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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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

This manual explains the sample program functions of the port functions 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.**

## 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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# 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

**Conventions**       The function lists are structured as follows.

## Hardware name

[Function]	Function description
[Function name]	Name of sample function
[Argument]	Type and overview of argument
[Processing content]	Processing content of sample 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

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

Item	V850E/IA4	V850E/IA3	V850ES/IK1	V850ES/IE2
Port 0	P00 to P07	P00, P02 to P07	P00 to P06	
Port 1	P10 to P17	P10 to P17	P10 to P17 (P16 (CLMER))	
Port 2	P20 to P27	Not provided	P20 to P27	
Port 3	P30 to P37	P30 to P37	P30 to P33	
Port 4	P40 to P44	P40 to P44		
Port 5	P50 to P52	Not provided		
Port 7	P70 to P77	P70 to P75	Not provided	
Port DL	PDL0 to PDL15	PDL0 to PDL15	PDL0 to PDL7	

**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	This manual
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	U18243E
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

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## Port functions

### Port input

[Function]	Sets all ports as input pins of port mode.
[Function name]	port_input_main
[Argument]	None
[Processing content]	Calls setting function of each port and sets to input pin.
[SFR used]	None
[call functions]	port0_input, port1_input, port2_input, port3_input, port4_input, port5_input, port7_input, portDL_input
[Variable]	None
[Interrupt]	None
[Interrupt source]	None
[File name]	port_input.c
[Caution]	None

[Function name]	port0_input
[Processing content]	Sets P0 pin to input mode of I/O port.
[SFRs used]	PMC0: 0x00 (Sets to I/O port) PU0: 0x00 (Sets on-chip pull-up resistor as unused) PM0: 0xFF (Sets to input mode)
[call function]	None
[Variable]	None
[File name]	port_input.c
[Cautions]	<ul style="list-style-type: none"><li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode or in alternate-function mode.</li><li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li></ul>

[Function name]	port1_input
[Processing content]	Sets P1 pin to input mode of I/O port.
[SFRs used]	PMC1: 0x00 (Sets to I/O port) PU1: 0x00 (Sets on-chip pull-up resistor as unused) PM1: 0xFF (Sets to input mode)
[call function]	None
[Variable]	None
[File name]	port_input.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode, when the pins function as input pins in alternate-function mode, or when the TOQ0T1 to TOQ1T3, TOQ0B1 to TOQ0B3, and TOP21 pins which are output pins during alternate-function mode go into a high impedance state due to TOQ0OFF and TOP2OFF pins or software processing.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

[Function name]	port2_input
[Processing content]	Sets P2 pin to input mode of I/O port.
[SFRs used]	PMC2: 0x00 (Sets to I/O port) PU2: 0x00 (Sets on-chip pull-up resistor as unused) PM2: 0xFF (Sets to input mode)
[call function]	None
[Variable]	None
[File name]	port_input.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode, or when the TOQ1T1 to TOQ1T3, TOQ1B1 to TOQ1B3, and TOP31 pins which are output pins during alternate-function mode go into a high impedance state due to TOQ1OFF and TOP3OFF pins or software processing.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

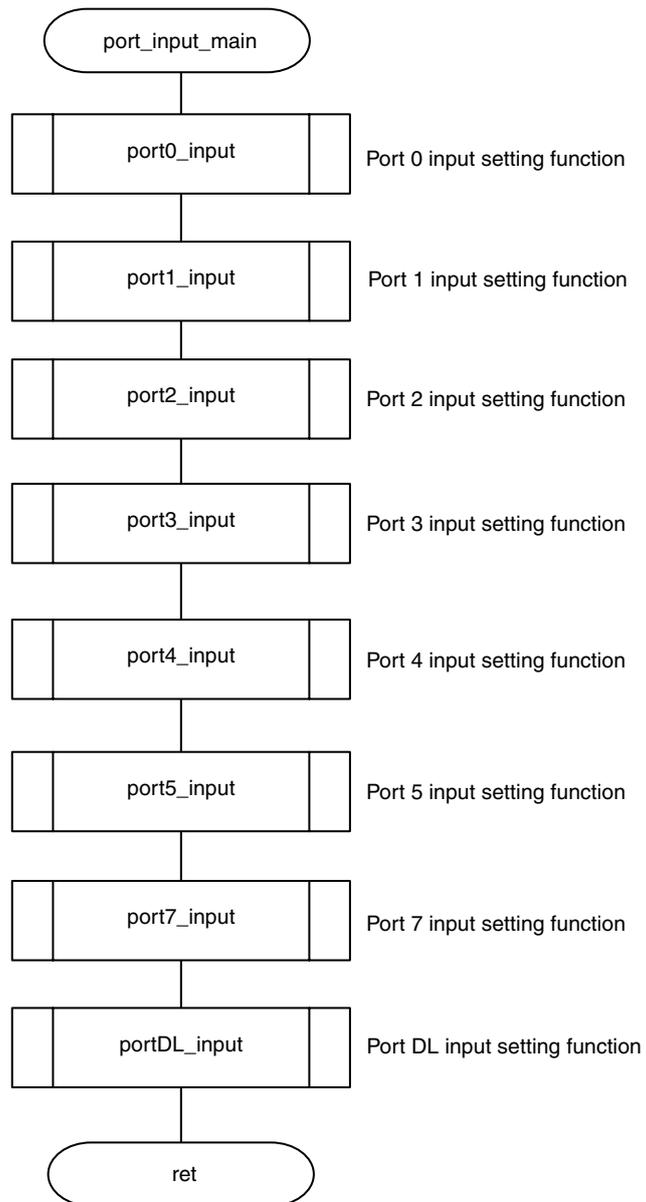
[Function name]	port3_input
[Processing content]	Sets P3 pin to input mode of I/O port.
[SFRs used]	PMC3: 0x00 (Sets to I/O port) PU3: 0x00 (Sets on-chip pull-up resistor as unused) PM3: 0xFF (Sets to input mode)
[call function]	None
[Variable]	None
[File name]	port_input.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode or when the pins function as input pins in the alternate-function mode.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

