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2010年4月1日
瑞萨电子公司

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M16C/65 群

可变周期、可变占空比的 PWM 输出

1. 要点

使用定时器 A0 和定时器 A1 产生可变周期、可变占空比的 PWM 输出。

使用下面的外围功能：

- 定时器 A 的定时器模式
- 定时器 A 的单次触发模式

2. 说明

本篇资料，适用于 M16C/65 群单片机。

本篇应用说明也适用于 M16C 族中与上面所述的群具有相同 SFR（特殊功能寄存器）定义的产品。关于产品功能的改进，请参看手册中的相关信息。在使用本篇应用说明的程序前，需进行详细的评价。

3. 规格

- (1) 设置定时器 A0 为定时器模式，设置定时器 A1 为单次触发定时器模式。
- (2) 用定时器 A0 设定 PWM 的周期为 1ms，用定时器 A1 设定 PWM 的“高”电平宽度是 500 μ s。定时器 A0 和定时器 A1 都使用 fITIMAB 作为计数源。
- (3) 连接一个 20MHz 的振荡器到 XIN。
- (4) 通过 TAPOFS 寄存器的 POFSi 位，选择 TAiOUT 引脚的输出极性。(i = 0、1)

4. 定时器 A 的操作

- (1) 设定计数启动标志为“1”，定时器 A0 开始计数。定时器 A0 对计数源 fITIMAB 进行递减计数。
- (2) 如果定时器 A0 递减计数发生下溢时，重加载寄存器的设定值将被加载到计数器，计数器继续进行计数。同时，定时器 A0 的中断请求位置为“1”。
- (3) 定时器 A0 的下溢触发定时器 A1 开始计数。当定时器 A1 的计数器开始计数时，TA1OUT 引脚输出“高”电平。
用定时器 A1 实现对定时器 A0 的下溢次数进行递减计数。
- (4) 定时器 A1 计数器的值变为“0000h”时，TA1OUT 引脚输出“低”电平，重加载寄存器的设定值被加载到计数器，计数器停止继续计数。此时定时器 A1 的中断请求位置成为“1”。

