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H8/300L Super Low Power Series

Using the 10-Bit PWM Function to Generate Variable-Duty-Cycle Pulse Output

Introduction

The 10-bit PWM function is used to output pulses with the pulse period of 204.8 µs and high-level width of 154.4 µs from the PWM1 output pin

Target Device

H8/38024

Contents

1. Specifications

1. Pulses with a specified duty cycle controlled by the 10-bit PWM function are output through PWM1 output pin as shown in figure 1.
2. In this sample task, output pulses have a 75.4% duty cycle with the period of 204.8 µs and high-level width of 154.4 µs.

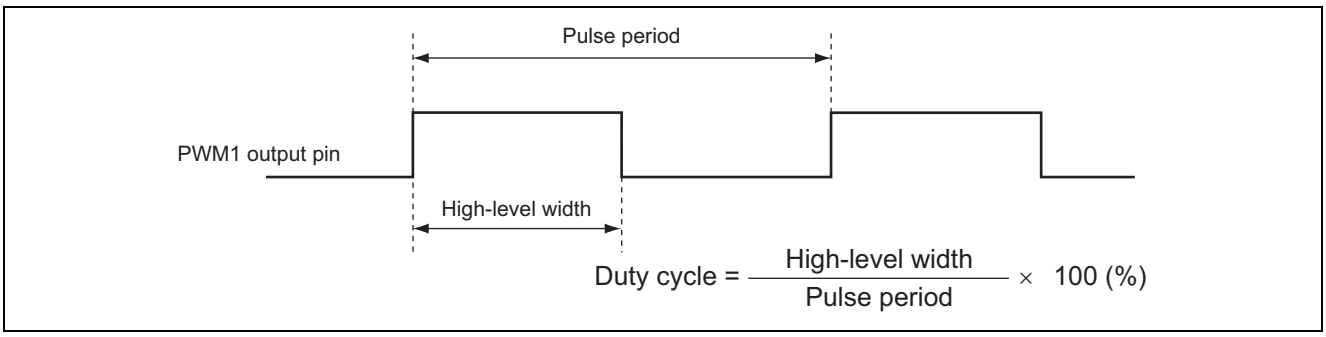


Figure 1 Variable Duty-Cycle Pulse Output by 10-Bit PWM Function

2. Description of Functions Used

1. In this sample task, pulses with a specified duty cycle are output through the PWM1 output pin by using the 10-bit PWM function.
   a. Figure 2 shows the block diagram of the 10-bit PWM function which is described below.
      - The system clock (ϕ) is 5-MHz clock, which is a reference clock used to operate the CPU and its peripheral functions.
      - The PWM1 Control Register (PWCR1) is an 8-bit write-only register and selects the input clock.
      - A pulse division method is used for less ripple.
      - The PWM1 Data Registers U and L (PWDRU1, PWDRL1) are 10-bit write-only registers, with the upper two bits assigned to PWDRU1 and the lower eight bits assigned to PWDRL1. The data written in the PWDRU1 and PWDRL1 corresponds to the total of the "High" level width in one PWM waveform cycle. Writing 10-bit data to the PWDRU1 and PWDRL1 causes the register contents to be latched into the PWM waveform generator to update the PWM waveform generation data. The 10-bit data must always be written by writing to the lower 8 bits to the PWDRL1 first then writing the upper 2 bits to the PWDRU1.
      - The Port Mode Register 9 (PMR9) is an 8-bit readable/writable register and controls switching of the pin functions of Port 9. By the setting of bit 0 (PWM1: P9/PWM pin function switching) of this register, the P90/PWM1 pin is set to function as the PWM1 output pin.
      - PWM waveform of the pulse division method is output through the PWM1 output pin (PWM1).

Note: When a PWM waveform is output using the 10-bit PWM function in this sample task, the normal PWM waveform may not be output depending on the rewriting timing of the PWM data registers.

