RX71M Group

Initial Settings Example

Introduction

This application note describes the settings that must be made after a reset of a RX71M Group microcontroller, including clock settings, disabling of peripheral functions still running after a reset, and nonexistent port settings.

Target Device

- RX71M Group 177- and 176-pin versions, ROM capacity: 2 MB to 4 MB
- RX71M Group 145- and 144-pin versions, ROM capacity: 2 MB to 4 MB
- RX71M Group 100-pin version, ROM capacity: 2 MB to 4 MB

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

The sample code makes settings to disable peripheral functions still running after a reset, nonexistent port settings, and clock settings. The description in this application note applies to the processing that occurs following power-on (cold start).

1.1 Disabling Peripheral Functions Still Running After a Reset

Some peripheral functions start operating immediately after power-on, and some have the module stop function disabled. The processing covered under this item disables the following functions:

EXDMAC, DMAC, DTC, standby RAM, ECCRAM, and RAM0

Note that the above processing is not performed by the sample code. As necessary, overwrite the corresponding constants to execute the processing.

1.2 Nonexistent Port Settings

On products with pin counts under 176 pins, it is necessary to set the pins for ports that exist on 176-pin products but not on the target device to the output mode. On 176-pin products the bits for ports 54 to 56 should be set to output, while on 100-pin products the bits for port 56 should be set to output. The sample code contains initial setting values suitable for 176-pin products. Overwrite the constants as necessary to accommodate the actual target device.

1.3 Clock Settings

1.3.1 Overview

The procedure for making clock settings is as follows:

1. Sub-clock settings
2. Main clock settings
3. HOCO clock settings
4. PLL clock settings
5. System clock switching

By making changes to the constants defined in r_init_clock.h, the sample code described in this application note can be used to change the various clock settings.

The sample code sets the PLL clock as the system clock and does not use a sub-clock. Overwrite the constants as necessary to match the clocks you wish to use.

1.3.2 Clock Specifications Assumed in Sample Code

Table 1.1 lists the clock specifications assumed in sample code.

Table 1.1 Clock Specifications Assumed in Sample Code

Clock	Oscillation Frequency	Oscillation Stabilization Time	Remarks
Main clock oscillator	24 MHz	4.2 ms*2	Crystal
Sub-clock oscillator	32.768 kHz*1	1.3 s*2	For low clock
PLL clock	240 MHz (main clock ×1/1 ×10)	—*3	
HOCO clock	20 MHz*1	—*3	

Notes:1. Oscillation disabled by the sample code.
2. The oscillator's stabilization time will differ due to factors such as the wiring pattern and oscillation constant of the system. To obtain the oscillation stabilization time, request an evaluation by the oscillator manufacturer of the system in which the oscillator will be used.
3. See Electrical Characteristics in User's Manual: Hardware.

1.3.3 Clock Selection

By making changes to the constants defined in r_init_clock.h, the sample code described in this application note can be used to select settings such as the clock source of the system clock and whether each clock is oscillating or stopped. To determine which constants can be changed, see the listing of (user changeable) constants used by the sample code in tables 3.6 and 3.7.

Table 1.2 lists clock selection examples. The sample code sets the PLL clock as the system clock and does not use a sub-clock (No. 1).

Table 1.2 Clock Selection Examples

No.	1	2	3	4	5	6
System clock	PLL	PLL	HOCO	HOCO	Main clock	Main clock
PLL clock	Oscillating	Oscillating	Stopped	Stopped	Stopped	Stopped
Main clock	Oscillating	Oscillating	Stopped	Stopped	Oscillating	Oscillating
HOCO clock	Stopped	Stopped	Oscillating	Oscillating	Stopped	Stopped
Sub-clock	Stopped	Oscillating (using RTC)	Stopped	Oscillating (using RTC)	Stopped	Oscillating (using RTC)
Operating mode	High-speed operating mode	High-speed operating mode	High-speed operating mode	High-speed operating mode	Low-speed operating mode 1	Low-speed operating mode 1
Memory wait cycles*1	1 wait cycle	1 wait cycle	0 wait cycles	0 wait cycles	0 wait cycles	0 wait cycles
Constants						
SEL_SYSCLK	CLK_PLL	CLK_PLL	CLK_HOCO	CLK_HOCO	CLK_MAIN	CLK_MAIN
SEL_PLL	B_USE	B_USE	B_NOT_USE	B_NOT_USE	B_NOT_USE	B_NOT_USE
SEL_MAIN	B_USE	B_USE	B_NOT_USE	B_NOT_USE	B_USE	B_USE
SEL_HOCO	B_NOT_USE	B_NOT_USE	B_USE	B_USE	B_NOT_USE	B_NOT_USE
SEL_SUB*2	B_NOT_USE	B_NOT_USE	B_NOT_USE	B_NOT_USE	B_NOT_USE	B_NOT_USE
SEL_RTC*2	B_NOT_USE	B_USE	B_NOT_USE	B_USE	B_NOT_USE	B_USE
REG_OPCCR	OPCM_HIGH	OPCM_HIGH	OPCM_HIGH	OPCM_HIGH	OPCM_LOW_1	OPCM_LOW_1

Notes: 1. Do not clear the MEMWAIT bit to 0 if the ICLK frequency is 120 MHz or higher. Do not set the MEMWAIT bit to 1 when the operating power control mode is low-speed operating mode 2.
2. Set SEL_SUB to B_USE (use) when the sub-clock is used as the system clock, and set SEL_RTC to B_USE when the sub-clock is used as the RTC count source. The sub-clock oscillates when either SEL_SUB or SEL_RTC, or both of them, are set to B_USE.

2. Operation Confirmation Conditions

The operation of the sample code referenced in this application note (Nos. 1 to 6 in table 1.2) has been confirmed under the following conditions.

Table 2.1 Operation Confirmation Conditions

Item		Contents
MCU used		R5F571MLCDFC (RX71M Group)
Operating frequency	PLL clock selected as system clock (Nos. 1 and 2 in table 1.2)	Main clock: 24 MHz PLL: 240 MHz (main clock ×1/1 ×10) System clock (ICLK): 240 MHz (PLL ×1/1) Peripheral module clock A (PCLKA): 120 MHz (PLL ×1/2) Peripheral module clocks B to D (PCLKB to PCLKD): 60 MHz (PLL ×1/4) Flash interface clock (FCLK): 60 MHz (PLL ×1/4) External bus clock (BCLK): 60 MHz (PLL ×1/4)
	HOCO clock selected as system clock (Nos. 3 and 4 in table 1.2)	HOCO: 20 MHz System clock (ICLK): 20 MHz (HOCO ×1/1) Peripheral module clock A (PCLKA): 20 MHz (HOCO ×1/1) Peripheral module clock B to D (PCLKB to PCLKD): 10 MHz (HOCO ×1/2) Flash interface clock (FCLK):10 MHz (HOCO ×1/2) External bus clock (BCLK):10 MHz (HOCO ×1/2)
	Main clock selected as system clock (Nos. 5 and 6 in table 1.2)	Main clock: 24MHz System clock (ICLK): 750 kHz (main clock ×1/32) Peripheral module clock A (PCLKA):750 kHz (main clock ×1/32) Peripheral module clock B to D (PCLKB to PCLKD): 750 kHz (main clock ×1/32) Flash interface clock (FCLK):750 kHz (main clock ×1/32) External bus clock (BCLK):750 kHz (main clock ×1/32)
Operating voltage		3.3 V
Integrated development environment		Renesas Electronics e^2 studio Version: 2021-01
C compiler		Renesas Electronics C/C++ Compiler Package for RX Family V3.02
		Compiler option The integrated development environment default settings are used.
iodefine.h version		V 1.0A
Endian		Little endian or big endian
Operating mode		Single-chip mode
Processor mode		Supervisor mode
Sample code version		Version 1.02
Board used		Renesas Starter Kit+ for RX71M (Product No. R0K50571MSxxxBE)

3. Software

After disabling peripheral functions still running after a reset and making nonexistent port settings, the sample code makes clock settings.

3.1 Disabling Peripheral Functions Still Running After a Reset

The sample code disables peripheral functions still running after a reset.

Only the peripheral modules listed below are not in the module stop state after a reset is canceled. To transition a module to the module stop state, set the corresponding module stop bit to 1 (transition to module stop state). Putting modules into the module stop state can reduce the power consumption of the device.

In the sample code the value of the constant MSTP_STATE_<target module name> is 0 (MODULE_STOP_DISABLE), so the target module does not transition to the module stop state. To transition one or more modules to the module stop state on the target system, set the corresponding constant(s) to 1 (MODULE_STOP_ENABLE) in r_init_stop_module.h.

Table 3.1 lists the peripheral modules that are not in the module stop state after a reset.

Table 3.1 Peripheral Modules Not in Module Stop State After a Reset

Peripheral Module	Module Stop Setting Bit	Value After Reset	Setting When Not Using Module
EXDMAC	MSTPCRA.MSTPA29 bit	0 (module stop state canceled)	1 (transition to module stop state)
DMAC/DTC	MSTPCRA.MSTPA28 bit		
Standby RAM	MSTPCRC.MSTPC7 bit		
ECCRAM	MSTPCRC.MSTPC6 bit		
RAM0	MSTPCRC.MSTPC0 bit		

3.2 Nonexistent Port Settings

3.2.1 Processing Overview

The sample code sets the bits in the PDR registers corresponding to nonexistent ports to 1 (output). When writing in byte units to PDR or PODR registers containing nonexistent ports after this function has been called, set the direction control bits corresponding to the nonexistent ports to 1 and the port output data storage bits corresponding to the nonexistent ports to 0.

Table 3.2 lists the nonexistent ports.

