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2010年4月1日
瑞萨电子公司

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7548/7549 群

定时器 A 的操作（输出比较功能实现 PWM 输出）

1. 要点

本篇资料介绍如何使用定时器 A 的比较输出功能产生 PWM 波形。

2. 说明

该应用说明适用于以下条件：

采用的 MCU: M37548 群

M37549 群

振荡频率: 8MHz

3. 内容

3.1 PWM 输出波形说明

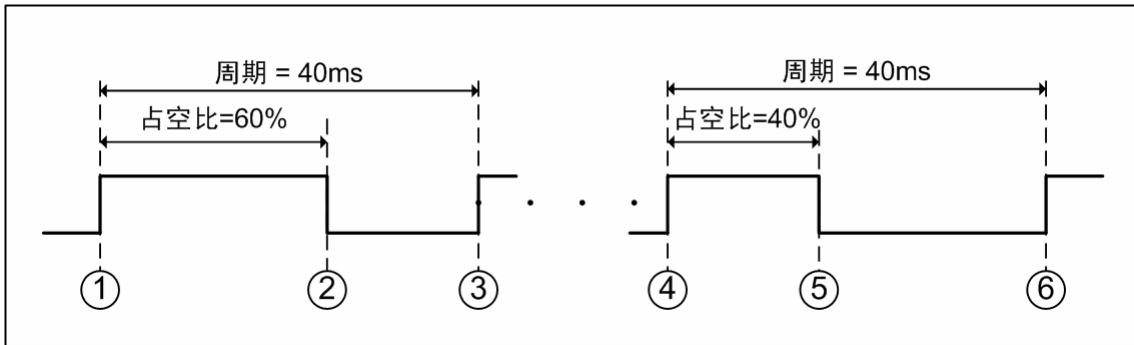


图 1 PWM 输出波形示意图

● 说明

1. 初始化定时器 A 和输出比较功能，设定 PWM 输出的周期和占空比。
2. 当定时器 A 的计数值与比较锁存器中的值一致时，比较输出触发产生；比较输出波形反转。
3. 在定时器下一次下溢时，比较缓冲器中的新设定值写入比较锁存器，当比较输出触发再次产生后，输出波形反转。
4. 重复输出 10 个周期的 PWM 波形后调整占空比参数。
5. 当比较锁存器中新设定值与定时器计数值一致时，比较输出触发产生；比较输出波形反转。
6. 重复输出 10 个周期，调整了占空比的 PWM 波形。

