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April 1st, 2010
Renesas Electronics Corporation

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38D2 Group

Timer 3, Timer X (PWM Signal Output Control: Remote Controller Carrier Wave Output Control)

1. Abstract

The following article introduces and shows an application example of the PWM signal (remote controller carrier wave) output from P35/Txout1 pin by Timer 3 and Timer X of the 38D2 Group.

2. Introduction

The explanation of this issue is applied to the following conditions:

- Applicable MCU: 38D2 Group
- Oscillation frequency: 4 MHz
- Memory size: 24 KB ROM, 640 bytes RAM

3. Contents

3.1 Application Example of PWM Signal Output Control

- Outline
  - Generate the PWM signal (remote controller carrier wave) by Timer X.
  - Control the output of the PWM signal to the P35/Txout1 pin by Timer 3.
  - Switch the ON/OFF of the output of the P35/Txout1 pin every Timer 3 underflow.
  - Change the interval of ON/OFF of the output of the P35/Txout1 pin by changing Timer 3 set value.

- Specifications
  - PWM signal: 38 KHz, duty 1/3
  - P35/Txout1 output: standard interval T = 320 us, 8T output ON → 4T output OFF → T output ON

Figure 1 shows the PWM output control by Timer 3, and Figure 2 shows the connection of Timer and the dividing ratio.