Table 3.2 Nonexistent Ports

Port Symbol	177- and 176-Pin Products	Pins	145- and 144-Pin Products	Pins	100-Pin Products	Pins
PORT0	—	—	—	—	P00 to P03	4
PORT1	—	—	P10, P11	2	P10, P11	2
PORT2	—	—	—	—	—	—
PORT3	—	—	—	—	—	—
PORT4	—	—	—	—	—	—
PORT5	P54 to P56	3	—	—	P56	1
PORT6	—	—	—	—	P60 to P67	8
PORT7	—	—	—	—	P70 to P77	8
PORT8	—	—	—	—	P80 to P83, P86, P87	6
PORT9	—	—	P94 to P97	4	P90 to P97	8
PORTA	—	—	—	—	—	—
PORTB	—	—	—	—	—	—
PORTC	—	—	—	—	—	—
PORTD	—	—	—	—	—	—
PORTE	—	—	—	—	—	—
PORTF	—	—	PF0 to PF4	5	PF0 to PF5	6
PORTG	—	—	PG0 to PG7	8	PG0 to PG7	8
PORTJ	—	—	—	—	PJ5	1

3.2.2 Pin Count Setting

The setting in the sample code (PIN_SIZE=176) is for 176-pin products. The other pin counts supported by this application note are 177, 145, 144, and 100. If the pin count of the target device is other than 176, change the value of PIN_SIZE in r_init_port_initialize.h to match the target device.

3.3 Clock Settings

3.3.1 Clock Setting Procedure

Table 3.3 lists the steps in the clock setting procedure, the processing performed in each step, and the default settings of the sample code. Using the default settings, the sample code sets the PLL clock as the main clock and turns off the HOCO and sub-clock.

Table 3.3 Clock Setting Procedure

Step	Processing	Details of Processing		Sample Code Settings
1	Sub-clock setting*2	Not used	Initializes the sub-clock control circuit.	The sub-clock is not used.
		Used	Initializes the sub-clock control circuit, sets the drive capacity, and sets in SOSCWTCR the waiting time until output of the sub-clock to the internal clock starts; then starts oscillation by the sub-clock. After this, waits for the clock oscillation stabilization waiting time*1.	
2	Main clock setting*2	Not used	This setting is unnecessary.	The main clock is used.
		Used	Sets the main clock drive capacity and sets in MOSCWTCR the waiting time until output of the main clock to the internal clocks starts, then starts oscillation by the main clock. After this, waits for the clock oscillation stabilization waiting time*1.	
3	HOCO clock setting*2	Not used	Turns off the HOCO power supply.	The HOCO clock is not used.
		Used	Sets the HOCO frequency, then starts oscillation by the HOCO clock. After this, waits for the clock oscillation stabilization waiting time*1.	
4	PLL clock setting*2	Not used	Stops the PLL.	The PLL clock is used.
		Used	Sets the PLL input division ratio and frequency multiplication factor, then starts oscillation by the PLL clock. After this, waits for the clock oscillation stabilization waiting time*1.	
5	Operating power control mode setting	Sets the operating power control mode according to the operating frequency and operating voltage used.		High-speed operating mode is selected.
6	Clock division ratio settings	Changes the clock division ratios.		• ICLK: ×1/1 • PCLKA: ×1/2 • PCLKB to PCLKD, BCLK, and FCLK: ×1/4 • BCLK: Output stopped
7	System clock switching	Switches according to the system used.		Switches to PLL clock.

Notes: 1. Confirms that the appropriate bit in the oscillation stabilization flag register (OSCOVFSR) is set to 1.
2. Change the values of the constants in r_init_clock.h as necessary to match the selection of the clocks you wish to use or not use.

3.4 Section Configuration

Table 3.4 lists the information of the Section Changed in the Sample Code.

To add, change, or delete sections, refer to the latest version of the RX Family CC-RX Compiler User's Manual.

Table 3.4 Information of the Section Changed in the Sample Code

Section Name	Change	Address	Description
End_of_RAM	Add	0007 FFFCh	End address of the on-chip RAM
End_of_ECCRAM	Add	00FF FFFCh	End address of the ECCRAM

3.5 File Composition

Table 3.5 lists the files used in the sample code. Files generated by the integrated development environment are not included in this table.

Table 3.5 Files Used in the Sample Code

File Name	Outline	Remarks
main.c	Main processing routine	
r_init_stop_module.c	Disable peripheral functions still running after a reset	
r_init_stop_module.h	Header file of r_init_stop_module.c	
r_init_port_initialize.c	Initial nonexistent port settings	
r_init_port_initialize.h	Header file of r_init_port_initialize.c	
r_init_clock.c	Initial clock settings	
r_init_clock.h	Header file of r_init_clock.c	

3.6 Option-Setting Memory

Table 3.6 lists the option-setting memory configured in the sample code. When necessary, set a value suited to the user system.

Table 3.6 Option-Setting Memory Configured in the Sample Code

Symbol	Address	Setting Value	Contents
OFS0	0012 006B to 0012 0068h	FFFF FFFFh	IWDT stopped after a reset WDT stopped after a reset
OFS1	0012 006Fh to 0012 006Ch	FFFF FFFFh	Voltage monitor 0 reset disabled after a reset HOCO oscillation disabled after a reset
MDE	0012 0067h to 0012 0064h	FFFF FFFFh	Little endian

3.7 Constants

Tables 3.7 and 3.8 list the (user changeable) constants used by the sample code, table 3.9 lists the (non user changeable) constants, and tables 3.10 to 3.12 list the constants specific to each package.

Table 3.7 Constants (User Changeable) Used by Sample Code (1/2)

Constant Name	Setting Value	Contents
SEL_MAIN*1	B_USE	Main clock enable/disable selection B_USE: Used (main clock enabled) B_NOT_USE: Not used (main clock disabled)
MAIN_CLOCK_HZ*1	24,000,000 L	Main clock oscillator frequency (Hz)
REG_MOFCR*1	00h	Main clock oscillator drive capacity setting (setting value of MOFCR register)
REG_MOSCWTCR*1	53h	Setting value of main clock wait control register
SEL_SUB*1*2	B_NOT_USE	Sub-clock usage selection (used as system clock) B_USE: Used B_NOT_USE: Not used
SEL_RTC*1*2	B_NOT_USE	Sub-clock usage selection (used as RTC count source) B_USE: Used B_NOT_USE: Not used
SUB_CLOCK_HZ*1	32,768 L	Sub-clock oscillator frequency (Hz)
REG_SOSCWTCR*1	21h	Setting value of sub-clock wait control register
REG_RCR3*1	CL_LOW	Sub-clock oscillator drive capacity selection CL_STD: Drive capacity for standard clock CL_LOW: Drive capacity for low clock
SEL_PLL*1	B_USE	PLL clock enable/disable selection B_USE: Used (PLL clock enabled) B_NOT_USE: Not used (PLL clock disabled)
REG_PLLCR*1	1300h	PLL input division ratio and frequency multiplication factor settings (setting value of PLLCR register)

Notes: 1. Change the settings values in r_init_clock.h to match the target system.
2. The sub-clock oscillates when either SEL_SUB or SEL_RTC, or both of them, are set to B_USE (use).

Table 3.8 Constants (User Changeable) Used by Sample Code (2/2)

Constant Name	Setting Value	Contents
SEL_HOCO*1	B_NOT_USE	HOCO clock enable/disable selection B_USE: Used (HOCO clock enabled) B_NOT_USE: Not used (HOCO clock disabled)
REG_HOCOCR2*1	FREQ_20MHZ	HOCO clock frequency selection FREQ_16 MHZ: 16 MHz FREQ_18 MHZ: 18 MHz FREQ_20 MHZ: 20 MHz
SEL_SYSCLK*1	CLK_PLL	System clock clock source selection CLK_PLL: PLL CLK_HOCO: HOCO CLK_MAIN: main clock CLK_SUB: sub-clock
REG_OPCCR*1	OPCM_HIGH	Operating power control mode selection*6 OPCM_HIGH: High-speed operating mode OPCM_LOW_1: Low-speed operating mode 1*4 OPCM_LOW_2: Low-speed operating mode 2*5
MSTP_STATE_EXDMAC*2	MODULE_STOP_DISABLE	EXDMAC module stop state selection MODULE_STOP_DISABLE: Disable module stop MODULE_STOP_ENABLE: Transition to module stop
MSTP_STATE_DMACDTC*2	MODULE_STOP_DISABLE	DMAC and DTC module stop state selection MODULE_STOP_DISABLE: Disable module stop MODULE_STOP_ENABLE: Transition to module stop
MSTP_STATE_STBYRAM*2	MODULE_STOP_DISABLE	Standby RAM module stop state selection MODULE_STOP_DISABLE: Operating MODULE_STOP_ENABLE: Stopped
MSTP_STATE_ECCRAM*2	MODULE_STOP_DISABLE	ECCRAM module stop state selection MODULE_STOP_DISABLE: Operating MODULE_STOP_ENABLE: Stopped
MSTP_STATE_RAM0*2	MODULE_STOP_DISABLE	RAM0 module stop state selection MODULE_STOP_DISABLE: Operating MODULE_STOP_ENABLE: Stopped
PIN_SIZE*3	176	Pin count of target device
REG_MEMWAIT*7	MEMWAIT_1WAIT	Memory wait cycle selection MEMWAIT_0WAIT: 0 wait cycles MEMWAIT_1WAIT: 1 wait cycle

Notes: 1. Change the settings values in r_init_clock.h to match the target system.
2. Change the settings values in r_init_stop_module.h to match the target system.
3. Change the settings values in r_init_port_initialize.h to match the target system.
4. It is not possible to select low-speed operating mode 1 when the PLL clock is set to oscillate.
5. It is not possible to select low-speed operating mode 2 when the PLL clock or HOCO is set to oscillate.
6. The operating frequency range and operating voltage range differ depending on the operating mode. For details, see RX71M Group User's Manual: Hardware.
7. Do not select the 0 wait cycles setting when the ICLK frequency is 120 MHz or above. Do not select the 1 wait cycle setting when the operating power control state is low-speed operating mode 2.

