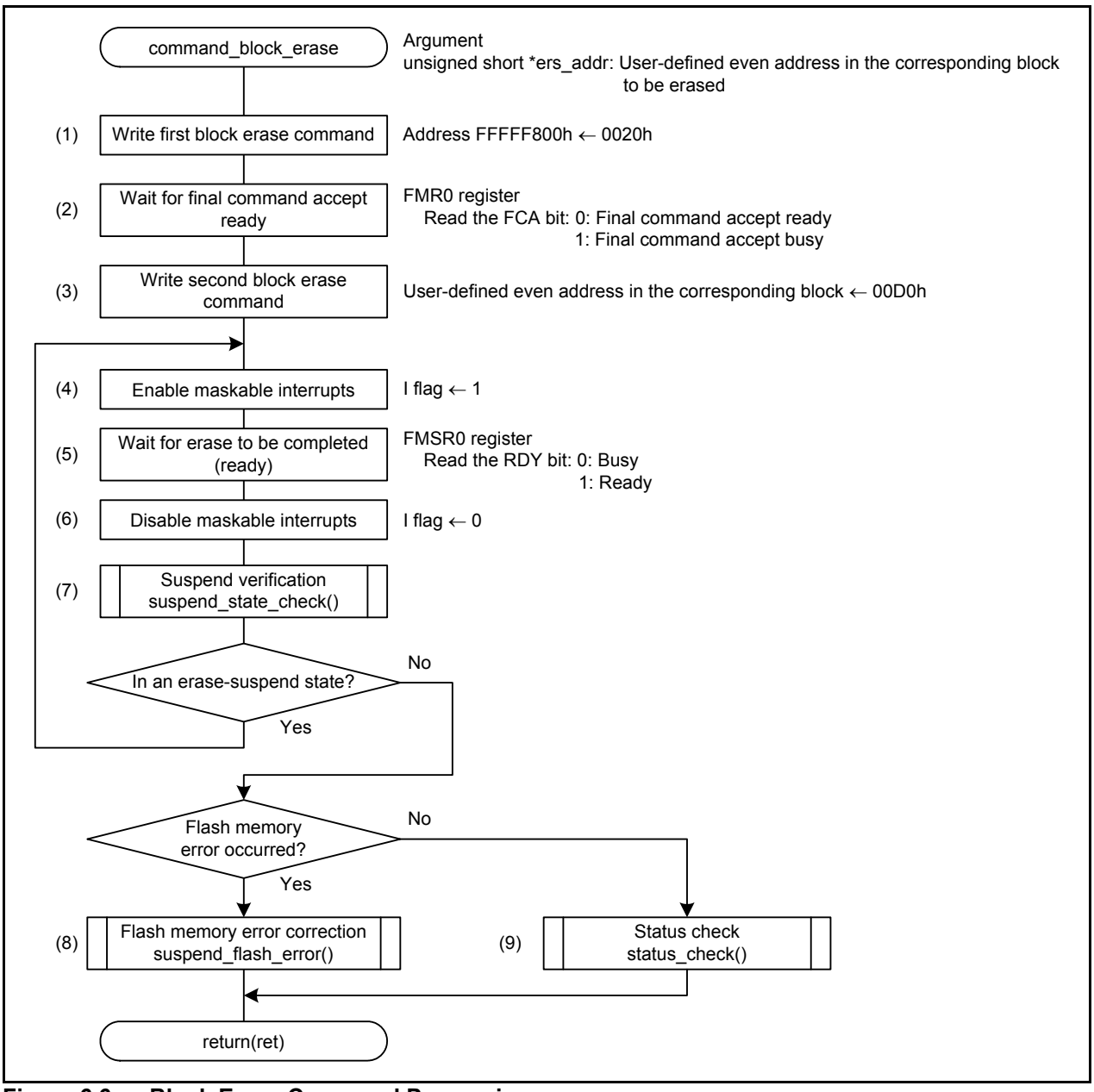

Figure 6.6 Block Erase Command Processing

6.7.6 Program Command Processing

Figure 6.7 shows Program Command Processing.

