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April 1st, 2010
Renesas Electronics Corporation

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Manual for Using Sample Program Functions
Standby Functions
(V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2)

This manual explains the sample program functions of the standby function for the V850E/IA4 microcontroller.

The explanations are based on usage with the V850E/IA4 microcontroller. Refer to this manual when using the V850E/IA3, V850ES/IK1, and V850ES/IE2 microcontrollers.

Caution

This sample program is provided for reference purposes only and operations are therefore not subject to guarantee by NEC Electronics Corporation. When using this sample program, customers are kindly advised to sufficiently evaluate this product based on their system before usage.

Document No. U18243EJ1V0AN00 (1st edition)
Date Published November 2006 N CP(K)

NOTES FOR CMOS DEVICES

① 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, etc., 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).

② HANDLING OF UNUSED INPUT PINS

Unconnected CMOS device inputs can be cause of malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

③ PRECAUTION AGAINST ESD

A strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it when it has occurred. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that 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 should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

④ STATUS BEFORE INITIALIZATION

Power-on does not necessarily define the initial status of a MOS device. Immediately after the power source is turned ON, devices with reset functions have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. A device is not initialized until the reset signal is received. A reset operation must be executed immediately after power-on for devices with reset functions.

⑤ POWER ON/OFF SEQUENCE

In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current.

The correct power on/off sequence must be judged separately for each device and according to related specifications governing the device.

⑥ INPUT OF SIGNAL DURING POWER OFF STATE

Do not input signals or an I/O pull-up power supply while the device is not powered. 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.

Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

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M8E 02. 11-1

INTRODUCTION

Cautions 1. Download the program used in this manual from the NEC Electronics Website (http://www.necel.com/).

2. When using this sample program, reference the following startup file and link directive file and adjust them if as necessary.

- **Startup file: IA4_start.s**
- **Link directive file: IA4_link.dir**

3. In this sample program, control after releasing each standby mode varies depending on whether interrupt is enabled or disabled.

After the HALT mode and IDLE mode are released and an interrupt is enabled, the control branches to the handler, and after the STOP mode is released and interrupt is disabled, the next instruction is executed.

Conventions The function lists are structured as follows.

Hardware name (symbol)

[Function]	Function description
[Function name]	Name of sample function
[Argument]	Type and overview of argument
[Processing content]	Processing content of sample function
[Starting method]	Conditions for calling a function
[SFR(s) used]	Register name and setting content
[call function(s)]	Name and function of call function(s)
[Variable(s)]	Type, name, and overview of variable(s) used in sample function
[Interrupt(s)]	Name of function
[Interrupt source(s)]	Name
[File name]	Name of corresponding sample program file
[Caution(s)]	Caution(s) upon function usage

Interrupt function

[Function name]	Name of interrupt function
[Processing content]	Processing content of interrupt function
[SFR(s) used]	Register name and setting content
[call function(s)]	None
[Variable(s)]	Name of variable, function
[File name]	Name of corresponding sample program file
[Caution(s)]	None

Product Differences The differences between the V850E/IA4 and the V850E/IA3, V850ES/IK1, and V850ES/IE2 related to the standby functions are shown below.

Item	V850E/IA4	V850E/IA3	V850ES/IK1	V850ES/IE2
Conditions for releasing HALT mode	• Non-maskable interrupt request signal (INTWDT) • Unmasked maskable interrupt request signal • Reset signal ($\overline{\text{RESET}}$ pin input, WDTRES signal generation)	• Non-maskable interrupt request signal (INTWDT) • Unmasked maskable interrupt request signal • Reset signal ($\overline{\text{RESET}}$ pin input, WDTRES signal generation)	• Non-maskable interrupt request signal (INTWDT) • Unmasked maskable interrupt request signal • Reset signal ($\overline{\text{RESET}}$ pin input, WDTRES signal generation, LVIRES signal generation, POCRES signal generation)	
Conditions for releasing IDLE mode	• Unmasked external interrupt request signal (INTP0 to INTP5, INTP7 pin input) • Unmasked internal interrupt request signal from peripheral functions operable in IDLE mode (interrupt request signal related to CSIB in slave mode). • $\overline{\text{RESET}}$ pin input	• Unmasked external interrupt request signal (INTP0, INTP2 to INTP5, INTP7 pin input) • Unmasked internal interrupt request signal from peripheral functions operable in IDLE mode (interrupt request signal related to CSIB in slave mode). • $\overline{\text{RESET}}$ pin input	• Unmasked external interrupt request signal (INTP0 to INTP5 pin input) • Unmasked internal interrupt request signal (INTLVI) • Unmasked internal interrupt request signal from peripheral functions operable in IDLE mode (interrupt request signal related to CSIB in slave mode). • Reset signal ($\overline{\text{RESET}}$ pin input, LVIRES signal generation, POCRES signal generation)	
Conditions for releasing STOP mode	• Unmasked external interrupt request signal (INTP0 to INTP5, INTP7 pin input) • Unmasked internal interrupt request signal from peripheral functions operable in STOP mode (interrupt request signal related to CSIB in slave mode). • $\overline{\text{RESET}}$ pin input	• Unmasked external interrupt request signal (INTP0, INTP2 to INTP5, INTP7 pin input) • Unmasked internal interrupt request signal from peripheral functions operable in STOP mode (interrupt request signal related to CSIB in slave mode). • $\overline{\text{RESET}}$ pin input	• Unmasked external interrupt request signal (INTP0 to INTP5 pin input) • Unmasked internal interrupt request signal (INTLVI) • Unmasked internal interrupt request signal from peripheral functions operable in STOP mode (interrupt request signal related to CSIB in slave mode). • Reset signal ($\overline{\text{RESET}}$ pin input, LVIRES signal generation, POCRES signal generation)	

Related Documents The related documents indicated in this publication may include preliminary versions. However, preliminary versions are not marked as such.

