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M16C/64 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/64 群单片机。

本篇资料中的参考例程也适用于 M16C 族产品中与 M16C/64 群具有相同 SFR (特殊功能寄存器) 定义的产品。

由于 M16C 系列产品中有些功能会有所改进，请参看用户手册。如果使用本篇资料中所列功能时，请仔细检查每一步操作。

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 f_{TIMAB} 作为计数源。
- (3) 连接一个 16MHz 的振荡器到 XIN。
- (4) 通过 TAPOFS 寄存器的 POFS_i 位，选择 TAI_iOUT 引脚的输出极性不反转（TA_i 位为“0”，即计数停止时，输出“低”电平）。（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 f_{TIMAB} 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：

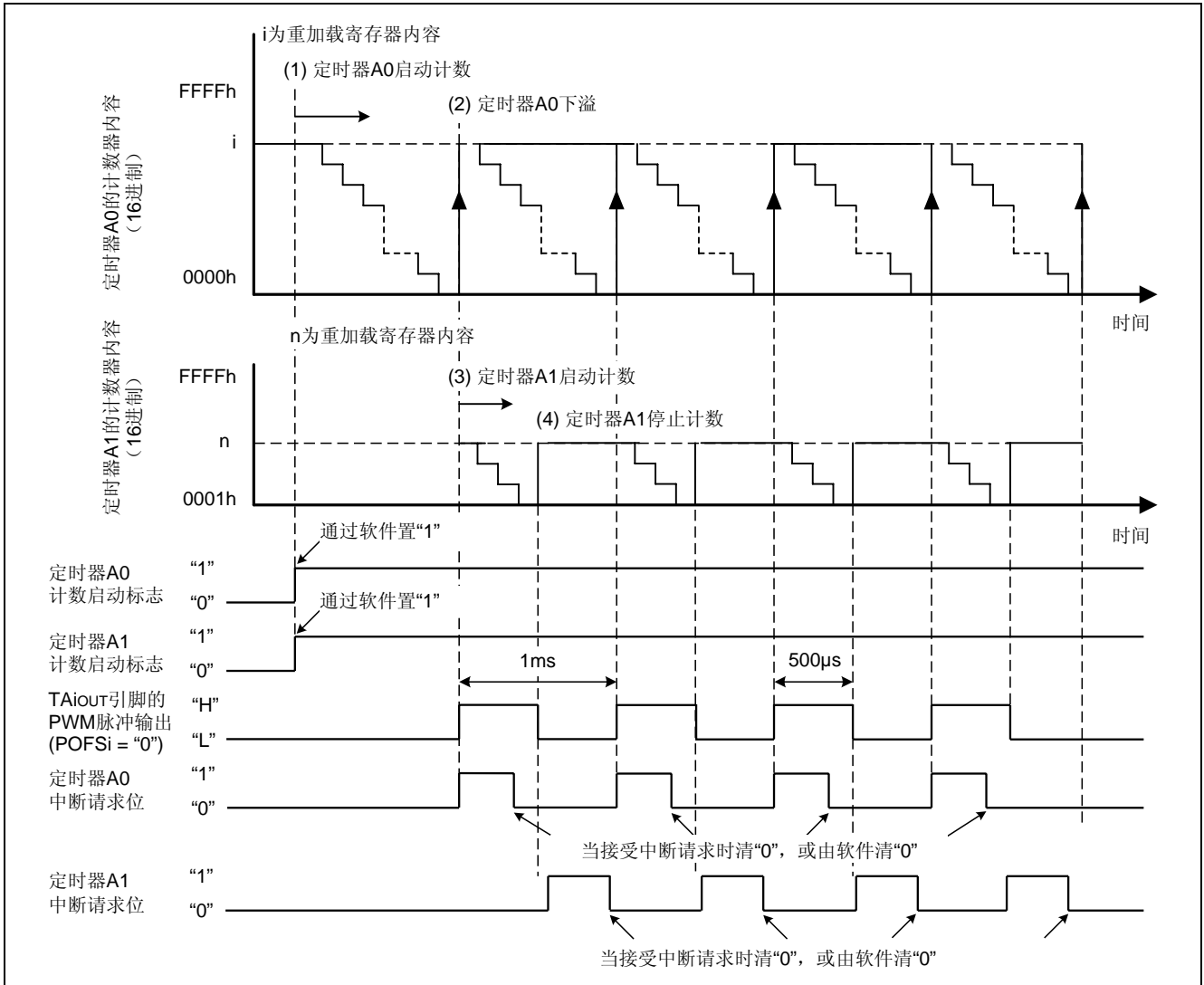


图 1. 周期和占空比可变的 PWM 输出的工作时序图

连接示意图如下所示：

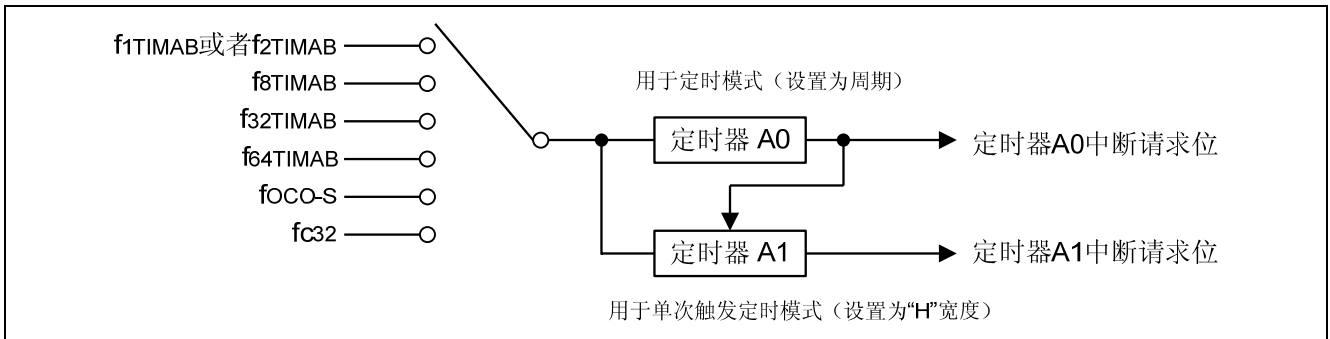


图 2. 周期和占空比可变的 PWM 输出的定时器连接示意图

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

TACSi 寄存器 (注 1)				TAiMR 寄存器		计数源	计数源周期
TCS3/ TCS7	TCS2/ TCS6	TCS1/ TCS5	TCS0/ TCS4	TCK1	TCK0		f(PLL):24MHz f(XCIN):32.768kHz
0	-	-	-	0	0	f1TIMAB/f2TIMAB (注 2)	41.7ns/83.3ns
0	-	-	-	0	1	f8TIMAB	333.3ns
0	-	-	-	1	0	f32TIMAB	1333.3ns
0	-	-	-	1	1	fc32	976.56ns
1	0	0	0	-	-	f1TIMAB/f2TIMAB (注 2)	41.7ns/83.3ns
1	0	0	1	-	-	f8TIMAB	333.3ns
1	0	1	0	-	-	f32TIMAB	1333.3ns
1	0	1	1	-	-	f64TIMAB	2666.7ns
1	1	0	1	-	-	foco-s	约 8μs
1	1	1	0	-	-	fc32	976.56μs

注 1: 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 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)。