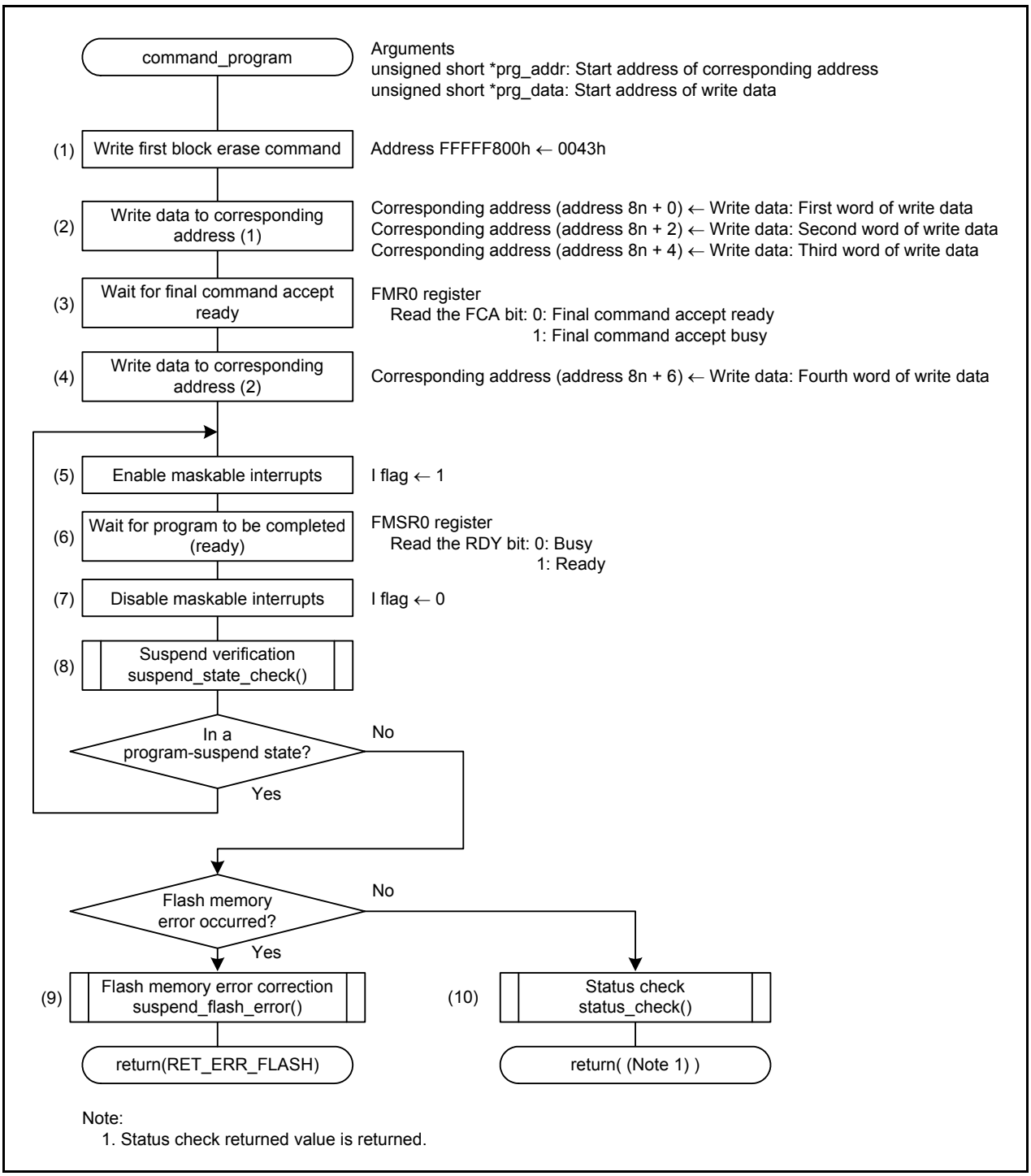

Figure 6.7 Program Command Processing

6.7.7 Status Check

Figure 6.8 shows the Status Check.