Documents related to V850E/IA3, V850E/IA4, V850ES/IK1, and V850ES/IE2

Document Name	Document No.
V850E1 Architecture User's Manual	U14559E
V850E/IA3, V850E/IA4 Hardware User's Manual	U16543E
V850ES Architecture User's Manual	U15943E
V850ES/IK1 Hardware User's Manual	U16910E
V850ES/IE2 Hardware User's Manual	U17716E
Inverter Control by V850 Series Vector Control by Hole Sensor Application Note	U17338E
Inverter Control by V850 Series Vector Control by Encoder Application Note	U17324E
Inverter Control by V850 Series 120° Excitation Method Control by Zero-Cross Detection Application Note	U17209E
Manual for Using Sample Program Functions Serial Communication (UARTA) (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18233E
Manual for Using Sample Program Functions Serial Communication (CSIB) (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18234E
Manual for Using Sample Program Functions DMA Functions (V850E/IA3, V850E/IA4) Application Note	U18235E
Manual for Using Sample Program Functions Timer M (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18236E
Manual for Using Sample Program Functions Watchdog Timer (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18237E
Manual for Using Sample Program Functions Timer P (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18238E
Manual for Using Sample Program Functions Timer Q (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18239E
Manual for Using Sample Program Functions Timer ENC (V850E/IA3, V850E/IA4) Application Note	U18240E
Manual for Using Sample Program Functions Port Functions (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18241E
Manual for Using Sample Program Functions Clock Generator (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18242E
Manual for Using Sample Program Functions Standby Functions (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	This manual
Manual for Using Sample Program Functions Interrupt Functions (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18244E
Manual for Using Sample Program Functions A/D Converters 0 and 1 (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18245E
Manual for Using Sample Program Functions A/D Converter 2 (V850E/IA3, V850E/IA4) Application Note	U18246E

CONTENTS

Standby functions
HALT mode

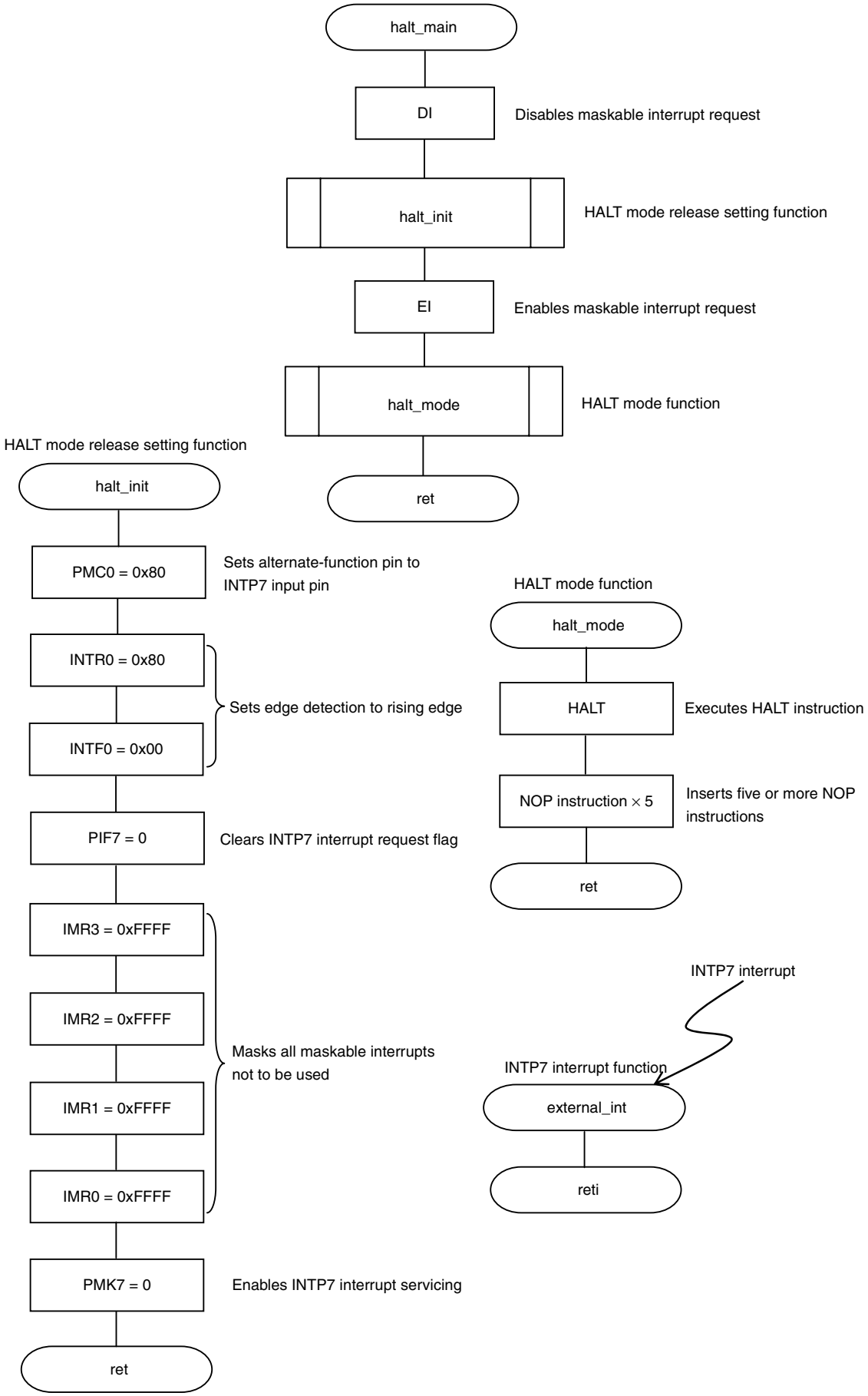
[Function]	Sets standby function (HALT mode).
[Function name]	halt_main
[Argument]	None
[Processing content]	Sets from normal operation mode to HALT mode. The HALT mode is released by an external interrupt request signal.
[Starting method]	None
[SFR used]	None
[call functions]	halt_init, halt_mode
[Variable]	None
[Interrupt]	external_int
[Interrupt source]	INTP7
[File name]	halt.c
[Caution]	Interrupts not to be used must be masked before setting to HALT mode.

