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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）

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/f8TIMAB/f32TIMAB/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></td>
<td>○ 脉冲输出</td>
</tr>
<tr>
<td>门控功能</td>
<td>○ 无门控功能</td>
</tr>
<tr>
<td></td>
<td>只有在 TAin 中断请求位置为“低”电平期间进行计数</td>
</tr>
<tr>
<td></td>
<td>只有在 TAin 中断请求位置为“高”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>
<tr>
<td></td>
<td>输出波形“低”电平有效（输出反转）</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”，计数器开始对计数脉冲源的下降沿计数。
（2）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”。
（3）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。

选择定时器模式的定时器工作时序图如下所示：

图1. 选择定时器模式定时器的工作时序图
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>TACSi 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>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>0</td>
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<td>-</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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）。
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。在改变 TCDIV0 之后，请再次设定和定时器 A 相关的其它寄存器。）
### 定时器 A 操作（计数器模式）

#### 定时器 A 计数源选择寄存器 0 TACS0【地址 01D0h】

<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>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- **<TCS2~TCS0> TA1** 计数源选择位 (注1)
  - 000: f2TIMAB或f1TIMAB (注2)
  - 001: f1TIMAB
  - 010: f2TIMAB
  - 011: f32TIMAB
  - 100: f64TIMAB
  - 101: f128TIMAB
  - 110: f32C2
  - 111: 不能设定

#### 定时器 A 计数源选择寄存器 1 TACS1【地址 01D1h】

<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>
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<tbody>
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<td>0</td>
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<td>0</td>
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<td>0</td>
</tr>
</tbody>
</table>

- **<TCS6~TCS4> TA1** 计数源选择位 (注1)
  - 000: f2TIMAB或f1TIMAB (注2)
  - 001: f1TIMAB
  - 010: f2TIMAB
  - 011: f32TIMAB
  - 100: f64TIMAB
  - 101: f128TIMAB
  - 110: f32C2
  - 111: 不能设定

#### 定时器 A 计数源选择寄存器 2 TACS2【地址 01D2h】

<table>
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<th>b5</th>
<th>b4</th>
<th>b3</th>
<th>b2</th>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- **<TCS7> TA1** 计数源选择指定位 (注1)
  - 0: TCK0、TCK1有效，TCS6~TCS4无效

**注1**: 关于各种设定情况下的计数器周期，请参考表2。
**注2**: 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）。
(2) 选择定时器模式和功能

选择定时器模式和功能

- <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 (TAiOUT 作为输入/输出端口)
- <MR2, MR1> 门控功能选择位
  - 00: 门控功能禁止 (TAiIN 作为普通端口)
  - 01: 门控功能禁止
- <MR3> 在定时器模式时，请置为“0”
- <TCK1, TCK0> 计数源选择位 (注1)
  - 00: fTIMAB 或 fTIMAB (注2)
  - 01: fTIMAB
  - 10: f2TIMAB
  - 11: f32

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 fTIMAB 作为计数源，PCLK0 位为 1 选择 fTIMAB 作为计数源（复位设定值）。

(3) 选择定时器波形输出功能

选择定时器波形输出功能

- <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Ai寄存器 (i=0~4)

设置定时器Ai寄存器

- 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fosc作为计数源时有效，复位预分频器的目的是为了产生xn时钟的32分频周期fosc。

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
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</thead>
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   而设计和制造的。特别是对于重要和可靠性要求极高的机器和系统等（将本公司指定用于汽车方面的产品用
   于汽车时除外），如果要用于上述的目的，需先向本公司的营业窗口咨询。另外，对于由于上述目的
   而造成的损失等，本公司概不负责。
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   概不负责。
| 1) 生命体维持装置。 |
| 2) 植入于人体使用的装置。 |
| 3) 用于治疗（切除、给药等）的装置。 |
| 4) 其他直接到人的生命的装置。
| 9. 在使用本资料所记载的产品时，对最大额定值，工作电压电流的范围、放热特性、安装条件及其他条件请
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| 10. 本公司一直致力于提高产品的质量和可靠性，但一般来说，半导体产品总会以一定的概率发生故障，或者由
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   难或造成社会性的损失，希望客户能自行进行冗余设计、采取延时接口及进行防止错误运行等的安全设计
   （包括硬件和软件两方面的设计）以及老化处理等，这是作为机器和系统的出厂保证。特别是单片机的软件，
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定时器 A 操作 (计数器模式)