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瑞萨电子公司

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M16C/64 群

蜂鸣器输出

1. 要点

使用定时器模式实现蜂鸣器发声功能。

使用下面的外围功能：

- 定时器 A 的定时器模式脉冲输出功能

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) 使用定时器 A0 发出 2kHz 的蜂鸣音。

(2) 将相关端口用上拉电阻上拉。当蜂鸣器关闭时，设定端口为高阻态，端口保持为上拉之后的固定电压。

(3) 连接一个 16MHz 的振荡器到 XIN。

(4) 通过 TAPOFS 寄存器的 POFS0 位，选择 TA0OUT 引脚的输出极性。

4. 定时器 A 的操作

(1) 定时器 A0 开始计数。禁止定时器 A0 的中断请求。

(2) 通过选择脉冲输出功能有效，单片机开始输出脉冲。P7_0 作为 TA0OUT 引脚输出 2kHz 的脉冲。

(3) 通过选择脉冲输出功能无效，单片机停止脉冲输出。P7_0 变为输入端口，端口状态呈现高阻态。

工作时序图如下所示：

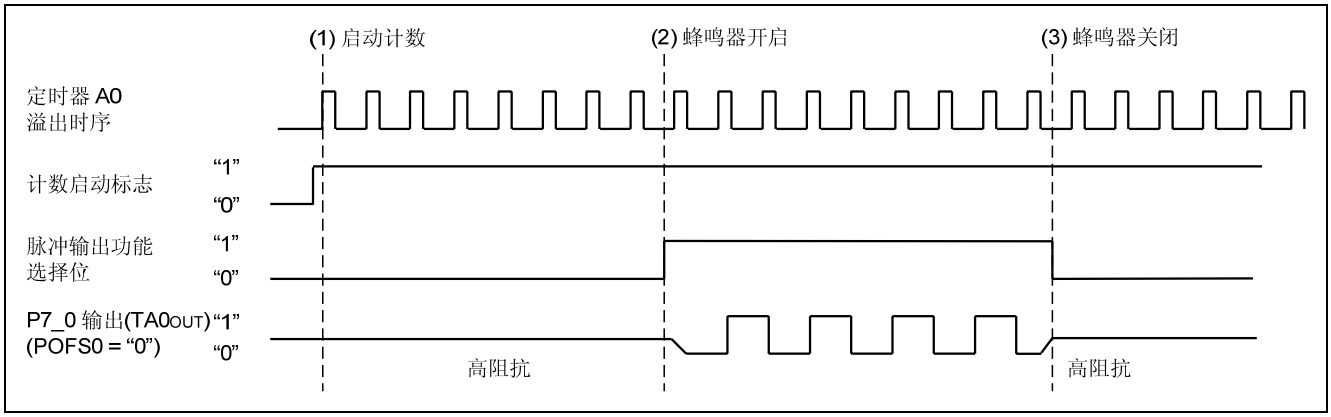


图 1. 蜂鸣器输出的工作时序图

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 2 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	f_{1TIMAB}/f_{2TIMAB}（注 2）	41.7ns/83.3ns
0	-	-	-	0	1	f_{8TIMAB}	333.3ns
0	-	-	-	1	0	$f_{32TIMAB}$	1333.3ns
0	-	-	-	1	1	f_{C32}	976.56ns
1	0	0	0	-	-	f_{1TIMAB}/f_{2TIMAB}（注 2）	41.7ns/83.3ns
1	0	0	1	-	-	f_{8TIMAB}	333.3ns
1	0	1	0	-	-	$f_{32TIMAB}$	1333.3ns
1	0	1	1	-	-	$f_{64TIMAB}$	2666.7ns
1	1	0	1	-	-	foco-s	约 8μs
1	1	1	0	-	-	f_{C32}	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 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）。