[Function name]	halt_init	
[Processing content]	Sets an external interrupt request signal (INTP7) for releasing HALT mode.	
[SFRs used]	PMC0:	0x80 (Sets to alternate-function pin.)
	INTR0:	0x80 (Sets valid edge to rising edge.)
	INTF0:	0x00 (Sets valid edge to rising edge.)
	PIC7.PIF7:	0 (Clears INTP7 interrupt request flag.)
	IMR3:	0xFFFF (Masks interrupt.)
	IMR2:	0xFFFF (Masks interrupt.)
	IMR1:	0xFFFF (Masks interrupt.)
	IMR0:	0xFFFF (Masks interrupt.)
	PIC7.PMK7:	0 (Enables INTP7 interrupt servicing.)
[call function]	None	
[Variable]	None	
[File name]	halt.c	
[Caution]	None	

[Function name]	halt_mode
[Processing content]	Executes HALT instruction.
[SFR used]	None
[call function]	None
[Variable]	None
[File name]	halt.c
[Caution]	Insert five or more NOP instructions after the HALT instruction.

Interrupt function

[Function name]	external_int
[Processing content]	There is no particular processing because this is used for confirmation of external interrupt occurrence.
[SFR used]	None
[call function]	None
[Variable]	None
[File name]	halt.c
[Caution]	None


halt_main
DI
Disables maskable interrupt request
halt_init
HALT mode release setting function
EI
Enables maskable interrupt request
halt_mode
HALT mode function
ret
HALT mode release setting function
halt_init
PMC0 = 0x80
Sets alternate-function pin to INTP7 input pin
INTR0 = 0x80
Sets edge detection to rising edge
INTF0 = 0x00
PIF7 = 0
Clears INTP7 interrupt request flag
IMR3 = 0xFFFF
IMR2 = 0xFFFF
IMR1 = 0xFFFF
IMR0 = 0xFFFF
Masks all maskable interrupts not to be used
PMK7 = 0
Enables INTP7 interrupt servicing
ret
HALT mode function
halt_mode
HALT
Executes HALT instruction
NOP instruction × 5
Inserts five or more NOP instructions
ret
INTP7 interrupt
INTP7 interrupt function
external_int
reti

Standby functions
IDLE mode

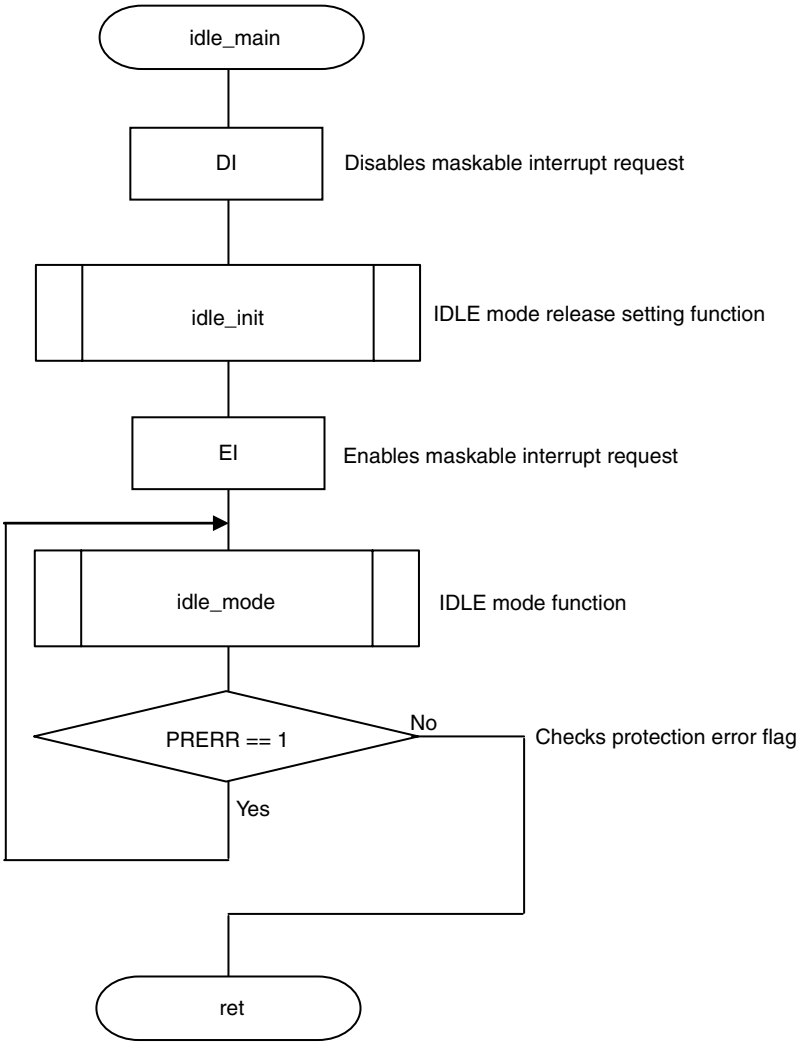
[Function]	Sets standby function (IDLE mode).
[Function name]	idle_main
[Argument]	None
[Processing content]	Sets from normal operation mode to IDLE mode. The IDLE mode is released by an external interrupt request signal.
[Starting method]	None
[SFR used]	None
[call functions]	idle_init, idle_mode
[Variable]	None
[Interrupt]	external_int
[Interrupt source]	INTP7
[File name]	idle.c
[Caution]	Interrupts not to be used must be masked before setting to IDLE mode.