工作时序图如下所示：

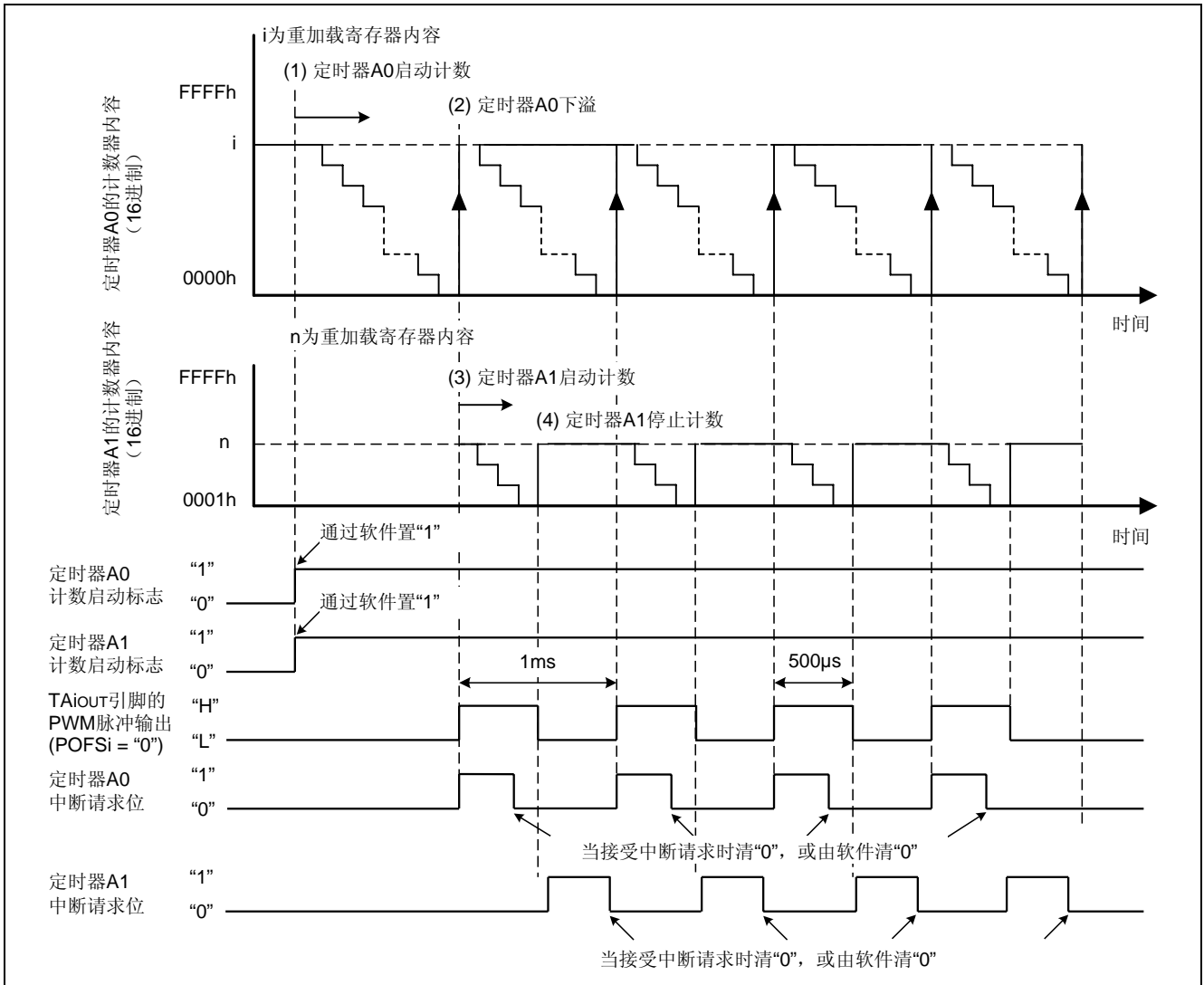


图 1. 周期和占空比可变的 PWM 输出的工作时序图

连接示意图如下所示：

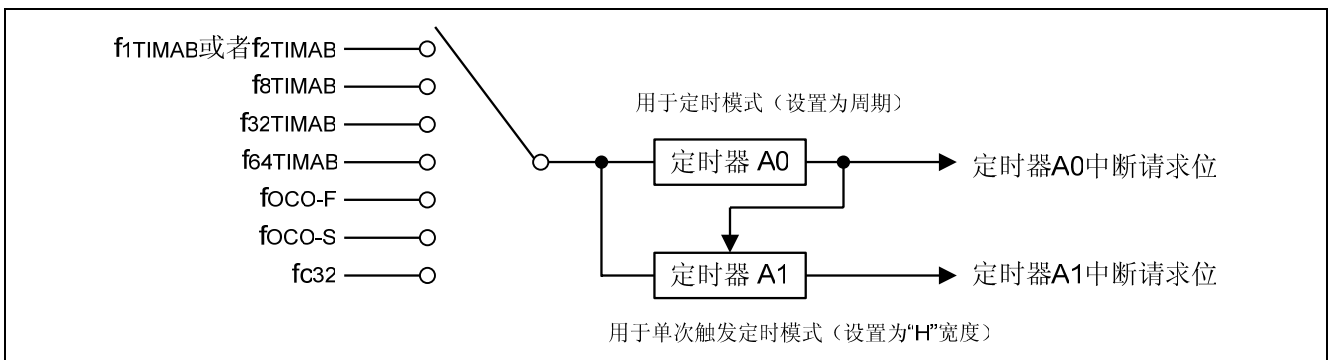


图 2. 周期和占空比可变的 PWM 输出的定时器连接示意图

5. 寄存器设置

在定时器模式中，定时器 A 可以选择如表 1 中所列的各种计数源，定时器 A 计数源的结构框图如图 3 所示。

表 1. 定时器 A 计数源的选择

TCKDIV00 寄存器 (注 1)	TACSi 寄存器 (注 2)				TAiMR 寄存器		计数源	计数源周期
	TCS3/ TCS7	TCS2/ TCS6	TCS1/ TCS5	TCS0/ TCS4	TCK1	TCK0		
								f(XIN):20MHz f(XcIN):32.768kHz f(oco-F):约 20MHz f(oco-s):约 125kHz
0	0	-	-	-	0	0	f1TIMAB/f2TIMAB (注 3)	50ns/100ns
0	0	-	-	-	0	1	f8TIMAB	400ns
0	0	-	-	-	1	0	f32TIMAB	1600ns
0	0	-	-	-	1	1	fc32	976.56μs
0	1	0	0	0	-	-	f1TIMAB/f2TIMAB (注 3)	50ns/100ns
0	1	0	0	1	-	-	f8TIMAB	400ns