[Function name]	port4_input
[Processing content]	Sets P4 pin to input mode of I/O port.
[SFRs used]	PMC4: 0x00 (Sets to I/O port) PU4: 0x00 (Sets on-chip pull-up resistor as unused) PM4: 0xFF (Sets to input mode)
[call function]	None
[Variable]	None
[File name]	port_input.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode or when the pins function as input pins in the alternate-function mode (including when the <u>SCKB0</u> pin is in slave mode).</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

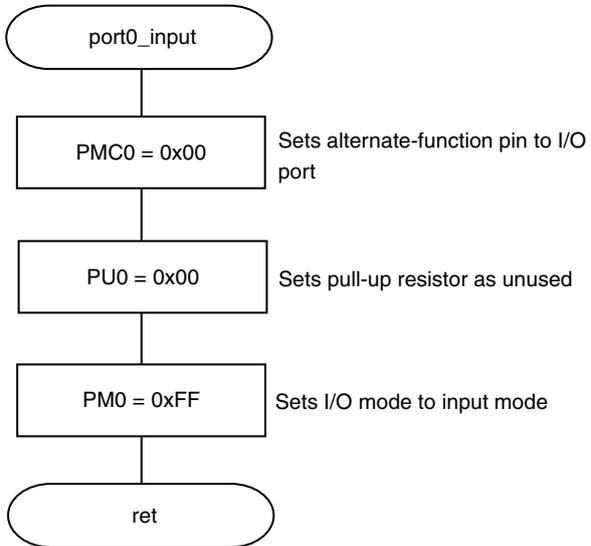
[Function name]	port5_input
[Processing content]	Sets P5 pin to input mode of I/O port.
[SFRs used]	PMC5: 0x00 (Sets to I/O port) PU5: 0x00 (Sets on-chip pull-up resistor as unused) PM5: 0xFF (Sets to input mode)
[call function]	None
[Variable]	None
[File name]	port_input.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode or when the pins function as input pins in the alternate-function mode.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

[Function name]	port7_input
[Processing content]	Sets P7 pin to input mode of input port.
[SFR used]	PMC7: 0x00 (Sets to input port)
[call function]	None
[Variable]	None
[File name]	port_input.c
[Caution]	None

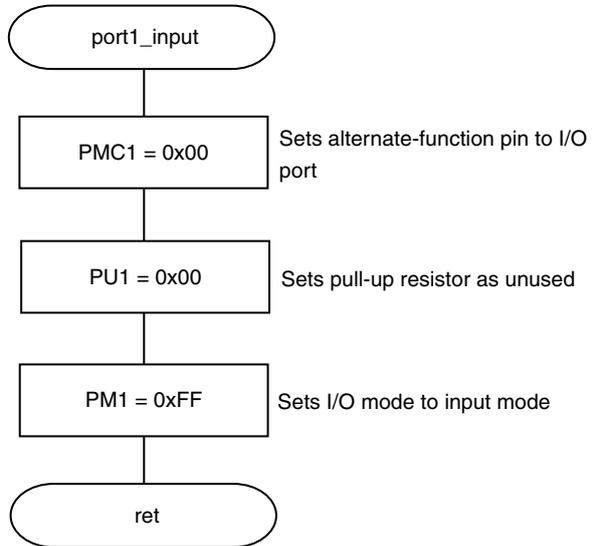
[Function name]	portDL_input
[Processing content]	Sets PDL pin to input mode of I/O port.
[SFRs used]	PUDL: 0x0000 (Sets on-chip pull-up resistor as unused) PMDL: 0xFFFF (Sets to input mode)
[call function]	None
[Variable]	None
[File name]	port_input.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>