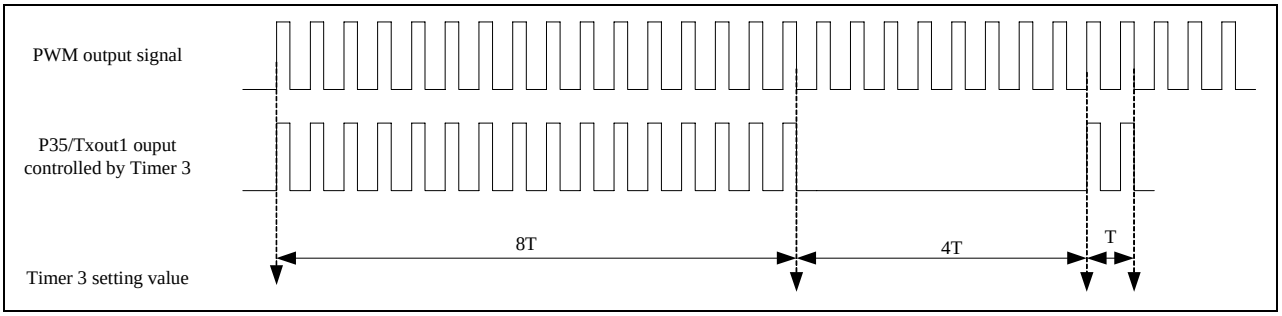

Figure 1 PWM Output Control by Timer 3

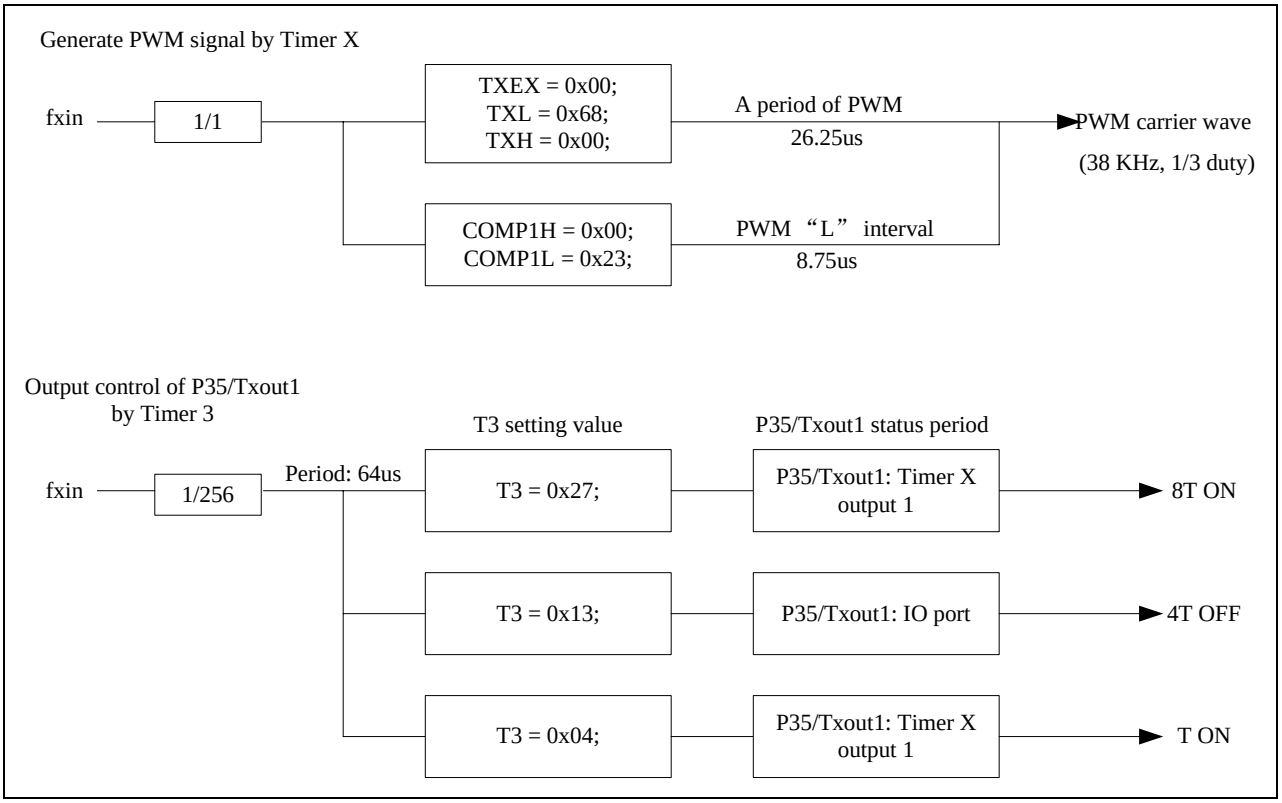

Figure 2 Connection of Timer and Dividing Ratio

3.2 Relevant Register Setting

