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Renesas Electronics Corporation

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H8S/2200 Series

DC Motor Control Processing Using PWM

Introduction

The rotational speed of a DC motor is controlled using the TPU timer's PWM function.

Target Device

H8S/2215

Contents

1. Overview

The rotational speed of a DC motor is controlled by means of a PWM signal output from the TIOCA0 pin.

2. Configuration

The configuration on which the contents of this Application Note has been confirmed is shown below.

Table 1 Parts Used

No.	Parts (Manufacturer)	Type Name	Specifications
1	H8S/2215 CPU board (from Hitachi ULSI Systems)	Solution Engine	Board power supply input: 5 VDC Operating frequency: 16 MHz MCU operating mode: 7
2	Transistors	2SC3890	h_{FE}: ×10 to ×30
3	Rectification diode	UF2010	
4	DC motor	FA-130	Operating voltage 1.5 to 3 V Max. 640 mA

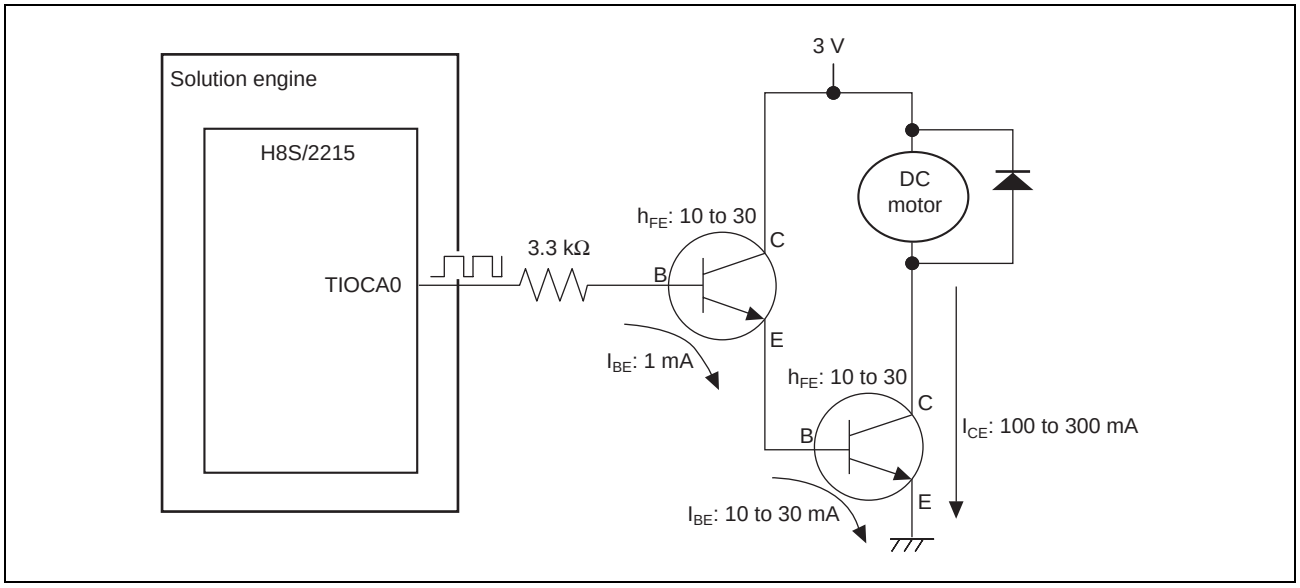


Figure 1

3. Description of Functions

A PWM signal is output from the TIOCA0 pin and controls the rotational speed of a DC motor.

The PWM signal output pattern is determined by the set values of the following internal RAM areas.