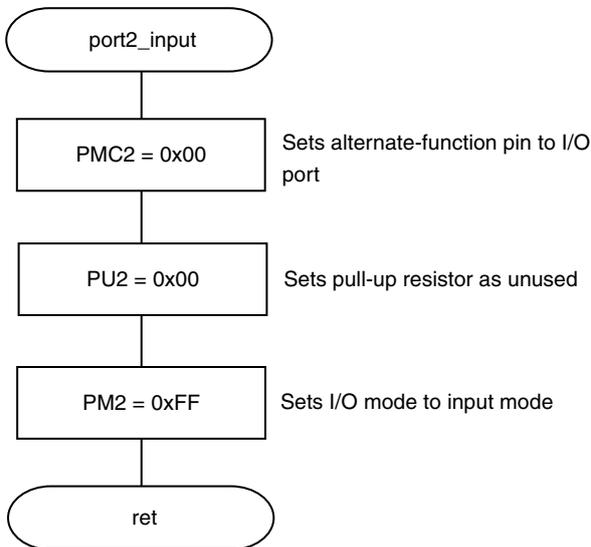
Port 0 input setting function



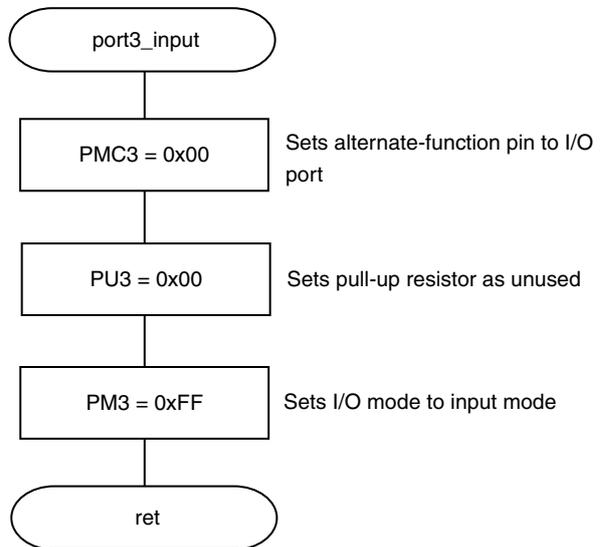
Port 1 input setting function



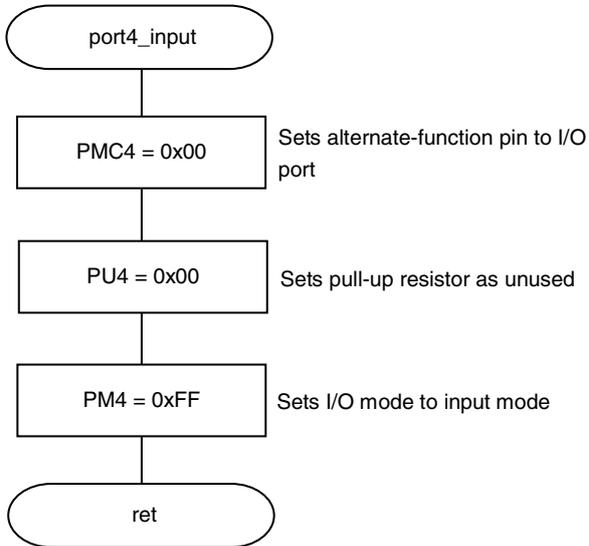
Port 2 input setting function



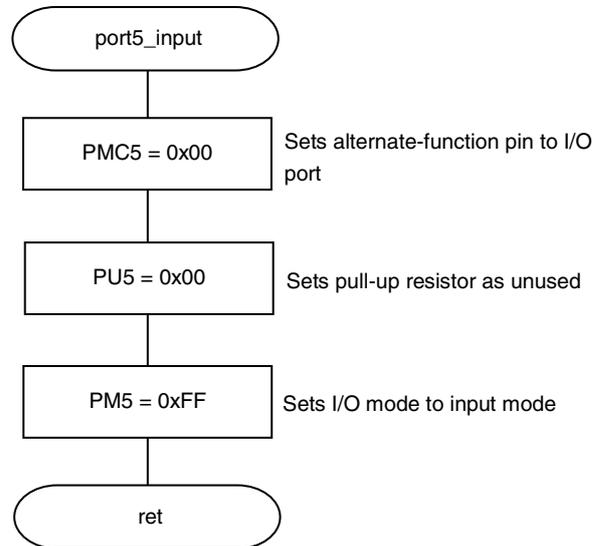
Port 3 input setting function



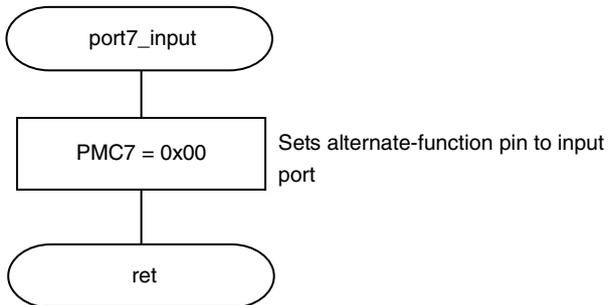
Port 4 input setting function



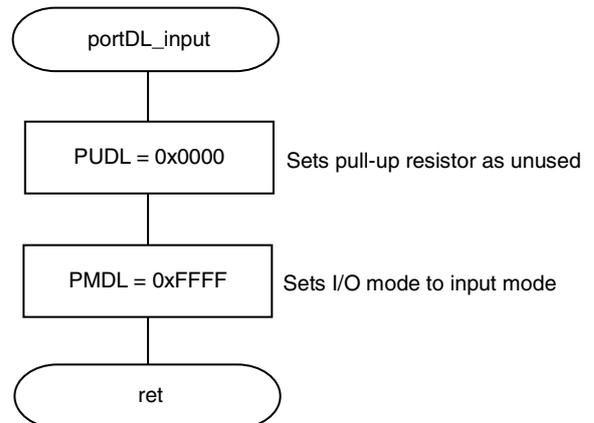
Port 5 input setting function



Port 7 input setting function



Port DL input setting function



## Port functions

### Port output

[Function]	Sets all ports as output pins of port mode.
[Function name]	port_output_main
[Argument]	None
[Processing content]	Calls setting function of each port and sets to output pin.
[SFR used]	None
[call functions]	port0_output, port1_output, port2_output, port3_output, port4_output, port5_output, portDL_output
[Variable]	None
[Interrupt]	None
[Interrupt source]	None
[File name]	port_output.c
[Caution]	None

[Function name]	port0_output
[Processing content]	Sets P0 pin to output mode of I/O port.
[SFR used]	PMC0: 0x00 (Sets to I/O port) P0: 0x00 (Sets initial value to output data) PM0: 0x00 (Sets to output mode)
[call function]	None
[Variable]	None
[File name]	port_output.c
[Caution]	Set the initial value of the output data as desired according to specifications.