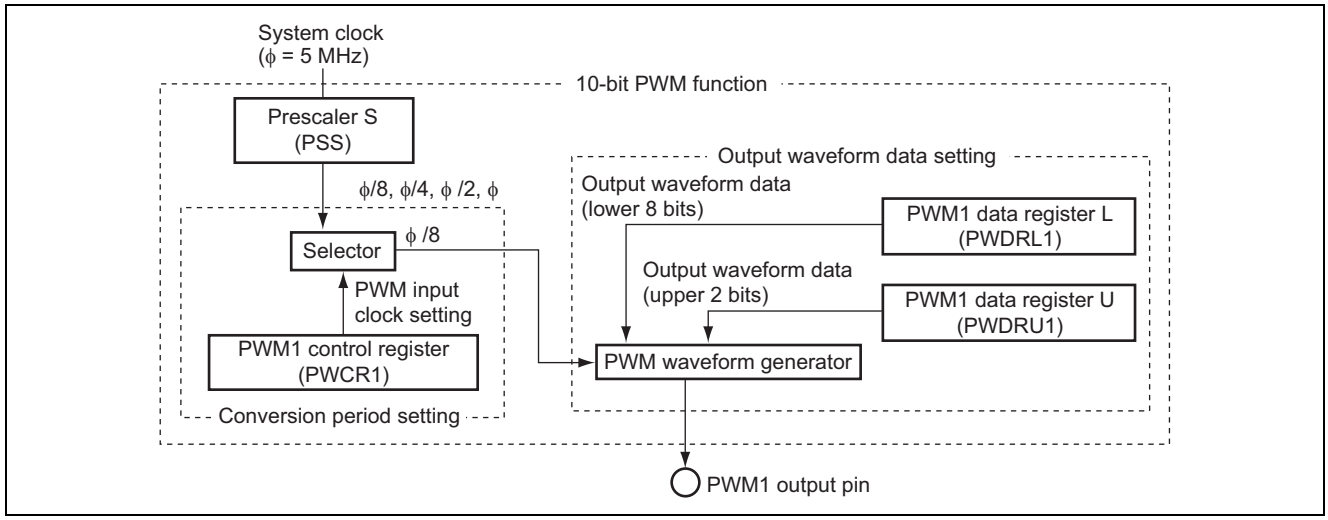


Figure 2 Block Diagram of 10-Bit PWM Function

2. Table 1 shows the assignment of functions in this sample task. The functions are assigned as shown in table 1 to output pulses with a specified duty cycle by using the 10-bit PWM function.

Table 1 Assignment of Functions

Function	Assignment
PSS	A 13-bit up-counter using the system clock (5 MHz) as input
PWCR1	Selects the clock to be supplied to the 10-bit PWM block.
PWDRU1	The upper two bits of PWM output waveform data are set.
PWDRL1	The lower eight bits of PWM output waveform data are set.
PWM1	PWM waveform output pin

3. Principle of Operation

1. Figure 3 illustrates the principle of operation of this sample task. A PWM waveform with a specified duty cycle, which is controlled by the 10-bit PWM function, is output through the hardware processing and software processing shown in the figure.

