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Renesas Electronics Corporation

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SH7144/45 Group

DC Motor Control Signal Output

1. Specifications

Waveforms necessary for DC brushless motor control are output as shown in figure 1. The output waveforms are output by chopping the respective pin gate signals and reset-synchronized PWM output.

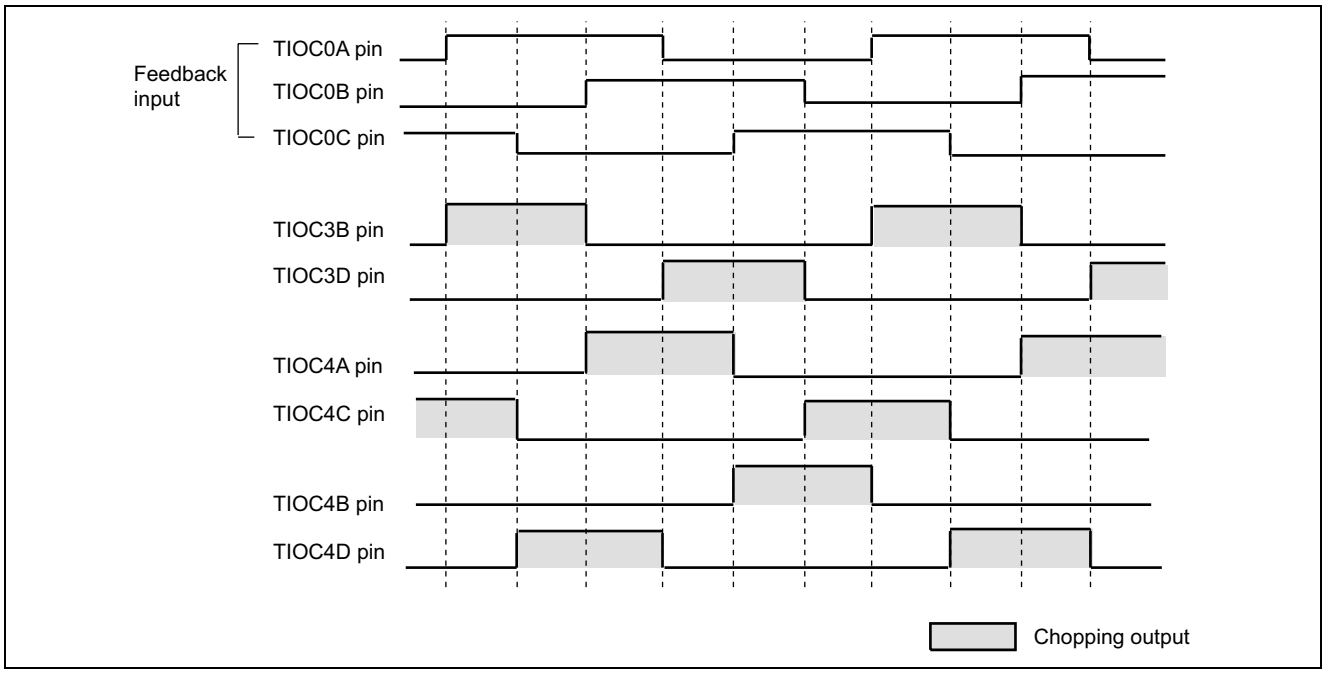


Figure 1 Example of DC Brushless Motor Control Signal Output

2. Functions Used

In this sample task, MTU channels 3 and 4 are used in combination, and 3-phase PWM waveform output is performed with one common transition point in the relationship between the positive phase and negative phase. Gate signals generated from the generated waveforms and feedback input are chopped and output.

Figure 2 shows a block diagram of the MTU as used in this sample task.