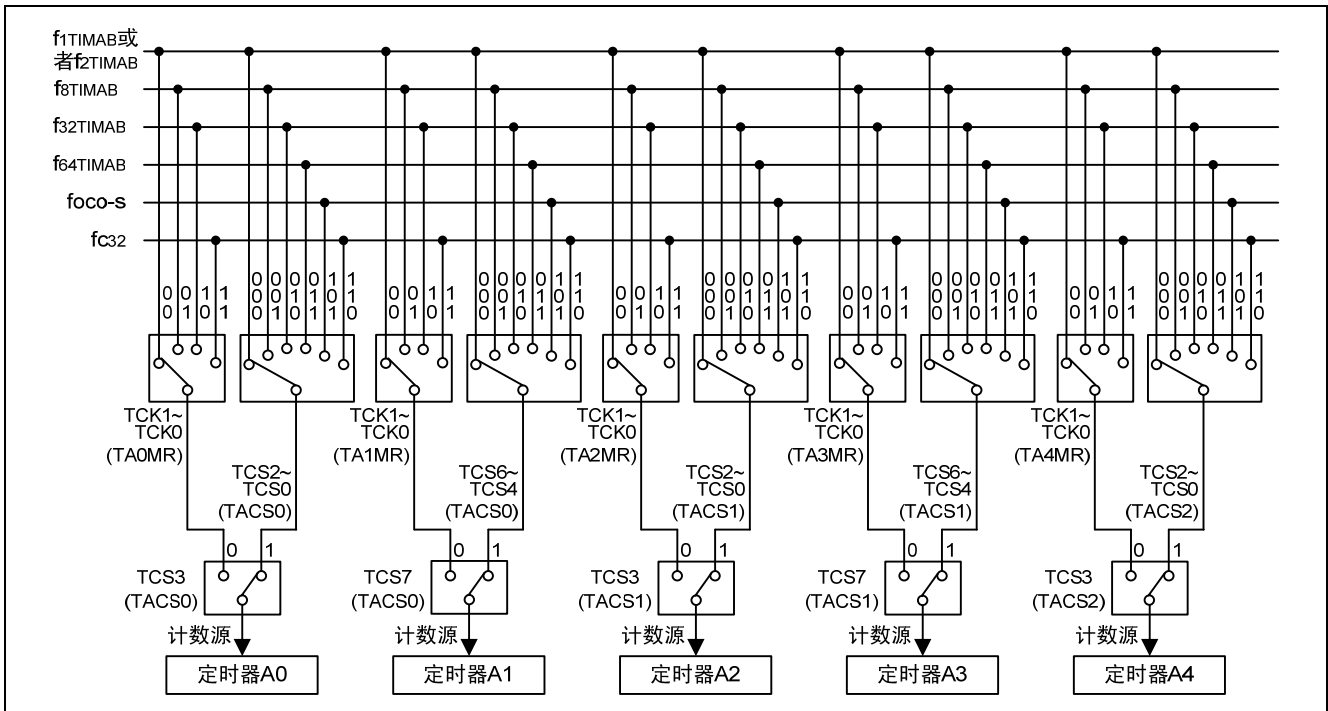
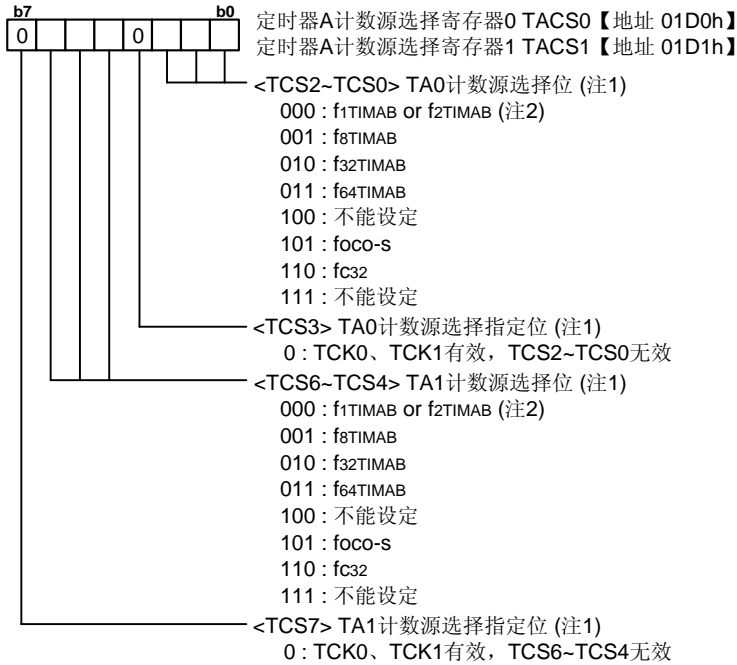