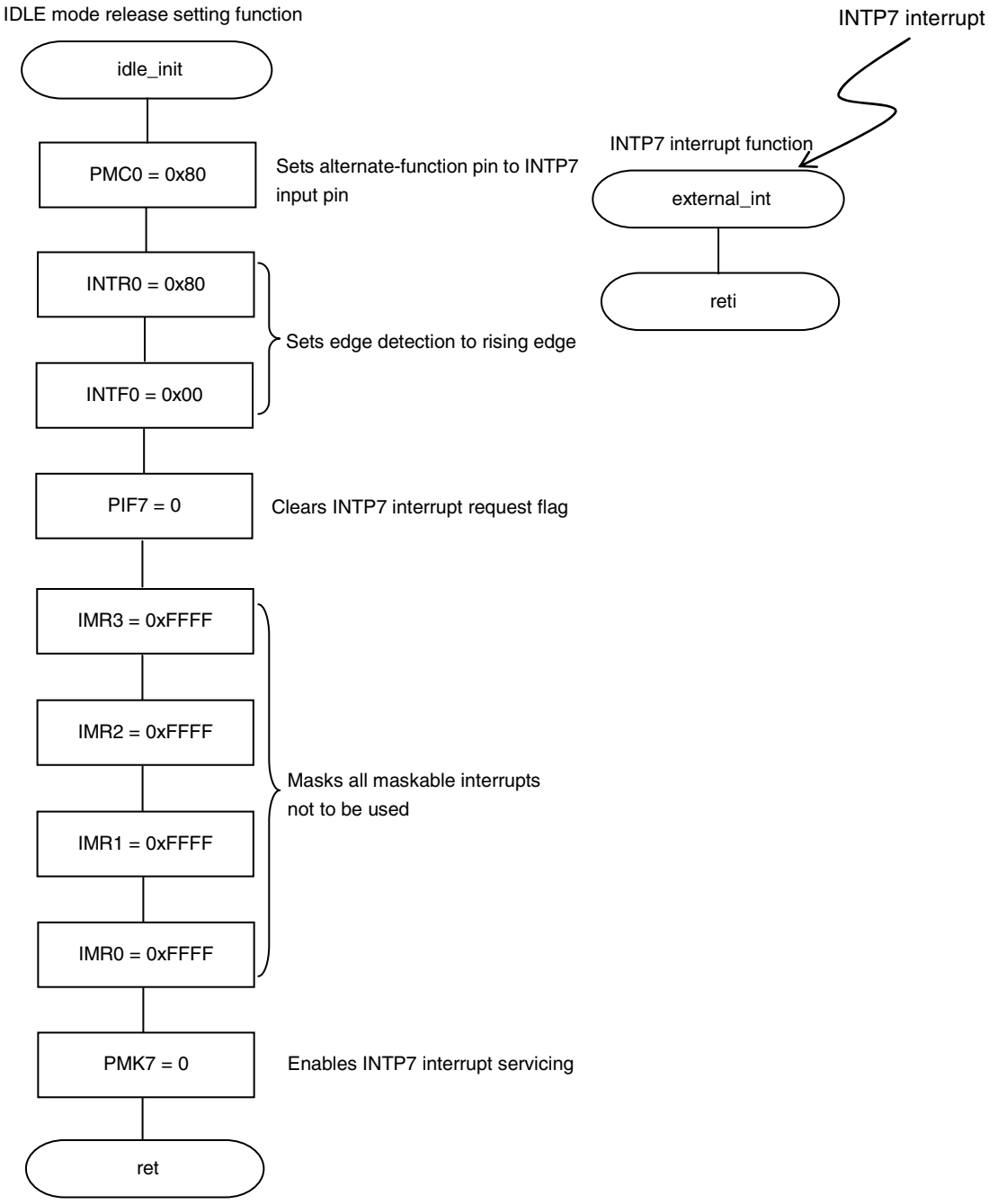
[Function name]	idle_init	
[Processing content]	Sets an external interrupt request signal (INTP7) for releasing IDLE mode.	
[SFRs used]	PMC0:	0x80 (Sets to alternate-function pin.)
	INTR0:	0x80 (Sets valid edge to rising edge.)
	INTF0:	0x00 (Sets valid edge to rising edge.)
	PIC7.PIF7:	0 (Clears INTP7 interrupt request flag.)
	IMR3:	0xFFFF (Masks interrupt.)
	IMR2:	0xFFFF (Masks interrupt.)
	IMR1:	0xFFFF (Masks interrupt.)
	IMR0:	0xFFFF (Masks interrupt.)
	PIC7.PMK7:	0 (Enables INTP7 interrupt servicing.)
[call function]	None	
[Variable]	None	
[File name]	idle.c	
[Caution]	None	

