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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 TIMAB 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 XIN。
(4) 通过 TAPFCS 寄存器的 POFSi 位，选择 TAiOUT 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 TIMAB 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。
(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：
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

<table>
<thead>
<tr>
<th>TCKDIV00</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 0 0 0 0 0 0</td>
<td>f1TIMAB/f2TIMAB</td>
<td>50ns/100ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 1 1 1 1</td>
<td>f32TIMAB</td>
<td>1600ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 1 1 1 1 1</td>
<td>f64TIMAB</td>
<td>3200ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 0 0 0 0 0</td>
<td>f976.56µs</td>
<td>50ns/100ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 0 0 1 1 1</td>
<td>f32TIMAB</td>
<td>1600ns</td>
<td></td>
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<td>0 1 0 1 1 1 1</td>
<td>f64TIMAB</td>
<td>3200ns</td>
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<tr>
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<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: TACS 寄存器的 TCS0~TCS7 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。TACS 寄存器的 TCS7~TCS4 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 TCS7~TCS4 位和定时器 A4 计数源的选择相对应。

注 3: 如 PCLKR 寄存器中的 PCK0 位为“0”选择 f2TIMAB 作为计数源 PCK0 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AC

选择定时器AB分频时钟
（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 TCDIV0【地址 01CBh】

定时器AB分频时钟选择位
Q：fi
保留位
设定为“0”
什么也不指定。只能写“0”，读时值不定
保留位
设定为“0”
选择定时器计数源

选择定时器模式和功能

设置定时器AO寄存器
### 设定定时器A1

**选择事件计数器模式和功能**

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<td>0</td>
<td>0</td>
<td>1</td>
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- **定时器A1模式寄存器 TA1MR【地址 0337h】**
  - `<TMOD1, TMOD0>` 工作模式选择位
    - 01: 事件计数器模式
  - `<MR0>` 脉冲输出功能选择位
    - 0: 不输出脉冲 (TA1out作为输入/输出端口)
  - `<MR1>` 计数极性选择位
    - 0: 外部信号下降沿计数
  - `<MR2>` 在事件计数器模式时，请置为“0”
  - `<TCK0>` 计数运行类型选择位
    - 0: 重加载型

### 触发选择寄存器

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<tbody>
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<td>1</td>
<td>0</td>
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</tbody>
</table>

- **触发选择寄存器TRGSR【地址0323h】**
  - `<TA1TGH, TA1TGL>` 定时器A1事件/触发选择位
    - b3 b2  1 0: 选择TA0的上溢或者下溢

### 设置定时器A1寄存器

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<th>b2</th>
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<tr>
<td>03h</td>
<td>E7h</td>
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- **定时器A1寄存器 TA1【地址 0329h~0328h】**

### 选择定时器波形输出功能

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<tr>
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<td>0</td>
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- **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
    - 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

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- **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

### 开始计数
6. 参考文献

数据手册
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8. 除上述第7项内容外，不能将本资料中记载的产品用于以下用途。如果用于以下用途而造成的损失，本公司概不负责。
9. 在使用本资料中记载的产品时，对于最大额定值，工作电源电压的范围、工作特性、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，对因此而造成的故障和出现的事故，本公司不承担任何责任。
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，半导体产品总会有一定的概率发生故障，或者由于使用条件不同而出现错误运行等。为了避免由于产品的发生故障或者错误运行而导致人身事故和火灾，本公司规定在使用本公司的半导体产品时，必须注意以下事项：
11. 如果把本资料中记载的产品从其载体设备上卸下，有可能造成用户设备的危险。用户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易取出的设备。如果从顾客的设备上取出而造成事故时，本公司将不承担任何责任。
12. 在未得到本公司的事先书面认可时，不可将本资料的一部分或者全部转载或者复制。
13. 如果需要了解关于本资料的详细内容，或者有其他关心的问题，请向本公司的营业窗口咨询。