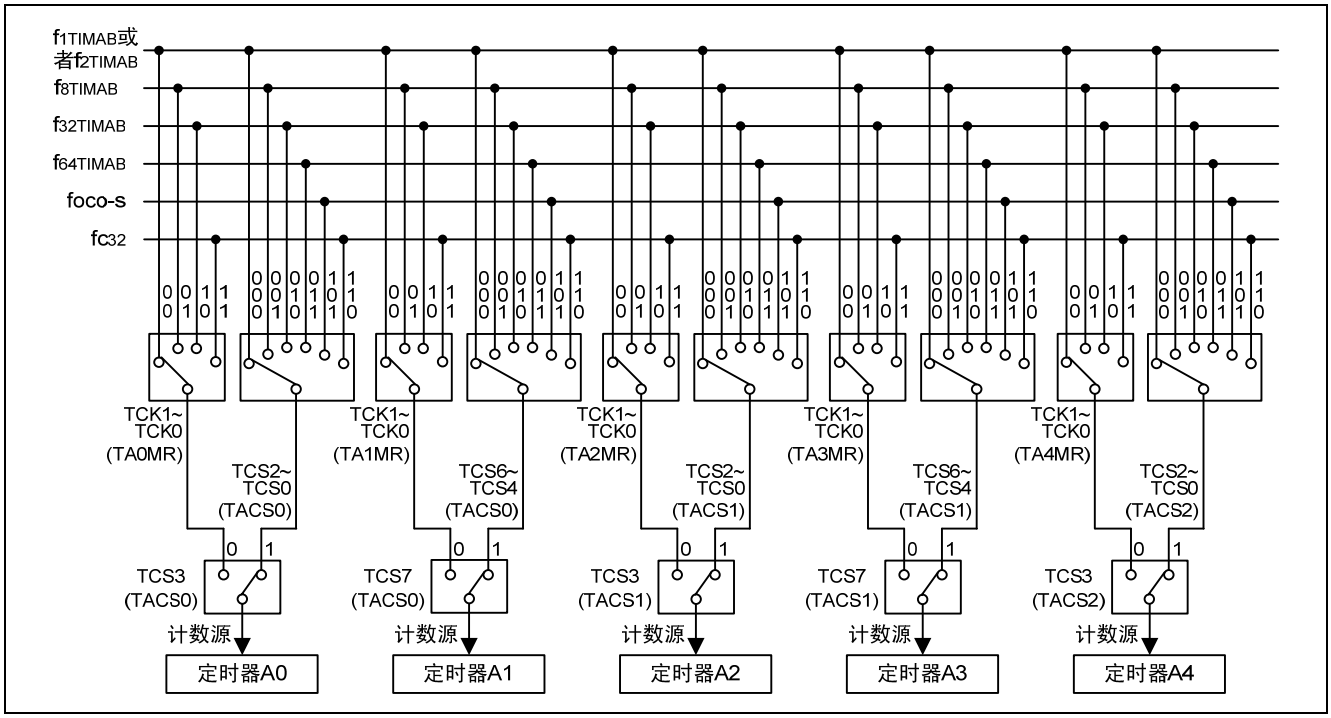


图 2. 定时器 A 的计数源

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/64 群的硬件手册。

选择定时器计数源

b7 b0

0 | | | | | | | |

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} or f_{2TIMAB} (注2)
001 : f_{8TIMAB}
010 : $f_{32TIMAB}$
011 : $f_{64TIMAB}$
100 : 不能设定
101 : f_{OCO-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2。
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

b7 b0

0 | 0 | 0 | 0 | 0 | 0 | 0 | 0

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 (TAi_{OUT}作为输入/输出端口)

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

<MR3> 在定时器模式时，必须置为“0”

<TCK1, TCK0> 计数源选择位 (注1)
00 : f_{1TIMAB} or 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2。
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