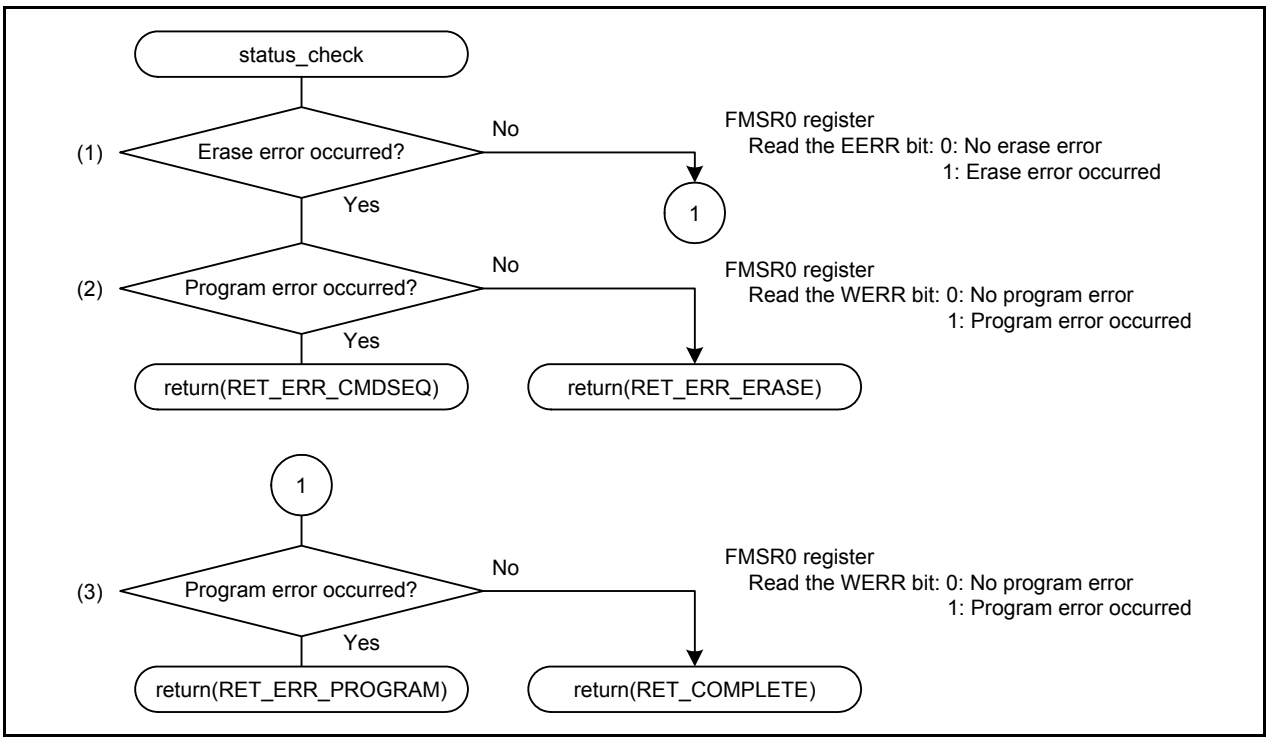

Figure 6.8 Status Check

6.7.8 Suspend Verification

Figure 6.9 shows Suspend Verification.

