M16C/63, M16C/64A, and M16C/65 Groups

Example of Pulse Width Modulator

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1. Abstract

This application notes describes the setting method and example for the pulse width modulator in the M16C/63, M16C/64A, and M16C/65 Groups.

2. Introduction

The application example described in this document applies to the following microcomputers (MCUs):

• MCUs: M16C/63 Group
M16C/64A Group
M16C/65 Group

This application note can be used with other M16C Family MCUs which have the same special function registers (SFRs) as the above groups. Check the user's manual for any modifications to functions. Careful evaluation is recommended before using the program described in this application note.

3. Application Example

This section describes using PWM0 to output a waveform from port P9_3.

3.1 Application Example Settings

PWM0 cycle and high-level width are set to approximately 3.0 ms and 100 µs, and output. When an $\overline{\text{INT0}}$ interrupt is generated, the duty is changed to 50% (high-level width is approximately 1.5 ms).
Table 3.1 lists the Application Example Settings.

Table 3.1 Application Example Settings

Item	Setting	
Output pins	✓	Output PWM0 signal from P9_3
		Output PWM0 signal from P4_6 (1)
PWM count sources	✓	f1 divided by 2
		f1 divided by 4
		f1 divided by 8
		f1 divided by 16

Note:
1. Neither the P4_6 nor P4_7 pin exists in the M16C/63 Group 80-pin package.

3.2 Application Example Waveform

Figure 3.1 shows the Sample Output Waveform, and Figure 3.2 shows the PWMPRE0 and PWMREG0 Register Settings.

Peripheral clock (f1) is set to the main clock (XIN = 8 MHz) no division.

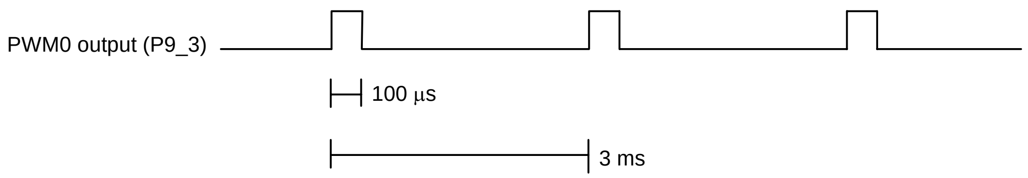

Figure 3.1 Sample Output Waveform

When the PWM cycle width and high-level width are set to 3 ms and 100 µs corresponding to Figure 3.1 Sample Output Waveform:

Relationship between related registers and PWM cycle, and high-level width is as follows:

$$\text{PWM cycle} = \frac{(2^8 - 1) \times (m + 1)}{fj} \quad \text{(unit: s)}$$

$$\text{High-level width} = \frac{(m + 1) \times n}{fj} \quad \text{(unit: s)}$$

fj: Frequency of count source (unit: Hz)
m: PWMPRE0 register setting value
n: PWMREG0 register setting value

When the frequency of the count source is set to f1 divided by 2:

$$\text{PWM cycle (approximately 3 ms)} = \frac{(256 - 1) \times (m + 1)}{(8 \times 10^6) / 2}$$

PWMPRE0 register setting value m = 46.

$$\text{High-level width (approximately 100 µs)} = \frac{(46 + 1) \times n}{(8 \times 10^6) / 2}$$

Assuming the formulas above:
PWMPRE0 register setting value m = 46
PWMREG0 register setting value n = 9

Figure 3.2 PWMPRE0 and PWMREG0 Register Settings

3.3 Flowchart

Figure 3.3 shows the Main Program Flowchart.