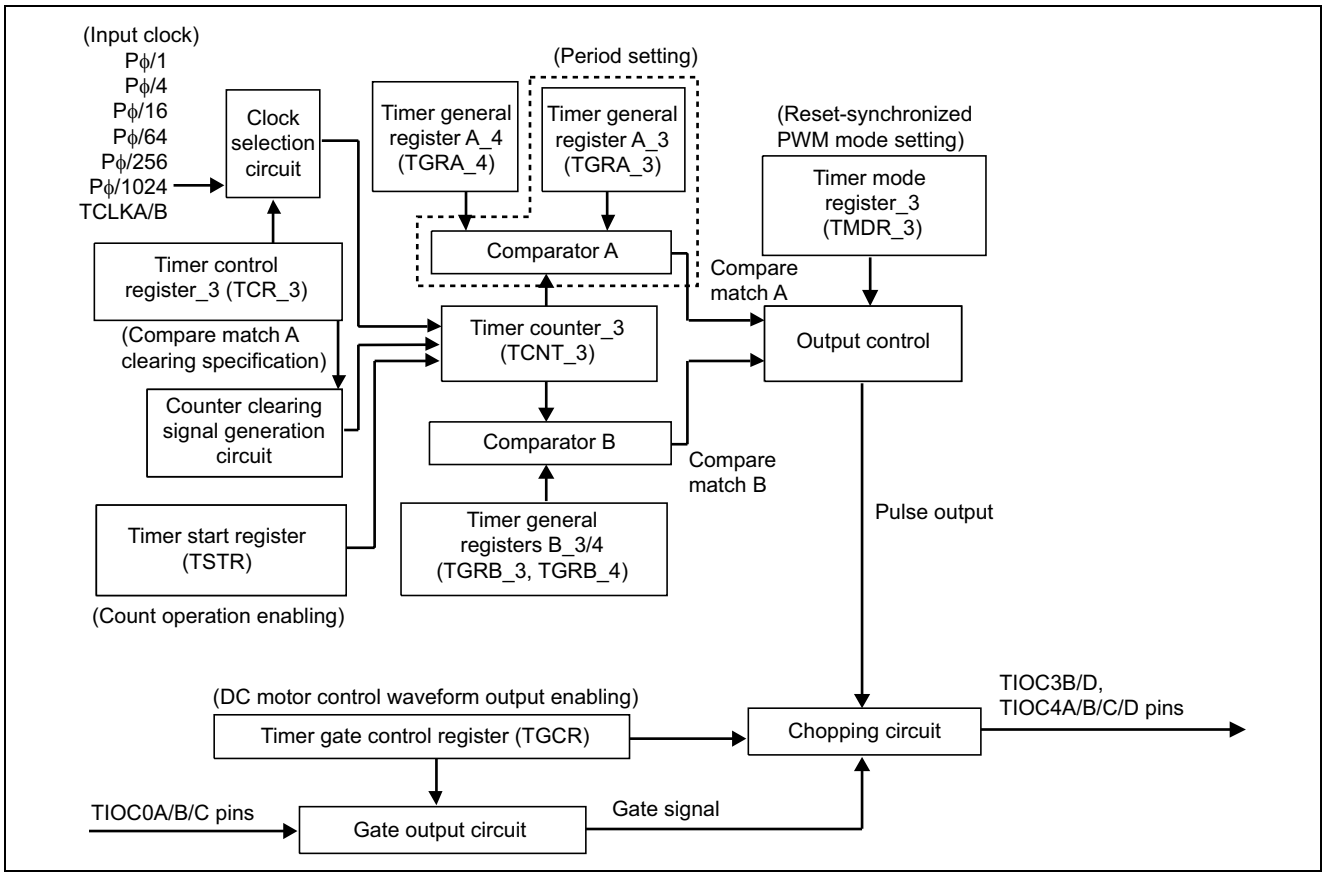


Figure 2 Block Diagram of MTU/ch3, ch4

Table 1 shows the function assignments used in this task. DC motor control waveform output is performed by assigning MTU functions as shown in the table.

Table 1 Function Assignments

Pin or Register Name	Function Assignment
TIOC3B	PWM pulse output pins
TIOC3D	
TIOC4A	
TIOC4B	
TIOC4C	
TIOC4D	
TIOC0A	Feedback signal input pins
TIOC0B	
TIOC0C	
TSTR	Enabling/disabling of ch3, ch4 timer counter operation
TCR_3	Selection of ch3 timer counter clearing source and input clock
TMDR_3	Ch3, ch4 set to operate in reset-synchronized PWM mode
TGRA_3	PWM period setting
TGRB_3	Output waveform transition timing setting
TGRC_3	
TGRD_3	
TGRA_4	
TGRB_4	
TOER	Enabling/disabling of TIOC3B/D and TIOC4A/B/C/D pin timer output
TGCR	Enabling/disabling of DC motor control waveform output

3. Principles of Operation

Figure 3 illustrates the principles of operation of this sample task. DC motor control waveform output is performed automatically by hardware. (See the section on positive-phase/negative-phase PWM 3-phase output in this Application Note for information on the principles of reset-synchronized PWM operation.)