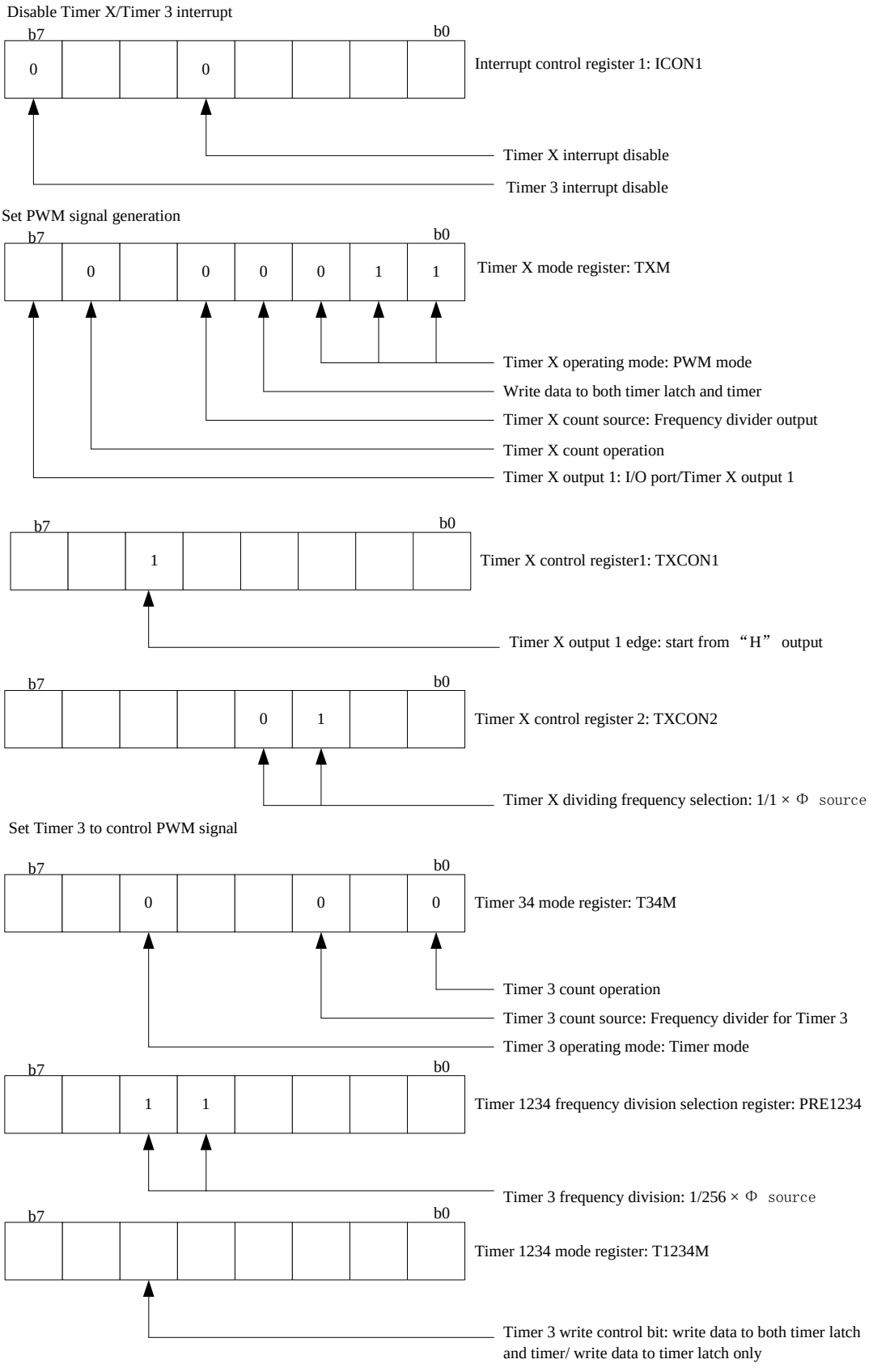

Figure 3 Relevant Register Setting

3.3 Flow Chart

Following is flow chart of main program for PWM signal output control by Timer 3 and Timer X.