[Function name]	port1_output
[Processing content]	Sets P1 pin to output mode of I/O port.
[SFRs used]	PMC1: 0x00 (Sets to I/O port) P1: 0x00 (Sets initial value to output data) PM1: 0x00 (Sets to output mode)
[call function]	None
[Variable]	None
[File name]	port_output.c
[Caution]	Set the initial value of the output data as desired according to specifications.

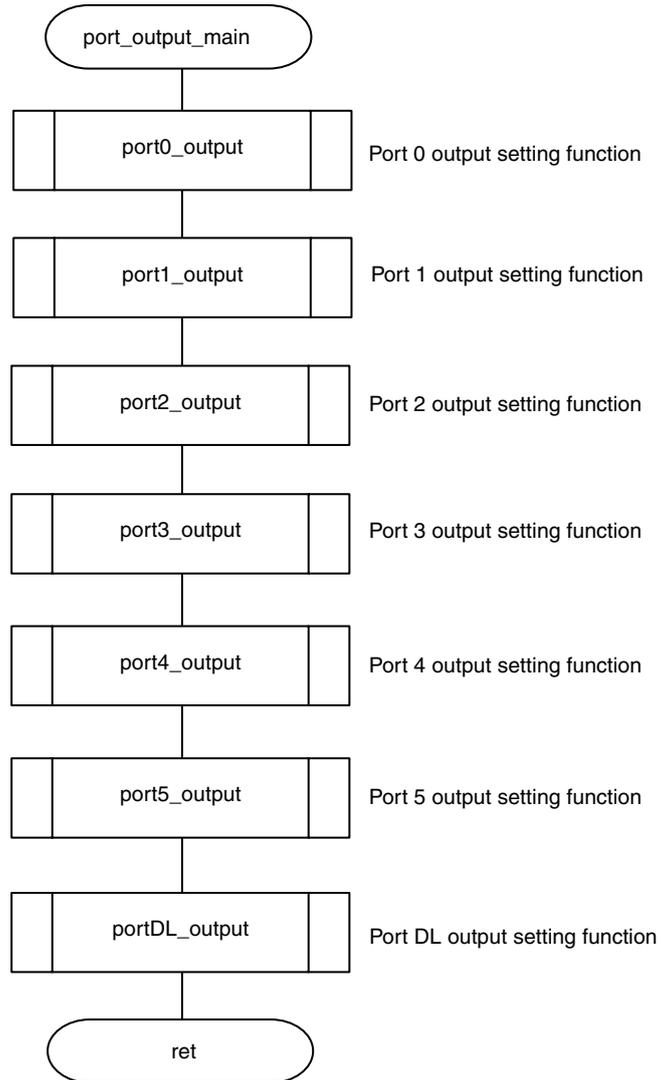
[Function name]	port2_output
[Processing content]	Sets P2 pin to output mode of I/O port.
[SFRs used]	PMC2: 0x00 (Sets to I/O port) P2: 0x00 (Sets initial value to output data) PM2: 0x00 (Sets to output mode)
[call function]	None
[Variable]	None
[File name]	port_output.c
[Caution]	Set the initial value of the output data as desired according to specifications.

[Function name]	port3_output
[Processing content]	Sets P3 pin to output mode of I/O port.
[SFRs used]	PMC3: 0x00 (Sets to I/O port) P3: 0x00 (Sets initial value to output data) PM3: 0x00 (Sets to output mode)
[call function]	None
[Variable]	None
[File name]	port_output.c
[Caution]	Set the initial value of the output data as desired according to specifications.

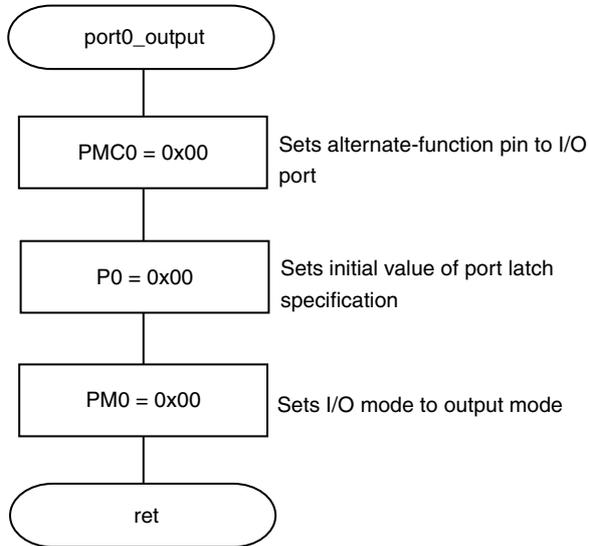
[Function name]	port4_output
[Processing content]	Sets P4 pin to output mode of I/O port.
[SFRs used]	PMC4: 0x00 (Sets to I/O port) P4: 0x00 (Sets initial value to output data) PM4: 0xE0 (Sets to output mode)
[call function]	None
[Variable]	None
[File name]	port_output.c
[Caution]	Set the initial value of the output data as desired according to specifications.

[Function name]	port5_output
[Processing content]	Sets P5 pin to output mode of I/O port.
[SFRs used]	PMC5: 0x00 (Sets to I/O port) P5: 0x00 (Sets initial value to output data) PM5: 0xF8 (Sets to output mode)
[call function]	None
[Variable]	None
[File name]	port_output.c
[Caution]	Set the initial value of the output data as desired according to specifications.