Internal RAM Area Name	Data Length	Function
pwm_cycle	int	Specifies the period of the PWM signal cycle. The actual period is TPU timer count cycle × pwm cycle and in this Application Note, the following settings are used: operating frequency: 16 MHz, TPU timer count cycle: ϕ/64, pwm_cycle set value: 100, so that PWM signal cycle period = 62.5 ns × 64 × 100 = 400 µs
low_signal	int	Specifies the period when the PWM signal is low. The actual low period is TPU timer count cycle × low signal and in this Application Note, the following settings are used: operating frequency: 16 MHz, TPU timer count cycle: ϕ/64, pwm_cycle set value: 50, so that PWM signal low period = 62.5 ns × 64 × 50 = 200 µs

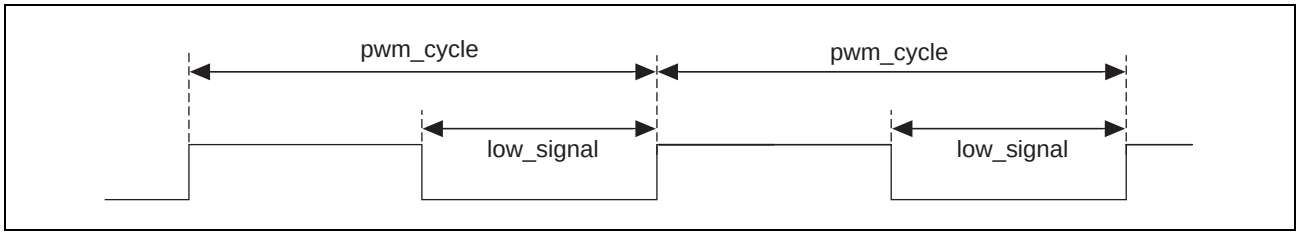


Figure 2

The longer the low_signal period is with respect to pwm_cycle, the slower is the rotational speed of the DC motor.

4. Principles of Operation

4.1 Initialization Processing

Before DC motor control processing is performed, the microcomputer is started up and the following initial internal register settings are made.

(1) Low-Power Consumption Control and Clock Oscillator Initialization

Register Name ← Set Value	Bit	Bit Name	Set Value	Description
LPWRCR	7:4	—	0000	
← H'03	3	RFCUT	0	Uses internal feedback resistance control
	2	—	0	Reserved
	1:0	STC[1:0]	11	PLL is bypass
MSTPCRA	7	MSTPA7	0	DMAC module operation
← H'0D	6	MSTPA6	0	DTC module operation
	5	MSTPA5	0	TPU module operation
	4	MSTPA4	0	TMR module operation
	3:2	MSTPA[3:2]	11	Reserved
	1	MSTPA1	0	A/D converter operation
	0	MSTPA0	1	Reserved
MSTPCRB	7	MSTPB7	0	SCI_0 module operation
← H'1F	6	MSTPB6	0	SCI_1 module operation
	5	MSTPB5	0	SCI_2 module operation
	4:1	MSTPB[4:1]	1111	Reserved
	0	MSTPB0	1	USB module stoppage
MSTPCRC	7:6	MSTPC[7:6]	11	Reserved
← H'DF	5	MSTPC5	0	D/A converter operation
	4:0	MSTPC[4:0]	11111	Reserved

4.2 DC Motor Control Processing Using PWM

(1) Overview

The PWM mode 1 of TPU timer channel 0 is used to output a PWM signal from the TIOCA0 pin.

(2) TPU_0 Settings

The PWM mode 1 is set, a PWM signal is generated by a TGRA/TGRB compare match, and is output from the TIOCA0 pin.

No.	Setting	Set Register
1	• TCNT cleared by compare match A • Count on rising edge • TCNT count cycle set to ϕ/64	TCR_0 ← H'23
2	PWM1 mode set	TMDR_0 ← H'02
3	• Specification of TIOCB0 pin initial value of 1, and 1 output on compare match • Specification of TIOCA0 pin initial value of 0, and 0 output on compare match	TIORH_0 ← H'61
4	PWM signal cycle specified in TRGA_0	TGRA_0 ← internal RAM (pwm_cycle)
5	PWM signal low period specified in TRGB_0	TGRB_0 ← internal RAM (low_signal)
6	TPU_0 timer start	TSTR ← H'01

(3) Current Amplification

As the microcomputer's allowable output high-level current (I_{OH}) is a small 1 mA, it cannot drive a DC motor directly. It is therefore amplified to 100 to 300 mA by means of transistors as shown in the configuration diagram in section 2.

