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April 1st, 2010
Renesas Electronics Corporation

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APPLICATION NOTE

Handling of Open-Circuit I/O Port Pins

Introduction

Demonstrates the handling of open-circuit I/O port pins.

Target Device

H8/300H Tiny Series H8/3664

Contents

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1. Specifications

1. Demonstrates the handling of open-circuit I/O port pins.
2. Open-circuit I/O port pins for use as I/O pins are set as outputs.
3. Open-circuit I/O port pins for use as input pins are pulled up or down.
4. Open-drain-type output pins are placed in the electric-potential state where the transistor is turned on.

2. Description of Functions

1. In this sample task, processing to handle open-circuit I/O ports is applied. The general ports of the H8/3664 are as follows:

- Input/output ports: Ports 2, 7, and 8;
- Input port: Port B; and
- Input/output ports with pull-up MOSFETs: Ports 1 and 5

Processing methods for each pin are:

- Input/output ports: Set as output ports;
- Input port: Set as pulled-down port; and
- Input/output ports with pull-up MOSFETs: The pull-up MOSFETs are turned on.

Figure 2.1 shows examples of the states of representative ports.

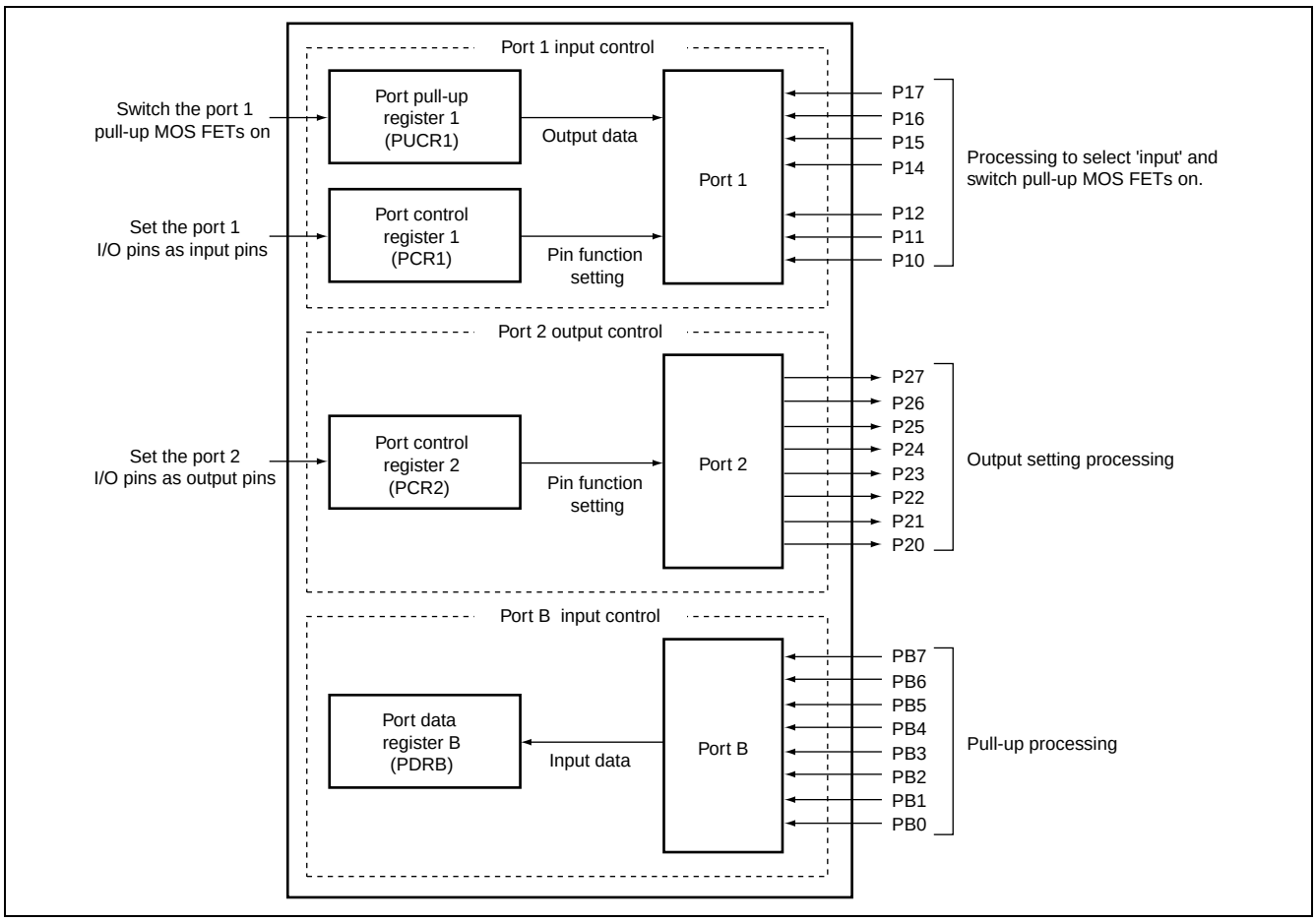