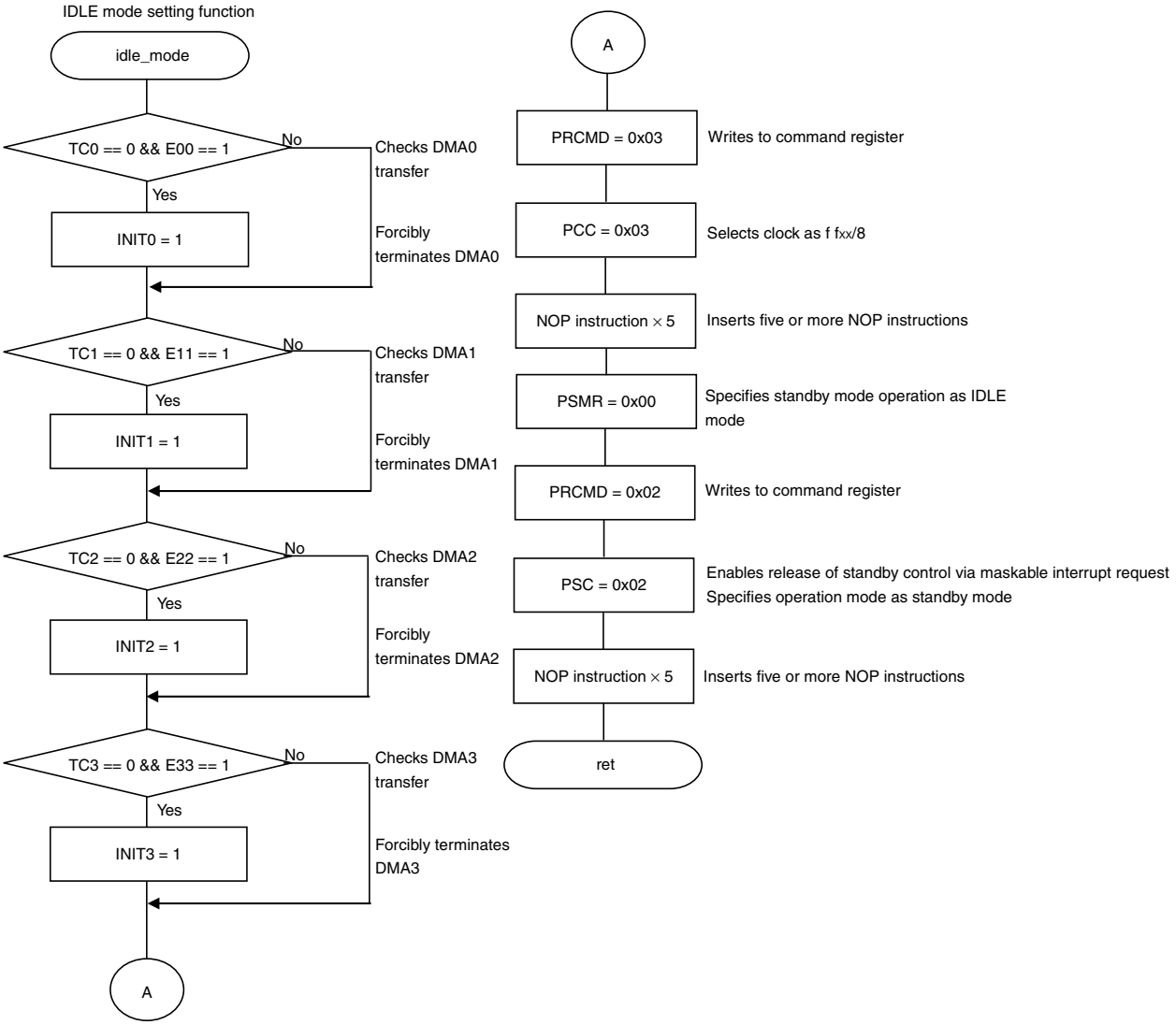
[Function name]	idle_mode	
[Processing content]	Executes IDLE mode by forcibly terminating all DMA transfers.	
[SFRs used]	DCHC0.TC0	DMA0 transfer status bit
	DCHC0.E00:	1 (Enables DMA0 transfer.)
	DCHC0.INIT0:	1 (Forcibly terminates DMA0 transfer.)
	DCHC1.TC1	DMA1 transfer status bit
	DCHC1.E11:	1 (Enables DMA1 transfer.)
	DCHC1.INIT1:	1 (Forcibly terminates DMA1 transfer.)
	DCHC2.TC2	DMA2 transfer status bit
	DCHC2.E22:	1 (Enables DMA2 transfer.)
	DCHC2.INIT2:	1 (Forcibly terminates DMA2 transfer.)
	DCHC3.TC3	DMA3 transfer status bit
	DCHC3.E33:	1 (Enables DMA3 transfer.)
	DCHC3.INIT3:	1 (Forcibly terminates DMA3 transfer.)
	PRCMD:	0x03 (Writes to command register (used when writing to a special register).)
	PCC:	0x03 (Selects clock as fxx/8.)
	PSMR:	0x00 (Sets to IDLE mode.)
	PRCMD:	0x02 (Writes to command register (used when writing to a special register).)
	PSC:	0x02 (Enables standby mode release and sets to standby mode.)
[call function]	None	
[Variable]	None	
[File name]	idle_mode.c	
[Cautions]	• DMA transfer is forcibly terminated in this sample program, because all DMA transfers must be terminated before performing data setting to the special register. • PCC and PSC registers are special registers and can therefore only be written in combination of specific sequences. • When setting to IDLE mode, set in the order of, the PCC register (set to 03H), the PSMR.PSM0 bit, and the PSC.STB bit.	