5. Sample Program

5.1 File Configuration

The sample program is provided as an HEW (High-performance Embedded Workshop) project. When h8s.hws is executed, HEW is started up and the source program can be referenced or modified. Users who do not have HEW should use an editor or similar software to refer directly to the following source files.

No.	File Name	Purpose
1	resetprg.c	This file is executed from reset vector address 0 when a reset is input to the microcomputer.
2	intprg.c	This file is executed in the event of generation of an interrupt from an interrupt source other than a reset. (Not used in this Application Note)
3	dbsct.c	Processing that sets the start address and end address of a section used by the _INITSCT function in resetprg.c in the section initialization table. For the contents, see section 9.10 of the H8S, H8/300 Series C/C++ Compiler, Assembler, and Optimizing Linkage Editor User's Manual. This manual can be obtained from Renesas Technology's home page*.
4	pwm_ctl.c	Main routine of this Application Note
5	iodefine.h	H8S/2215 internal register structure definition file Partial modifications are added to the file generated automatically by HEW. See the source code for the location of the modifications. Modification locations are not directly relevant to this Application Note.
6	stacksct.h	Defines the stack size.

Note: * http://www.renesas.com

5.2 Linkage

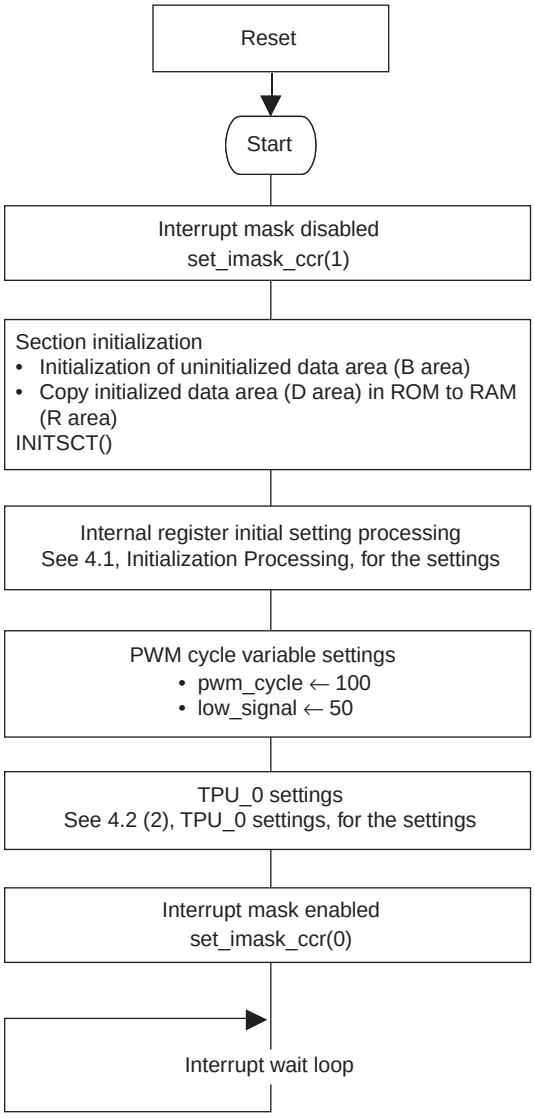
The linkage addresses of the various sections are shown below.

With the HEW project file, referencing and setting can be performed by selecting option –Standard Toolchain option — Link/Librarq tab — Category: section.

Section	Start Address
PResetPRG	H'000400
PIntPRG	
P	H'000800
C$DSEC	
C$BSEC	
D	
B	H'FFB000
R	
S	H'FFEDB0

6. Flowcharts

(1) Overall Flow



7. Reference

No.	Document Title	Source
1	H8S/2215 Hardware Manual (REJ09B0140-0400O)	Can be downloaded from Renesas Technology's home page*

Note: * http://www.renesas.com

Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Sep.03.04	—	First edition issued

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