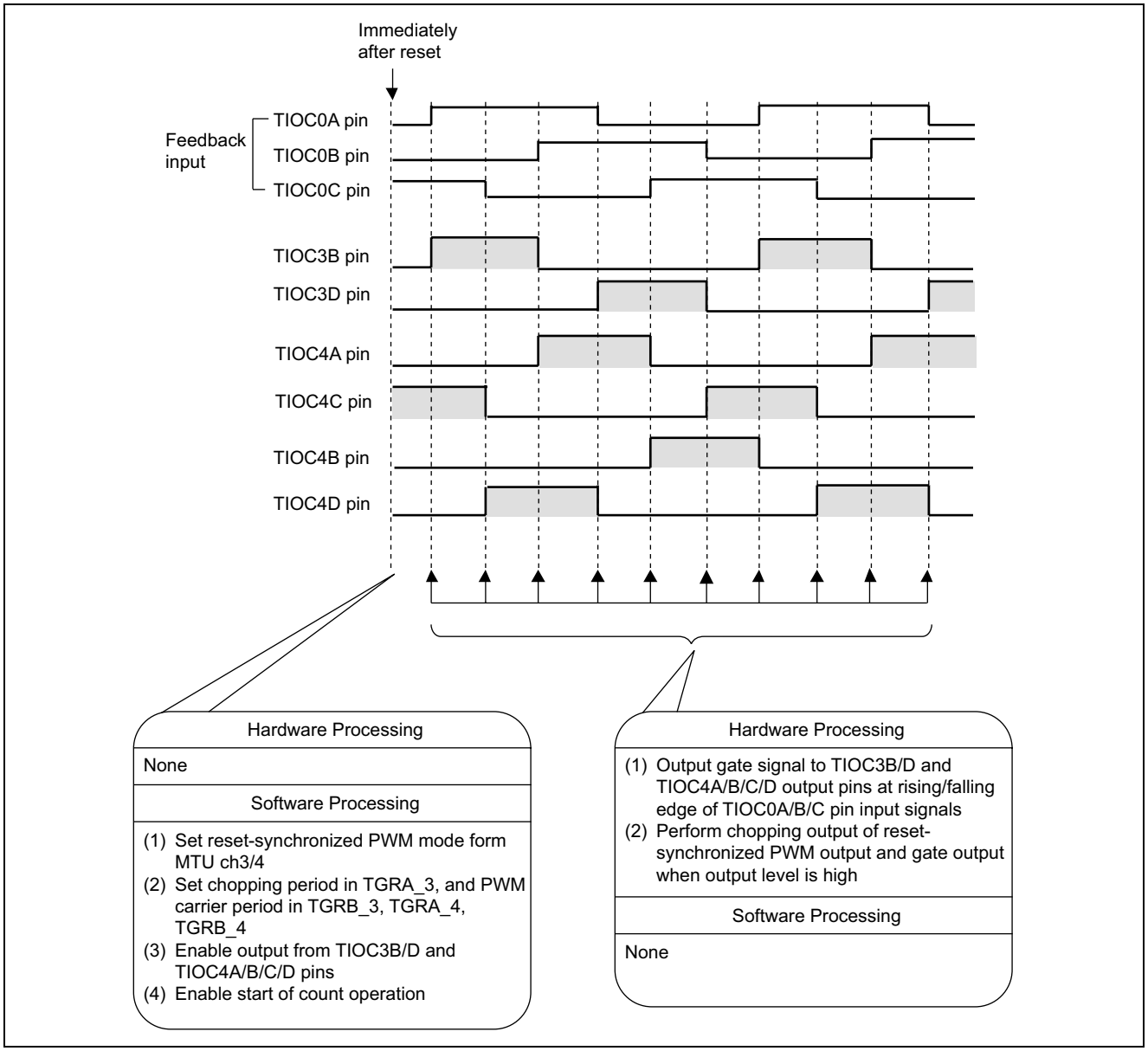


Figure 3 Principles of Operation of DC Motor Control Signal Output

4. Software

(1) Modules

Module Name	Label	Function Assignment
Main routine	dc_3	DC motor control waveform generation