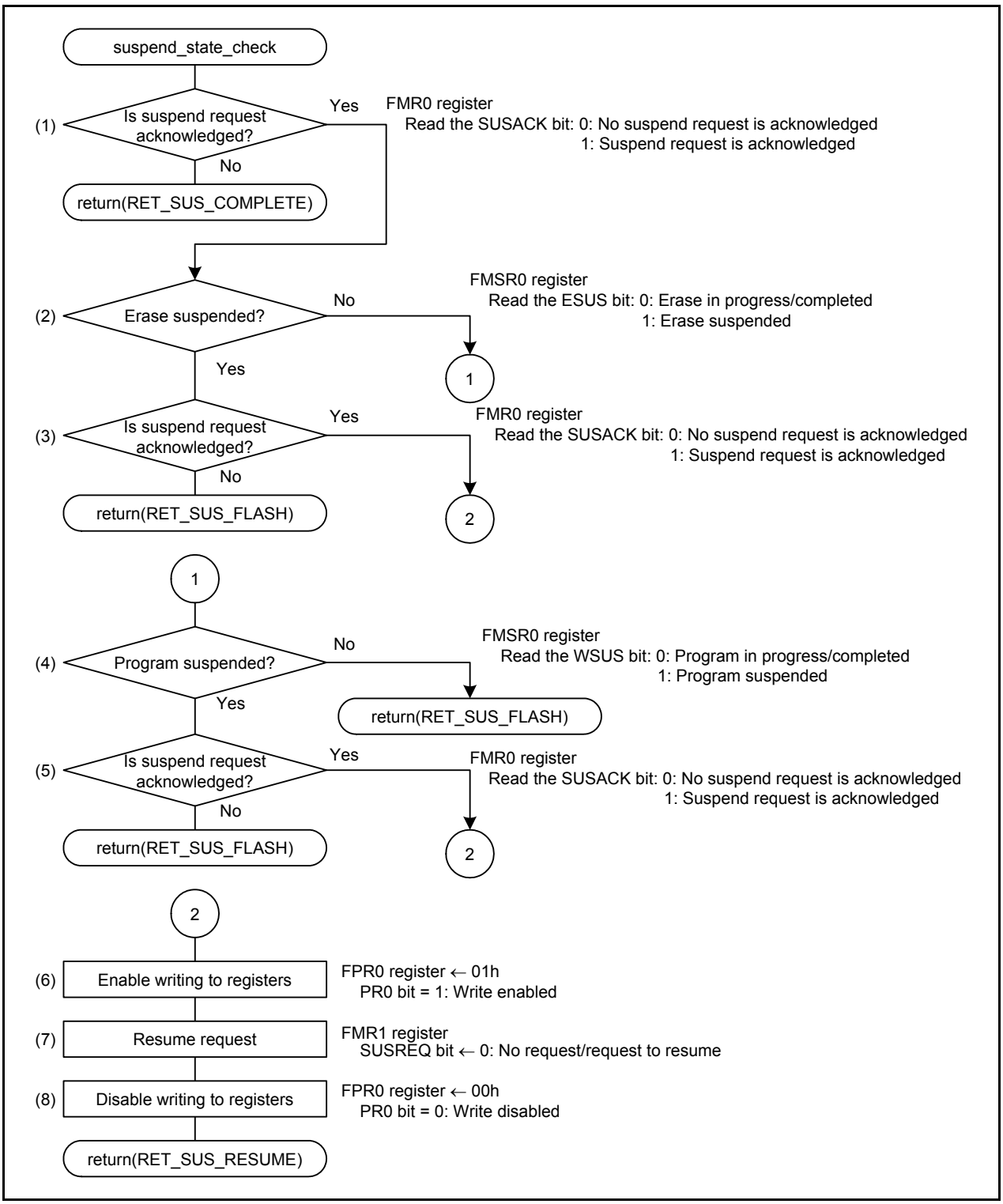

Figure 6.9 Suspend Verification

6.7.9 Block Erase Error Processing

Figure 6.10 shows Block Erase Error Processing.