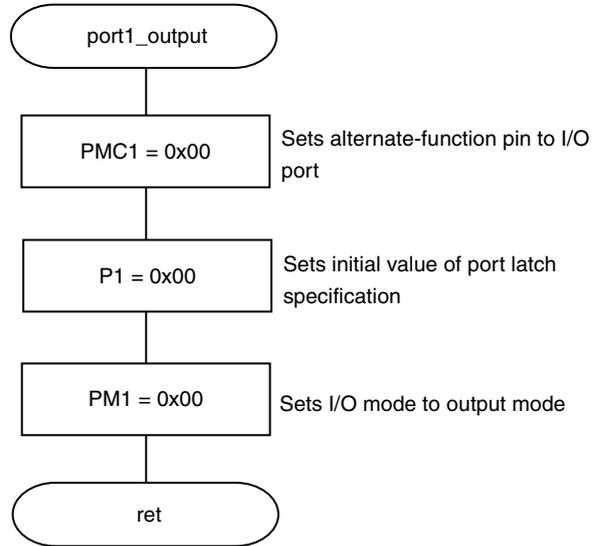
[Function name]	portDL_output
[Processing content]	Sets PDL pin to output mode of I/O port.
[SFRs used]	PDL: 0x0000 (Sets initial value to output data) PMDL: 0x0000 (Sets to output mode)
[call function]	None
[Variable]	None
[File name]	port_output.c
[Caution]	Set the initial value of the output data as desired according to specifications.