Interrupt function

[Function name]	external_int
[Processing content]	There is no particular processing because this is used for confirmation of external interrupt occurrence.
[SFR used]	None
[call function]	None
[Variable]	None
[File name]	idle.c
[Caution]	None


idle_main
DI
Disables maskable interrupt request
idle_init
IDLE mode release setting function
EI
Enables maskable interrupt request
idle_mode
IDLE mode function
PRERR == 1
No
Checks protection error flag
Yes
ret


IDLE mode release setting function
idle_init
PMC0 = 0x80
Sets alternate-function pin to INTP7 input pin
INTR0 = 0x80
Sets edge detection to rising edge
INTF0 = 0x00
PIF7 = 0
Clears INTP7 interrupt request flag
IMR3 = 0xFFFF
IMR2 = 0xFFFF
Masks all maskable interrupts not to be used
IMR1 = 0xFFFF
IMR0 = 0xFFFF
PMK7 = 0
Enables INTP7 interrupt servicing
ret
INTP7 interrupt
INTP7 interrupt function
external_int
reti

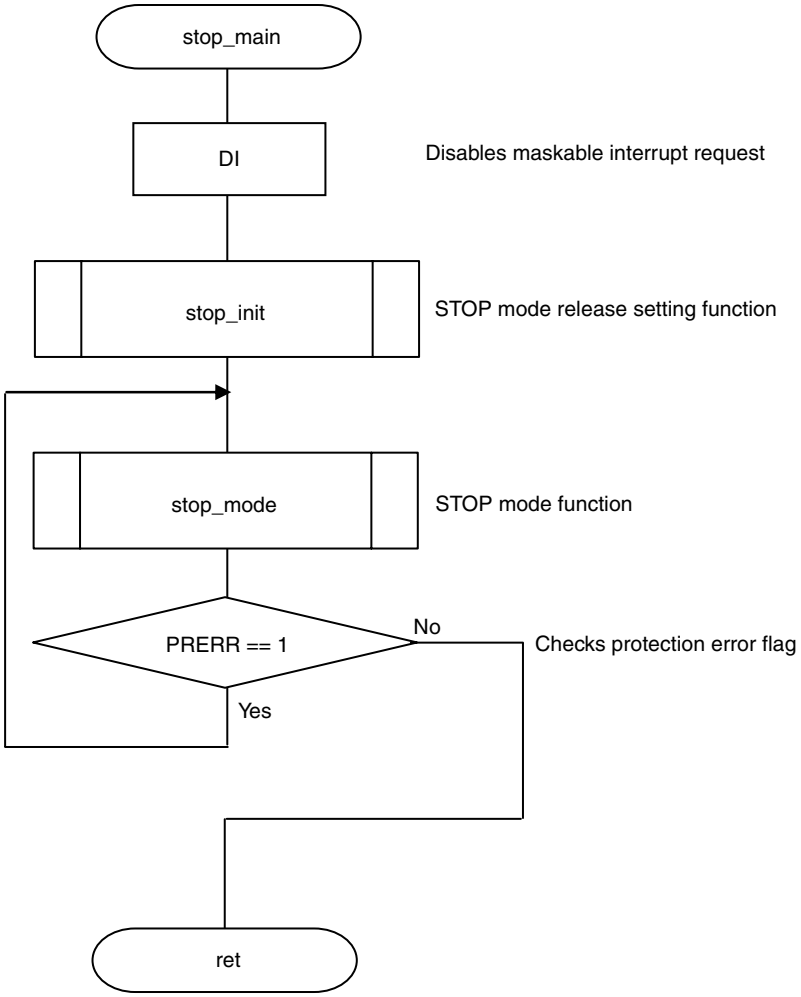

IDLE mode setting function
idle_mode
TC0 == 0 && E00 == 1
No
Checks DMA0 transfer
Yes
INIT0 = 1
Forcibly terminates DMA0
TC1 == 0 && E11 == 1
No
Checks DMA1 transfer
Yes
INIT1 = 1
Forcibly terminates DMA1
TC2 == 0 && E22 == 1
No
Checks DMA2 transfer
Yes
INIT2 = 1
Forcibly terminates DMA2
TC3 == 0 && E33 == 1
No
Checks DMA3 transfer
Yes
INIT3 = 1
Forcibly terminates DMA3
A
A
PRCMD = 0x03
Writes to command register
PCC = 0x03
Selects clock as f fxx/8
NOP instruction × 5
Inserts five or more NOP instructions
PSMR = 0x00
Specifies standby mode operation as IDLE mode
PRCMD = 0x02
Writes to command register
PSC = 0x02
Enables release of standby control via maskable interrupt request
Specifies operation mode as standby mode
NOP instruction × 5
Inserts five or more NOP instructions
ret