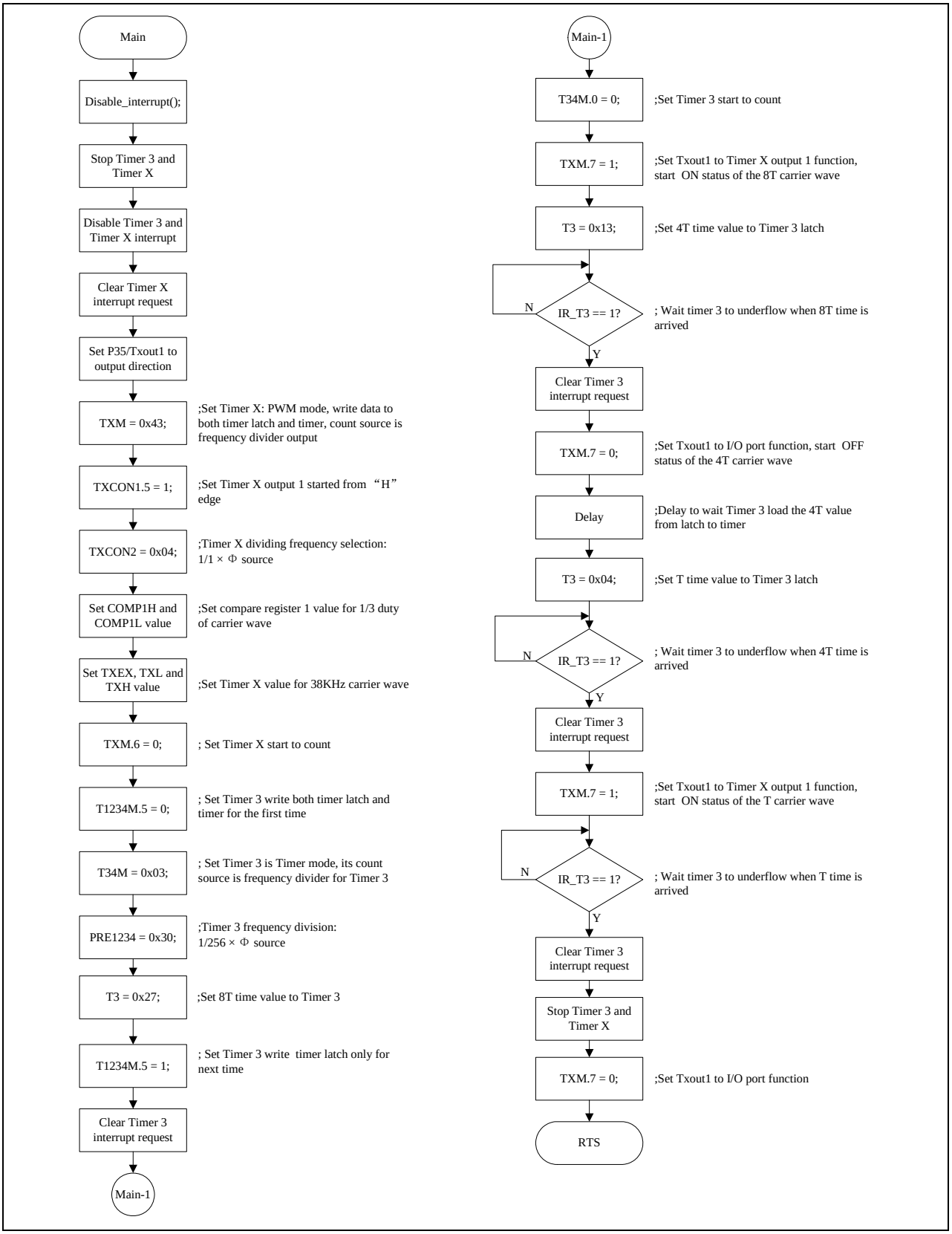

Figure 4 Flow Chart of Main Program

4. Sample Program Code

```
/************************************************************************
*   File Name   : rec05b0027_0100_source.c
*   CPU         : M38D24 Group
*   Function    : Timer 3, Timer X (PWM signal output control)
*   Version     : 1.00 (2007-04-13)
*   Copyright (C) 2007, Renesas Technology Corp. All rights reserved.
************************************************************************/

/************************************************************************
*     Include File
************************************************************************/
#include <intr740.h>
#include "sfr_38d2.h"

/************************************************************************
Name        : Main
************************************************************************/
void main(void)
{
   unsigned char temp_i;
   disable_interrupt();  /*disable all interrupt*/

   T34M.0 = 1;           /*Timer 3 stop to operation*/
   TXM.6 = 1;            /*Timer X stop to operation*/

   IE_TX = 0;            /*disable Timer X interrupt*/
   IE_T3 = 0;            /*disable Timer 3 interrupt*/
   IR_TX = 0;            /*clear Timer X interrupt request*/

   P3D.5 = 1;            /*P35/Txout1 output direction*/

   TXM = 0x43;           /*set TXM register value*/
   TXCON1.5 = 1;         /*Timer X output 1 started from "H"*/
   TXCON2 = 0x04;        /*set Timer X dividing frenquency*/
   COMP1H = 0x00;        /*set compare register 1 value*/
   COMP1L = 0x23;
   TXEX = 0x00;          /*set Timer X value*/
   TXL = 0x68;
   TXH = 0x00;
   TXM.6 = 0;            /*set Timer X to start operation*/

   T1234M.5 = 0;         /*Timer 3:write both timer and timer latch*/
   T34M = 0x03;          /*set T34M related Timer 3*/
   PRE1234 = 0x30;       /*set Timer 3 frequency division*/
   T3 = 0x27;            /*set 8T time value to Timer 3*/
   T1234M.5 = 1;         /*Timer 3 write control:write timer latch only*/

   IR_T3 = 0;            /*clear Timer 3 interrupt request*/
   T34M.0 = 0;           /*Timer 3 start to operate*/
   TXM.7 = 1;            /*set Timer X output 1 function*/

   T3 = 0x13;            /*set 4T time value to Timer 3 latch ahead of schedule*/
   while(!IR_T3){}       /*wait to end of 8T time count*/
   IR_T3 = 0;            /*clear Timer 3 interrupt request*/
   TXM.7 = 0;            /*set Timer X output 1 as IO port function*/
   for(temp_i=0;temp_i<2;temp_i++)
```

```
    {;}                     /*wait load timer latch value(4T) to Timer 3 register*/
    T3 = 0x04;              /*set T time value to Timer 3 latch ahead of schedule*/
    while(!IR_T3){}         /*wait to end of 4T time count*/
    IR_T3 = 0;              /*clear Timer 3 interrupt request*/
    TXM.7 = 1;              /*set Timer X output 1 function*/
    while(!IR_T3){}         /*wait to end of T time count*/
    IR_T3 = 0;              /*clear Timer 3 interrupt request*/
    T34M.0 = 1;             /*Timer 3 stop to operation*/
    TXM.6 = 1;              /*Timer X stop to operation*/
    TXM.7 = 0;              /*set Timer X output 1 as IO port function*/
}
```

5. Reference Document

Hardware Manual
38D2 Group Datasheet
The latest version can be downloaded from the Renesas Technology website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Technology website.

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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Apr.13.07	—	First edition issued

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