(2) Arguments

Label or Register Name	Function	Data Length	Module	Input/Output
cycle	Used to set timer value for PWM pulse period	1 word	Main routine	Input
duk1	Used to set TIOC3B/3D output waveform transition timing			
duk2	Used to set TIOC4A/4C output waveform transition timing			
duk3	Used to set TIOC4B/4D output waveform transition timing			

(3) Internal Registers Used

Register Name	Function	Address	Set Value
P_STBY.MSTCR2	MTU module standby mode clearing	H'FFFF861E	H'd0fd
P_PORTE.PEIORL	Sets TIOC3B/D, TIOC4A/B/C/D as output pins	H'FFFF83B4	H'fa00
P_PORTE.PECRL1	Sets TIOC3B/D, TIOC4A/B/C/D as MTU input/output pins	H'FFFF83B8	H'5544
P_PORTE.PECRL2	Sets TIOC0A, TIOC0B,TIOC0C as MTU input pins	H'FFFF83BA	H'0015
P_MTU34.TCR_3	Selection of timer counter clearing source and input clock	H'FFFF8200	H'22
P_MTU34.TOCR	Enabling of toggle output synchronized with PWM period, and positive-phase/negative-phase output level setting	H'FFFF820B	H'03
P_MTU34.TGRA_3	PWM carrier period setting	H'FFFF8218	cycle
P_MTU34.TGRB_3	Used to set TIOC3B, TIOC3D output waveform transition timing	H'FFFF821A	duk1
P_MTU34.TGRA_4	Used to set TIOC4A, TIOC4C output waveform transition timing	H'FFFF821C	duk2
P_MTU34.TGRB_4	Used to set TIOC4B, TIOC4D output waveform transition timing	H'FFFF821E	duk3
P_MTU34.TOER	Sets TIOC3B/3D, TIOC4A/4B/4C/4D as MTU output pins	H'FFFF820A	H'ff
P_MTU34.TMDR_3	Sets reset-synchronized PWM mode	H'FFFF8202	H'c8
P_MTU34.TGCR	Enables DC motor control waveform output	H'FFFF820D	H'f0