Table 3.9 Constants (Non User Changeable) Used by Sample Code

Constant Name	Setting Value	Contents
B_NOT_USE	0	Not used
B_USE	1	Used
CL_LOW	02h	Sub-clock: Drive capacity for low clock
CL_STD	0Ch	Sub-clock: Drive capacity for standard clock
FREQ_16MHZ	00h	HOCO frequency: 16 MHz
FREQ_18MHZ	01h	HOCO frequency: 18 MHz
FREQ_20MHZ	02h	HOCO frequency: 20 MHz
CLK_PLL	0400h	Clock source: PLL
CLK_HOCO	0100h	Clock source: HOCO
CLK_SUB	0300h	Clock source: Sub-clock
CLK_MAIN	0200h	Clock source: Main clock
MEMWAIT_0WAIT	0	Memory wait cycles: 0 wait cycles
MEMWAIT_1WAIT	1	Memory wait cycles: 1 wait cycle
REG_SCKCR*1	20C2 1222h (PLL selected) 10C1 0111h (HOCO selected) 55C5 5555h (other than the above)	Internal clock division ratio and BCLK/SDCLK pin output control settings (setting value of PLLCR register)
OPCM_HIGH	00h	Operating power control mode: High-speed operating mode
OPCM_LOW_1	06h	Operating power control mode: Low-speed operating mode 1
OPCM_LOW_2	07h	Operating power control mode: Low-speed operating mode 2
SUB_CLOCK_CYCLE	(1,000,000,000L / SUB_CLOCK_HZ)	Sub-clock cycle (ns)
FOR_CMT0_TIME	121212L	Count cycle (ns) of timer for RTC software wait cycles (CMT0) = 1/LOCO (264 kHz) ×32 (LOCO = 264 kHz (max.), PCLKB ×1/32)
MODULE_STOP_ENABLE	1	Transition to module stop state
MODULE_STOP_DISABLE	0	Cancel module stop state

Notes: 1. The setting value differs depending on the selected system clock clock source.

Table 3.10 Constants for 177- and 176-Pin Products (PIN_SIZE=177 or PIN_SIZE=176)

Constant Name	Setting Value	Contents
DEF_P0PDR	0x00	Port P0 direction register setting value
DEF_P1PDR	0x00	Port P1 direction register setting value
DEF_P2PDR	0x00	Port P2 direction register setting value
DEF_P3PDR	0x00	Port P3 direction register setting value
DEF_P4PDR	0x00	Port P4 direction register setting value
DEF_P5PDR	0x70	Port P5 direction register setting value
DEF_P6PDR	0x00	Port P6 direction register setting value
DEF_P7PDR	0x00	Port P7 direction register setting value
DEF_P8PDR	0x00	Port P8 direction register setting value
DEF_P9PDR	0x00	Port P9 direction register setting value
DEF_PAPDR	0x00	Port PA direction register setting value
DEF_PBPDR	0x00	Port PB direction register setting value
DEF_PCPDR	0x00	Port PC direction register setting value
DEF_PDPDR	0x00	Port PD direction register setting value
DEF_PEPDR	0x00	Port PE direction register setting value
DEF_PFPDR	0x00	Port PF direction register setting value
DEF_PGPDR	0x00	Port PG direction register setting value
DEF_PJPDR	0x00	Port PJ direction register setting value

Table 3.11 Constants for 145- and 144-Pin Products (PIN_SIZE=145 or PIN_SIZE=144)

Constant Name	Setting Value	Contents
DEF_P0PDR	0x00	Port P0 direction register setting value
DEF_P1PDR	0x03	Port P1 direction register setting value
DEF_P2PDR	0x00	Port P2 direction register setting value
DEF_P3PDR	0x00	Port P3 direction register setting value
DEF_P4PDR	0x00	Port P4 direction register setting value
DEF_P5PDR	0x00	Port P5 direction register setting value
DEF_P6PDR	0x00	Port P6 direction register setting value
DEF_P7PDR	0x00	Port P7 direction register setting value
DEF_P8PDR	0x00	Port P8 direction register setting value
DEF_P9PDR	0xF0	Port P9 direction register setting value
DEF_PAPDR	0x00	Port PA direction register setting value
DEF_PBPDR	0x00	Port PB direction register setting value
DEF_PCPDR	0x00	Port PC direction register setting value
DEF_PDPDR	0x00	Port PD direction register setting value
DEF_PEPDR	0x00	Port PE direction register setting value
DEF_PFPDR	0x1F	Port PF direction register setting value
DEF_PGPDR	0xFF	Port PG direction register setting value
DEF_PJPDR	0x00	Port PJ direction register setting value

Table 3.12 Constants for 100-Pin Products (PIN_SIZE=100)

Constant Name	Setting Value	Contents
DEF_P0PDR	0x0F	Port P0 direction register setting value
DEF_P1PDR	0x03	Port P1 direction register setting value
DEF_P2PDR	0x00	Port P2 direction register setting value
DEF_P3PDR	0x00	Port P3 direction register setting value
DEF_P4PDR	0x00	Port P4 direction register setting value
DEF_P5PDR	0x40	Port P5 direction register setting value
DEF_P6PDR	0xFF	Port P6 direction register setting value
DEF_P7PDR	0xFF	Port P7 direction register setting value
DEF_P8PDR	0xCF	Port P8 direction register setting value
DEF_P9PDR	0xFF	Port P9 direction register setting value
DEF_PAPDR	0x00	Port PA direction register setting value
DEF_PBPDR	0x00	Port PB direction register setting value
DEF_PCPDR	0x00	Port PC direction register setting value
DEF_PDPDR	0x00	Port PD direction register setting value
DEF_PEPDR	0x00	Port PE direction register setting value
DEF_PFPDR	0x3F	Port PF direction register setting value
DEF_PGPDR	0xFF	Port PG direction register setting value
DEF_PJPDR	0x20	Port PJ direction register setting value

3.8 Functions

Table 3.13 lists the functions.

Table 3.13 Functions

Function Name	Outline
Main	Main processing routine
R_INIT_StopModule	Disable peripheral functions still running after a reset
R_INIT_Port_Initialize	Initial nonexistent port settings
R_INIT_Clock	Initial clock settings
CGC_oscillation_main	Main clock oscillation enable
CGC_oscillation_HOCO	HOCO clock oscillation enable
CGC_oscillation_PLL	PLL clock oscillation enable
CGC_oscillation_sub	Sub-clock oscillation enable
CGC_disable_subclk	Sub-clock disable
oscillation_subclk	Sub-clock oscillation enable
resetting_wtcr_subclk	Sub-clock wait control register resetting
init_RTC	Initialization RTC
cmt0_wait	Software wait cycles using CMT0

3.9 Function Specifications

The following tables list the sample code function specifications.

Main	
Outline	Main processing routine
Header	None
Declaration	void main(void)
Description	Calls the settings function for disabling peripheral functions still running after a reset, the initial nonexistent port settings function, and the initial clock settings function.
Arguments	None
Return Value	None

R_INIT_StopModule	
Outline	Disable peripheral functions still running after a reset
Header	r_init_stop_module.h
Declaration	void R_INIT_StopModule(void)
Description	Makes settings to transition to the module stop state.
Arguments	None
Return Value	None
Remarks	In the sample code, no transition to the module stop state occurs.

R_INIT_Port_Initialize	
Outline	Initial nonexistent port settings
Header	r_init_port_initialize.h
Declaration	void R_INIT_Port_Initialize(void)
Description	Makes initial settings to the port direction registers corresponding to the pins of nonexistent port.
Arguments	None
Return Value	None
Remarks	The setting in the sample code (PIN_SIZE=176) is for 176-pin products. When writing in byte units to PDR or PODR registers containing nonexistent ports after this function has been called, set the direction control bits corresponding to the nonexistent ports to 1 and the port output data storage bits corresponding to the nonexistent ports to 0.

R_INIT_Clock	
Outline	Initial clock settings
Header	r_init_clock.h
Declaration	void R_INIT_Clock(void)
Description	Makes initial clock settings and specifies the number of memory wait cycles.
Arguments	None
Return Value	None
Remarks	In the sample code processing is selected that sets the PLL clock as the system clock, specifies one memory wait cycle, and does not use a sub-clock.

CGC_oscillation_main	
Outline	Main clock oscillation enable
Header	r_init_clock.h
Declaration	void CGC_oscillation_main (void)
Description	Sets the drive capacity of the main clock and sets the MOSCWTCR register, then starts oscillation of the main clock. After this, waits for the main clock oscillation stabilization waiting time.
Arguments	None
Return Value	None

CGC_oscillation_HOCO	
Outline	HOCO clock oscillation enable
Header	r_init_clock.h
Declaration	void CGC_oscillation_HOCO (void)
Description	Sets the HOCO frequency, then starts oscillation of the HOCO. After this, waits for the HOCO oscillation stabilization waiting time.
Arguments	None
Return Value	None

CGC_oscillation_PLL	
Outline	PLL clock oscillation enable
Header	r_init_clock.h
Declaration	void CGC_oscillation_PLL (void)
Description	Sets the PLL input division ratio and frequency multiplication factor, then starts oscillation of the PLL clock. After this, waits for the PLL clock oscillation stabilization waiting time.
Arguments	None
Return Value	None

CGC_oscillation_sub	
Outline	Sub-clock oscillation enable
Header	r_init_clock.h
Declaration	void CGC_oscillation_sub (void)
Description	Makes settings for using the sub-clock as the system clock or as the RTC count source, or for both.
Arguments	None
Return Value	None

CGC_disable_subclk	
Outline	Sub-clock disable
Header	r_init_clock.h
Declaration	void CGC_disable_subclk (void)
Description	Makes settings for when the sub-clock is not used as the system clock or as the RTC count source.
Arguments	None
Return Value	None

oscillation_subclk	
Outline	Sub-clock oscillation enable
Header	None
Declaration	static void oscillation_subclk (void)
Description	Makes settings to start sub-clock oscillation.
Arguments	None
Return Value	None

resetting_wtcr_subclk	
Outline	Sub-clock wait control register resetting
Header	None
Declaration	static void resetting_wtcr_subclk (void)
Description	Resets the wait control register when returning from software standby mode. In this case the wait control register is set to the minimum value.
Arguments	None
Remarks	

init_RTC	
Outline	Initialization RTC
Header	None
Declaration	static void init_RTC (void)
Description	Makes initial settings for the RTC (clock supply setting and RTC software reset).
Arguments	None
Return Value	None

cmt0_wait		
Outline	Software wait cycles using CMT	
Header	None	
Declaration	static void cmt0_wait (uint32_t cnt)	
Description	Used when waiting before writing to the RTC register.	
Arguments	uint32_t cnt	Wait time cnt = Wait time (ns) ÷ FOR_CMT0_TIME*1
Return Value	None	
Remarks	Note 1. The duration of FOR_CMT0_TIME is calculated based on LOCO = 264 kHz (max.). The actual wait time will differ depending on the LOCO frequency.	

3.10 Flowcharts

3.10.1 Main Processing

Figure 3.1 shows the main processing.

