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2010年4月1日
瑞萨电子公司

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M16C/65 群

长周期定时器

1. 要点

将定时器 A0 和定时器 A1 相连接，作为一个带 16 位预定标器的 16 位定时器使用。
使用下面的外围功能：

- 定时器 A 的定时器模式
- 定时器 A 的事件计数模式

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 为事件计数模式。
(2) 用定时器 A0 实现对计数源 f_{1TIMAB} 进行 1ms 计时，用定时器 A1 实现对 A0 的 1 秒计数。
(3) 连接一个 20MHz 的振荡器到 X_{IN}。
(4) 通过 TAPOFS 寄存器的 POFSi 位，选择 TAi_{OUT} 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”，开始计数。定时器 A0 对计数源 f_{1TIMAB} 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”。用定时器 A1 实现对定时器 A0 的下溢次数进行递减计数。
(3) 如果定时器 A1 减计数溢出，重加载寄存器的设定值也将被加载到计数器，计数器继续进行计数。此时定时器 A1 的中断请求位置为“1”。

工作时序图如下所示：

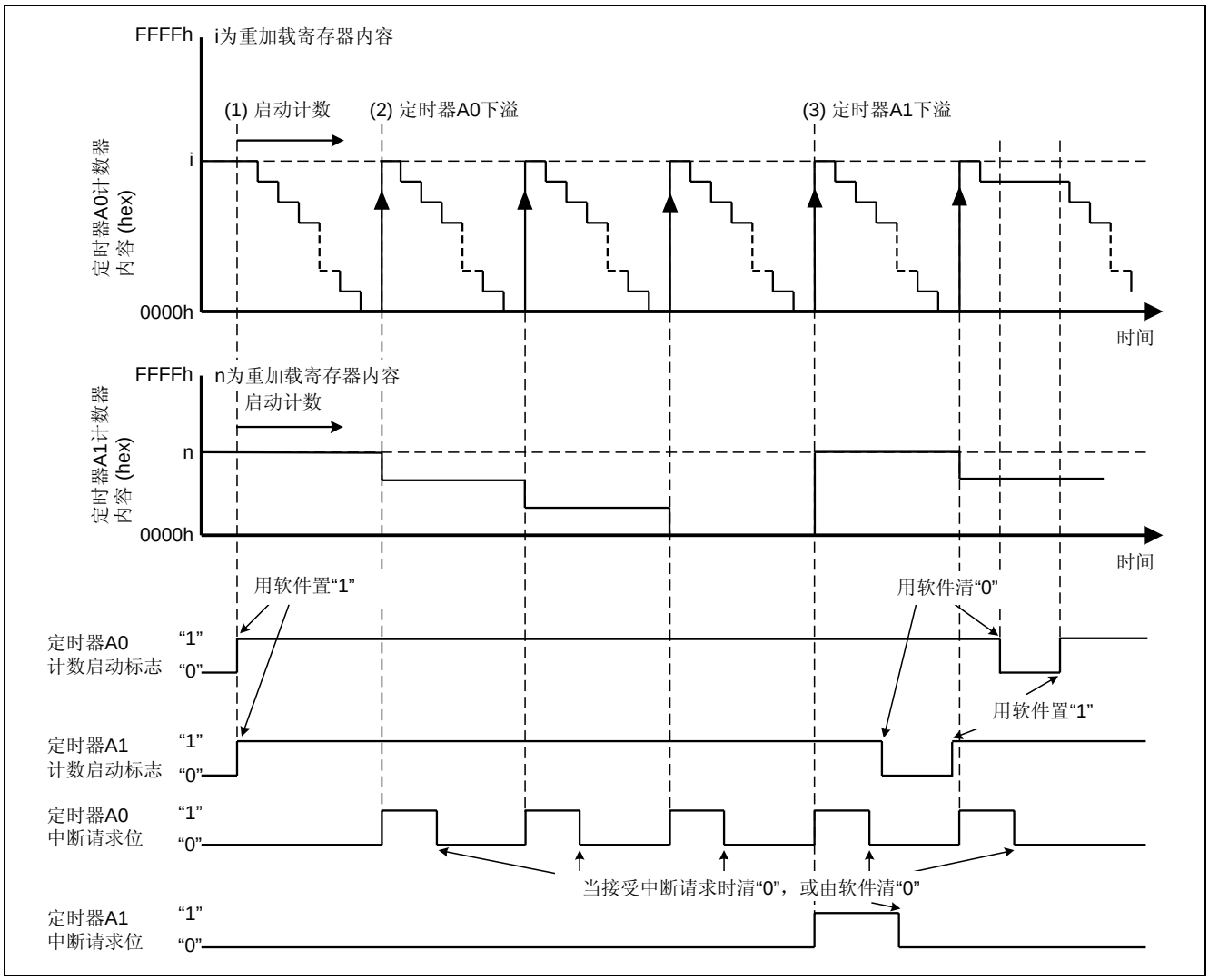


图 1. 长周期定时器的工作时序图

连接示意图如下所示：

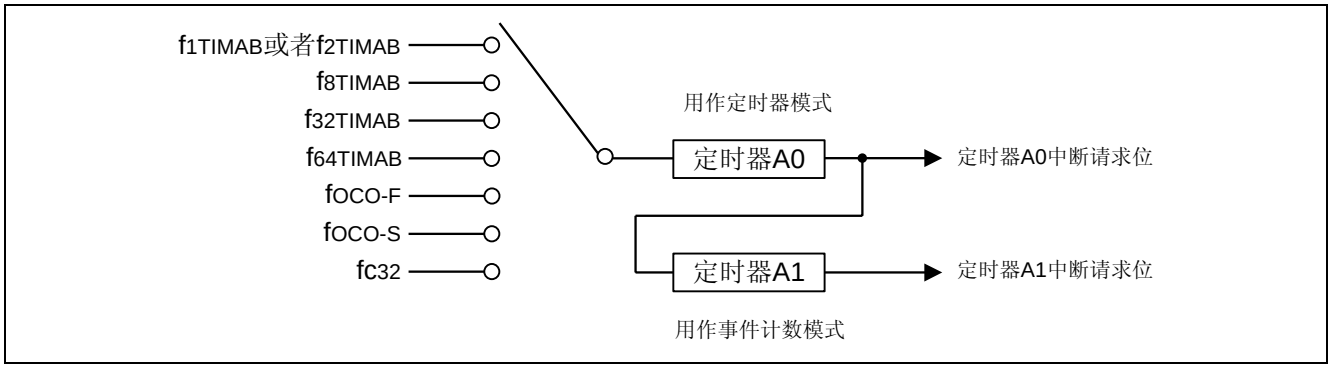


图 2. 长周期定时器的连接示意图

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

TCKDIVC0 寄存器（注 1）	TACSi 寄存器（注 2）				TAiMR 寄存器		计数源	计数源周期
TCDIV00	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）。

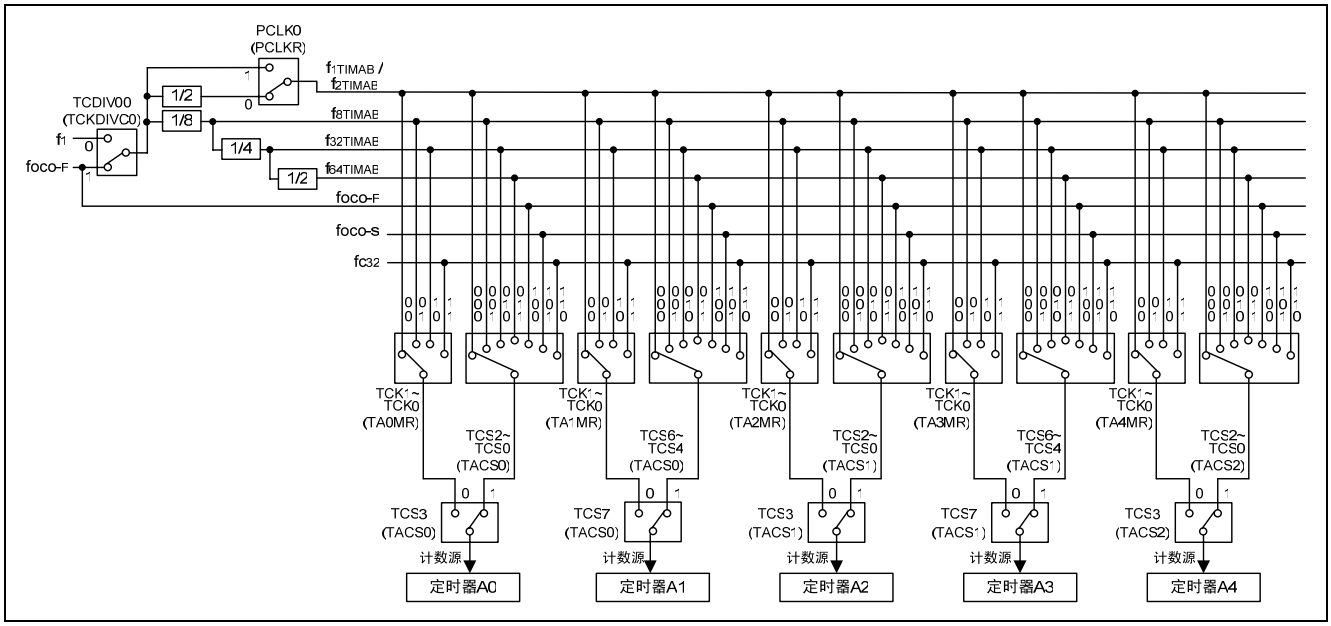


图 3. 定时器 A 的计数源

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。

设定定时器A0

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							b0
0	0	0	0	×	0	0	0

定时器AB分频控制寄存器0 TCKDIVC0【地址 01CBh】

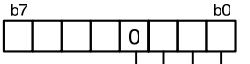
b0：定时器AB分频前时钟选择位
0 : f1

b1：保留位
设定为“0”

b5：什么也不指定。只能写“0”，读时值不定

b7：保留位
设定为“0”