Figure 2.1 Settings for Open Pins on Ports 1, 2, and B

2. Table 2.1 lists the function assignments of this task example. Eight-bit parallel input to port B is performed by assigning functions as shown in table 2.1.

Table 2.1 Function Assignments

Function	Assigned Function
PMR1	Function switching (between I/O and IRQ etc.) for some pins of ports 1 and 2.
PCR1	Each bit selects input/output for the corresponding pin of general I/O port 1.
PUCR1	Pin-by-pin control of the pull-up MOSFETs for each port-1 pin which is set as an input.
PCR2	Each bit selects input/output for the corresponding pin of general I/O port 2.
PMR5	Function switching (between I/O and other functions) for some pins of port 5
PCR5	Each bit selects input/output for the corresponding pin of general I/O port 5.
PUCR5	Pin-by-pin control of the pull-up MOSFETs for each port-5 pin which is set as an input.
PCR7	Each bit selects input/output for the corresponding pin of general I/O port 7.
PCR8	Each bit selects input/output for the corresponding pin of general I/O port 8.

3. Description of Operation

1. Operation of this sample task is described in figures 3.1 to 3.3. Through software/hardware processing as shown in the figures, processing for the open-circuit pins of ports with pull-up MOSFETs (e.g. port 1), general I/O ports (e.g. port 2), and input ports (e.g. port B) is applied.