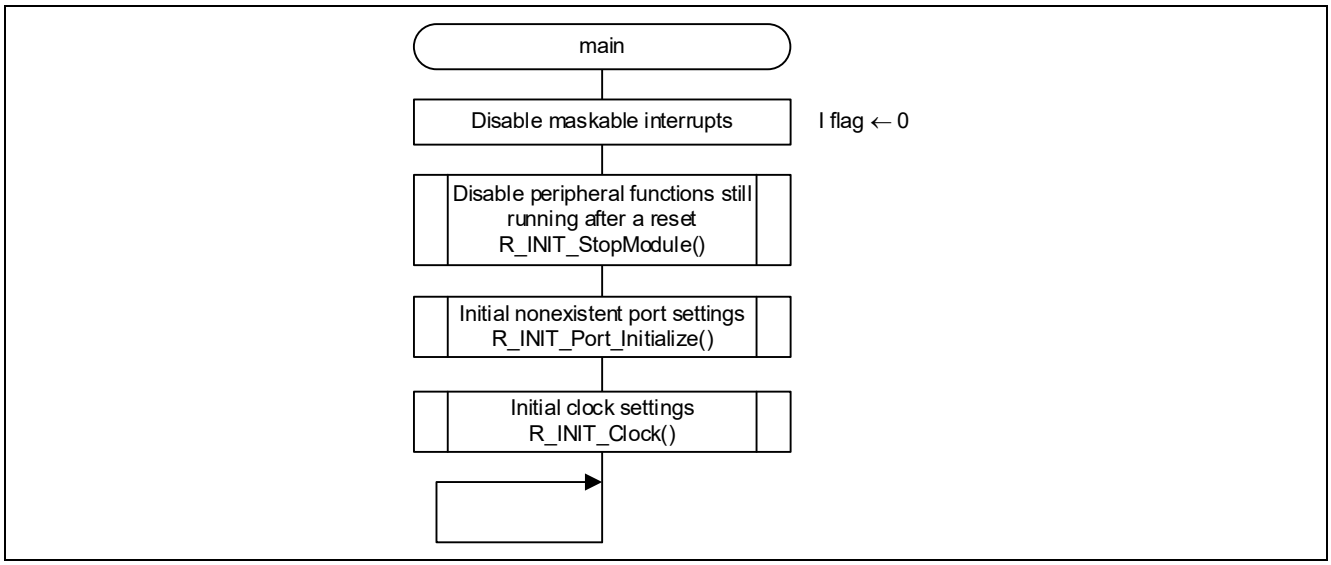
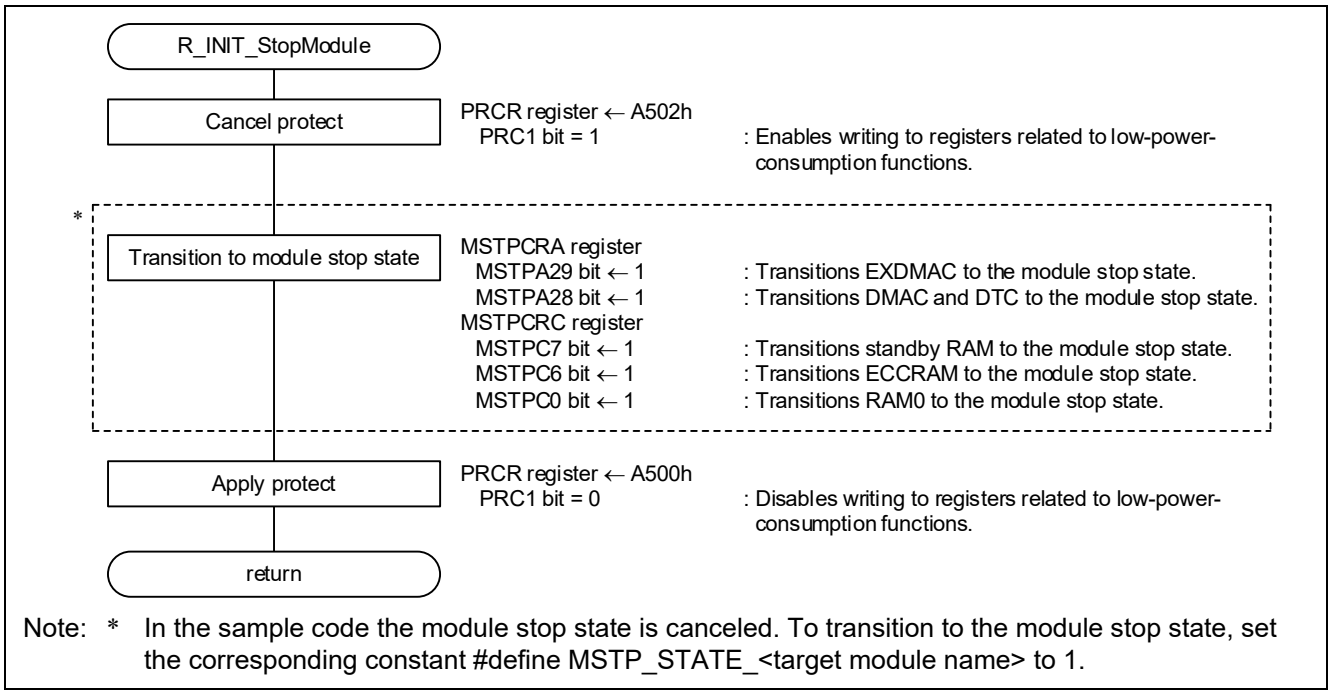


Figure 3.1 Main Processing

3.10.2 Disable Peripheral Functions Still Running After a Reset

Figure 3.2 is a flowchart of the processing for disabling of peripheral functions still running after a reset.

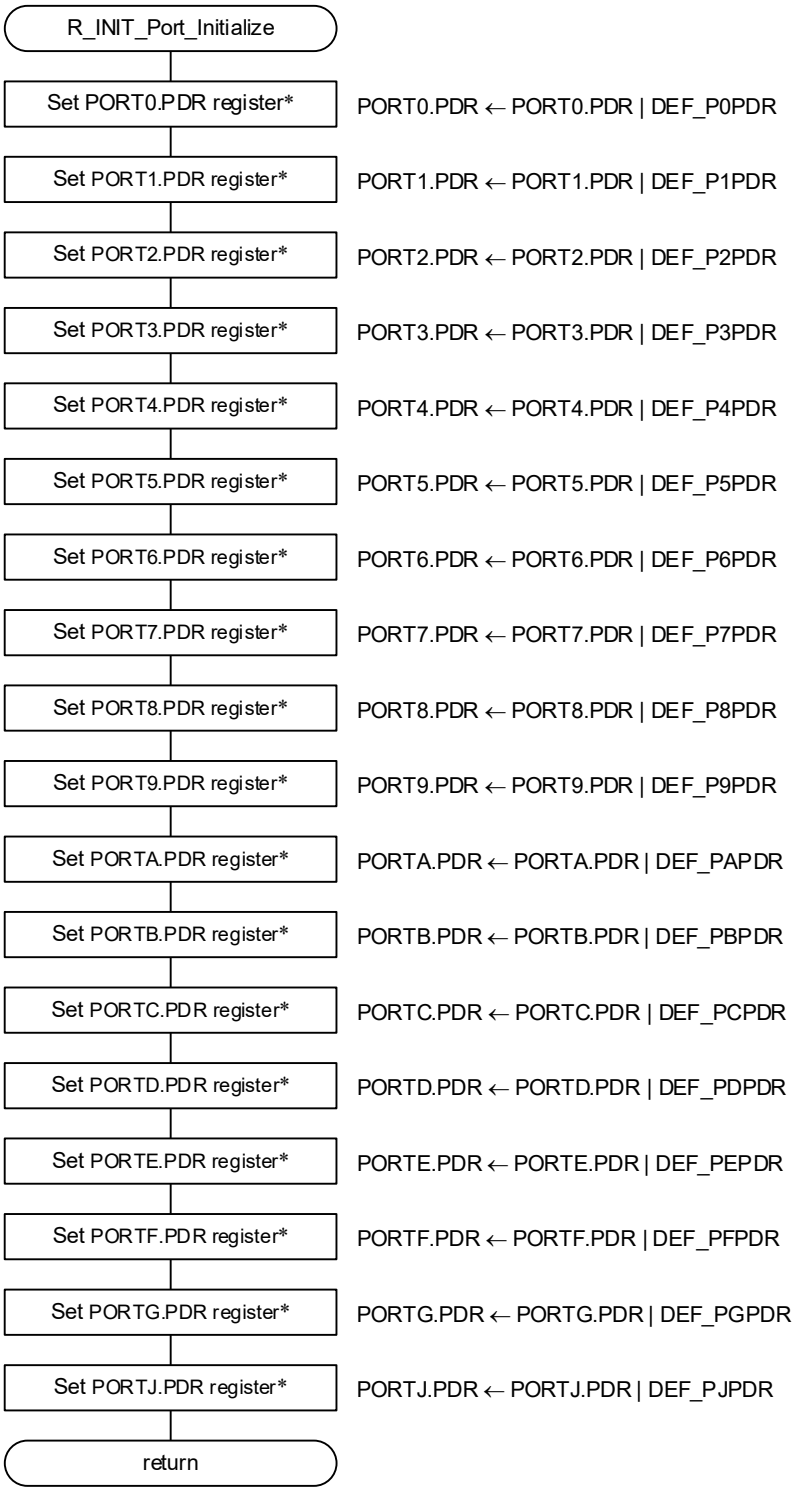


Note: * In the sample code the module stop state is canceled. To transition to the module stop state, set the corresponding constant #define MSTP_STATE_<target module name> to 1.

Figure 3.2 Disable Peripheral Functions Still Running After a Reset

3.10.3 Initial Nonexistent Port Settings

Figure 3.3 is a flowchart of the processing for making initial nonexistent port settings.