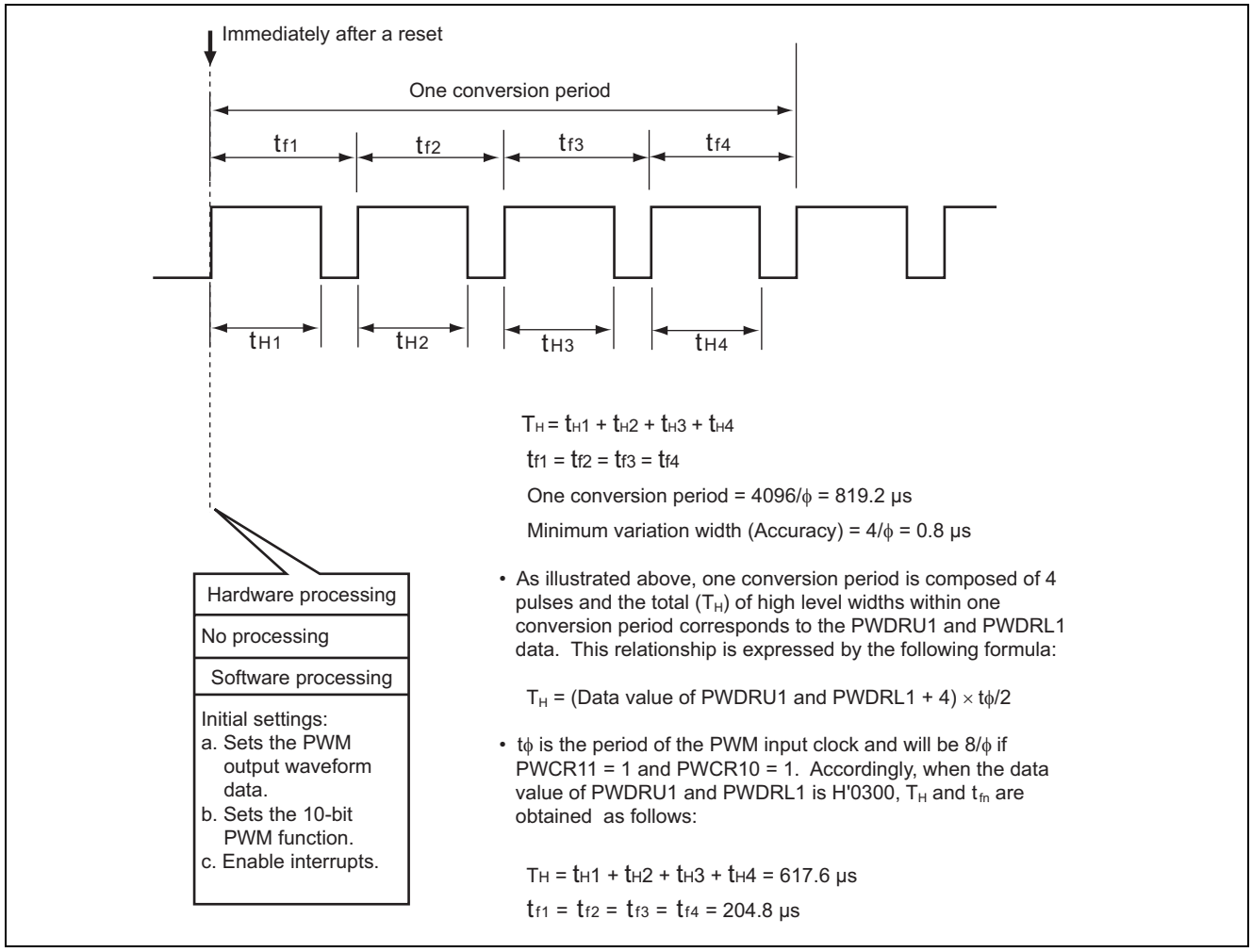


Figure 3 Operation Principle of Variable-Duty-Cycle Pulse Output by 10-bit PWM Function

4. Description of Software

4.1 Modules

Table 2 describes the module in this sample task.

Table 2 Description of Module

Module	Label	Function
Main Routine	main	Sets the 10-bit PWM function and enables interrupts.

4.2 Arguments

The arguments used in this sample task are described in table 3.

Table 3 Description of Arguments

Argument	Function	Used in	Data Length	Input/ Output
pwmu_data	The upper two bits of PWM1 output waveform data which are to be set in PWDRU1	Main Routine	1 byte	Input
pwml_data	The lower eight bits of PWM1 output waveform data which are to be set in PWDRL1	Main Routine	1 byte	Input

4.3 Internal registers

Table 4 describes the internal registers in this sample task.

Table 4 Description of Internal Registers

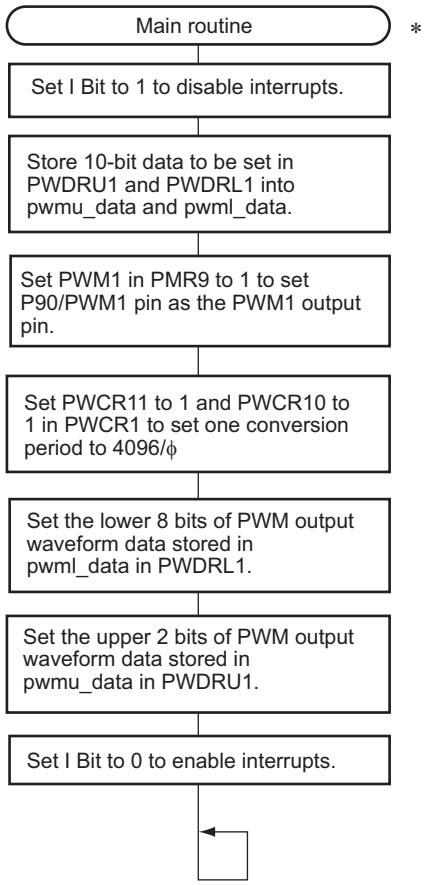
Register		Function	Address	Setting
PWCR1	PWCR11 PWCR10	PWM1 Control Register (Clock Select 1,0) When PWCR11 = 1 and PWCR10 = 1, selects ϕ/8 as the clock supplied to the 10-bit PWM block.	H'FFD0 Bit 1 Bit 0	PWCR11 = 1 PWCR10 = 1
PWDRU1		PWM1 Data Register U Sets the upper two bits of PWM output waveform data.	H'FFD1	H'03
PWDRL1		PWM1 Data Register L Sets the lower eight bits of PWM output waveform data.	H'FFD2	H'00
PMR9	PWM1	Port Mode Register 9 (P90/PWM1 pin function switching) When PWM1 = 0, set the P90/PWM1 pin function as the P90 output pin. When PWM1 = 1, the P90/PWM1 pin function as the PWM1 output pin.	H'FFEC Bit 0	1