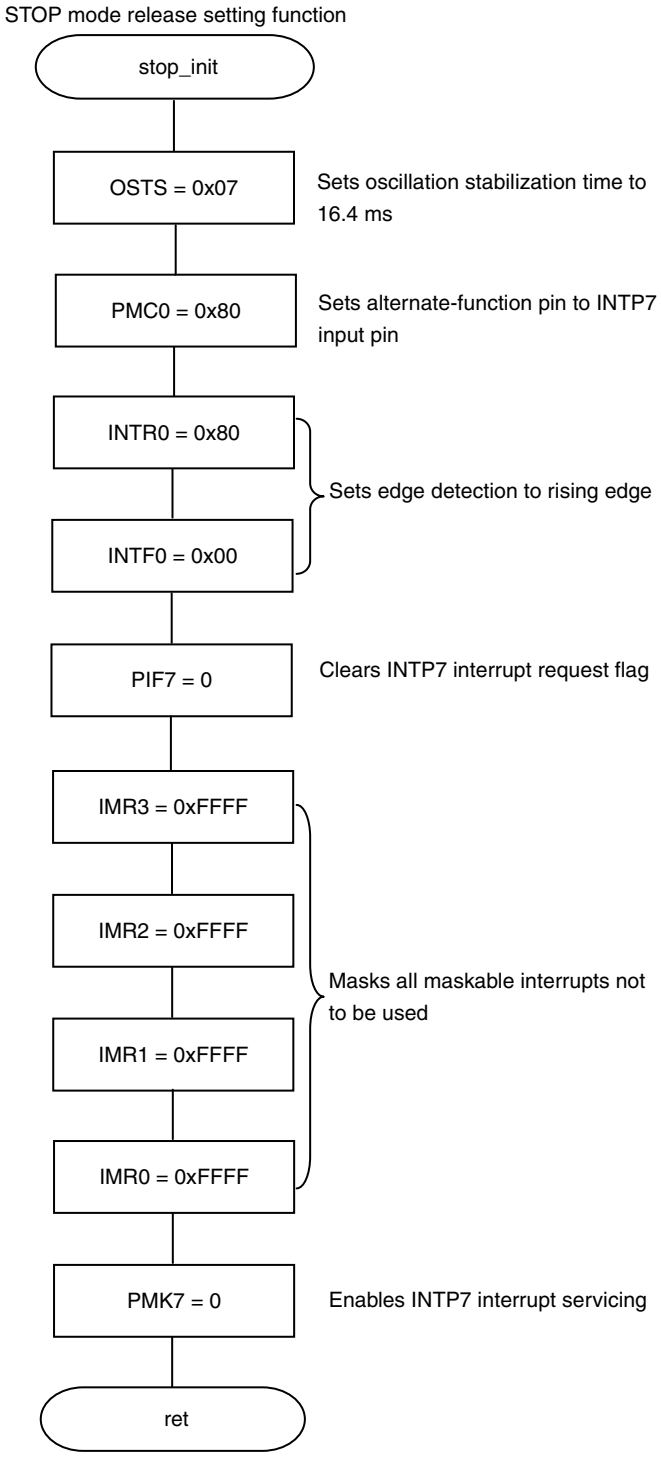
Standby functions
STOP mode

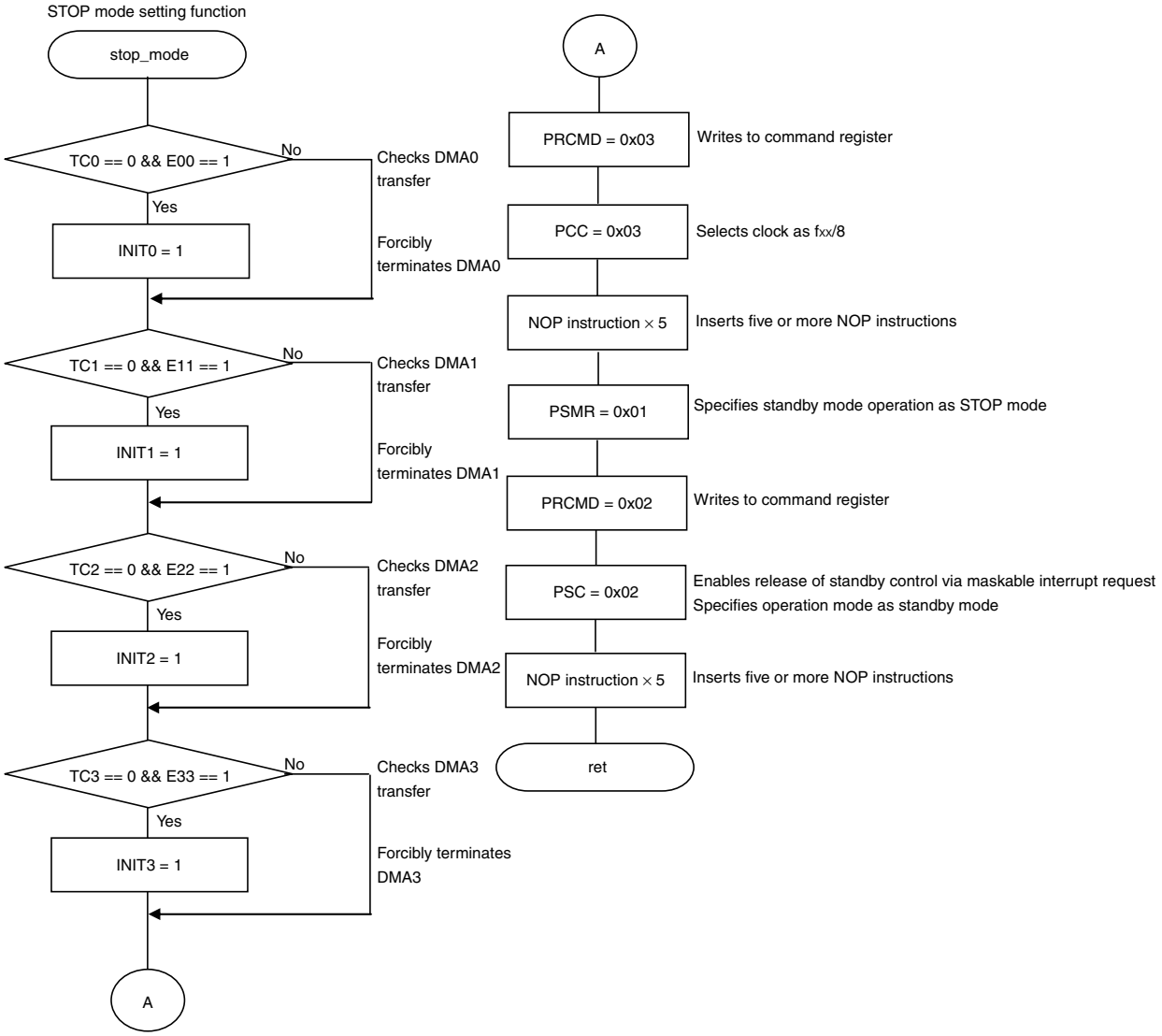
[Function]	Sets standby function (STOP mode).
[Function name]	stop_main
[Argument]	None
[Processing content]	Sets from normal operation mode to STOP mode. The STOP mode is released by an external interrupt request signal.
[Starting method]	None
[SFR used]	None
[call functions]	stop_init, stop_mode
[Variable]	None
[Interrupt]	None
[Interrupt source]	None
[File name]	stop.c
[Cautions]	• Interrupts not to be used must be masked before setting to STOP mode. • The INTP7 interrupt request signal is kept set after releasing STOP mode.