3.2 PWM 输出波形产生时序图

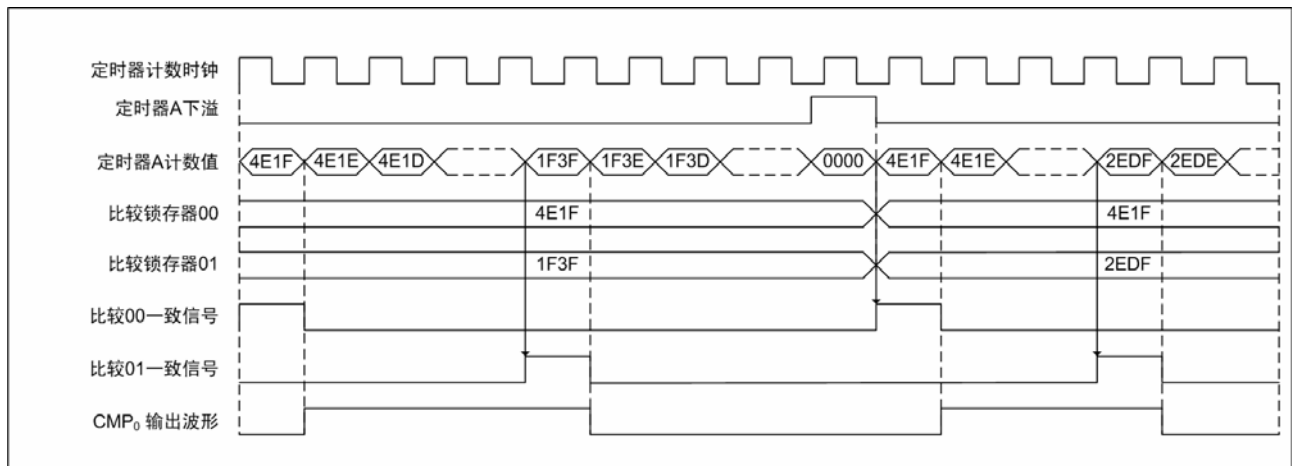


图 2 输出比较功能产生 PWM 波形的时序图

3.3 PWM 参数计算公式

以下公式用于计算 PWM 波形的周期和占空比参数：

$$\text{PWM 周期} = (TA + 1) / f(\text{定时器计数时钟});$$

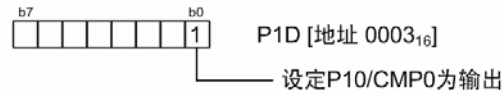
$$\text{输出“H”脉冲占空比} = [(CRAi0 - CRAi1) / (TA + 1)] \times 100\%; \quad (i = 0, 1, 2)$$

注：定时器 A 包括低位（TAL）和高位（TAH）；
CRAi0 和 CRAi1 为输出比较通道 i 的比较锁存器；
输出比较通道 i 选择正极性输出。

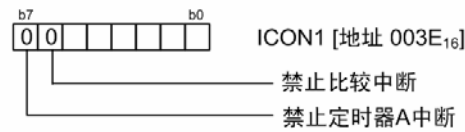
3.4 寄存器设置

7548/49 群有 3 个输出比较通道。每个通道 (0~2) 具有相同的功能，并且使用定时器 A 的计数值输出波形。本应用示例中，仅使用了输出比较通道 0 输出 PWM 波形。比较输出功能的设置如下。如果使用输出比较通道 1 或 2 输出 PWM 波形，设置方法是相同的。