4.4 RAM

No RAM area is used in this sample task.

5. Flowchart

1. Main routine



Note: * In this sample task, the stack pointer is set in INIT.SRC (assembly language).

6. 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
```

```
/************************************************************************************************/
/*                                                                                              */
/*  H8/300L Super Low Power Series                                                              */
/*      -H8/38024 Series-                                                                       */
/*  Application                                                                                 */
/*                                                                                              */
/*  'Duty Pulse  Output by 10-bit PWM Function'                                                 */
/*                                                                                              */
/*  Function                                                                                    */
/*  : 10bit PWM                                                                                 */
/*                                                                                              */
/*  External Clock :     10MHz                                                                  */
/*  Internal Clock :     5MHz                                                                   */
/*  Sub Clock :          32.768kHz                                                              */
/*                                                                                              */
/************************************************************************************************/

#include    <machine.h>

/************************************************************************************************/
/*  Symbol Definition                                                                           */
/************************************************************************************************/
struct BIT {
    unsigned char    b7:1;        /* bit7 */
    unsigned char    b6:1;        /* bit6 */
    unsigned char    b5:1;        /* bit5 */
    unsigned char    b4:1;        /* bit4 */
    unsigned char    b3:1;        /* bit3 */
    unsigned char    b2:1;        /* bit2 */
    unsigned char    b1:1;        /* bit1 */
    unsigned char    b0:1;        /* bit0 */
};
```

```
#define   PWCR1       *(volatile unsigned char *)0xFFD0     /* PWM Control Register             */
#define   PWCR1_BIT   (*(struct BIT *)0xFFD0)               /* PWM Control Register             */
#define   PWCR11      PWCR1_BIT.b1                          /* Clock Select                     */
#define   PWCR10      PWCR1_BIT.b0                          /* Clock Select                     */
#define   PWDRU1      *(volatile unsigned char *)0xFFD1     /* PWM Data Register U              */
#define   PWDRL1      *(volatile unsigned char *)0xFFD2     /* PWM Data Register L              */
#define   PMR9_BIT    (*(struct BIT *)0xFFEC)               /* Port Mode Register 9             */
#define   PWM1        PMR9_BIT.b0                           /* P14/PWM Terminal Function Change */

/************************************************************************************************/
/*  Function define                                                                             */
/************************************************************************************************/
extern void  INIT ( void );                                 /* SP Set                           */
void         main ( void );

/************************************************************************************************/
/*  Vector Address                                                                              */
/************************************************************************************************/
#pragma section      V1                                     /* Vector Section Set               */
void (*const VEC_TBL1[])(void) = {                          /* 0x0000 – 0x000F                  */
    INIT                                                    /* 0x0000 Reset Vector              */
};

#pragma section                                             /* P                                */
/************************************************************************************************/
/*  Main Program                                                                                */
/************************************************************************************************/
void main ( void )
{
    unsigned char     pwmu_data,pwml_data;

    set_imask_ccr(1);                               /* Interrupt Disable                    */

    pwmu_data = 0x03;
    pwml_data = 0x00;

    PWM1 = 1;

    PWCR1 = 0xFF;                                   /* Initialize PWM Clock, phi/8          */

    PWDRL1 = pwml_data;                             /* Initialize PWM Output Pulse Data Higher */
    PWDRU1 = pwmu_data;                             /* Initialize PWM Output Pulse Data Lower  */

    set_imask_ccr(0);                               /* Interrupt Disable                    */

    while(1){
        ;
    }
}
```

Link address specifications

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

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Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
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2.00	Nov.30.06	All pages	Content correction

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