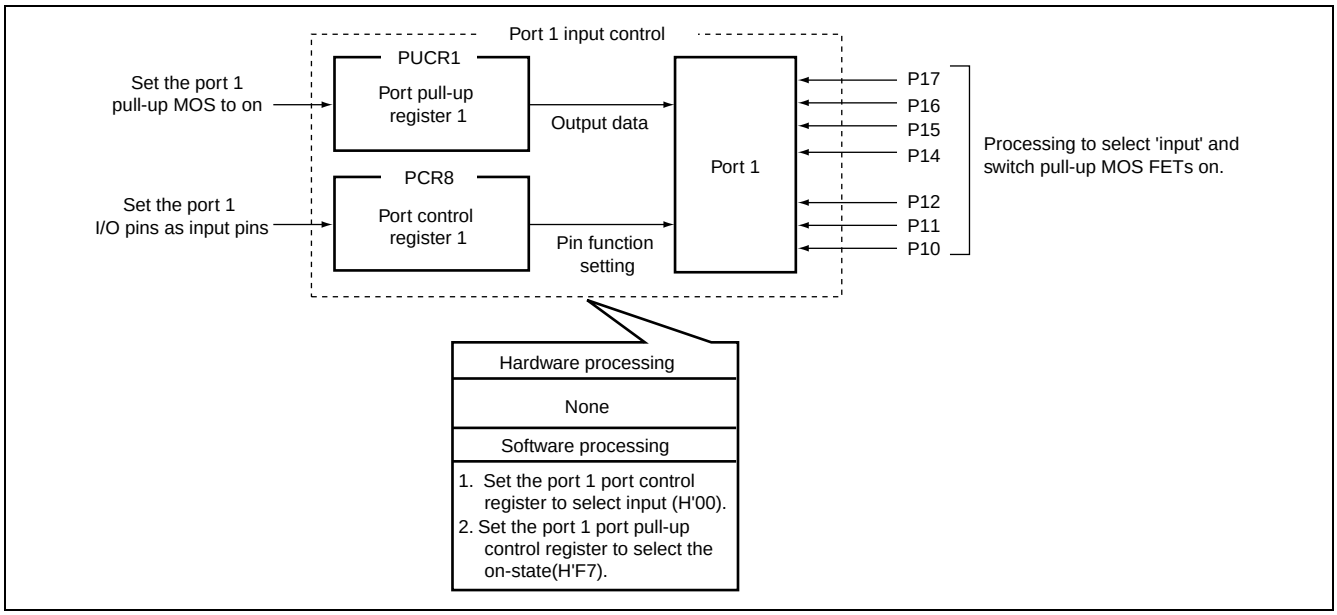


Figure 3.1 Processing for Open-Circuit Pins of Ports with Pull-Up MOSFETs (e.g. Port 1)

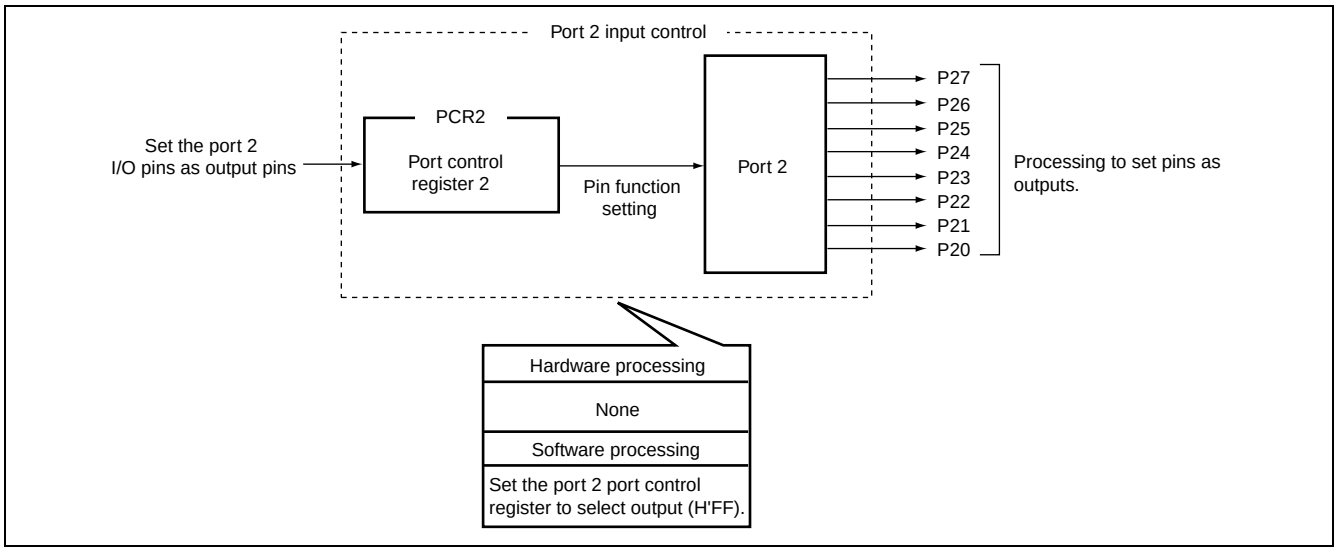


Figure 3.2 Processing for Open-Circuit Pins of General I/O Ports (e.g. Port 2)