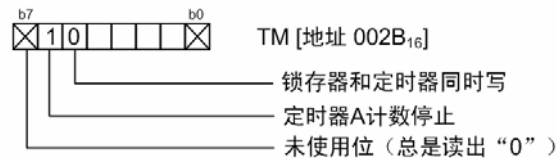
(1) 设置端口 P1 方向寄存器



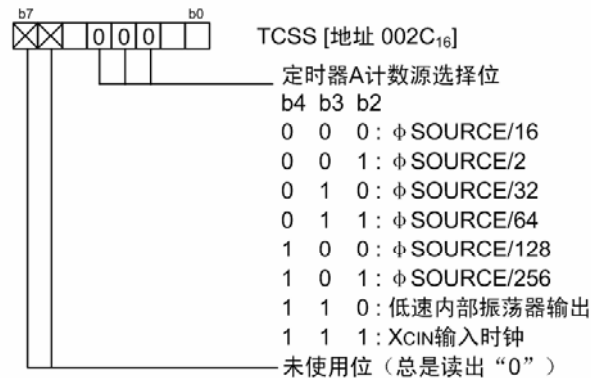
(2) 设置中断控制寄存器



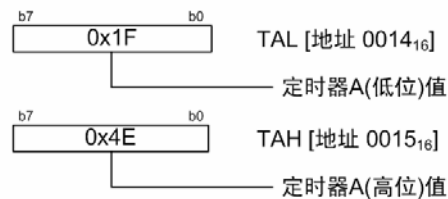
(3) 设置定时器 A 模式寄存器



(4) 设置定时器计数源设定寄存器

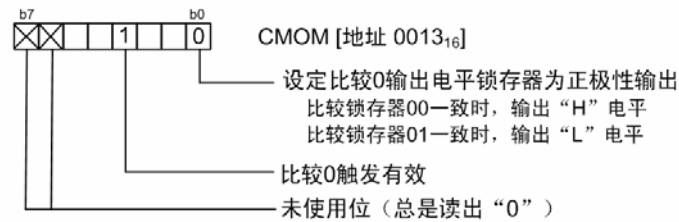


(5) 设置定时器 A 寄存器

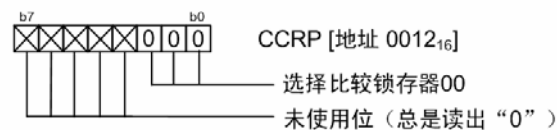


注: 必须按定时器 A 的低位、定时器 A 的高位的顺序, 给 2 个寄存器写。

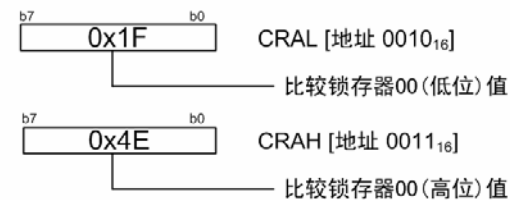
(6) 设置比较输出模式寄存器



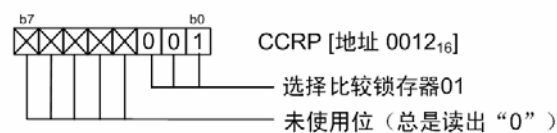
(7) 设置捕捉/比较寄存器R/W指针



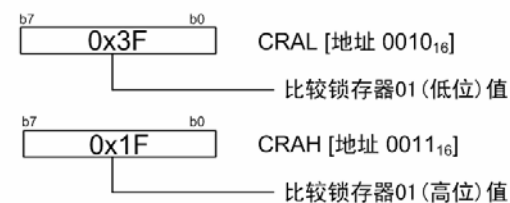
(8) 设置捕捉/比较寄存器



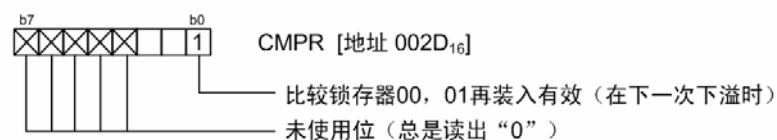