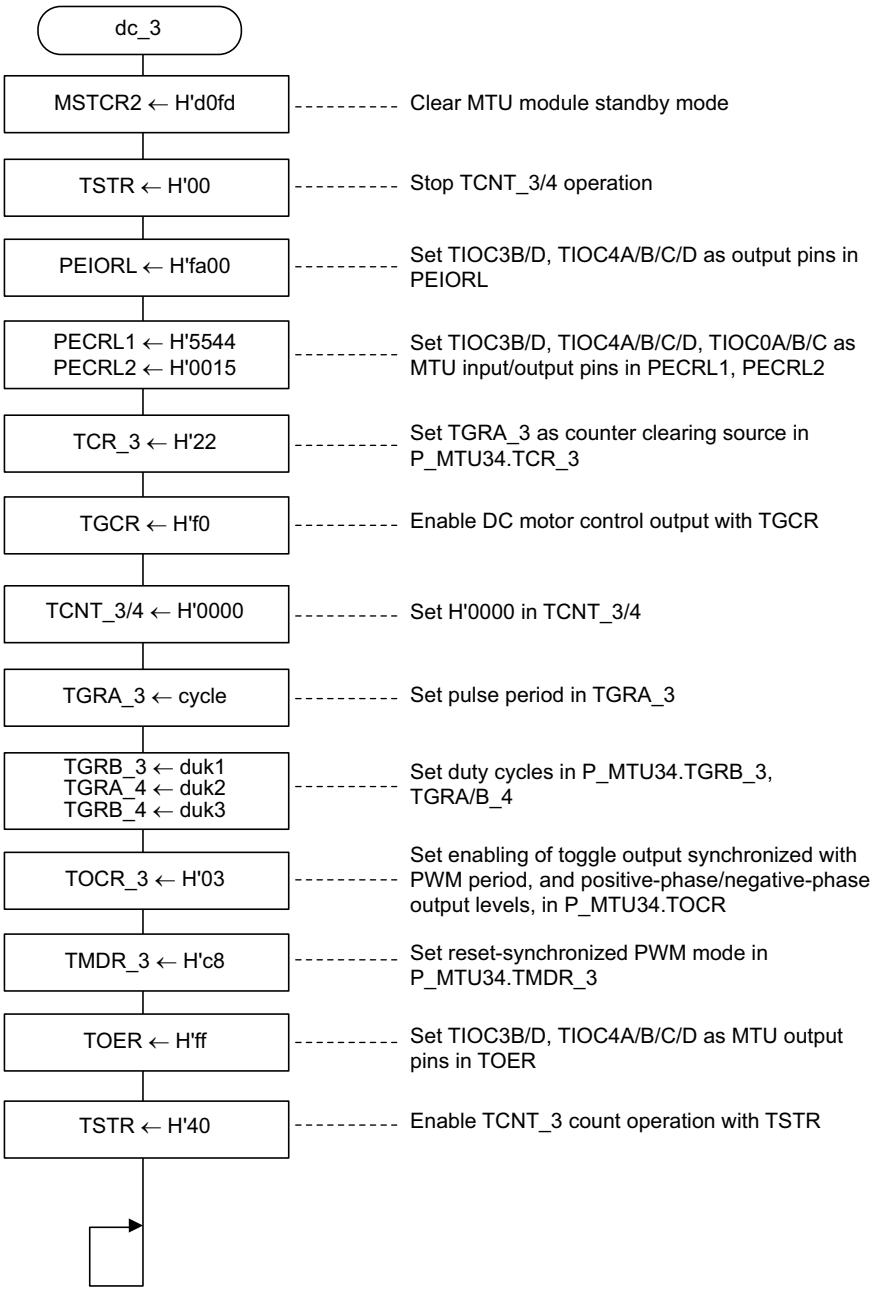
(4) RAM Used

This sample task does not use any RAM apart from the arguments.

Note: SH7145 header file names are used for register label names.

5. Flowcharts

(1) Main routine



6. Program Listing

```
/*------------------------------------------------------------------------*/
/*                                INCLUDE FILE                            */
/*------------------------------------------------------------------------*/
#include <machine.h>
#include "iodefine_7145F.h"
/*------------------------------------------------------------------------*/
/*                                PROTOTYPE                               */
/*------------------------------------------------------------------------*/
void dc_3(void);
/*------------------------------------------------------------------------*/
/*                              RAM ALLOCATION                            */
/*------------------------------------------------------------------------*/
#define cycle      (*(unsigned short *)0xffffe000)
#define duk1       (*(unsigned short *)0xffffe002)
#define duk2       (*(unsigned short *)0xffffe004)
#define duk3       (*(unsigned short *)0xffffe006)
/*------------------------------------------------------------------------*/
/*                               MAIN PROGRAM                             */
/*------------------------------------------------------------------------*/
void dc_3(void)
 {
  P_STBY.MSTCR2.WORD = 0xd0fd;    /* MTU module standby mode clear */
  P_MTU34.TSTR.BYTE = 0x00;       /* Stop timer counter */
  P_PORTE.PEIORL.WORD = 0xfa00;   /* TIOC3B/D,TIOC4A/B/C/D output */
  P_PORTE.PECRL1.WORD = 0x5544;   /* TIOC3B/D,TIOC4A/B/C/D output */
  P_PORTE.PECRL2.WORD = 0x0015;   /* TIOC0A/B/C = input */
  P_MTU34.TCR_3.BYTE = 0x22;      /* Counter clear by input capture TGRA_3 */
  P_MTU34.TGCR.BYTE = 0xf0;       /* for DC brushless motor control */
  P_MTU34.TCNT_3 = 0x0000;        /* Timer counter3 = 0 */
  P_MTU34.TCNT_4 = 0x0000;        /* Timer counter4 = 0 */
  P_MTU34.TGRA_3 = cycle;         /* Set carrier Period  */
  P_MTU34.TGRB_3 = duk1;          /* Set duty */
  P_MTU34.TGRA_4 = duk2;
  P_MTU34.TGRB_4 = duk3;
  P_MTU34.TOCR.BYTE = 0x03;       /* Set output level */
  P_MTU34.TMDR_3.BYTE = 0xc8;     /* Reset-synchronized pwm mode */
  P_MTU34.TOER.BYTE = 0xff;       /* Enable timer3/4 output */
  P_MTU34.TSTR.BYTE = 0x40;       /* Start timer3 */
  while(1);                       /* Loop */
 }
```

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