致尊敬的顾客

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2010年4月1日
瑞萨电子公司

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M16C/65 群
定时器 A 操作（计数器模式、门控功能）

1. 要点

在定时器模式中，可以选择如表 1 中所列的各种功能。在表 1 中用符号“〇”表示本篇资料所选的项目，图 1 是定时器的工作时序图。本篇资料的参考例程是定时器 A1 选择定时器模式的例子。

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. 选定功能

表 1. 选定功能

<table>
<thead>
<tr>
<th>设定项目</th>
<th>设定内容</th>
</tr>
</thead>
<tbody>
<tr>
<td>计数源</td>
<td>内部时钟源（f1TIMAB/f2TIMAB/f3TIMAB/f4TIMAB/f5TIMAB/f64TIMAB/fOCO-f/fOCO-s/fC32）</td>
</tr>
<tr>
<td>脉冲输出功能</td>
<td>无脉冲输出</td>
</tr>
<tr>
<td>门控功能</td>
<td>只有在 TAiN 引脚为“低”电平期间进行计数</td>
</tr>
<tr>
<td>输出极性控制</td>
<td>输出波形“高”电平有效</td>
</tr>
</tbody>
</table>

注：i = 0~4

4. 定时器 A 的操作

(1) 把计数开始标志位置为“1”，当 TAiN 引脚的输入电平为“高”时，计数器开始对计数脉冲源的下降沿计数。
(2) 当 TAiN 引脚的输入电平为“低”时，计数器停止计数，并且保持当前值。
(3) 在发生下溢时，重加载寄存器的设定值被加载到计数器，计数器继续进行计数。同时，定时器 Ai 中断请求位置为“1”。
(4) 把计数开始标志位置为“0”，计数器停止计数，并且保持当前值。

注：输入 TAiN 引脚信号的脉冲宽度不能小于 2 个计数周期。

选择定时器模式的定时器工作时序图如下所示：

图 1. 选择定时器模式、门控功能时的工作时序图
5. 寄存器设置

在定时器模式中，定时器 A 可以选择如表 2 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 2. 定时器 A 计数源的选择

<table>
<thead>
<tr>
<th>TCKDIV0 寄存器（注 1）</th>
<th>TACS1 寄存器（注 2）</th>
<th>TAIMR 寄存器</th>
<th>计数源</th>
<th>计数源周期</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCDIV00</td>
<td>TCS3/ TCS7</td>
<td>TCS2/ TCS6</td>
<td>TCS1/ TCS5</td>
<td>TCS0/ TCS4</td>
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<tr>
<td>0</td>
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<td>1</td>
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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 TCS7~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）。
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。

(1) 选择定时器计数源

（请在设定和定时器A相关的其它寄存器之前设定TCDIV0位。在改变TCDIV0位后，请再次设定和定时器A相关的其它寄存器。）

定时器AB分频控制寄存器0 TCDIV00【地址 01CBh】

定时器AB分频前分频选择位
C: fi
保留位
设定为‘0’
什么也不指定，只能写‘0’，该时值不定
保留位
设定为‘0’
### Timer A Operation (Counter Mode, Gate Function)

**Timer A Count Source Select Registers**
- **TACS0**【Address 01D0h】
- **TACS1**【Address 01D1h】
- **TACS2**【Address 01D2h】

#### TACS0 (Register 0)
- **b7-b0**
- **000**: f1TIMAB or f2TIMAB (Note 2)
- **001**: fTIMAB
- **010**: f3T1IMAB
- **011**: f4T1IMAB
- **100**: f32-F
- **101**: f32-S
- **110**: f642
- **111**: Not Set

#### TACS1 (Register 1)
- **b7-b0**
- **000**: f1TIMAB or f2TIMAB (Note 2)
- **001**: fTIMAB
- **010**: f3T1IMAB
- **011**: f4T1IMAB
- **100**: f32-F
- **101**: f32-S
- **110**: f642
- **111**: Not Set

#### TACS2 (Register 2)
- **b7-b0**
- **000**: f1TIMAB or f2TIMAB (Note 2)
- **001**: fTIMAB
- **010**: f3T1IMAB
- **011**: f4T1IMAB
- **100**: f32-F
- **101**: f32-S
- **110**: f642
- **111**: Not Set

---

*Notes:*
1. About the count source period under various settings, please refer to Table 2.
2. If PCLKR register PCLK0 is selected as f2TIMAB as the count source, PCLK0 is set as f1TIMAB (default setting).