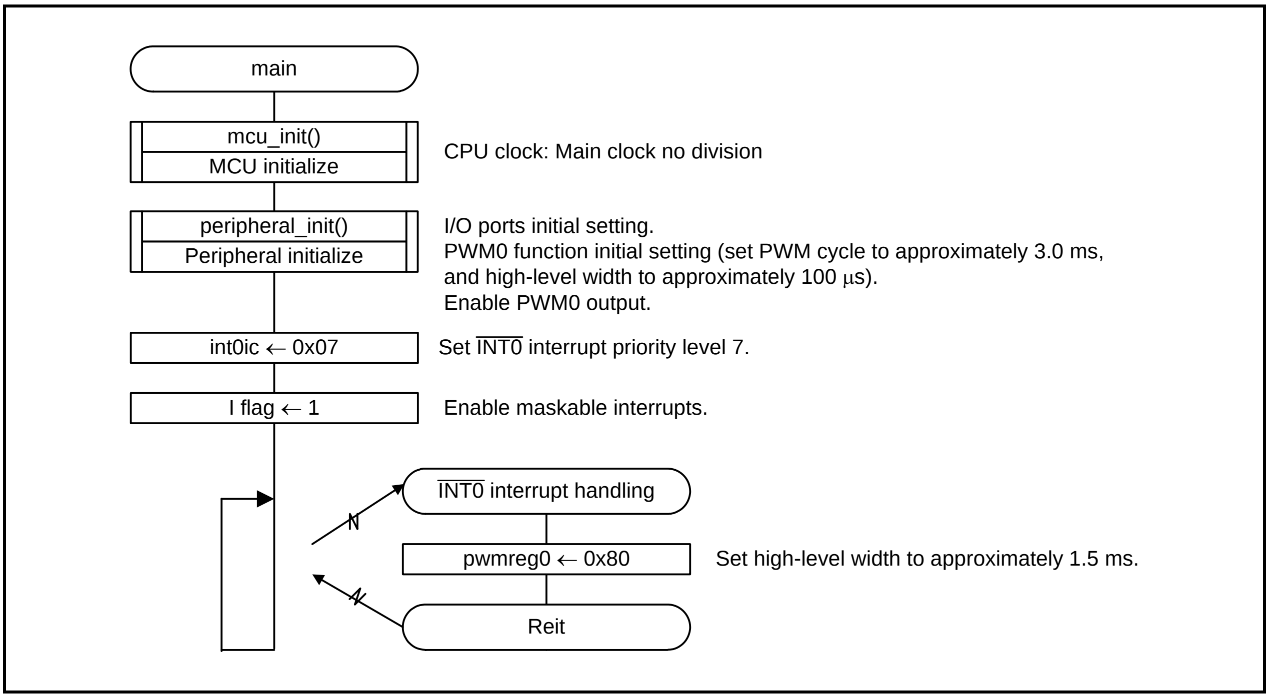

Figure 3.3 Main Program Flowchart

3.4 Sample Program Operation Example

The value written to the PWMREG0 register during PWM0 output is not reflected until the next cycle of PWM0 output begins.

The PWM output signal is low immediately after the MCU is reset. Then the associated waveform output starts.

Figure 3.4 shows the PWM0 Output Example of the Sample Program.