0	1	0	1	0	-	-	f32TIMAB	1600ns
0	1	0	1	1	-	-	f64TIMAB	3200ns
0	1	1	0	0	-	-	foco-F	约 50ns
0	1	1	0	1	-	-	foco-s	约 8μs
0	1	1	1	0	-	-	fc32	976.56μs
1	1	0	0	0	-	-	f1TIMAB/f2TIMAB (注 3)	约 50ns/100ns
1	1	0	0	1	-	-	f8TIMAB	约 400ns
1	1	0	1	0	-	-	f32TIMAB	约 1600ns
1	1	0	1	1	-	-	f64TIMAB	约 3200ns

注 1: TCDIV00 位是定时器 AB 分频前时钟选择位。请在设定和定时器 A 相关的其它寄存器之前设定 TCDIV00 位。在改变 TCDIV00 位后，请再次设定和定时器 A 相关的其它寄存器。

注 2: TACS0 寄存器的 TCS3~TCS0 位和定时器 A0 计数源的选择相对应，TACS0 寄存器的 TCS7~TCS4 位和定时器 A1 计数源的选择相对应，TACS1 寄存器的 TCS3~TCS0 位和定时器 A2 计数源的选择相对应，TACS1 寄存器的 TCS7~TCS4 位和定时器 A3 计数源的选择相对应，TACS2 寄存器的 TCS3~TCS0 位和定时器 A4 计数源的选择相对应。

注 3 如果 PCLKR 寄存器中的 PCLK0 位为“0”选择 f2TIMAB 作为计数源，PCLK0 位为“1”选择 f1TIMAB 作为计数源（复位设定值）。