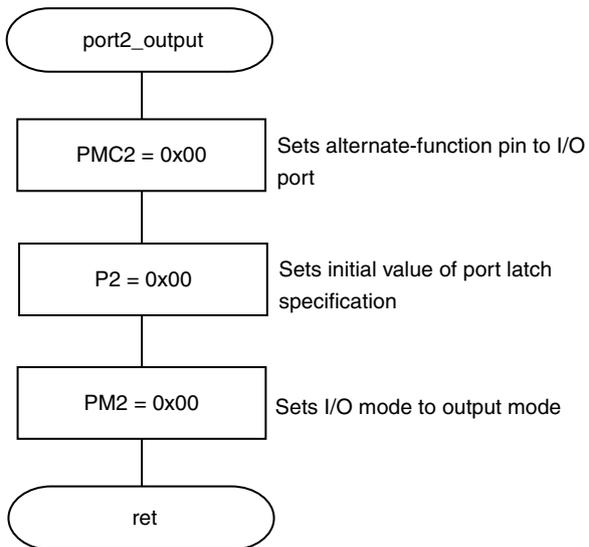
Port 0 output setting function



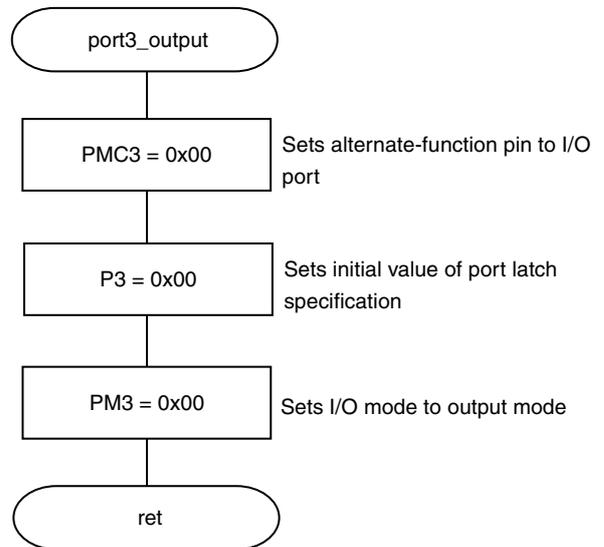
Port 1 output setting function



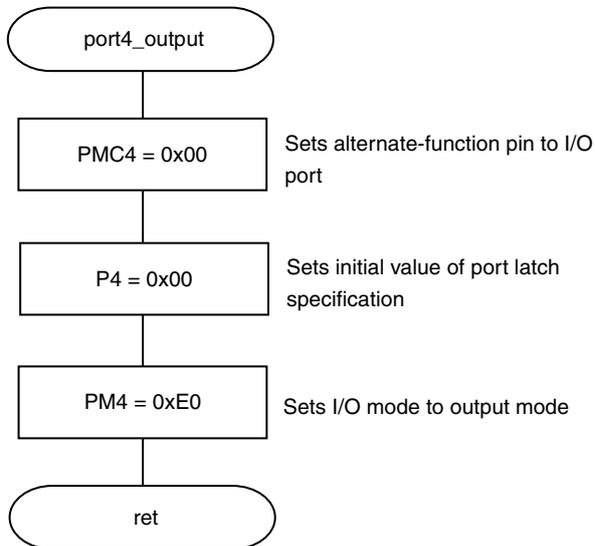
Port 2 output setting function



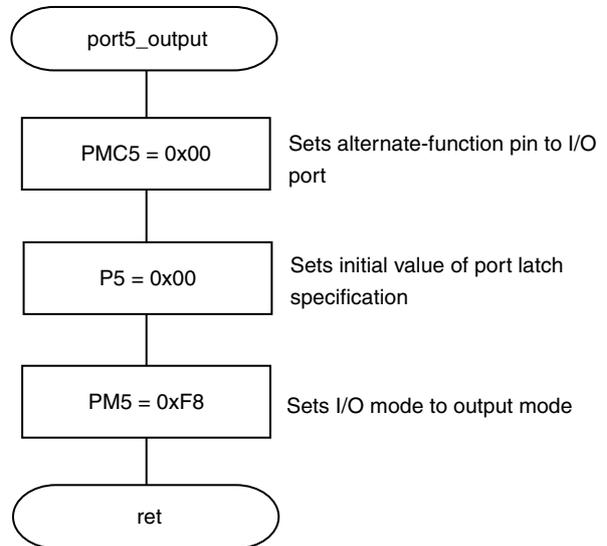
Port 3 output setting function



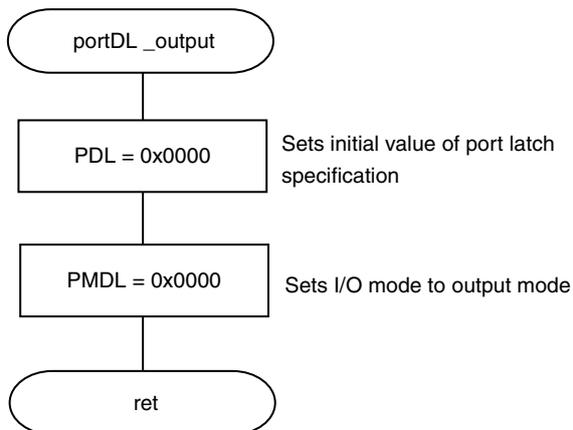
Port 4 output setting function



Port 5 output setting function



Port DL output setting function



## Port functions

### Alternate-function pins

[Function]	Sets all ports as alternate-function pins of alternate-function mode.
[Function name]	port_use_main
[Argument]	None
[Processing content]	Calls setting function of each port and sets to alternate-function pin.
[SFR used]	None
[call functions]	port0_use, port1_use, port2_use, port3_use, port4_use, port5_use, port7_use
[Variable]	None
[Interrupt]	None
[Interrupt source]	None
[File name]	port_use.c
[Caution]	None

[Function name]	port0_use
[Processing content]	Sets P0 pin as alternate-function pin.
[SFRs used]	PMCO: 0xFF (Sets to alternate-function pin) PU0: 0x00 (Sets on-chip pull-up resistor as unused) INTR0: 0x00 (Sets to falling edge) INTF0: 0xFF (Sets to falling edge)
[call function]	None
[Variable]	None
[File name]	port_use.c
[Cautions]	<ul style="list-style-type: none"><li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode or in alternate-function mode.</li><li>• The on-chip pull-up resistor is set as "Not connected" in this sample program.</li></ul>

[Function name]	port1_use
[Processing content]	Sets P1 pin as alternate-function pin.
[SFRs used]	PFC1: 0xFF (Sets to alternate-function pin) PFCE1: 0x00 (Sets to alternate-function pin) PMC1: 0xFF (Sets to alternate-function pin) PU1: 0x00 (Sets on-chip pull-up resistor as unused)
[call function]	None
[Variable]	None
[File name]	port_use.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode, when the pins function as input pins in alternate-function mode, or when the TOQ0T1 to TOQ0T3, TOQ0B1 to TOQ0B3, and TOP21 pins which are output pins during alternate-function mode go into a high impedance state due to TOQ0OFF and TOP2OFF pins or software processing.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

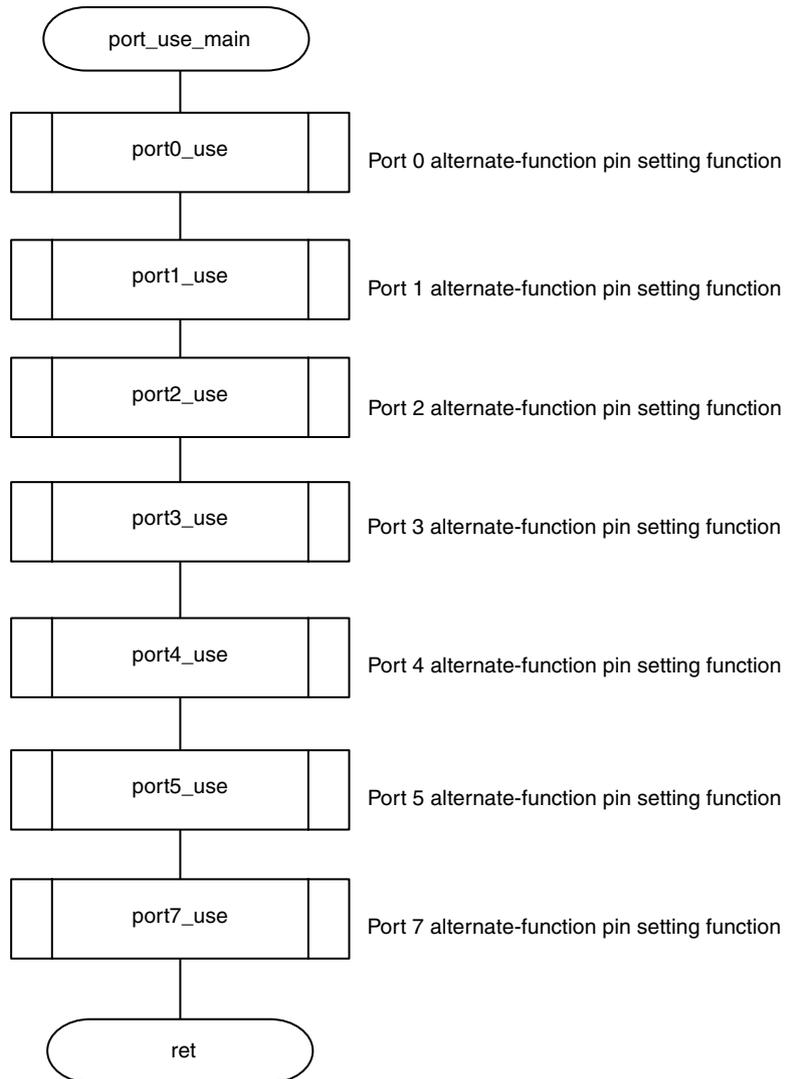
[Function name]	port2_use
[Processing content]	Sets P2 pin as alternate-function pin.
[SFRs used]	PMC2: 0xFF (Sets to alternate-function pin) PU2: 0x00 (Sets on-chip pull-up resistor as unused)
[call function]	None
[Variable]	None
[File name]	port_use.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode, or when the TOQ1T1 to TOQ1T3, TOQ1B1 to TOQ1B3, and TOP31 pins which are output pins during alternate-function mode go into a high impedance state due to TOQ1OFF and TOP3OFF pins or software processing.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