(9) 设置捕捉/比较寄存器R/W指针



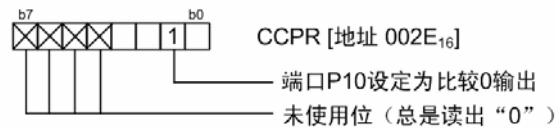
(10) 设置捕捉/比较寄存器



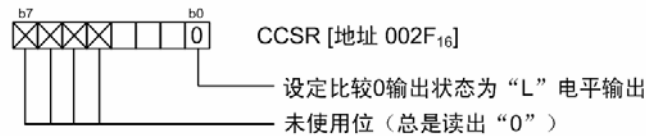
(11) 设置比较设定值再装入寄存器



(12) 设置捕捉/比较端口寄存器



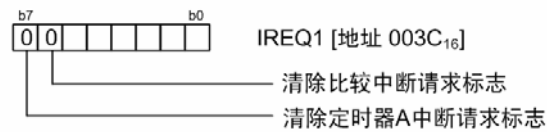
(13) 设置捕捉/比较状态寄存器



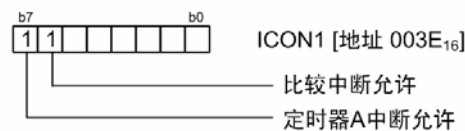
(14) 设置比较中断源设定寄存器



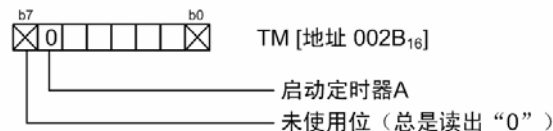
(15) 设置中断请求寄存器



(16) 设置中断控制寄存器



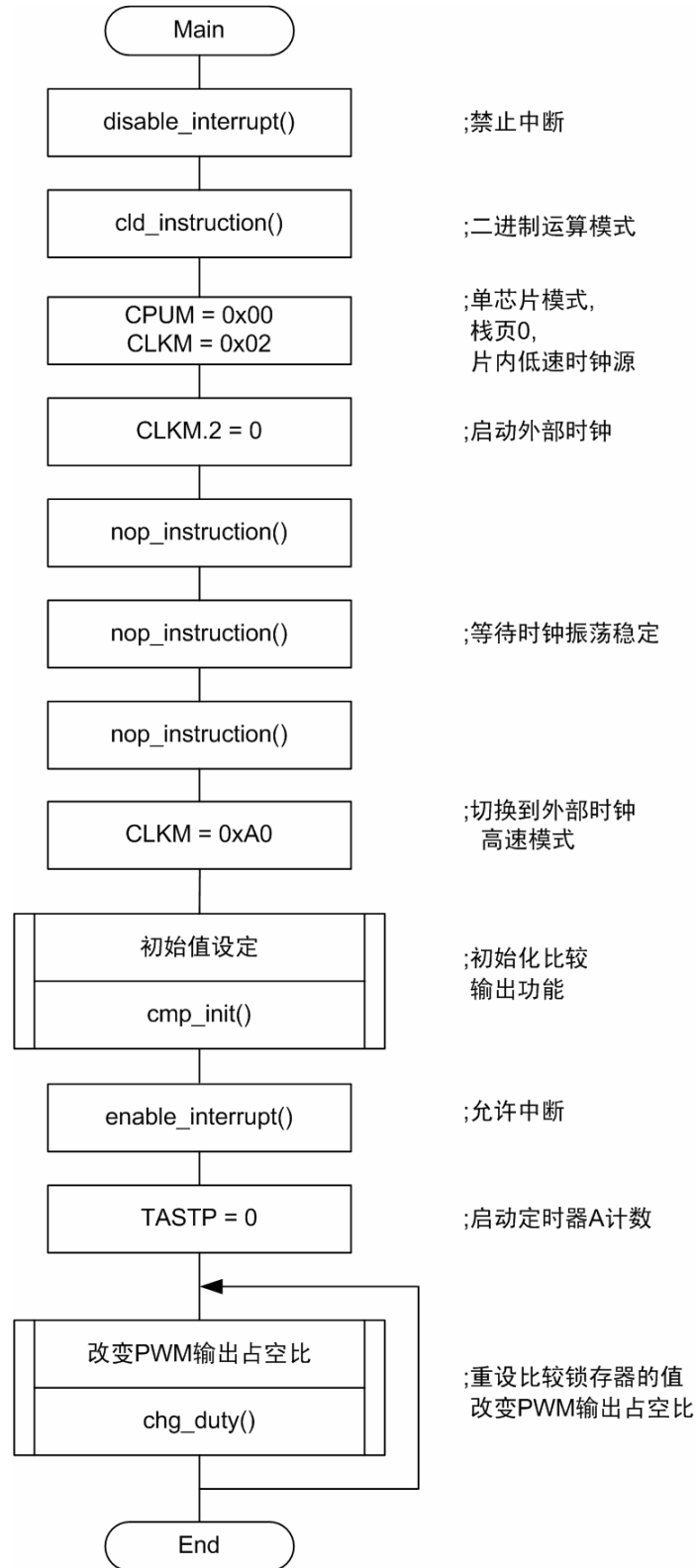
(17) 设置定时器A模式寄存器



注：在定时器 A 计数期间要改变输出比较通道 0 输出波形时，重复上述步骤（8）～（11）。必须将比较锁存器 00，01 重装入位设置为“1”（下一次下溢时重载入允许），这样就在定时器下一次下溢时，比较缓冲器中的新设定值才写入比较锁存器。