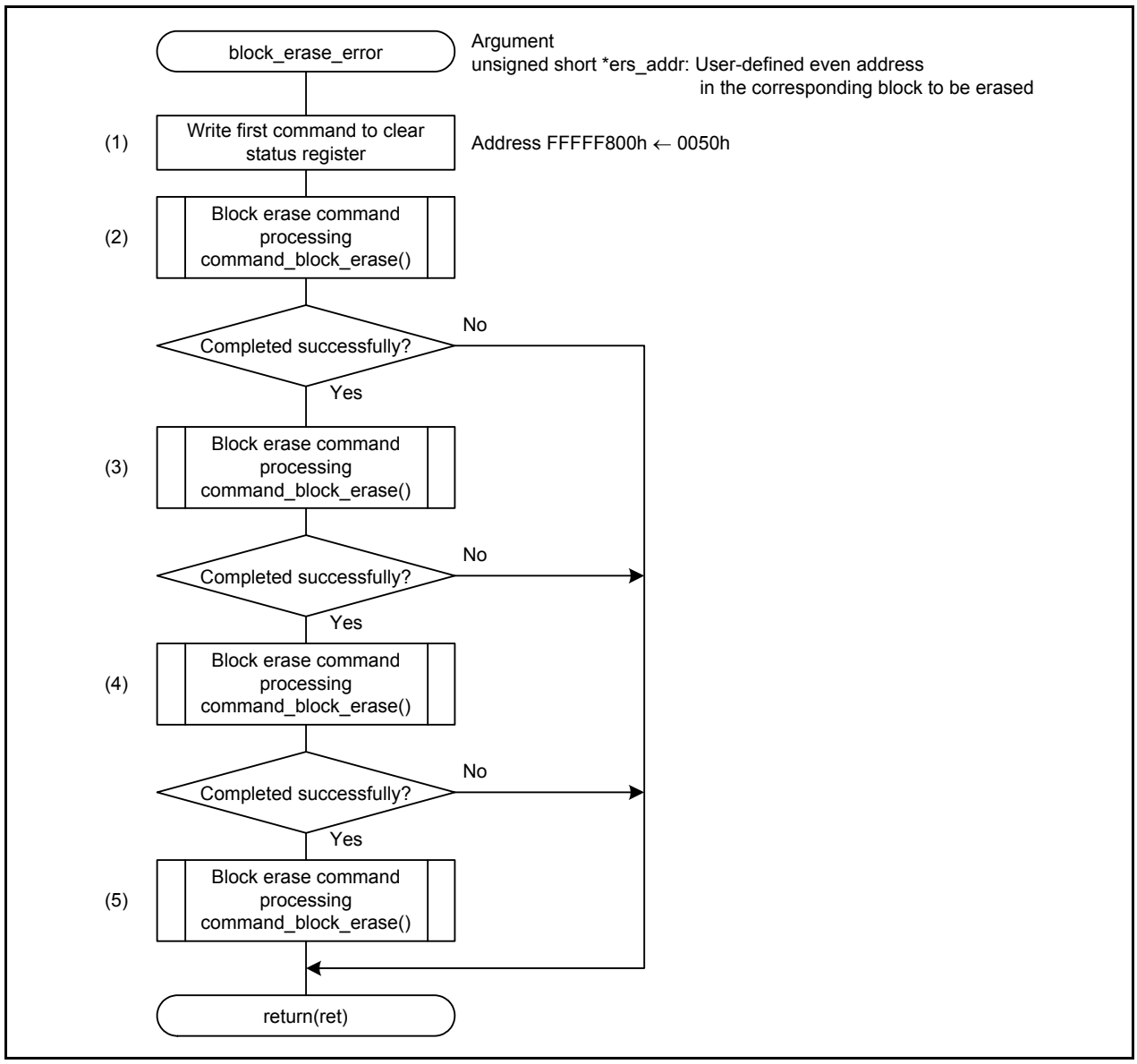

Figure 6.10 Block Erase Error Processing

6.7.10 Program Data Verification

Figure 6.11 shows Program Data Verification.