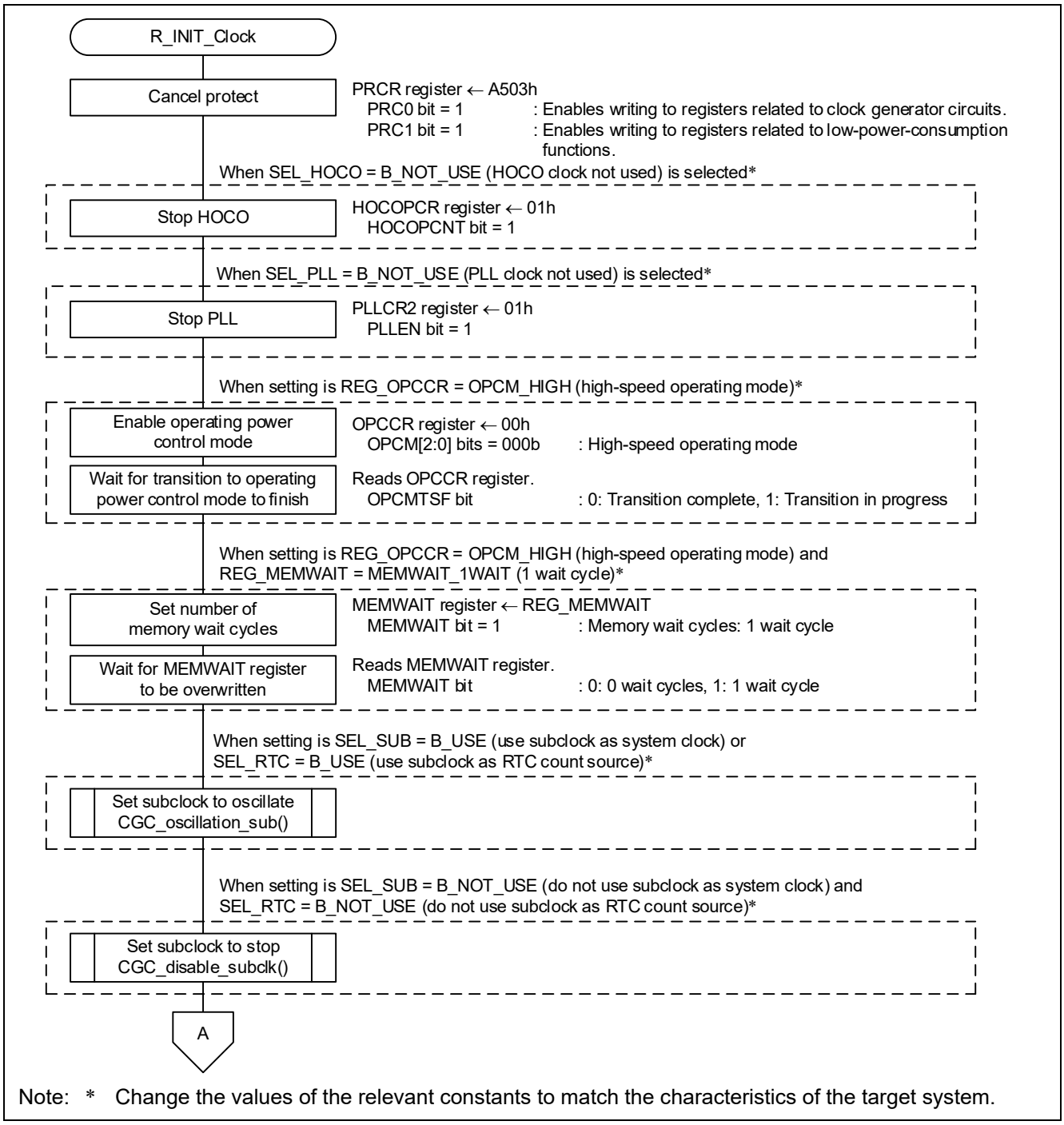


Note: * No processing of settings is performed for registers in which all bits correspond to existing pins (omitted during compile).

Figure 3.3 Initial Nonexistent Port Settings

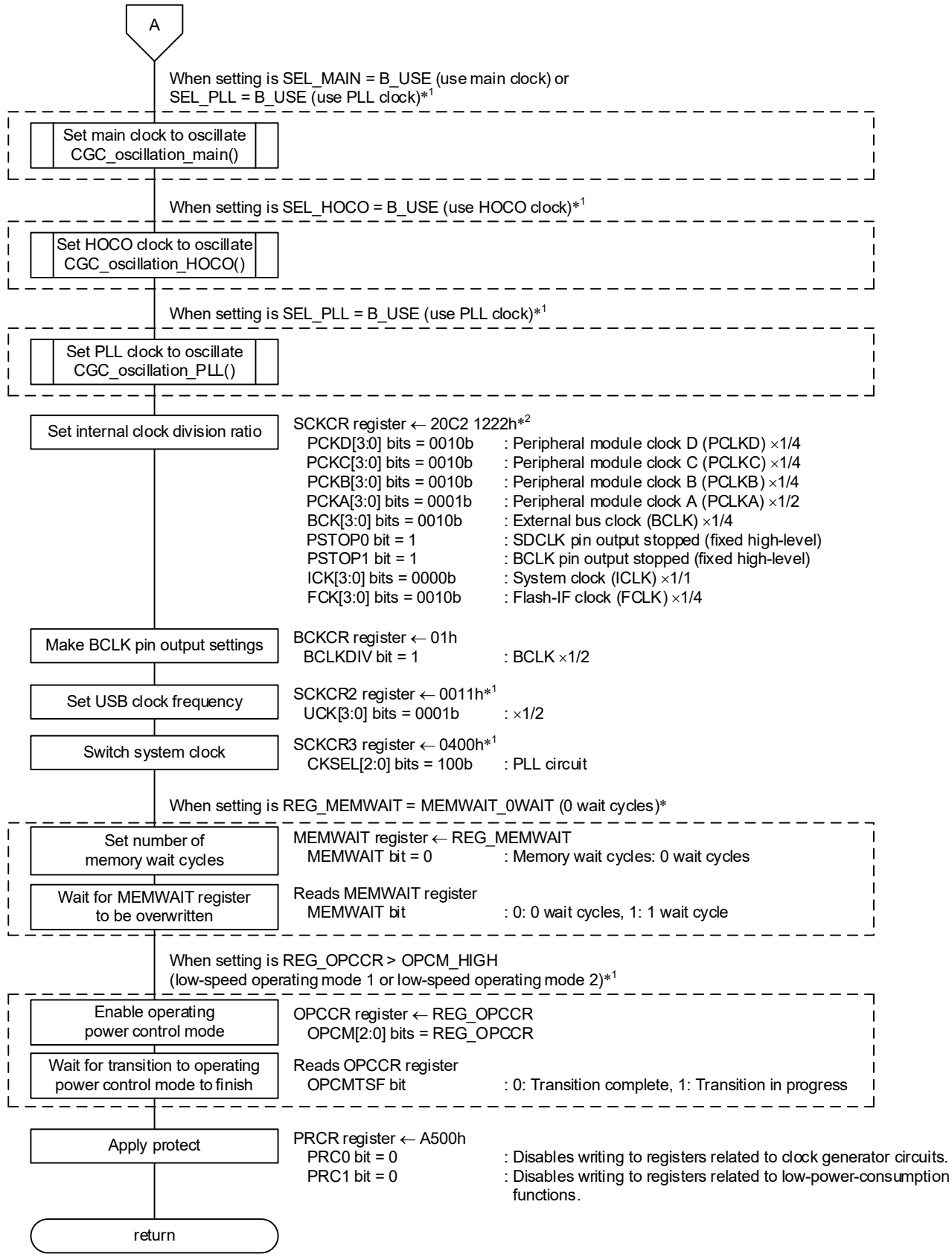
3.10.4 Initial Clock Settings

Figures 3.4 and 3.5 are flowcharts of the processing for making initial clock settings (1/2) and (2/2).



Note: * Change the values of the relevant constants to match the characteristics of the target system.

Figure 3.4 Initial Clock Settings (1/2)

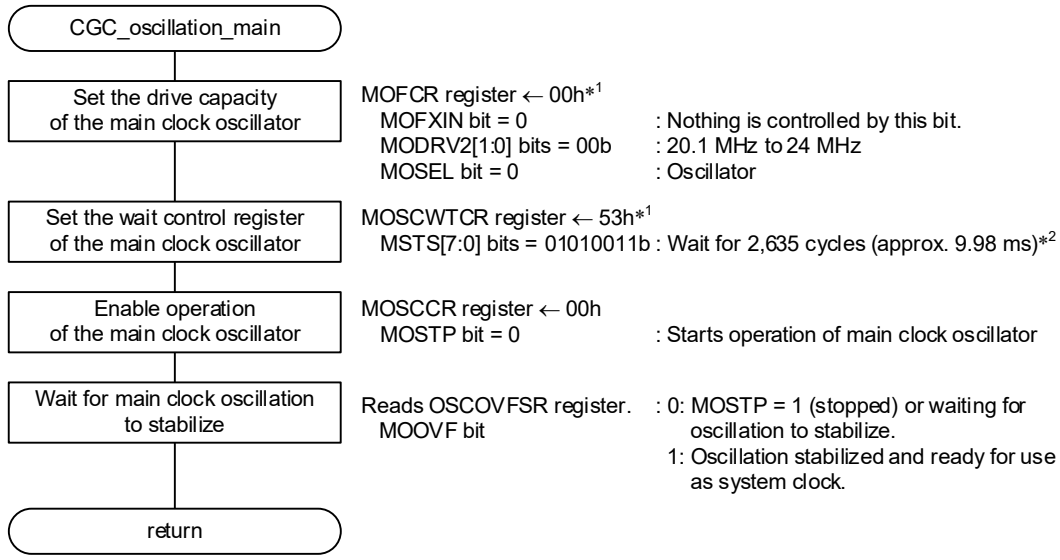


Notes: 1. Change the values of the relevant constants to match the characteristics of the target system.
2. The setting values differ depending on the system clock selected by the constant.

Figure 3.5 Initial Clock Settings (2/2)

3.10.5 Main Clock Oscillation Enable

Figure 3.6 is a flowchart of the processing for starting oscillation of the main clock.

