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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（单次触发模式、外部触发）

1. 要点
在单次触发模式中，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。

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>脉冲输出功能</td>
<td>有脉冲输出</td>
</tr>
<tr>
<td>计数开始条件</td>
<td>外部触发输入（TAiIN 引脚输入信号的下降沿）</td>
</tr>
<tr>
<td>计数开始条件</td>
<td>外部触发输入（TAiIN 引脚输入信号的上升沿）</td>
</tr>
<tr>
<td>计数开始条件</td>
<td>计数器溢出（TB2/TAj/TAk 溢出）</td>
</tr>
<tr>
<td>计数开始条件</td>
<td>向单次触发开始标志写“1”</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>输出极性控制</td>
<td>输出波形“低”电平有效（输出反转）</td>
</tr>
</tbody>
</table>

注：j = i – 1，在i = 0 时 j = 4  k = i + 1，在i = 4 时 k = 0

4. 定时器 A 的操作

(1) 当 TAiIN 引脚的输入电平从“L”变为“H”时，并且把计数开始标志位置为“1”时，计数器开始对计数脉冲源的下降沿计数。同时，TAiOUT 引脚输出“H”电平。

(2) 当计数值达到“0000h”时，TAiOUT 引脚输出“L”，重加载寄存器的设定值被加载到计数器，计数器停止计数。此时，定时器 Ai 中断请求位置为“1”。

(3) 当计数过程中发生触发时，重加载寄存器的设定值被加载到计数器，计数器继续计数。重加载的时序是在触发后的下一次计数的时刻。

(4) 把计数开始标志位置为“0”，计数器停止计数，重加载寄存器的设定值被加载到计数器。同时，TAiOUT 输出“L”电平。此时，定时器 Ai 中断请求位置为“1”。

注意：如果定时器 Ai 寄存器的值被设定为“0000h”，定时器不会工作，因此定时器 Ai 中断请求也不会产生。如果设定了脉冲输出，也不会有脉冲从 TAiOUT 引脚输出。

选择单次触发模式的定时器工作时序图如下所示：
定时器 A 操作（单次触发模式、外部触发）

图 1. 选择单次触发模式的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>TCDIV00 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>TCS3/ TCS7</td>
<td>TCS2/ TCS6</td>
<td>TCS1/ TCS5</td>
<td>TCS0/ TCS4</td>
<td>TCK1</td>
</tr>
<tr>
<td>0 0 0 - - - - - - 0 0</td>
<td>f1TIMAB/f2TIMAB (注 3)</td>
<td>50ns/100ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 1 1</td>
<td>f8TIMAB</td>
<td>400ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 1 1</td>
<td>f32TIMAB</td>
<td>1600ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 0 0</td>
<td>f1TIMAB/f2TIMAB (注 3)</td>
<td>50ns/100ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 0 0</td>
<td>f8TIMAB</td>
<td>400ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 1 1</td>
<td>f32TIMAB</td>
<td>1600ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 1 1</td>
<td>f64TIMAB</td>
<td>3200ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 0 0</td>
<td>f8TIMAB</td>
<td>400ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 1 1</td>
<td>f32TIMAB</td>
<td>1600ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 - - - - - - 1 1</td>
<td>f64TIMAB</td>
<td>3200ns</td>
<td></td>
<td></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 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）。
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/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 后，请再次设定和定时器 A 相关的其它寄存器。）

<table>
<thead>
<tr>
<th>1</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

定时器 AB 分频控制寄存器 TCDIV0 【地址 01CBh】

<table>
<thead>
<tr>
<th>1</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

定时器 AB 分频前时钟选择位 C：f1
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”
定时器 A 操作（单次触发模式、外部触发）

定时器 A 计数源选择寄存器 0 TACS0【地址 01D0h】
定时器 A 计数源选择寄存器 1 TACS1【地址 01D1h】

<TCS2~TCS0> TAi 计数源选择位 (注1)
- 000: fTIMAB或fTIMAC (注2)
- 001: fTIMAB
- 010: f32TIMAB
- 011: f64TIMAB
- 100: fOCO-F
- 101: fOCO-S
- 110: fC32
- 111: 不能设定

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

<TCS6~TCS4> TAi 计数源选择位 (注1)
- 000: fTIMAB或fTIMAC (注2)
- 001: fTIMAB
- 010: f32TIMAB
- 011: f64TIMAB
- 100: fOCO-F
- 101: fOCO-S
- 110: fC32
- 111: 不能设定

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

TACS0寄存器；i = 0，j = 1。TACS1寄存器；i = 2，j = 3
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fTIMAB作为计数源，PCLK0位为1选择fTIMAC作为计数源（复位设定值）。

定时器 A 计数源选择寄存器 2 TACS2【地址 01D2h】

<TCS2~TCS0> TAi 计数源选择位 (注1)
- 000: fTIMAB或fTIMAC (注2)
- 001: fTIMAB
- 010: f32TIMAB
- 011: f64TIMAB
- 100: fOCO-F
- 101: fOCO-S
- 110: fC32
- 111: 不能设定

<TCS3> TAi 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fTIMAB作为计数源，PCLK0位为1选择fTIMAC作为计数源（复位设定值）。

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fTIMAB作为计数源，PCLK0位为1选择fTIMAC作为计数源（复位设定值）。
(2) 选择单触发定时器模式和功能

选择单触发定时器模式
脉冲输出功能选择位
外部触发选择位
触发选择位
在单触发定时器模式时，请置为“0”
计数源选择位 (注1)
00 : f1TIMAB
01 : f2TIMAB
10 : f3TIMAB
11 : f4TIMAB

（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）。

(3) 清零定时器Ai中断请求位 参考“定时器A（单触发定时器模式）注意事项”

（4）设置事件/触发选择位

注：请将相应的端口方向寄存器清“0”（输入模式）
5. 设置单触发定时器的时间

- 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0001h～FFFFh

6. 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”，该时值不定

7. 设置时钟预分频器复位标志位

- 时钟预分频器复位标志 CPSRF【地址 0015h】

- <CPSR> 时钟预分频器复位标志
  - 0: 没有影响
  - 1: 复位预分频器（读时值为“0”）

8. 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
6. 参考文献

数据手册
M16C/65 群硬件手册
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contact.china@renesas.com
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定时器 A 操作（单次触发模式、外部触发）

注意

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