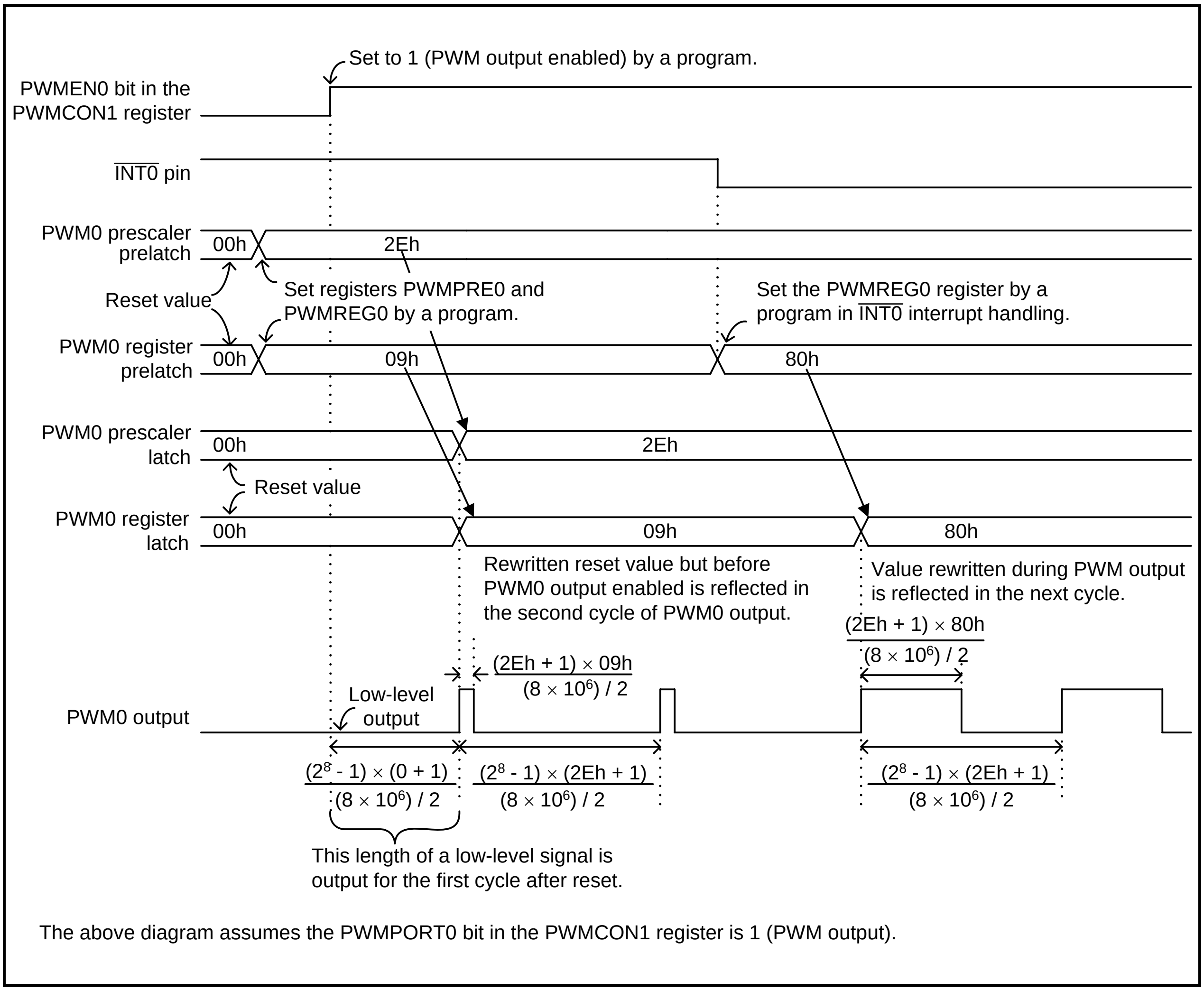

Figure 3.4 PWM0 Output Example of the Sample Program

3.5 Register Settings

Figure 3.5 to Figure 3.7 show Register Settings.

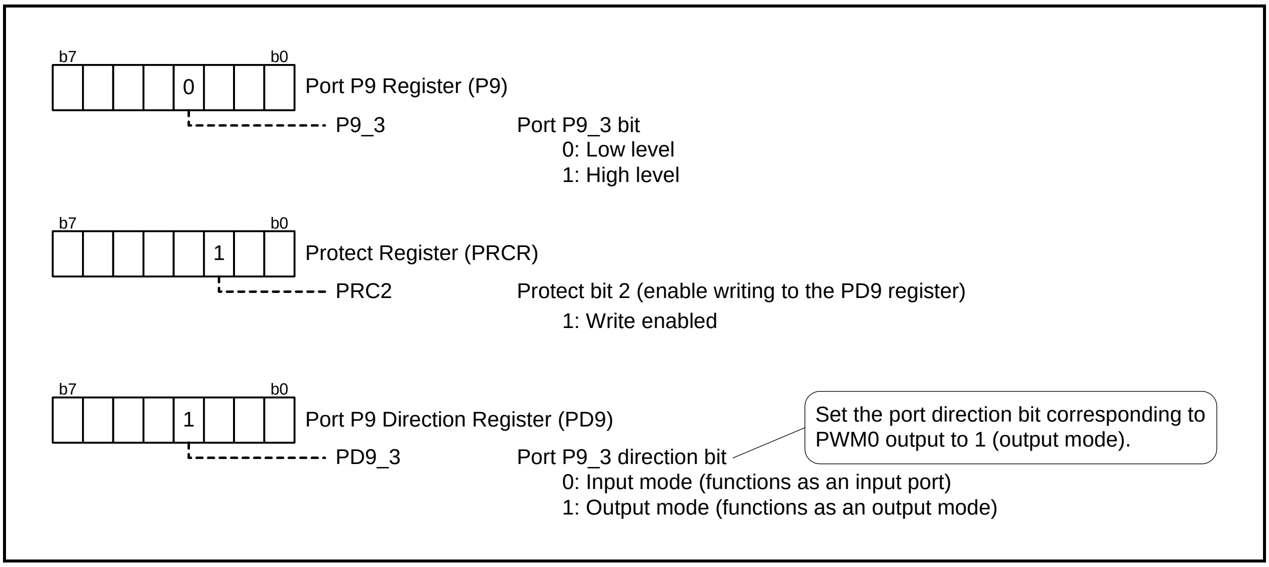

Figure 3.5 Register Settings (1)

