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瑞萨电子公司
2010年4月1日

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M16C/65 群
串行 I/O 操作（时钟同步串行 I/O 模式下的接收）

1. 要点

在时钟同步串行 I/O 模式下接收数据，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 是串行 I/O 的工作时序图。本篇资料的参考例程是使用 UART0 在时钟同步模式下接收数据的例子。

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>
<th>设定项目</th>
<th>设定内容</th>
</tr>
</thead>
<tbody>
<tr>
<td>传送时钟源</td>
<td>内部时钟</td>
<td>连续接收模式</td>
<td>禁止</td>
</tr>
<tr>
<td></td>
<td>(f1SIO/f2SIO/f3SIO/f32SIO)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>外部时钟（CLKi 引脚）</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTS 功能</td>
<td>RTS 功能允许</td>
<td>输出传送时钟到多个引脚（注 1）</td>
<td>不选择</td>
</tr>
<tr>
<td></td>
<td>RTS 功能禁止</td>
<td></td>
<td>选择</td>
</tr>
<tr>
<td>CLK 极性</td>
<td>在传送时钟的上升沿输入接收数据</td>
<td>数据逻辑选择功能</td>
<td>不反转</td>
</tr>
<tr>
<td></td>
<td>在传送时钟的下降沿输入接收数据</td>
<td></td>
<td>反转</td>
</tr>
<tr>
<td>传送时钟</td>
<td>LSB 先</td>
<td>CTS/RTS 引脚独立（注 2）</td>
<td>复用引脚</td>
</tr>
<tr>
<td></td>
<td>MSB 先</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

注 1：只能在 UART1 使用内部时钟时选择。

注 2：CTS0/RTS0 独立功能是 CTS0 与 RTS0 引脚功能不复用，从 P6_0 引脚输出 RTS0，从 P6_4 引脚输出 CTS0 的功能。当选择这个功能时，不能使用 UART1 的 CTS/RTS 功能，请将 CTS/RTS 禁止位设置为“1”。

4. 串行 I/O 的操作

(1) 将虚设数据设定到 UARTi 发送缓冲寄存器，并且将接收允许位和发送允许位均置为“1”，进入数据接收准备状态。此时，如果 RTSi 引脚的输出电平为“L”，将成为可接收的状态通知发送方（发送方 IC 在检查到 RTS 输出变为“L”电平后，输出传送时钟）。

(2) 与传送时钟的第一个上升沿同步，将 RxDi 引脚的输入信号保存到 UARTi 接收寄存器的最高位。然后，与发送时钟的上升沿同步通过右移 UARTi 接收数据的内容来读取数据。

(3) 当 UARTi 接收寄存器中有 1 个字节的数据时，UARTi 接收寄存器中的内容被传送到 UARTi 接收缓冲寄存器，发送时钟停止为“H”电平。此时，接收完成标志位和 UARTi 接收中断请求位为“1”。

(4) 当 UARTi 接收缓冲寄存器的低字节被读取时，接收完成标志位将被置为“0”。
串行 I/O 操作（时钟同步串行 I/O 模式下的接收）

使用 UARTi 在时钟同步 I/O 模式下接收数据的工作时序图如下所示：

硬件连接示例

运行示例

在数据接收前的CLK引脚的输入为"H"电平时，必须具备以下条件：
- 发送允许位 → "1"
- 接收允许位 → "1"
- 对UARTi发送缓冲寄存器写虚设数据

（）内标明的是位符号。
5. 寄存器设置

为了能实现定义在“4. 串行 I/O 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 UARTi 发送/接收模式寄存器（i = 0~2, 5~7）

<table>
<thead>
<tr>
<th>寄存器</th>
<th>地址</th>
</tr>
</thead>
<tbody>
<tr>
<td>UART0 发送/接收模式寄存器</td>
<td>U0MR</td>
</tr>
<tr>
<td>UART1 发送/接收模式寄存器</td>
<td>U1MR</td>
</tr>
<tr>
<td>UART2 发送/接收模式寄存器</td>
<td>U2MR</td>
</tr>
<tr>
<td>UART5 发送/接收模式寄存器</td>
<td>U5MR</td>
</tr>
<tr>
<td>UART6 发送/接收模式寄存器</td>
<td>U6MR</td>
</tr>
<tr>
<td>UART7 发送/接收模式寄存器</td>
<td>U7MR</td>
</tr>
</tbody>
</table>

- `<SMD2~SMD0>` 置为“001”
- `<CKDIR>` 内部/外部时钟选择位
  - 0: 外部时钟
- `<STPS>` 时钟同步 I/O 模式下无效
- `<PRY>` 时钟同步 I/O 模式下无效
- `<PRYE>` 时钟同步 I/O 模式下无效
- `<IOPOL>` TxD、RxD 输入/输出极性反转位
  - 通常情况下设置为“0”