[Function name]	port3_use
[Processing content]	Sets P3 pin as alternate-function pin.
[SFRs used]	PFC3: 0x2C (Sets to alternate-function pin) PMC3: 0xFF (Sets to alternate-function pin) PU3: 0x00 (Sets on-chip pull-up resistor as unused)
[call function]	None
[Variable]	None
[File name]	port_use.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode or when the pins function as input pins in the alternate-function mode.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

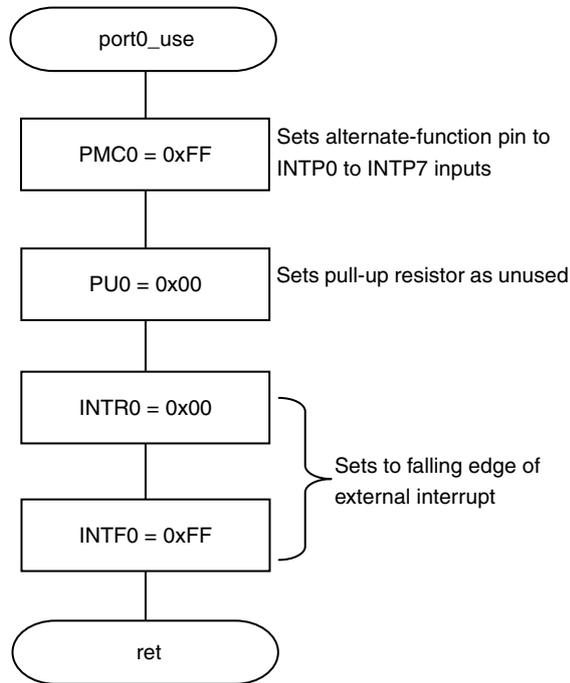
[Function name]	port4_use
[Processing content]	Sets P4 pin as alternate-function pin.
[SFRs used]	PFC4: 0x18 (Sets to alternate-function pin) PMC4: 0x1F (Sets to alternate-function pin) PU4: 0x00 (Sets on-chip pull-up resistor as unused)
[call function]	None
[Variable]	None
[File name]	port_use.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode or when the pins function as input pins in the alternate-function mode (including when the <u>SCKB0</u> pin is in slave mode).</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

[Function name]	port5_use
[Processing content]	Sets P5 pin as alternate-function pin.
[SFRs used]	PFC5: 0x01 (Sets to alternate-function pin) PMC5: 0x07 (Sets to alternate-function pin) PU5: 0x00 (Sets on-chip pull-up resistor as unused)
[call function]	None
[Variable]	None
[File name]	port_use.c
[Cautions]	<ul style="list-style-type: none"> <li>• The connection of the on-chip pull-up resistor becomes valid only when in input mode during port mode or when the pins function as input pins in the alternate-function mode.</li> <li>• The on-chip pull-up resistor is set as “Not connected” in this sample program.</li> </ul>

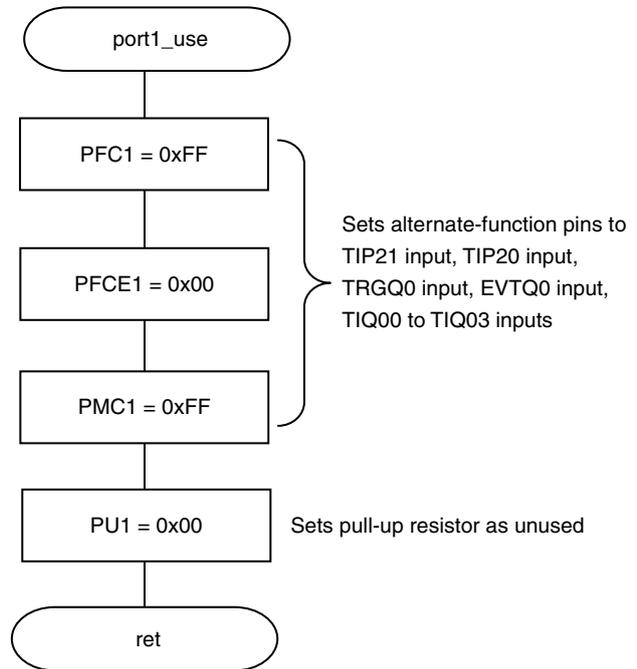
[Function name]	port7_use
[Processing content]	Sets P7 pin as alternate-function pin.
[SFR used]	PMC7: 0xFF (Sets to alternate-function pin)
[call function]	None
[Variable]	None
[File name]	port_use.c
[Caution]	None