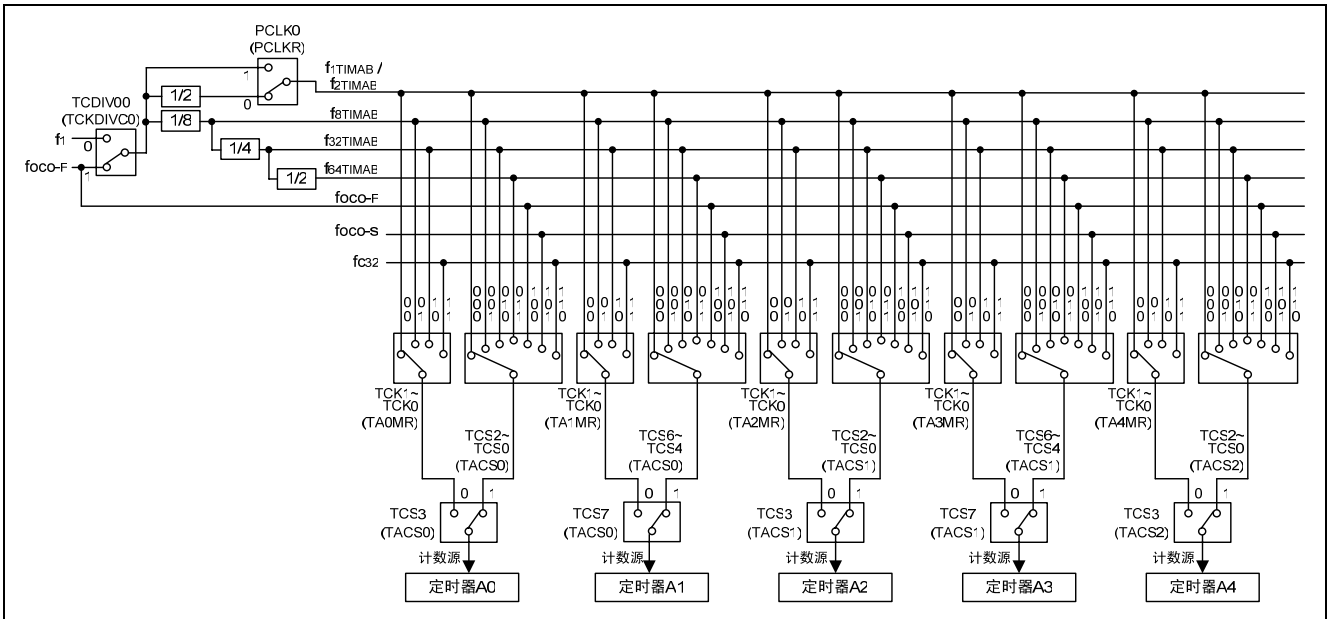


图 3. 定时器 A 的计数源

为了能够实现定义在“4. 定时器 A 的操作”的功能，下列寄存器必须按步骤顺序进行设置。对于每个寄存器的具体结构，请参考 M16C/65 群的硬件手册。

选择定时器AB分频前时钟

(请在设定和定时器A相关的其它寄存器之前设定TCDIV00位。在改变TCDIV00位后，请再次设定和定时器A相关的其它寄存器。)

b7	0	0	0	0	X	0	0	0	b0
----	---	---	---	---	---	---	---	---	----

定时器AB分频控制寄存器0 TCKDIVC0 【地址 01CBh】

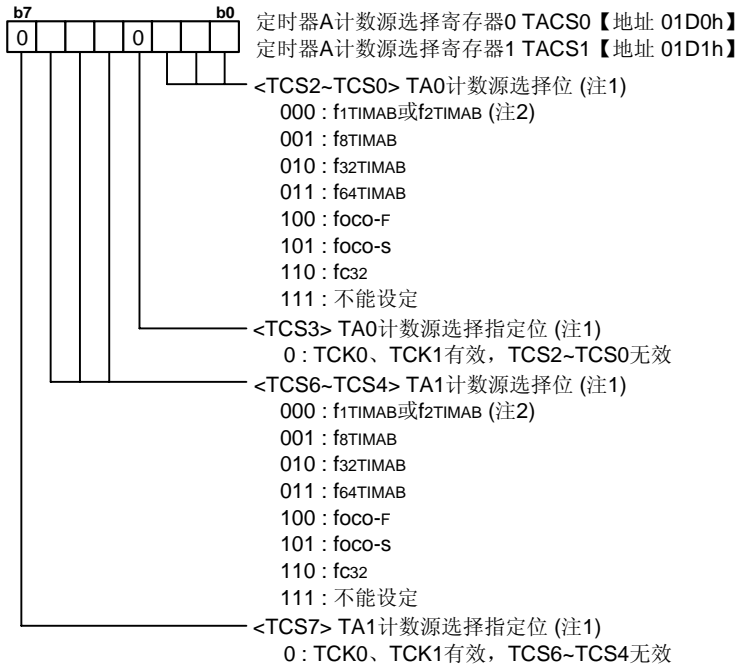
定时器AB分频前时钟选择位
0: f1

保留位
设定为“0”
什么也不指定。只能写“0”，读时值不定

保留位
设定为“0”