[Function name]	stop_init	
[Processing content]	Sets an external interrupt request signal (INTP7) for releasing STOP mode.	
[SFRs used]	OSTS:	0x07 (Sets oscillation stabilization time to 16.4 ms)
	PMC0:	0x80 (Sets to alternate-function pin.)
	INTR0:	0x80 (Sets valid edge to rising edge.)
	INTF0:	0x00 (Sets valid edge to rising edge.)
	PIC7.PIF7:	0 (Clears INTP7 interrupt request flag.)
	IMR3:	0xFFFF (Masks interrupt.)
	IMR2:	0xFFFF (Masks interrupt.)
	IMR1:	0xFFFF (Masks interrupt.)
	IMR0:	0xFFFF (Masks interrupt.)
	PIC7.PMK7:	0 (Enables INTP7 interrupt servicing.)
[call function]	None	
[Variable]	None	
[File name]	stop.c	
[Caution]	None	

[Function name]	stop_mode	
[Processing content]	Executes STOP mode by forcibly terminating all DMA transfers.	
[SFRs used]	DCHC0.TC0	DMA0 transfer status bit
	DCHC0.E00:	1 (Enables DMA0 transfer.)
	DCHC0.INIT0:	1 (Forcibly terminates DMA0 transfer.)
	DCHC1.TC1	DMA1 transfer status bit
	DCHC1.E11:	1 (Enables DMA1 transfer.)
	DCHC1.INIT1:	1 (Forcibly terminates DMA1 transfer.)
	DCHC2.TC2	DMA2 transfer status bit
	DCHC2.E22:	1 (Enables DMA2 transfer.)
	DCHC2.INIT2:	1 (Forcibly terminates DMA2 transfer.)
	DCHC3.TC3	DMA3 transfer status bit
	DCHC3.E33:	1 (Enables DMA3 transfer.)
	DCHC3.INIT3:	1 (Forcibly terminates DMA3 transfer.)
	PRCMD:	0x03 (Writes to command register (used when writing to a special register).)
	PCC:	0x03 (Selects clock as fxx/8.)
	PSMR:	0x01 (Sets to STOP mode.)
	PRCMD:	0x02 (Writes to command register (used when writing to a special register).)
	PSC:	0x02 (Enables standby mode release and sets to standby mode.)
[call function]	None	
[Variable]	None	
[File name]	stop.c	
[Cautions]	• DMA transfer is forcibly terminated in this sample program, because all DMA transfers must be terminated before performing data setting to the special register. • PCC and PSC registers are special registers and can therefore only be written in combination of specific sequences. • When setting to STOP mode, set in the order of, the PCC register (set to 03H), the PSMR.PSM0 bit, and the PSC.STB bit.	


stop_main
DI
Disables maskable interrupt request
stop_init
STOP mode release setting function
stop_mode
STOP mode function
PRERR == 1
No
Checks protection error flag
Yes
ret


STOP mode release setting function
stop_init
OSTS = 0x07
Sets oscillation stabilization time to 16.4 ms
PMC0 = 0x80
Sets alternate-function pin to INTP7 input pin
INTR0 = 0x80
INTF0 = 0x00
Sets edge detection to rising edge
PIF7 = 0
Clears INTP7 interrupt request flag
IMR3 = 0xFFFF
IMR2 = 0xFFFF
IMR1 = 0xFFFF
IMR0 = 0xFFFF
Masks all maskable interrupts not to be used
PMK7 = 0
Enables INTP7 interrupt servicing
ret


STOP mode setting function
stop_mode
TC0 == 0 && E00 == 1
No
Yes
Checks DMA0 transfer
INIT0 = 1
Forcibly terminates DMA0
TC1 == 0 && E11 == 1
No
Yes
Checks DMA1 transfer
INIT1 = 1
Forcibly terminates DMA1
TC2 == 0 && E22 == 1
No
Yes
Checks DMA2 transfer
INIT2 = 1
Forcibly terminates DMA2
TC3 == 0 && E33 == 1
No
Yes
Checks DMA3 transfer
INIT3 = 1
Forcibly terminates DMA3
A
A
PRCMD = 0x03
Writes to command register
PCC = 0x03
Selects clock as fxx/8
NOP instruction × 5
Inserts five or more NOP instructions
PSMR = 0x01
Specifies standby mode operation as STOP mode
PRCMD = 0x02
Writes to command register
PSC = 0x02
Enables release of standby control via maskable interrupt request
Specifies operation mode as standby mode
NOP instruction × 5
Inserts five or more NOP instructions
ret

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