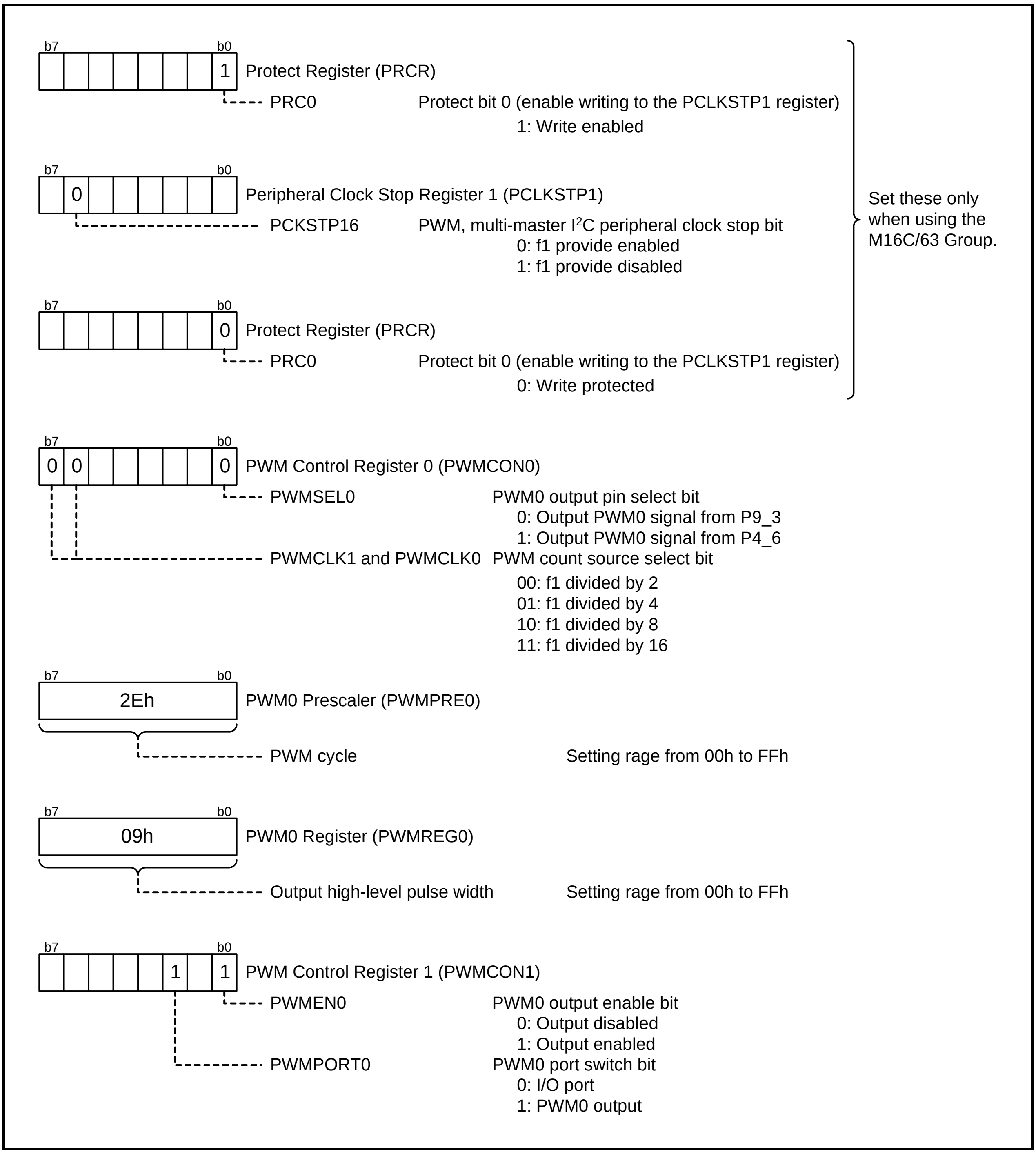

Figure 3.6 Register Settings (2)

$\overline{\text{INT0}}$ interrupt handling

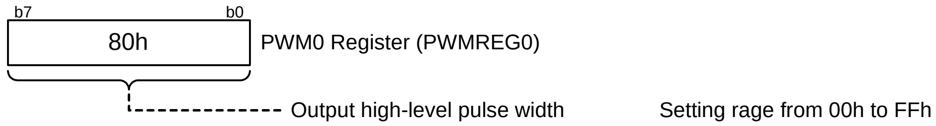

Figure 3.7 Register Settings (3)

4. Sample Program

A sample program can be downloaded from the Renesas Electronics website.
To download, click “Application Notes” in the left-hand side menu of the M16C Family page.

5. Reference Documents

M16C/63 Group User’s Manual: Hardware Rev.1.00
M16C/64A Group User’s Manual: Hardware Rev.1.10
M16C/65 Group User’s Manual: Hardware Rev.1.10
The latest versions can be downloaded from the Renesas Electronics website.

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

C Compiler User’s Manual
M16C Series, R8C Family C Compiler Package V.5.45
C Compiler User’s Manual Rev.2.00
The latest version can be downloaded from the Renesas Electronics website.

Website and Support

Renesas Electronics website
http://www.renesas.com/

Inquiries
http://www.renesas.com/inquiry

Revision History	M16C/63, M16C/64A, and M16C/65 Groups Example of Pulse Width Modulator

Rev.	Date	Description	
		Page	Summary
1.00	Aug 31, 2010	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins
   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.
   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.
2. Processing at Power-on
   The state of the product is undefined at the moment when power is supplied.
   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
     In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
     In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.
3. Prohibition of Access to Reserved Addresses
   Access to reserved addresses is prohibited.
   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.
4. Clock Signals
   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.
   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.
5. Differences between Products
   Before changing from one product to another, i.e. to one with a different part number, confirm that the change will not lead to problems.
   — The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.

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Refer to "http://www.renesas.com/" for the latest and detailed information.

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