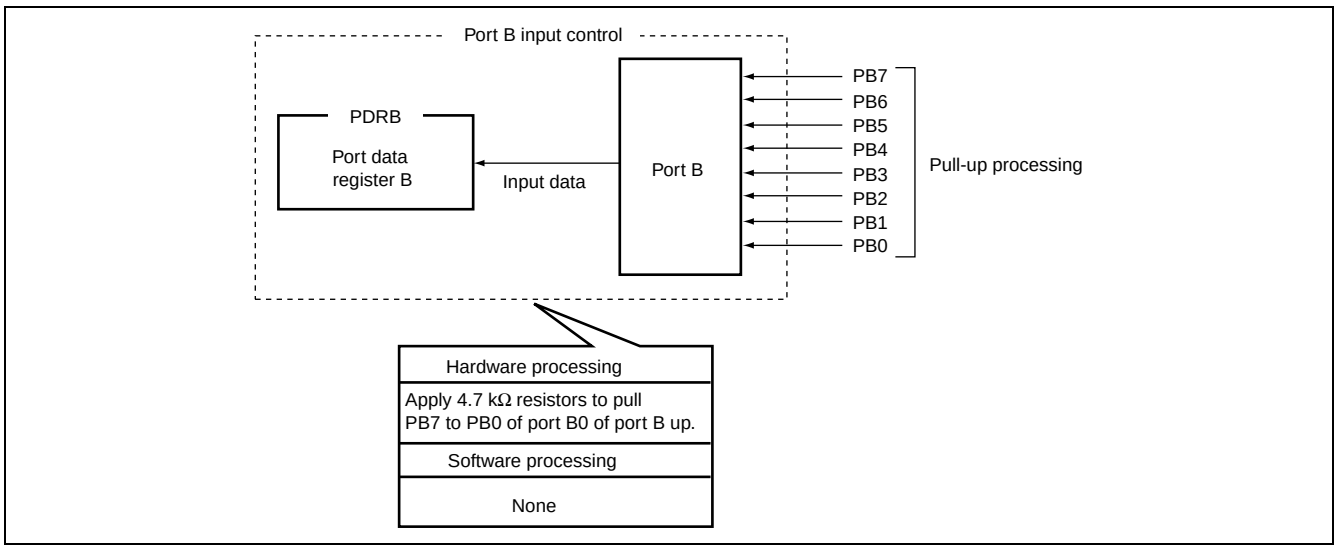


Figure 3.3 Processing for Open-Circuit Pins of Input Ports (e.g. Port B)

4. Description of Software

4.1 Module

Table 4.1 lists the single module of this sample task.

Table 4.1 Description of Module

Module Name	Label Name	Function
Main routine	main	Performs I/O port settings

4.2 Arguments

No arguments are used in this task.

4.3 Internal Registers Used

Table 4.2 lists the usage of internal registers in this sample task.

Table 4.2 Internal Registers Used

Register Name		Function	Address	Setting
PMR1	IRQ3	0: P17 is used as a general I/O pin. 1: P17 is used as the IRQ3/TRGV input pin.	H'FFE0	0
Port mode register 1	IRQ2	0: P16 is used as a general I/O pin. 1: P16 is used as the IRQ2 input pin.		0
	IRQ1	0: P15 is used as a general I/O pin. 1: P15 is used as the IRQ1 input pin.		0
	IRQ0	0: P14 is used as a general I/O pin. 1: P14 is used as the IRQ0 input pin.		0
	TXD	0: P22 is used as a general I/O pin. 1: P22 is used as the TXD output pin.		0
	TMOW	0: P10 is used as a general I/O pin. 1: P10 is used as the TMOW output pin.		0
PCR1	PCR17	0: P17 is used as an input pin. 1: P17 is used as an output pin.	H'FFE4	0
Port control register 1	PCR16	0: P16 is used as an input pin. 1: P16 is used as an output pin.		0
	PCR15	0: P15 is used as an input pin. 1: P15 is used as an output pin.		0
	PCR14	0: P14 is used as an input pin. 1: P14 is used as an output pin.		0

Table 4.2 Internal Registers Used (cont)