4. 程序流程图

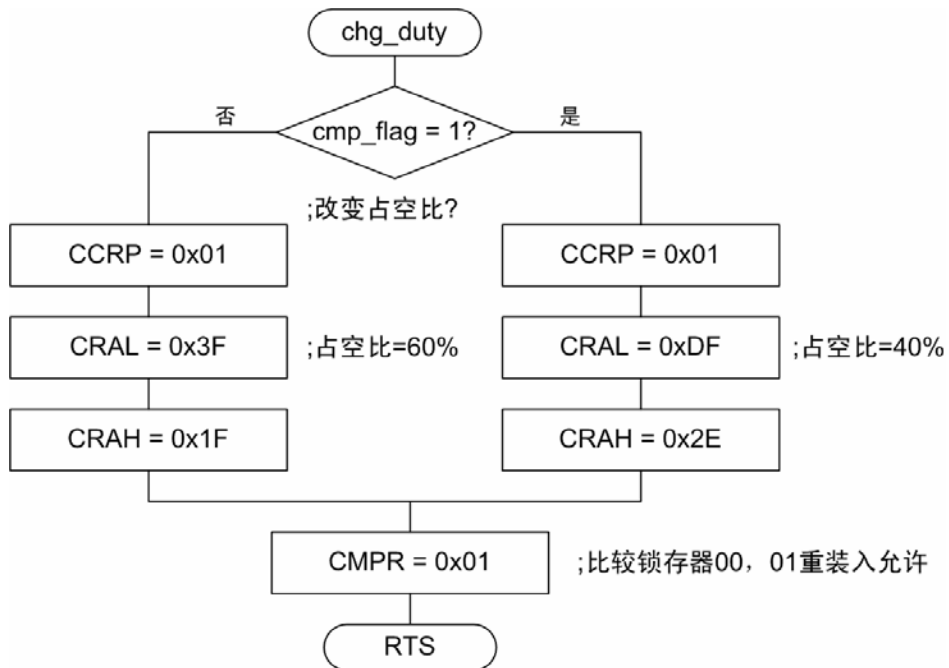
4.1 主程序



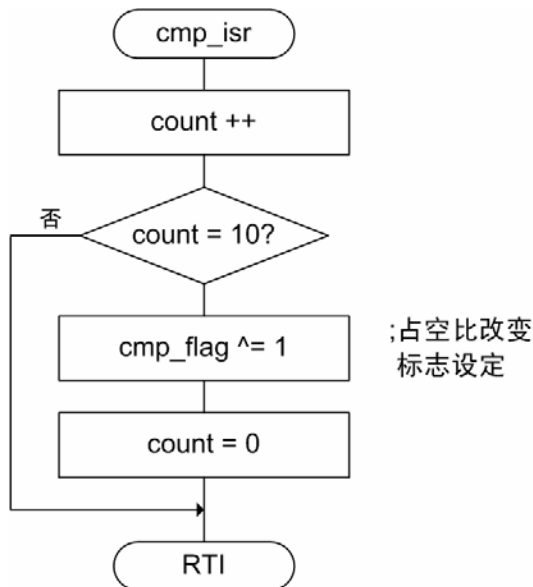
4.2 输出比较初始化子程序 (cmp_init)



4.3 PWM 输出占空比参数设定子程序 (chg_duty)



4.4 比较中断服务子程序 (cmp_isr)



5. 参考例程

请从瑞萨科技网站上下载参考例程。

在 7548/7549 群的网页上单击左边的“Application Notes”下载应用笔记。

6. 参考文献

数据手册

7548 群数据手册

7549 群数据手册

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Rev.	发行日	修订内容	
		页	要点
1.00	2006.10.23	—	初版发行
2.00	2008.03.07	2	修改 3.3 注
		3	修改 3.4 寄存器设置(1)和(4)的内容
		5	修改 3.4 寄存器设置(13)和注的内容
		9	修改 5 参考例程

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