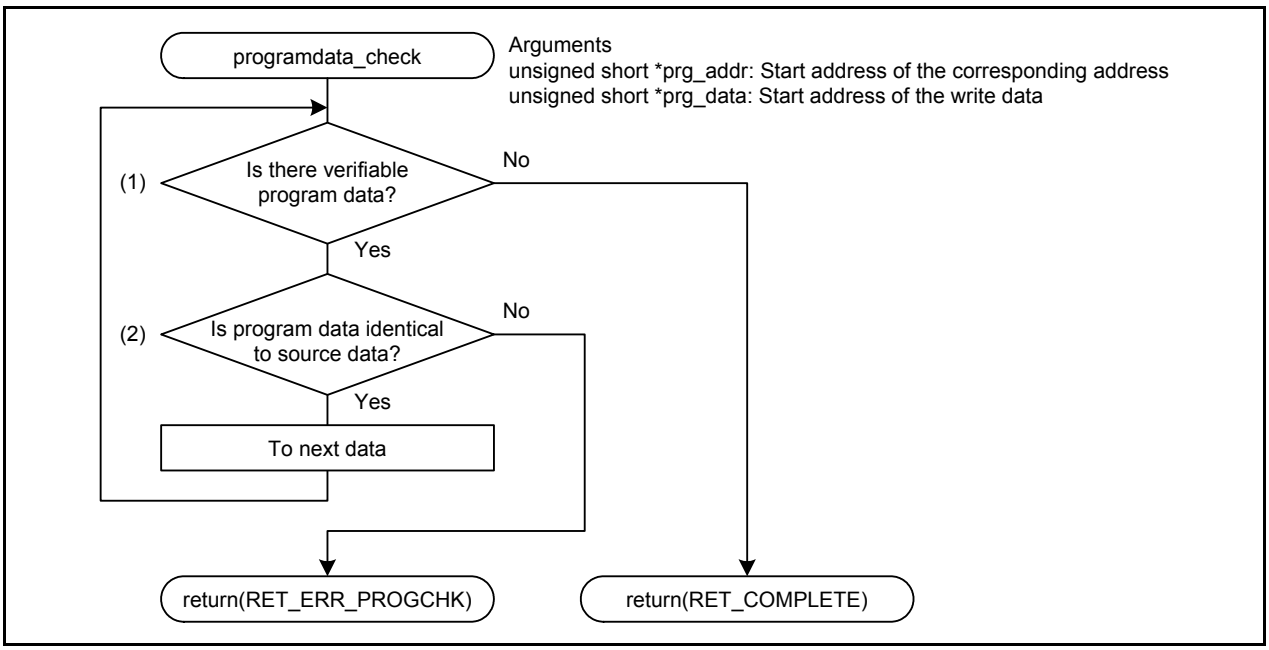

Figure 6.11 Program Data Verification

6.7.11 Flash Memory Error Processing During Suspend

Figure 6.12 shows Flash Memory Processing During Suspend.