选择定时器计数源



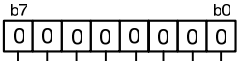
定时器A计数源选择寄存器0 TACS0【地址 01D0h】

<TCS2~TCS0> TA0计数源选择位 (注1)
000 : f_{1TIMAB}或f_{2TIMAB} (注2)
001 : f_{8TIMAB}
010 : $f_{32TIMAB}$
011 : $f_{64TIMAB}$
100 : foco-F
101 : foco-s
110 : f_{C32}
111 : 不能设定

<TCS3> TA0计数源选择指定位 (注1)
0 : TCK0、TCK1有效，TCS2~TCS0无效

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f_{2TIMAB}作为计数源，PCLK0位为1选择f_{1TIMAB}作为计数源（复位设定值）。

选择定时器模式和功能



定时器A0模式寄存器 TA0MR【地址 0336h】

<TMOD1, TMOD0> 工作模式选择位
00 : 定时器模式

<MR0> 脉冲输出功能选择位
0 : 不输出脉冲 ($TA0_{OUT}$作为输入/输出端口)

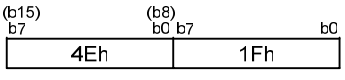
<MR2, MR1> 门控功能选择位
00 : 门控功能禁止 ($TA0_{IN}$作为普通端口)

<MR3> 在定时器模式时，请置为“0”

<TCK1, TCK0> 计数源选择位 (注1)
00 : f_{1TIMAB}或f_{2TIMAB} (注2)
01 : f_{8TIMAB}
10 : $f_{32TIMAB}$
11 : f_{C32}

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f_{2TIMAB}作为计数源，PCLK0位为1选择f_{1TIMAB}作为计数源（复位设定值）。

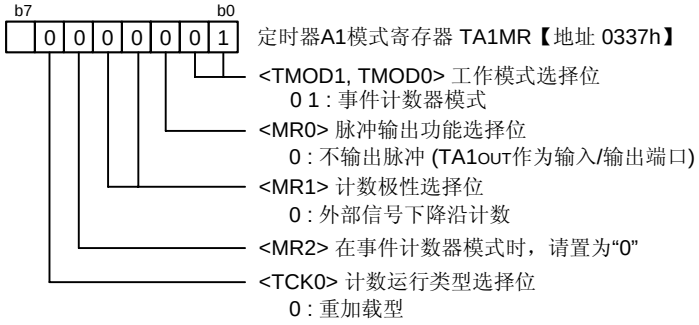
设置定时器A0寄存器



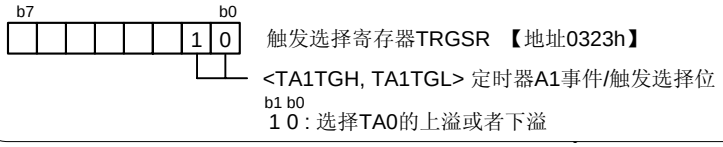
定时器A0寄存器 TA0【地址 0327h～0326h】

设定定时器A1

选择事件计数器模式和功能

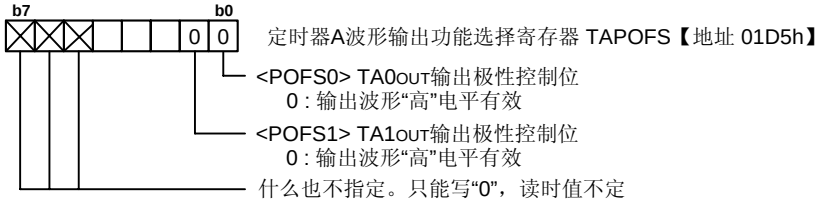


触发选择寄存器

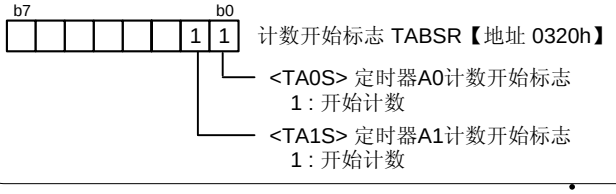


设置定时器A1寄存器

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

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数据手册

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Rev.	发行日	修订内容	
		页	要点
1.00	2009.12	—	初版发行

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   2）植埋于人体使用的装置。
   3）用于治疗（切除患部、给药等）的装置。
   4）其他直接影响到人的生命的装置。
9. 在使用本资料所记载的产品时，对于最大额定值、工作电源电压的范围、放热特性、安装条件及其他条件请在本公司规定的保证范围内使用。如果超出了本公司规定的保证范围使用时，对于由此而造成的故障和出现的事故，本公司将不承担任何责任。
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11. 如果把本资料所记载的产品从其载体设备上卸下，有可能造成婴儿误吞的危险。顾客在将本公司产品安装到顾客的设备上时，请顾客自行负责将本公司产品设置为不容易剥落的安全设计。如果从顾客的设备上剥落而造成事故时，本公司将不承担任何责任。
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