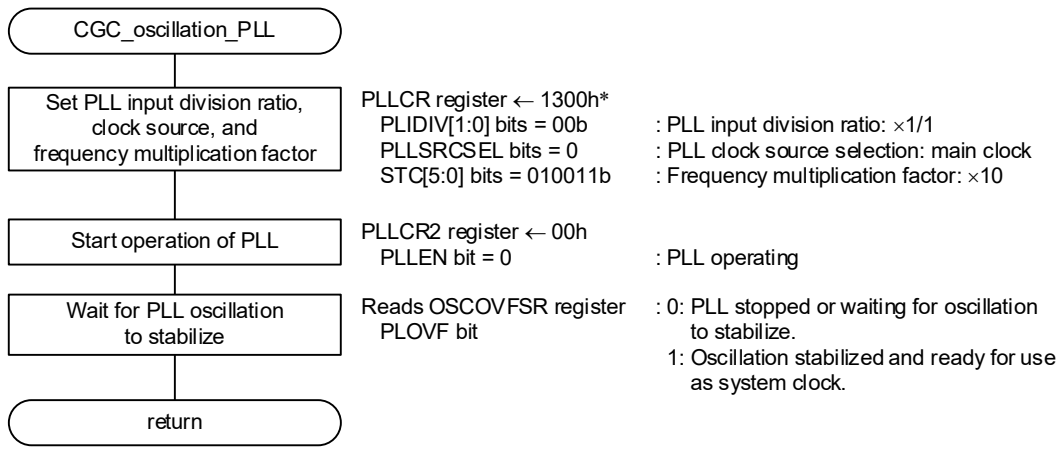


Notes: 1. Change the values of the relevant constants to match the characteristics of the target system.
2. The sample code accompanying this application note uses the initial value of the register.

Figure 3.6 Main Clock Oscillation Enable

3.10.6 PLL Clock Oscillation Enable

Figure 3.7 is a flowchart of the processing for starting oscillation of the PLL clock.

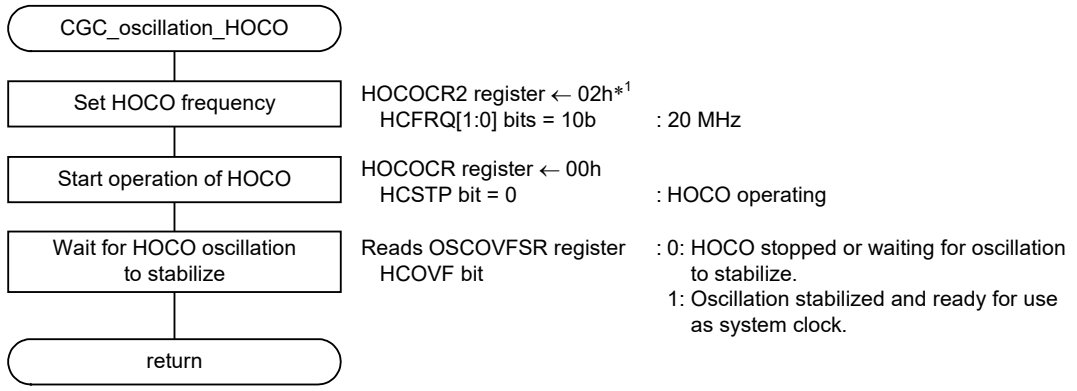


Note: * Change the values of the relevant constants to match the characteristics of the target system.

Figure 3.7 PLL Clock Oscillation Enable

3.10.7 HOCO Clock Oscillation Enable

Figure 3.8 is a flowchart of the processing for starting oscillation of the HOCO clock.

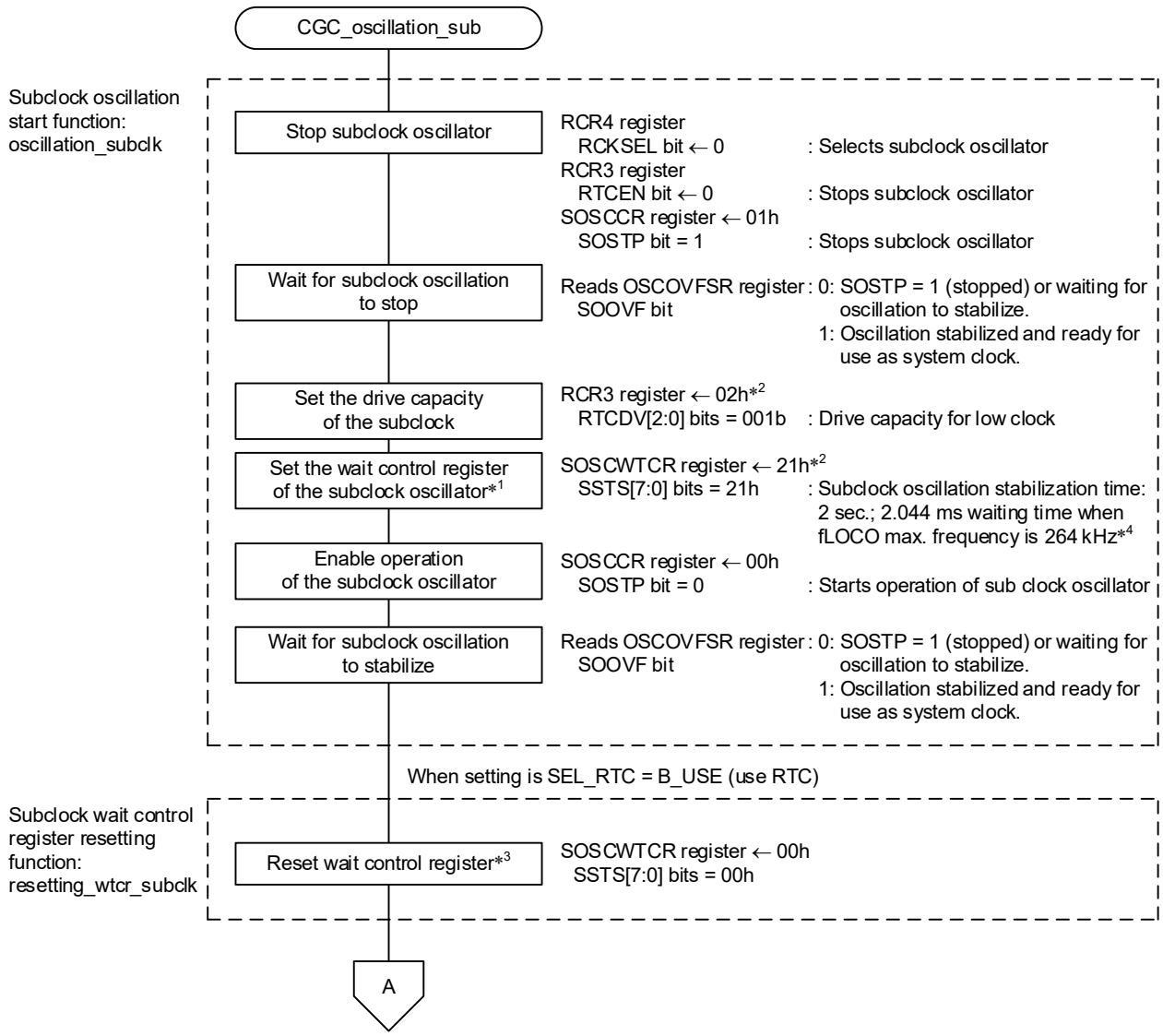


Notes: 1. Change the values of the relevant constants to match the characteristics of the target system.

Figure 3.8 HOCO Clock Oscillation Enable

3.10.8 Sub-clock Oscillation Enable

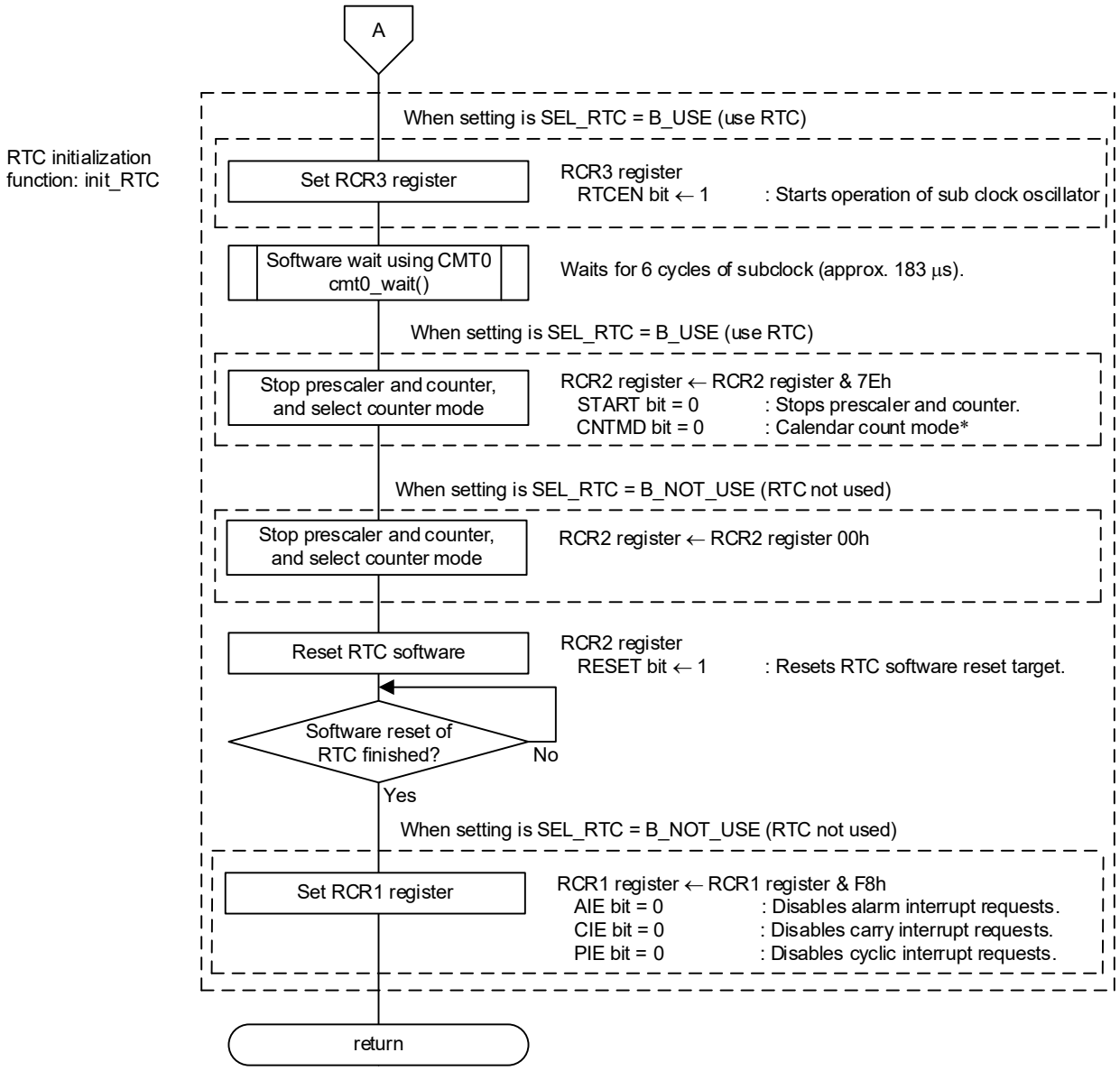
Figures 3.9 and 3.10 are flowcharts of the processing for starting oscillation of the sub-clock.