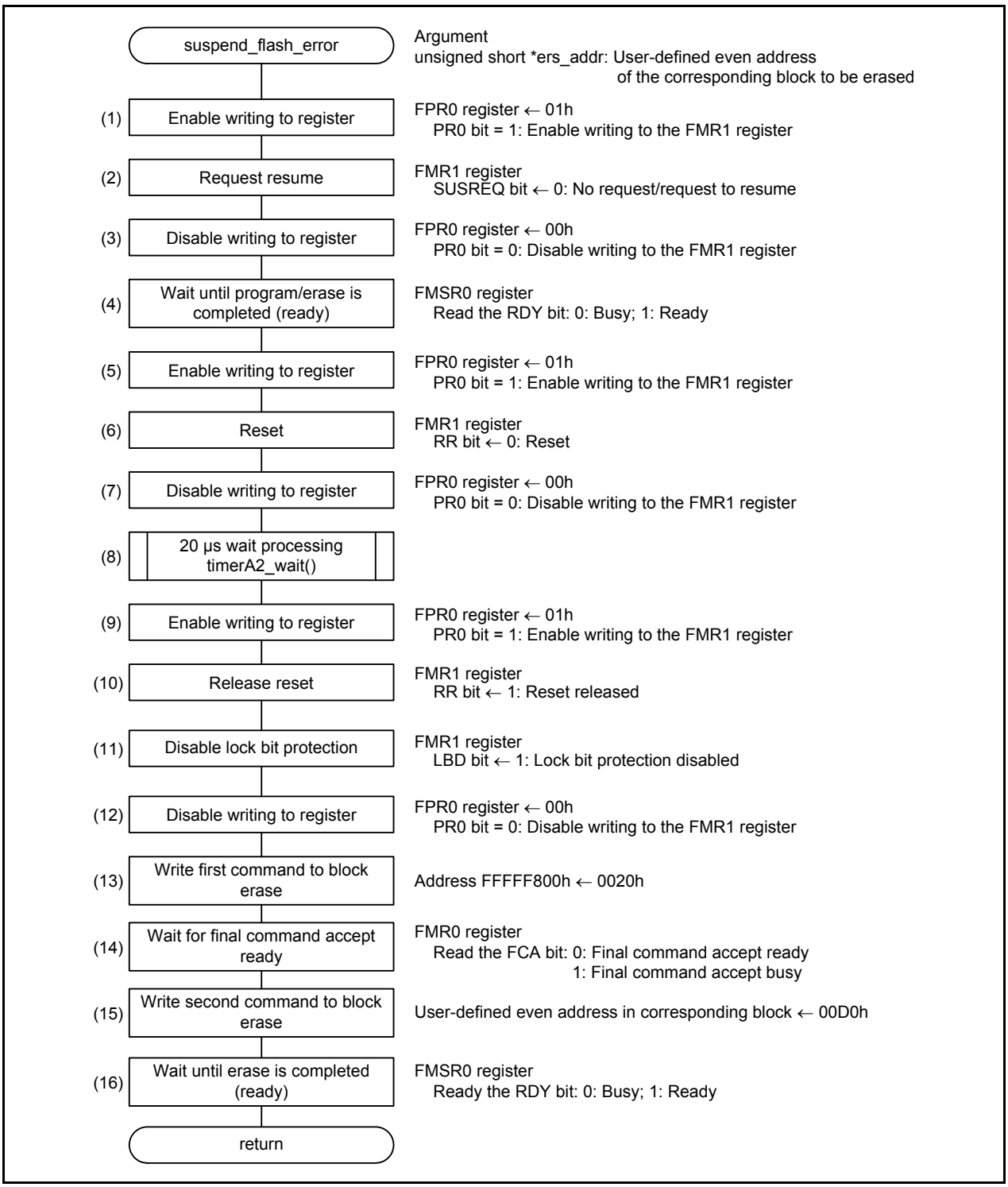

Figure 6.12 Flash Memory Processing During Suspend

6.7.12 Timer A0 Initial Setting

Figure 6.13 shows the Timer A0 Initial Setting.

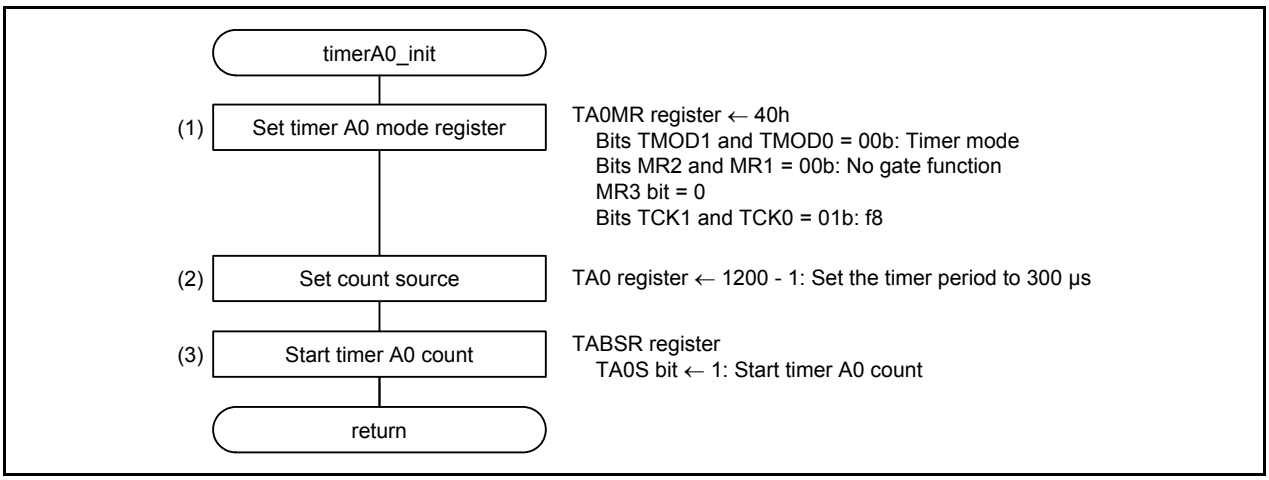

Figure 6.13 Timer A0 Initial Setting

6.7.13 Timer A2 Processing

Figure 6.14 shows Timer A2 Processing.