设置 UARTi 发送/接收控制寄存器（i = 0~2, 5~7）

<table>
<thead>
<tr>
<th>寄存器</th>
<th>地址</th>
</tr>
</thead>
<tbody>
<tr>
<td>UART0 发送/接收控制寄存器</td>
<td>U0C0</td>
</tr>
<tr>
<td>UART1 发送/接收控制寄存器</td>
<td>U1C0</td>
</tr>
<tr>
<td>UART2 发送/接收控制寄存器</td>
<td>U2C0</td>
</tr>
<tr>
<td>UART5 发送/接收控制寄存器</td>
<td>U5C0</td>
</tr>
<tr>
<td>UART6 发送/接收控制寄存器</td>
<td>U6C0</td>
</tr>
<tr>
<td>UART7 发送/接收控制寄存器</td>
<td>U7C0</td>
</tr>
</tbody>
</table>

- `<CLK1~CLK0>` UBRG 计数源选择位
  - 00: fSIO 或 f2SIO（注1）
  - 01: f8SIO
  - 10: f32SIO
  - 11: 不能设定
- `<CRS>` CTS/RTS 功能选择位（在 bit4 = “0” 时有效）
  - 0: 选择 RTS 功能（注2）
- `<TXEPT>` 发送寄存器空标志
  - 0: 发送寄存器中有数据（在发送中）
  - 1: 发送寄存器中无数据（发送结束）
- `<CRD>` CTS/RTS 禁止位
  - 0: 允许 CTS/RTS 功能
  - 1: 数据输出选择位
  - 0: TxDi/SDAi、SCLi 引脚为 CMOS 输出
  - 1: TxDi/SDAi、SCLi 引脚为 N沟道漏极开路
- `<CKPOL>` CLK 极性选择位
  - 0: 在传送时钟的下降沿输出发送数据，在上升沿输入接收数据
- `<UFORM>` 传送格式选择位
  - 0: LSB 先

注1: 当 PCLKR 寄存器的 PCLK0 位为“1” 时，选择时钟 fSIO。当 PCLKR 寄存器的 PCLK0 位为“0” 时，选择时钟 f2SIO。
注2: 请将对应引脚的端口方向位清“1”（输出模式）。

RCC05B0093-0100/Rev.1.00 2009.12 Page 4 of 10
串行 I/O 操作（时钟同步串行 I/O 模式下的接收）

设定UART发送/接收控制寄存器2
UART发送/接收控制寄存器2 UCON 【地址 0250h】
- <U0RRM> UART0连续接收模式允许位
  0: 禁止连续接收模式
- <U1RRM> UART1连续接收模式允许位
  0: 禁止连续接收模式
- <CLKMD0> 在bit5=“1”时有效
- <CLKMD1> UART1的CLK/CLKS选择位
  0: CLK输出仅为CLK1
- <RCSP> UART0 CTS/RTS独立位
  0: CTS/RTS复用引脚

设定UARTi发送/接收控制寄存器1 (i = 0~2, 5~7)
UART0发送/接收控制寄存器1 U0C1 【地址 024Dh】
UART1发送/接收控制寄存器1 U1C1 【地址 025Dh】
- <UiLCH> 数据逻辑选择位
  0: 无反转
- <UiERE> 错误信号输出允许位
  在时钟同步I/O模式下清“0”
UART2发送/接收控制寄存器1 U2C1 【地址 026Dh】
UART5发送/接收控制寄存器1 U5C1 【地址 028Dh】
UART6发送/接收控制寄存器1 U6C1 【地址 029Dh】
UART7发送/接收控制寄存器1 U7C1 【地址 02ADh】
- <UiRRM> UARTi连续接收模式允许位
  0: 禁止连续接收模式
- <UiLCH> 数据逻辑选择位
  0: 无反转
- <UiERE> 错误信号输出允许位
  在时钟同步I/O模式下清“0”

接收允许
UART0发送/接收控制寄存器1 U0C1 【地址 024Dh】
UART1发送/接收控制寄存器1 U1C1 【地址 025Dh】
- <TE> 发送允许位
  1: 允许发送
- <RE> 接收允许位
  1: 允许接收
UART2发送/接收控制寄存器1 U2C1 【地址 026Dh】
UART5发送/接收控制寄存器1 U5C1 【地址 028Dh】
UART6发送/接收控制寄存器1 U6C1 【地址 029Dh】
UART7发送/接收控制寄存器1 U7C1 【地址 02ADh】
- <TE> 发送允许位
  1: 允许发送
- <RE> 接收允许位
  1: 允许接收
串行 I/O 操作（时钟同步串行 I/O 模式下的接收）

写入虚设数据

设置虚设数据

开始接收

查看接收结束

接收数据

读取数据后进行处理
6. 参考文献

数据手册
M16C/65 群硬件手册
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<td>1.00</td>
<td>2009.12</td>
<td>初版发行</td>
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   2）涉及人体使用的装置。
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