Register Name		Function	Address	Setting
PCR1 Port control register 1 (cont)	PCR12	0: P12 is used as an input pin. 1: P12 is used as an output pin.	H'FFE4	0
	PCR11	0: P11 is used as an input pin. 1: P11 is used as an output pin.		0
	PCR10	0: P10 is used as an input pin. 1: P10 is used as an output pin.		0
PUCR1 Port pull-up control register 1	PUCR17	0: P17 pull-up MOSFET is off. 1: P17 pull-up MOSFET is on.	H'FFD0	1
	PUCR16	0: P16 pull-up MOSFET is off. 1: P16 pull-up MOSFET is on.		1
	PUCR15	0: P15 pull-up MOSFET is off. 1: P15 pull-up MOSFET is on.		1
	PUCR14	0: P14 pull-up MOSFET is off. 1: P14 pull-up MOSFET is on.		1
	PUCR12	0: P12 pull-up MOSFET is off. 1: P12 pull-up MOSFET is on.		1
	PUCR11	0: P11 pull-up MOSFET is off. 1: P11 pull-up MOSFET is on.		1
	PUCR10	0: P10 pull-up MOSFET is off. 1: P10 pull-up MOSFET is on.		1
PCR2 Port control register 2		When PCR27 to PCR20 = H'00, P27–P20 I/O pins function as input pins. When PCR27 to PCR20 = H'FF, P27–P20 I/O pins function as output pins.	H'FFE5	H'FF
PMR5 Port mode register 5:	WKP5	0: this is a general I/O pin. 1: this is the WKP5 input pin/ADTRG input pin.	H'FFE1	0
	WKP4	0: this is a general I/O pin. 1: this is the WKP4 input pin.		0
	WKP3	0: this is a general I/O pin. 1: this is the WKP3 input pin.		0
	WKP2	0: this is a general I/O pin. 1: this is the WKP2 input pin.		0
	WKP1	0: this is a general I/O pin. 1: this is the WKP1 input pin.		0
	WKP0	0: this is a general I/O pin. 1: this is the WKP0 input pin.		0

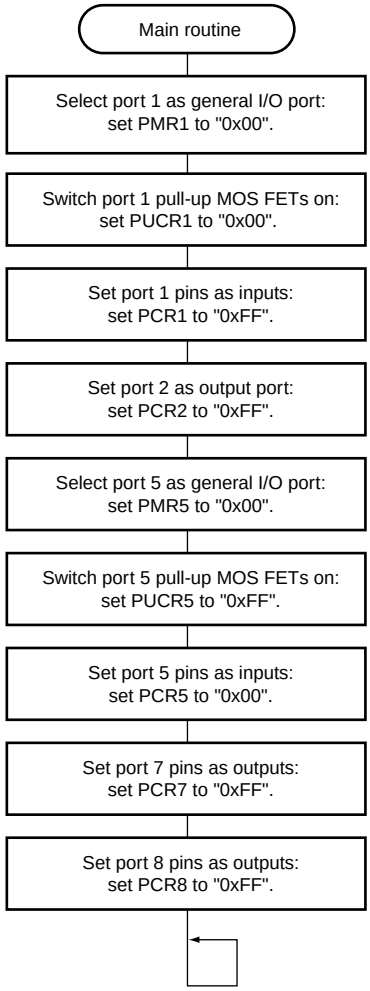
Table 4.2 Internal Registers Used (cont)

Register Name		Function	Address	Setting
PCR5 Port control register 5		When PCR57 to PCR50 = H'00, P57–P50 I/O pins are input pins. When PCR57 to PCR50 = H'FF, P57–P50 I/O pins are output pins.	H'FFE8	H'00
PUCR5 Port pull-up control register 5	PUCR55	0: P55 pull-up MOSFET is on. 1: P55 pull-up MOSFET is off.	H'FFD1	1
	PUCR54	0: P54 pull-up MOSFET is on. 1: P54 pull-up MOSFET is off.		1
	PUCR53	0: P53 pull-up MOSFET is on. 1: P53 pull-up MOSFET is off.		1
	PUCR52	0: P52 pull-up MOSFET is on. 1: P52 pull-up MOSFET is off.		1
	PUCR51	0: P51 pull-up MOSFET is on. 1: P51 pull-up MOSFET is off.		1
	PUCR50	0: P50 pull-up MOSFET is on. 1: P50 pull-up MOSFET is off.		1
PCR7 Port control register 7		When PCR77 to PCR70 = H'00, P77–P70 I/O pins function as input pins. When PCR77 to PCR70 = H'FF, P77–P70 I/O pins function as output pins.	H'FFEA	H'FF
PCR8 Port control register 8		When PCR87 to PCR80 = H'00, P87–P80 I/O pins function as input pins. When PCR87 to PCR80 = H'FF, P87–P80 I/O pins function as output pins.	H'FFEB	H'FF