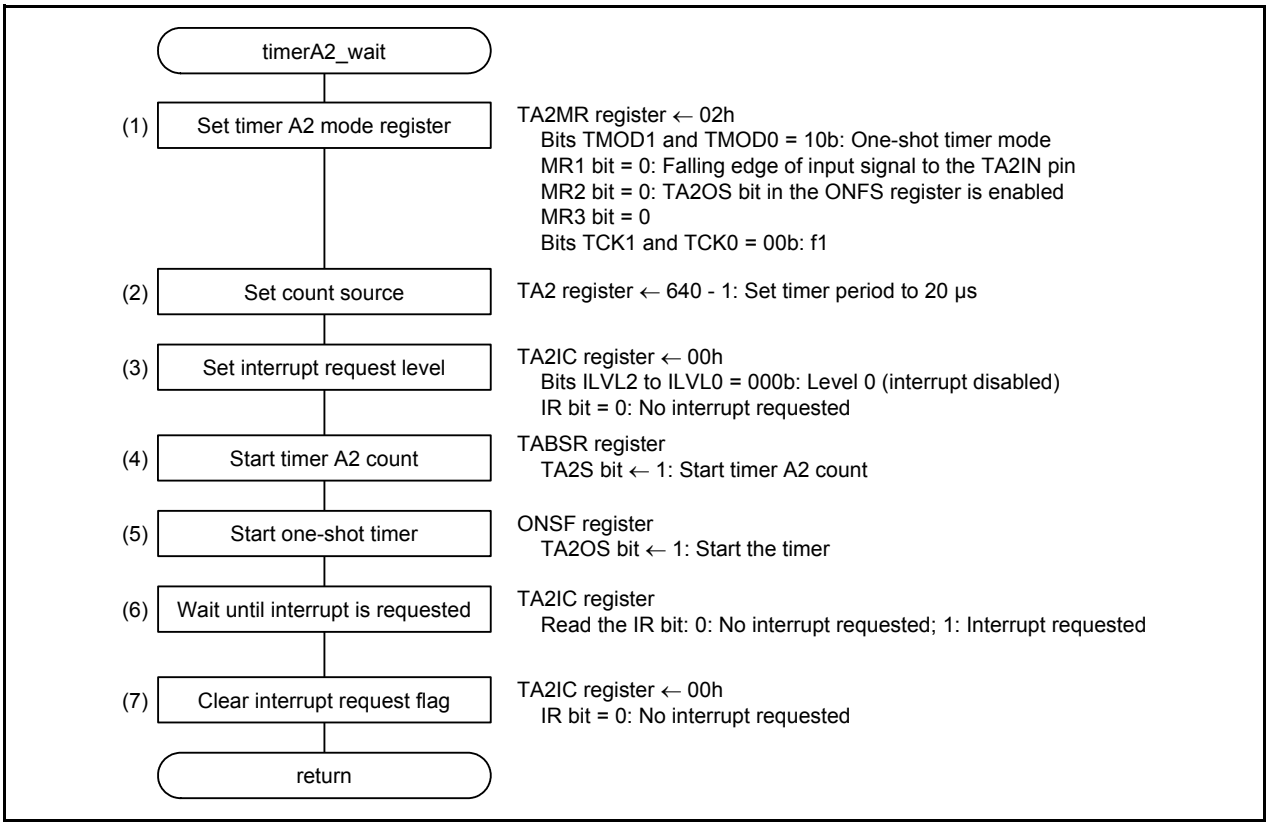

Figure 6.14 Timer A2 Processing

6.7.14 Timer A0 Interrupt Handling

Figure 6.15 shows Timer A0 Interrupt Handling.

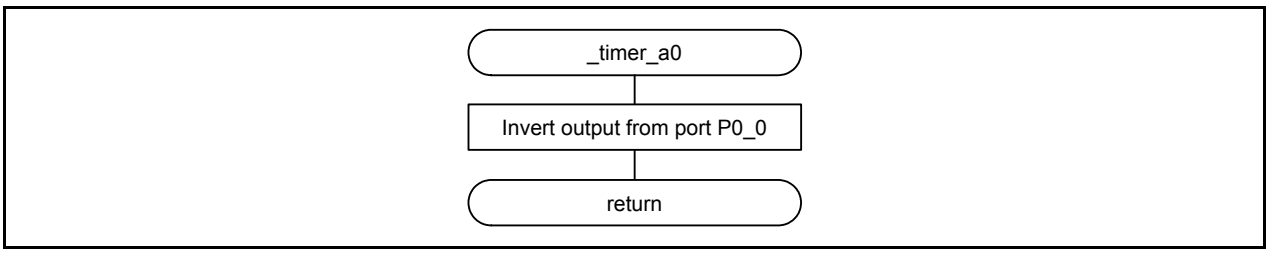

Figure 6.15 Timer A0 Interrupt Handling

7. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

8. Reference Documents

R32C/116A Group User's Manual: Hardware Rev.1.00
R32C/117A Group User's Manual: Hardware Rev.1.00
R32C/118A Group User's Manual: Hardware Rev.1.00
The latest versions can be downloaded from the Renesas Electronics website.

Technical Update/Technical News
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C Compiler Manual
R32C/100 Series C Compiler Package V.1.02
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Revision History	R32C/116A, 117A, and 118A Groups Rewriting Flash Memory Using the Suspend/Resume Function in EW1 Mode

Rev.	Date	Description	
		Page	Summary
1.00	Mar. 15, 2012	—	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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