---

**Register Descriptions**
- **b7**
  - **<TCS2~TCS0>** TA4 count source select (Note 1)
    - **000**: f1TIMAB or f2TIMAB (Note 2)
    - **001**: fTIMAB
    - **010**: f3T1IMAB
    - **011**: f4T1IMAB
    - **100**: f32-F
    - **101**: f32-S
    - **110**: f642
    - **111**: Not Set

- **b0**
  - **<TCS3>** TA4 count source select (Note 1)
    - **0**: TCK0, TCK1 effective; TCS2~TCS0无效

---

*Notes:*
1. About the count source period under various settings, please refer to Table 2.
2. If PCLKR register PCLK0 is selected as f1TIMAB as the count source, PCLK0 is set as f1TIMAB (default setting).
(2) 选择定时器模式和功能

<table>
<thead>
<tr>
<th>b7</th>
<th>b6</th>
<th>b5</th>
<th>b4</th>
<th>b3</th>
<th>b2</th>
<th>b1</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>

- 定时器A0模式寄存器 TA0MR 【地址 0336h】
- 定时器A1模式寄存器 TA1MR 【地址 0337h】
- 定时器A2模式寄存器 TA2MR 【地址 0338h】
- 定时器A3模式寄存器 TA3MR 【地址 0339h】
- 定时器A4模式寄存器 TA4MR 【地址 033Ah】

- <TMOD1, TMOD0> 工作模式选择位
  - 00：定时器模式
  - 01：脉冲输出功能选择

- <MR0> 脉冲输出功能选择位
  - 0：不输出脉冲 (TAiOUT作为输入/输出端口)

- <MR2, MR1> 门控功能选择位
  - 11：在TAiIN引脚为“L”电平时计数 (注1)

- <MR3> 在定时器模式时，请置为“0”

- <TClock1, TClock0> 计数源选择位 (注2)
  - 00：f1TIMAB或f2TIMAB (注3)
  - 01：f8TIMAB
  - 10：f32TIMAB
  - 11：fc32

注1：将对应的端口方向寄存器设置为0。
注2：TACSO~TACST2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周期，请参考表2。
注3：如果PCLKR寄存器中的PCLK0位为0选择f1TIMAB作为计数源，PCLK0位为1选择f2TIMAB作为计数源（复位设定值）。

(3) 选择定时器波形输出功能

- 定时器A波形输出功能选择寄存器 TAPOFS 【地址 01D5h】
- <POFS0> TA0OUT输出极性控制位
  - 0：输出波形“高”电平有效
- <POFS1> TA1OUT输出极性控制位
  - 0：输出波形“高”电平有效
- <POFS2> TA2OUT输出极性控制位
  - 0：输出波形“高”电平有效
- <POFS3> TA3OUT输出极性控制位
  - 0：输出波形“高”电平有效
- <POFS4> TA4OUT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

(4) 设置定时器A寄存器 (i=0～4)

<table>
<thead>
<tr>
<th>b16</th>
<th>b15</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

- 定时器A0寄存器 TA0 【地址 0327h～0326h】
- 定时器A1寄存器 TA1 【地址 0329h～0328h】
- 定时器A2寄存器 TA2 【地址 032Bh～032Ah】
- 定时器A3寄存器 TA3 【地址 032Dh～032Ch】
- 定时器A4寄存器 TA4 【地址 032Fh～032Eh】

设定为0000h～FFFFh
(5) 设置时钟预分频器复位标志位

这一功能只在选择F40作为计数器时有效，复位预分频器的目的是为了产生X40时钟的32分频值F40。

时钟预分频器复位标志 CPSRF【地址 0015h】

- CPSRF 时钟预分频器复位标志
  0: 没有影响
  1: 复位预分频器（该时值为'0'）

(6) 设置定时器计数开始标志位

计数开始标志 TABSR【地址 0320h】

- TA0S 定时器A0计数开始标志
  1: 开始计数

- TA1S 定时器A1计数开始标志
  1: 开始计数

- TA2S 定时器A2计数开始标志
  1: 开始计数

- TA3S 定时器A3计数开始标志
  1: 开始计数

- TA4S 定时器A4计数开始标志
  1: 开始计数

开始计数
6. 参考文献

数据手册
M16C/65 群硬件手册
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定时器 A 操作（计数器模式、门控功能）

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