⋮

选择定时器计数源

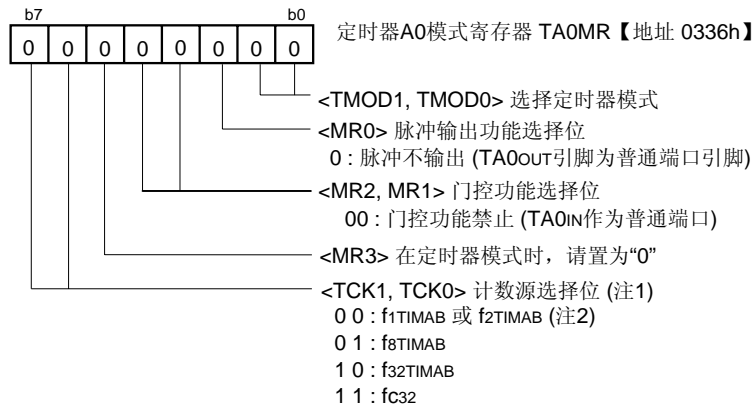


注1: 关于各种设定情况下的计数源周期, 请参考表1。

注2: 如果PCLKR寄存器中的PCLK0位为0选择f2TIMAB作为计数源, PCLK0位为1选择f1TIMAB作为计数源(复位设定值)。

设定定时器 A0

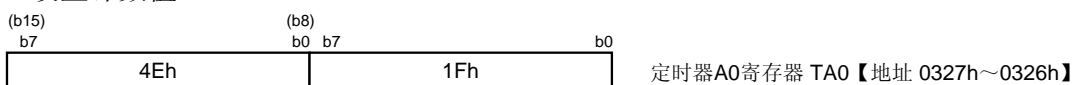
选择定时器模式和功能



注1: TACS0~TACS2寄存器的TCS3位和TCS7位设置为0 (TCK0位、TCK1位有效)。关于各种设定情况下的计数源周期, 请参考表1。

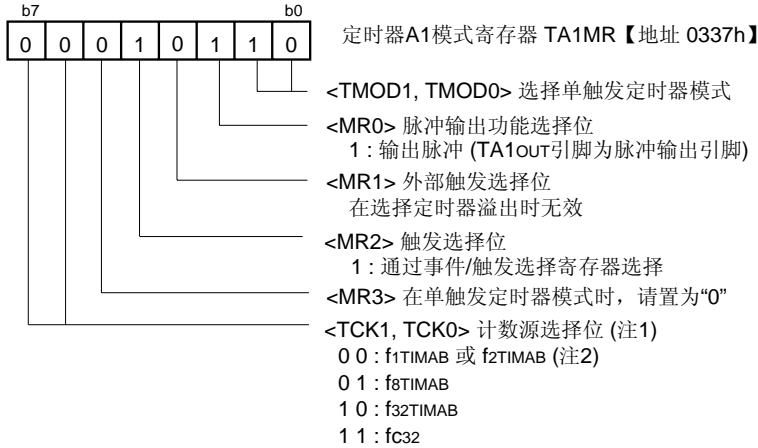
注2: 如果PCLKR寄存器中的PCLK0位为0选择f2TIMAB作为计数源, PCLK0位为1选择f1TIMAB作为计数源(复位设定值)。

设置计数值



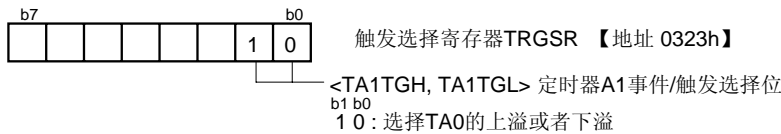
设定定时器 A1

选择单触发定时器模式和功能



注1: TACS0~TACS2寄存器的TCS3位和TCS7位设置为0 (TCK0位、TCK1位有效)。关于各种设定情况下的计数源周期, 请参考表1。
注2: 如果PCLKR寄存器中的PCLK0位为0选择f2TIMAB作为计数源, PCLK0位为1选择f1TIMAB作为计数源 (复位设定值)。

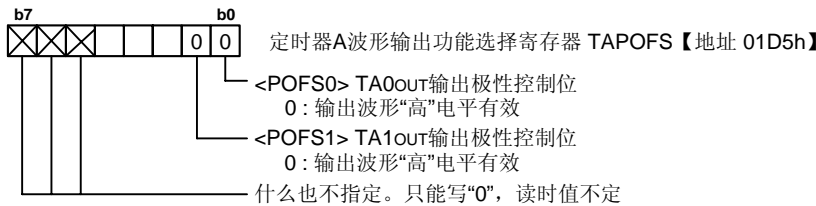
设置事件/触发选择位
(设定定时器A0触发定时器A1)



设置单触发定时器的时间



选择定时器波形输出功能



设置定时器计数开始标志位



开始计数

6. 参考文献

数据手册

M16C/65 群硬件手册

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