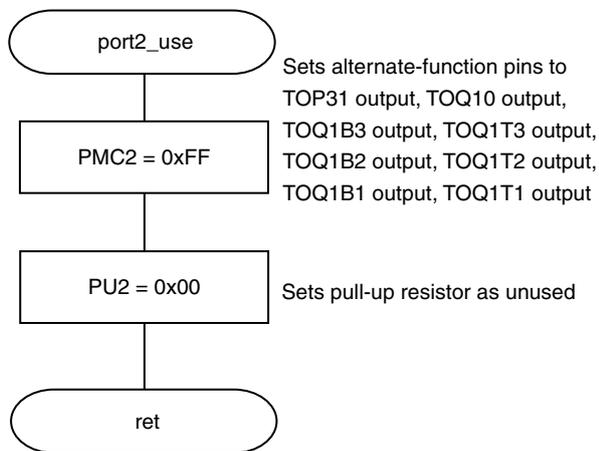
Port 0 alternate-function pin setting function



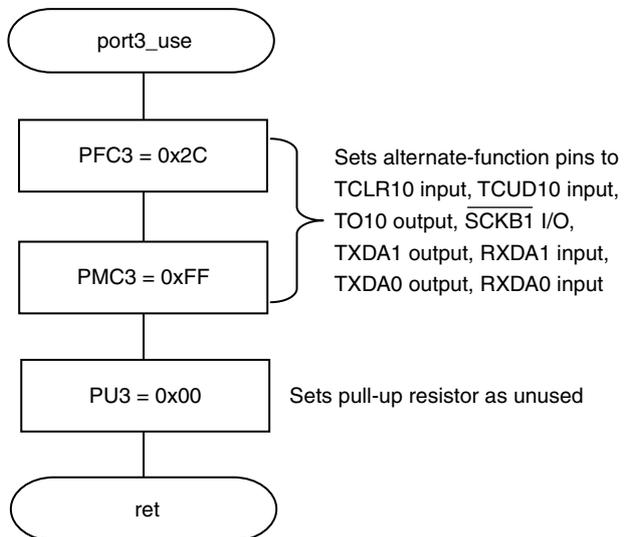
Port 1 alternate-function pin setting function



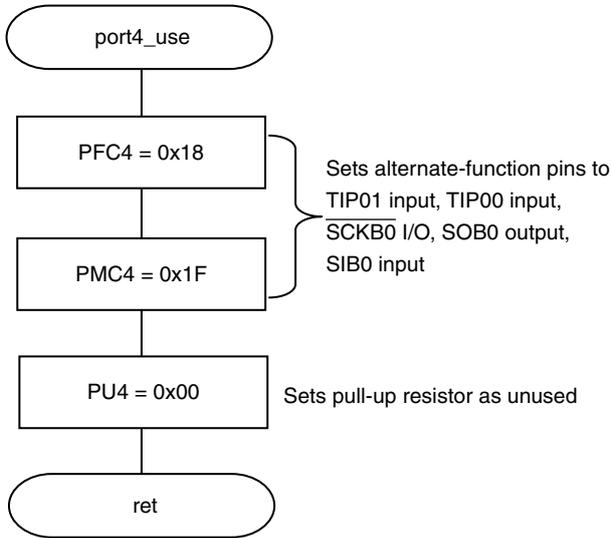
Port 2 alternate-function pin setting function



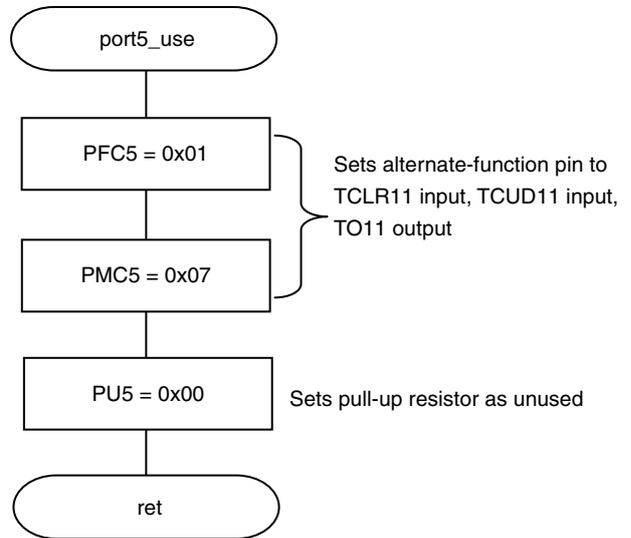
Port 3 alternate-function pin setting function



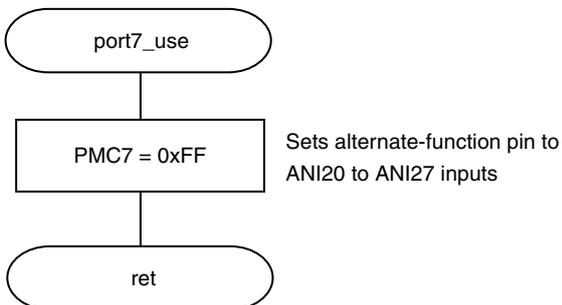
Port 4 alternate-function pin setting function



Port 5 alternate-function pin setting function



Port 7 alternate-function pin setting function



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