Notes: 1. Use the formulas in 9.2.18, Sub-Clock Oscillator Wait Control Register (SOSCWTCR), in RX71M Group User's Manual: Hardware to calculate the waiting time. Note that the sample code accompanying this application note uses the initial value of the register.

2. Change the value of the constant to match the characteristics of the target system.
3. When returning from software standby mode with the sub-clock selected as the system clock, supply of clock signals to the internals of the microcontroller starts after the time specified by bits SSTS7 to SSTS0 in SOSCWTCR has elapsed following generation of the return source. However, the sub-clock does not stop operating in software standby mode if value of the RTCEN bit in RCR3 is 1 (operates), in which case no oscillation stabilization time is needed for the sub-clock when returning from software standby mode. Therefore, bits SSTS7 to SSTS0 in SOSCWTCR are reset to 00h to minimize the sub-clock oscillation stabilization wait time.
4. The sample code accompanying this application note uses the initial value of the register.

Figure 3.9 Sub-clock Oscillation Enable (1/2)



Note: * The sample code accompanying this application note selects the calendar count mode. Change the values of the constants to match the characteristics of the target system.

Figure 3.10 Sub-clock Oscillation Enable (2/2)

3.10.9 Sub-clock Disable

Figure 3.11 is a flowchart of the processing for stopping the sub-clock.

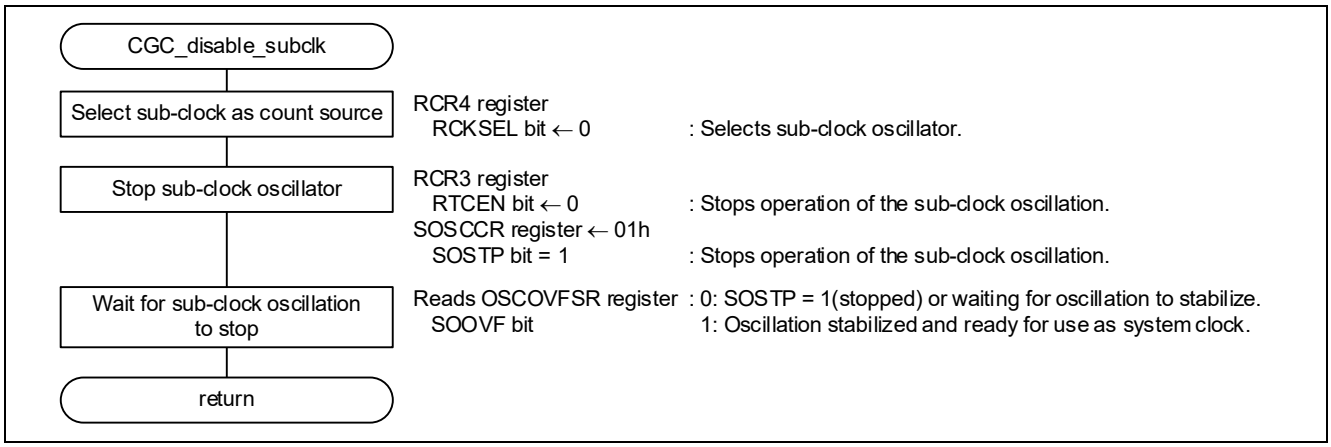
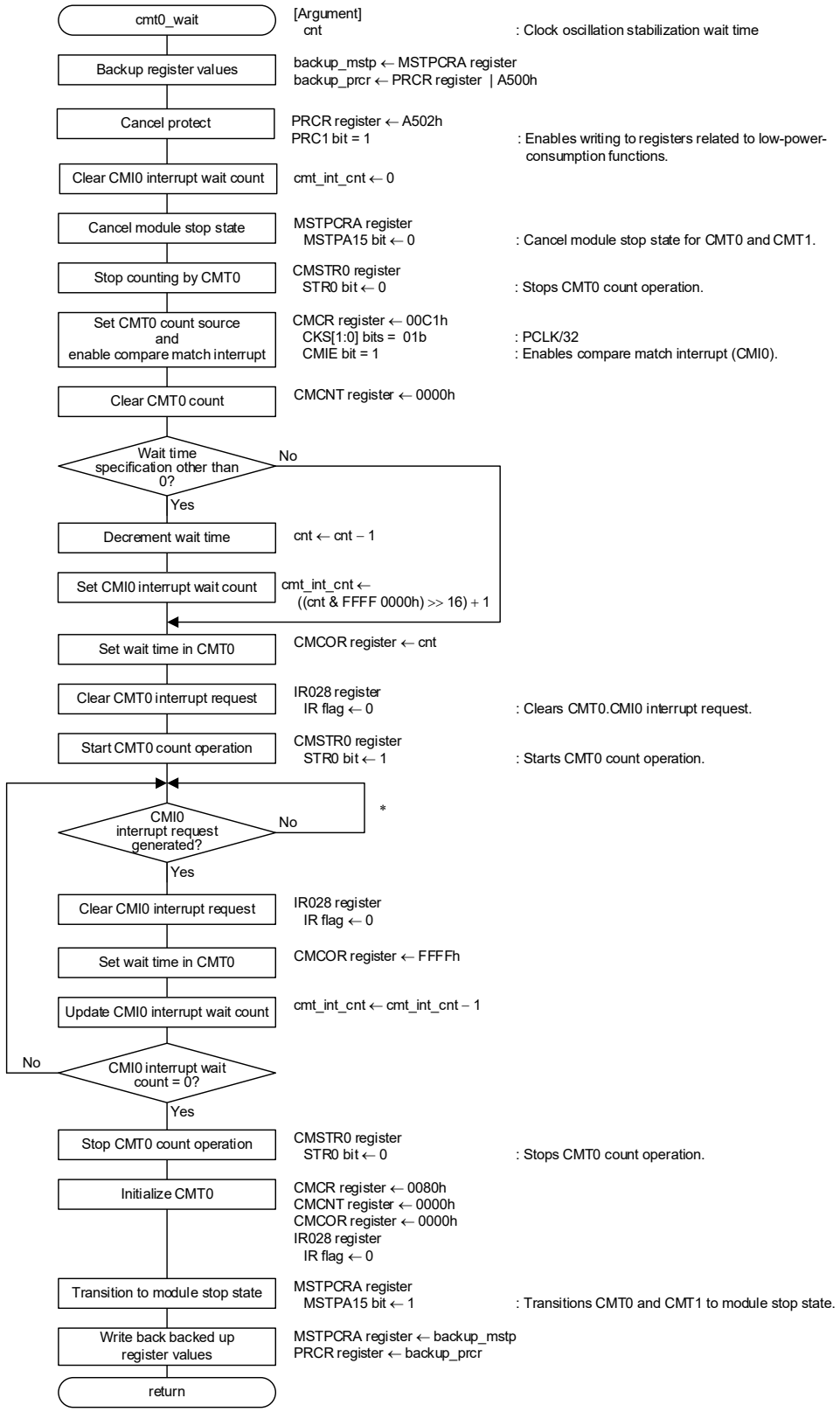


Figure 3.11 Sub-clock Disable

3.10.10 Software Wait Cycles Using CMT0

Figure 3.12 is a flowchart of the processing for implementing a software wait using CMT0.



Note: * When the watchdog timer (WDT) and independent watchdog timer (IWDT) are counting, use processing loop to refresh the WDT and IWDT.

Figure 3.12 Software Wait Cycles Using CMT0

4. Importing a Project

The sample code is provided as the e² studio project. This section describes importing a project into the e² studio and CS+. After importing a project, confirm that the build settings and the debug settings are correct.

4.1 Importing a Project into the e² studio

Follow the steps below to import your project into the e² studio.
(Windows/dialogs may differ depending on the e² studio version used.)