图 3. 定时器 A 的计数源

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/64 群的硬件手册。

选择定时器计数源

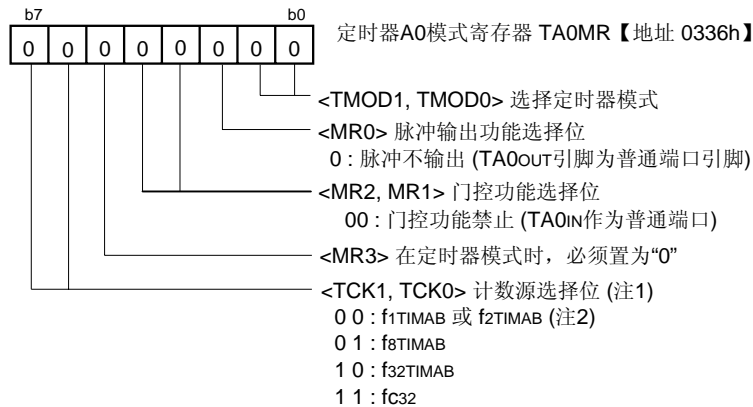


注1: 关于各种设定情况下的计数源周期, 请参考表2。

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

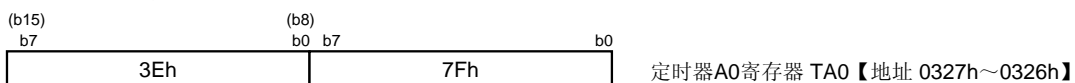
选择定时器模式和功能



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2。

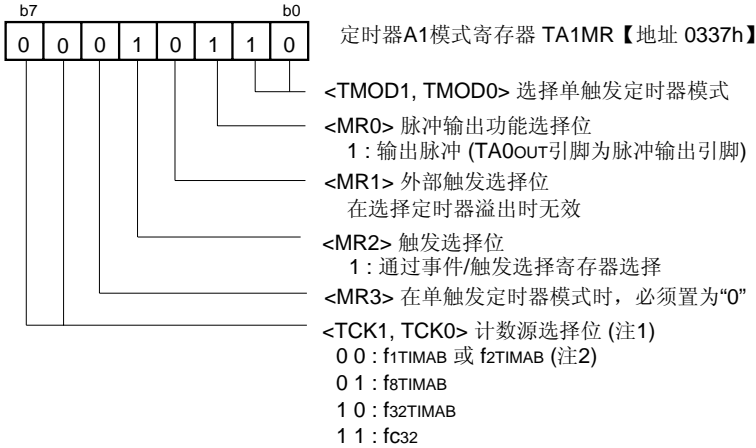
注2: 如果PCLKR寄存器中的PCLK0位为0选择f2TIMAB作为计数源, PCLK0位为1选择f1TIMAB作为计数源(复位设定值)。

设置计数值



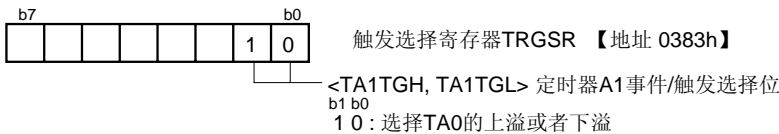
设定定时器 A1

选择单触发定时器模式和功能

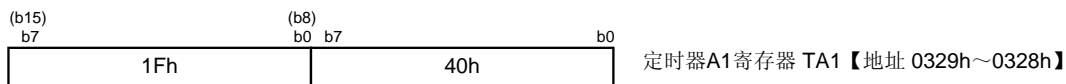


注1: TACS0~TACS2寄存器的TCS3位和TCS7位设置为0 (TCK0位、TCK1位有效)。关于各种设定情况下的计数源周期, 请参考表2。
注2: 如果PCLKR寄存器中的PCLK0位为0选择f2TIMAB作为计数源, PCLK0位为1选择f1TIMAB作为计数源 (复位设定值)。

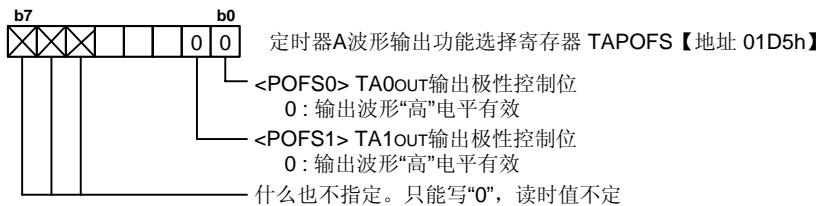
设置事件/触发选择位
(设定定时器A0触发定时器A1)



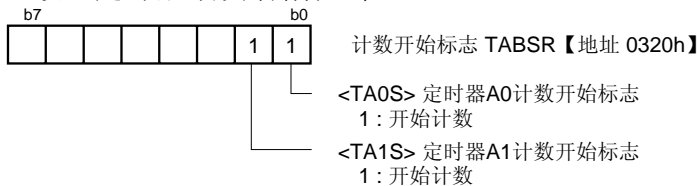
设置单触发定时器的时间



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/64 群硬件手册

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