5. Description of RAM Usage

No RAM is used by this sample task.

6. Flowchart



Note: In this example, the stack pointer is set by INIT. SRC (assembly language).

7. Program Listing

INIT. SRC (program listing)

```
      .EXPORT   _INIT
      .IMPORT   _main
 ;
      .SECTION  P,CODE
 _INIT:
      MOV.W     #H'FF80,R7
      LDC.B     #B'10000000,CCR
      JMP       @_main
 ;
      .END
```

```
/************************************************************/
/*                                                          */
/*  H8/300H Tiny Series -H8/3664-                           */
/*  Application Note                                        */
/*                                                          */
/*  Handling of Open-Circuit I/O Port Pins                  */
/*                                                          */
/*  Function                                                */
/*  : Port B Read                                           */
/*                                                          */
/*  External Clock : 16MHz                                  */
/*  Internal Clock : 16MHz                                  */
/*  Sub Clock      : 32.768kHz                              */
/*                                                          */
/************************************************************/

#include    <C:\ch38\include\machine.h>
```

```
/************************************************************/
/*  Symbol Defnition                                        */
/************************************************************/
#define   PMR1       *(volatile unsigned char *)0xFFE0       /* Port Mode Register 1            */
#define   PCR1       *(volatile unsigned char *)0xFFE4       /* Port Control Register 1         */
#define   PUCR1      *(volatile unsigned char *)0xFFD0       /* Port Pull-Up Control Register 1 */
#define   PCR2       *(volatile unsigned char *)0xFFE5       /* Port Control Register 2         */
#define   PMR5       *(volatile unsigned char *)0xFFE1       /* Port Mode Register 5            */
#define   PCR5       *(volatile unsigned char *)0xFFE8       /* Port Control Register 5         */
#define   PUCR5      *(volatile unsigned char *)0xFFD1       /* Port Pull-Up Control Register 5 */
#define   PCR7       *(volatile unsigned char *)0xFFEA       /* Port Control Register 7         */
#define   PCR8       *(volatile unsigned char *)0xFFE1       /* Port Control Register 8         */

/************************************************************/
/* Function Definition                                      */
/************************************************************/
extern  void    INIT( void );                                /* SP Set                          */

void    main    ( void );
/************************************************************/
/*  Vector Address                                          */
/************************************************************/
#pragma section     V1                                       /* VECTOR SETTING SECTION          */
void (*const VEC_TBL1[])(void) = {
/* 0x00 - 0x0f */
    INIT                                                     /* 00 Reset                        */
};
#pragma section                                              /* P                               */
```

```
/*********************************************************/
/*  Main Program                                         */
/*********************************************************/
void main ( void )
{
    PMR1 = 0x00;                                    /* Port Mode Register 1            */

    PCR1 = 0x00;                                    /* Port Control Register 1         */

    PUCR1 = 0xFF;                                   /* Port Pull-Up Control Register 1 */

    PCR2 = 0xFF;                                    /* Port Control Register 2         */

    PMR5 = 0x00;                                    /* Port Mode Register 5            */

    PCR5 = 0x00;                                    /* Port Control Register 5         */

    PCR7 = 0xFF;                                    /* Port Control Register 7         */

    PCR8 = 0xFF;                                    /* Port Control Register 8         */

    while(1){
       ;
    }
```

Link-address specification:

Section Name	Address
CV1	H'0000
P	H'0100
B	H'FB80