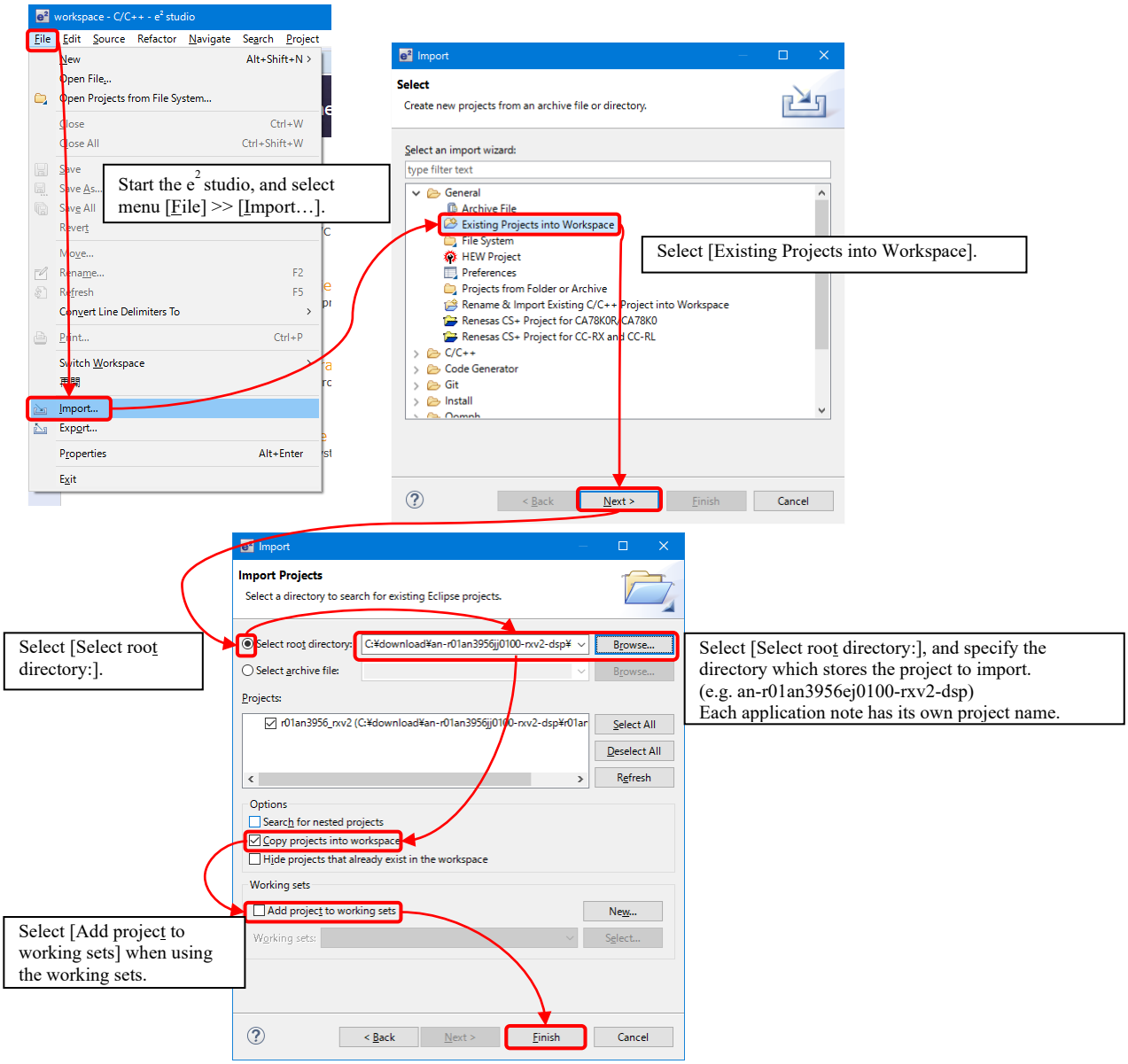


Figure 4.1 Importing a Project into the e² studio

4.2 Importing a Project into CS+

Follow the steps below to import your project into CS+.
(Windows/dialogs may differ depending on the CS+ version used.)

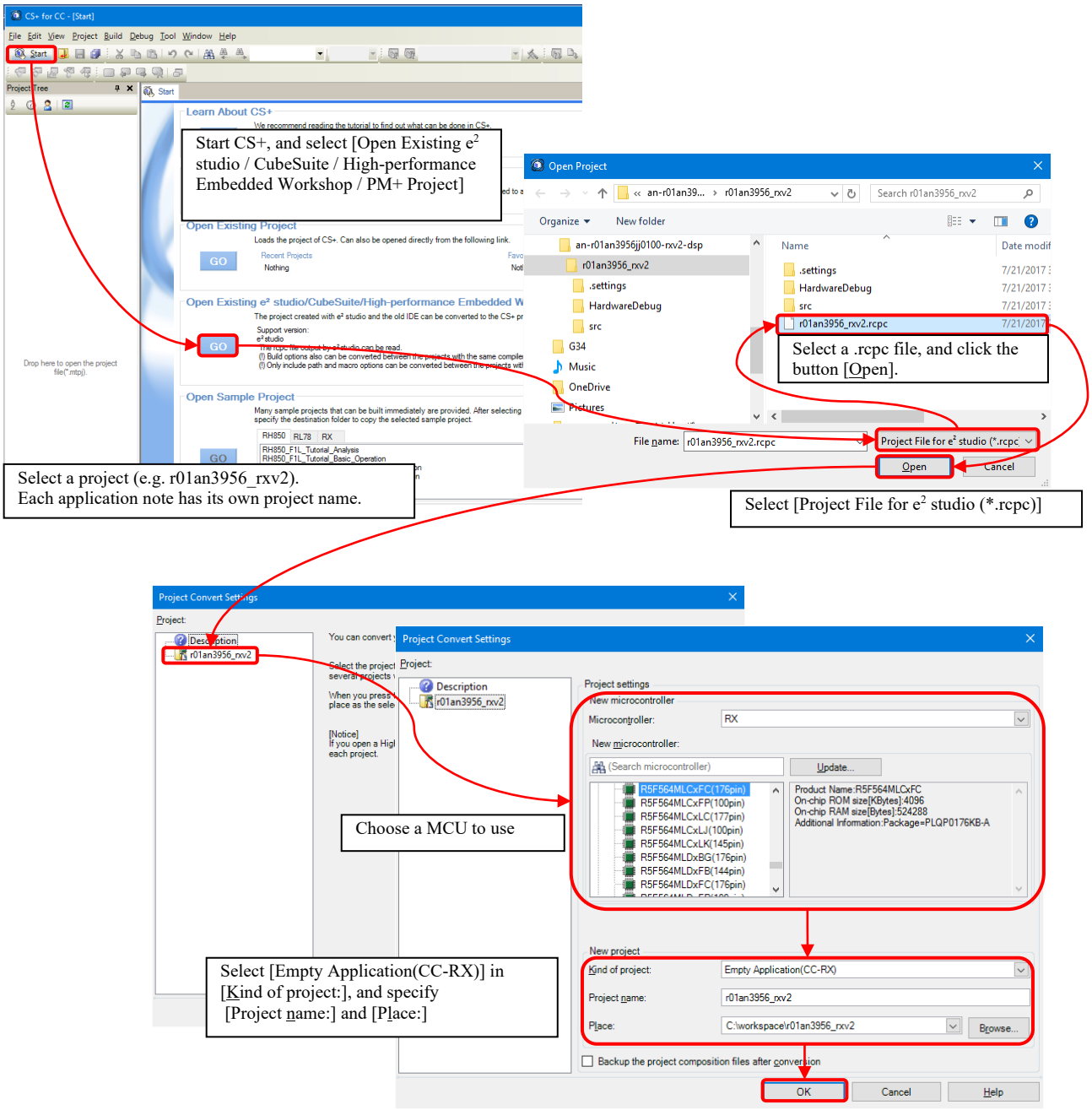


Figure 4.2 Importing a Project into CS+

5. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

6. Reference Documents

User's Manual: Hardware
RX71M Group User's Manual: Hardware (R01UH0493)
(The latest version can be downloaded from the Renesas Electronics website.)

Technical Update/Technical News
(The latest version can be downloaded from the Renesas Electronics website.)

User's Manual: Development Tools
RX Family CC-RX Compiler User's Manual (R20UT3248)
(The latest version can be downloaded from the Renesas Electronics website.)

Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Jun. 29, 15	—	First edition issued
1.01	Oct 30, 19	—	The source file and the header file name for non-existent port changed.
		—	The function name for non-existent port changed.
		—	The function name for initialization RTC changed.
		4	Clock settings procedure in 1.3.1 Overview changed. Table 1.1 Clock Specifications Assumed in Sample Code changed.
		5	Table1.2 Clock Selection Examples changed.
		6	Table2.1 Operation Confirmation Conditions changed.
		9	Table 3.3 Clock Setting Procedure changed.
		10	Section Configuration added. Table 3.6 Option-Setting Memory Configured in the Sample Code changed.
		11	Table3.7 Constants (User Changeable) Used by Sample Code (1/2) changed.
		12	Table3.8 Constants (User Changeable) Used by Sample Code (2/2) changed.
		13	Table 3.9 Constants (Non User Changeable) Used by Sample Code changed.
		16	Table 3.10 Functions changed.
		18,19	Function Specifications CGC_oscillation_main, CGC_oscillation_HOCO, CGC_oscillation_PLL, init_RTC changed. Function Specifications cmt0_wait added.
		22	Figure 3.4 Initial Clock Settings (1/2) changed.
		23	Figure 3.5 Initial Clock Settings (2/2) changed.
		24	Figure 3.6 Main Clock Oscillation Enable changed.
		25	Figure 3.8 HOCO Clock Oscillation Enable changed.
		27	Figure 3.10 Sub-clock Oscillation Enable (2/2) changed. Figure 3.11 Sub-clock Disable changed.
		28	Figure 3.12 Software Wait Cycles Using CMT0 changed.
		29,30	Importing a Project added.

Rev.	Date	Description Page	Summary
1.01	Oct 29, 19	Program	● Changed the path of iodefine.h ● Changed the the source file and the header file name for non-existent port From “r_init_non_existent_port.c” to “r_init_non_existent_port.c” From “r_init_non_existent_port.h” to “r_init_non_existent_port.h” ● Changed the function name for non-existent port From “R_INIT_NonExistentPort” to “R_INIT_Port_Initialize” ● Changed the function name for initialization RTC From “enable_RTC” to “init_RTC” ● Changed the following macro definition name From “MAIN_CLOCK_Hz” to “MAIN_CLOCK_HZ” From “SUB_CLOCK_Hz” to “SUB_CLOCK_HZ” From “FREQ_16MHz” to “FREQ_16MHZ” From “FREQ_18MHz” to “FREQ_18MHZ” From “FREQ_20MHz” to “FREQ_20MHZ” ● Changed the following variable name in cmt0_wait function From “backup_MSTP” to “backup_mstp” From “backup_PRCR” to “backup_prcr" ● Changed the setting value of USB clock ● Changed the initial setting of nonexistent port for PORTE ● Bug fix of CGC_oscillation_sub function In the CGC_oscillation_sub function, the bug that current consumption increases when RTC is not used was corrected. In the program before correction, when the sub-clock is used and RTC is not used, RTC initialization may not be performed correctly and RTC may operate unintentionally. ● Bug fix of CGC_disable_subclk function In the CGC_disable_subclk function, the bug that current consumption increases when RTC is not used was corrected. In the program before correction, when the sub-clock and RTC are not used, RT initialization may not be performed correctly and the RTC may operate unintentionally. ● Changed HOCO clock and PLL clock processing procedures ● Changed the setting of CMT0_CMCR register in cmt0_wait function
1.02	Feb. 1. 21	6	Table 2.1 Integrated development environment, C compiler, iodefine.h and Sample code version, changed.
		27	Figure 3.10 Subclock Oscillation Enable (2/2), changed.
		33, 34	Fixed the format of the date of Revision History.
		program	Technical update TN-RX*-A236B/E, supported.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

   The state of the product is undefined at the time 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 time 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 time 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 time when power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

   Handle unused pins in accordance 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 the 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.

5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is 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. Additionally, 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.

6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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(Rev.5.0-1 October 2020)

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