(b15) b7 (b8) b0 b7 b0

0Fh	9Fh

定时器 A0 寄存器 TA0【地址 0327h, 0326h】

选择定时器波形输出功能

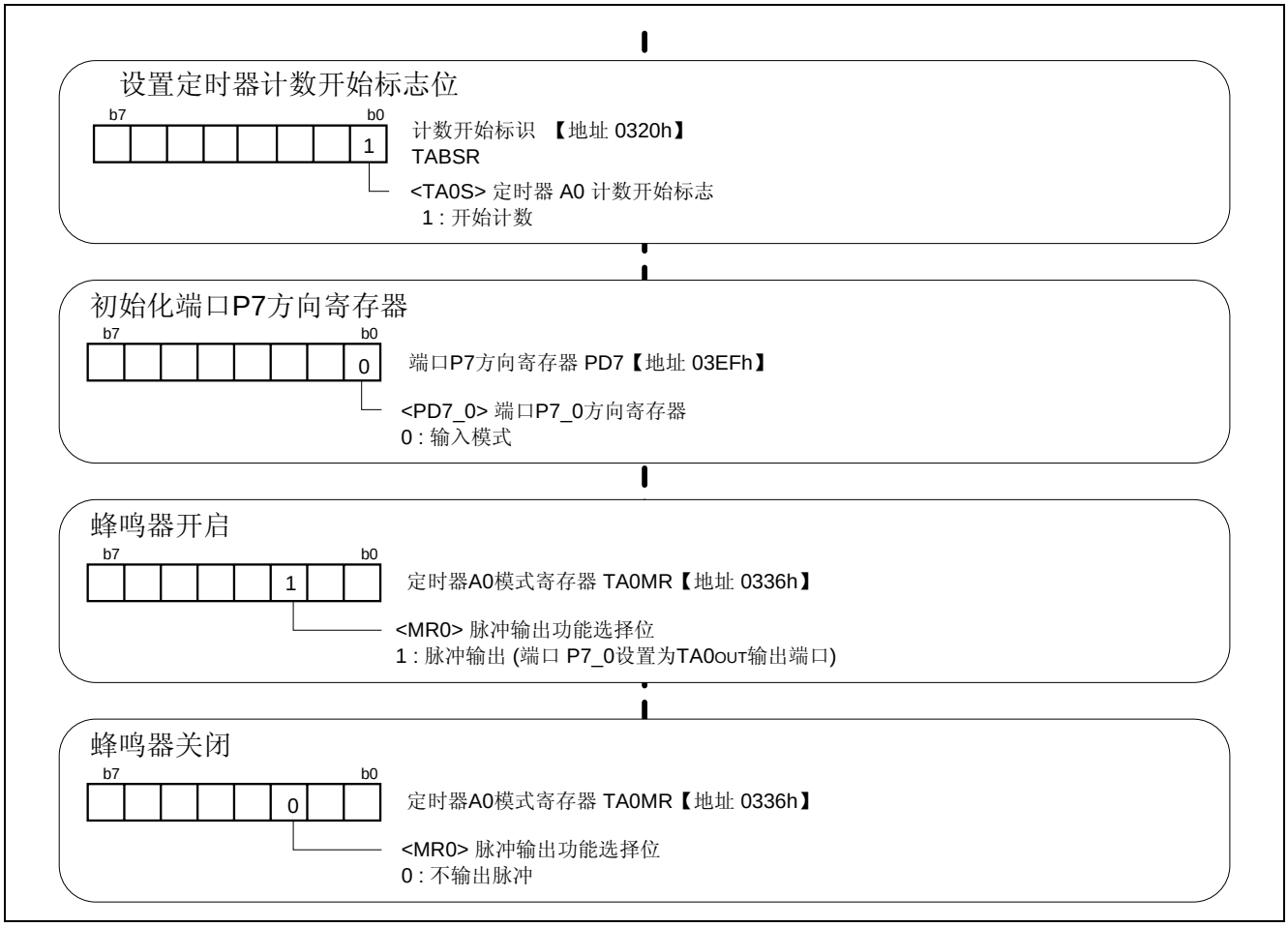
b7 b0

X | X | X | | | | 0 | 0

定时器A波形输出功能选择寄存器 TAPOFS【地址 01D5h】

<POFS0> $TA0_{OUT}$输出极性控制位
0 : 输出波形“高”电平有效

什么也不指定。只能写“0”，读时值不定


设置定时器计数开始标志位
b7
b0
1
计数开始标识 【地址 0320h】
TABSR
<TA0S> 定时器 A0 计数开始标志
1 : 开始计数
初始化端口P7方向寄存器
b7
b0
0
端口P7方向寄存器 PD7【地址 03EFh】
<PD7_0> 端口P7_0方向寄存器
0 : 输入模式
蜂鸣器开启
b7
b0
1
定时器A0模式寄存器 TA0MR【地址 0336h】
<MR0> 脉冲输出功能选择位
1 : 脉冲输出 (端口 P7_0设置为TA0OUT输出端口)
蜂鸣器关闭
b7
b0
0
定时器A0模式寄存器 TA0MR【地址 0336h】
<MR0> 脉冲输出功能选择位
0 : 不输出脉冲

6. 参考文献

数据手册

M16C/64 群硬件手册
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Rev.	发行日	修订内容	
		页	要点
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