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2010年4月1日  
瑞萨电子公司

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## M16C/64 群

### 串行 I/O 操作（时钟同步串行 I/O 模式下的发送、多路时钟输出功能）

#### 1. 要点

在时钟同步串行 I/O 模式下发送数据，可以选择如表 1 中所列的各种功能。在表 1 中用符号“○”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 在时钟同步模式下发送数据的例子。

#### 2. 说明

本篇资料，适用于 M16C/64 群单片机。

本篇资料中的参考例程也适用于 M16C 族产品中与 M16C/64 群具有相同 SFR（特殊功能寄存器）定义的产品。

由于 M16C 系列产品中有些功能会有所改进，请参看用户手册。如果使用本篇资料中所列功能时，请仔细检查每一步操作。

### 3. 选定功能

表 1. 选定功能

设定项目	设定内容		设定项目	设定内容	
传送时钟源	○	内部时钟 (f1SIO/f2SIO/f8SIO/f32SIO)	发送中断请求产生条件		发送缓冲器空
		外部时钟 (CLKi 引脚)		○	发送结束
CTS 功能		CTS 功能允许	输出传送时钟到 多个引脚 (注 1)		不选择
	○	CTS 功能禁止		○	选择
CLK 极性	○	在传送时钟的下降沿输出发送数据	数据逻辑选择功能	○	不反转
		在传送时钟的上升沿输出发送数据			反转
传送时钟	○	LSB 先	TxD、RxD 的 I/O 极性反转位	○	不反转
		MSB 先			反转

注 1: 只能在 UART1 使用内部时钟时选择。当选择这个功能时, 不能使用 UART1 的  $\overline{\text{CTS}}$  /  $\overline{\text{RTS}}$  功能, 请将  $\overline{\text{CTS}}$  /  $\overline{\text{RTS}}$  禁止位设置为“1”。

### 4. 串行 I/O 的操作

(1) 将发送允许位置为“1”, 对 UARTi 发送缓冲寄存器中写入发送数据, 进入数据发送状态就绪。

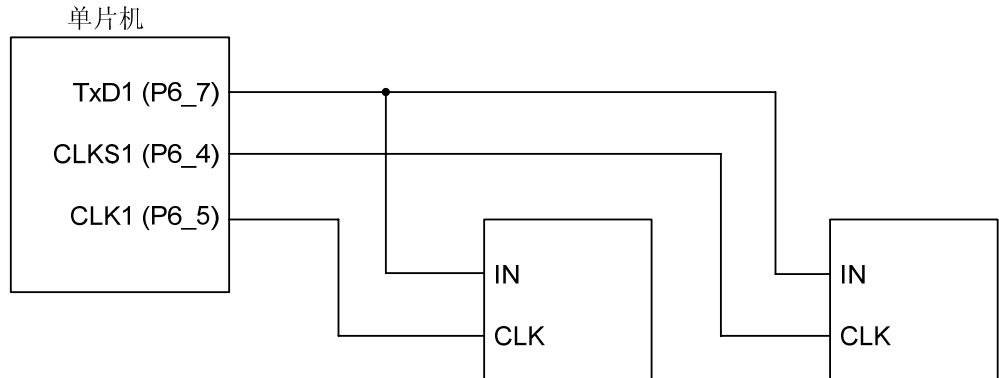
(2) 与传送时钟的第一个下降沿同步, UARTi 发送缓冲寄存器中发送数据被发送到 UARTi 发送寄存器中。此时, 产生 UARTi 发送中断请求位变为“1”, 发送数据的 bit0 也从 TxDi 引脚发送出去。然后, 发送数据与下降沿同步按照从低到高的顺序逐位被发送出去。

(3) 当一个字节的数据发送结束时, 发送寄存器空标志位变为“1”, 表示发送结束。并且, 发送时钟停止输出, 并保持为“H”电平。此时, URATi 发送中断请求位变为“1”。

(4) 如果将 CLK/CLKS 选择位 1 和 CLK/CLKS 选择位 0 置“1”, 则 CLKSi 引脚将变为时钟输出引脚。请在传送停止的状态更改此设置。

使用 UARTi 在时钟同步 I/O 模式下发送数据的工作时序图如下所示：

硬件连接示例



注：仅适用于时钟同步串行 I/O 模式下使用内部时钟进行传送。

运行示例

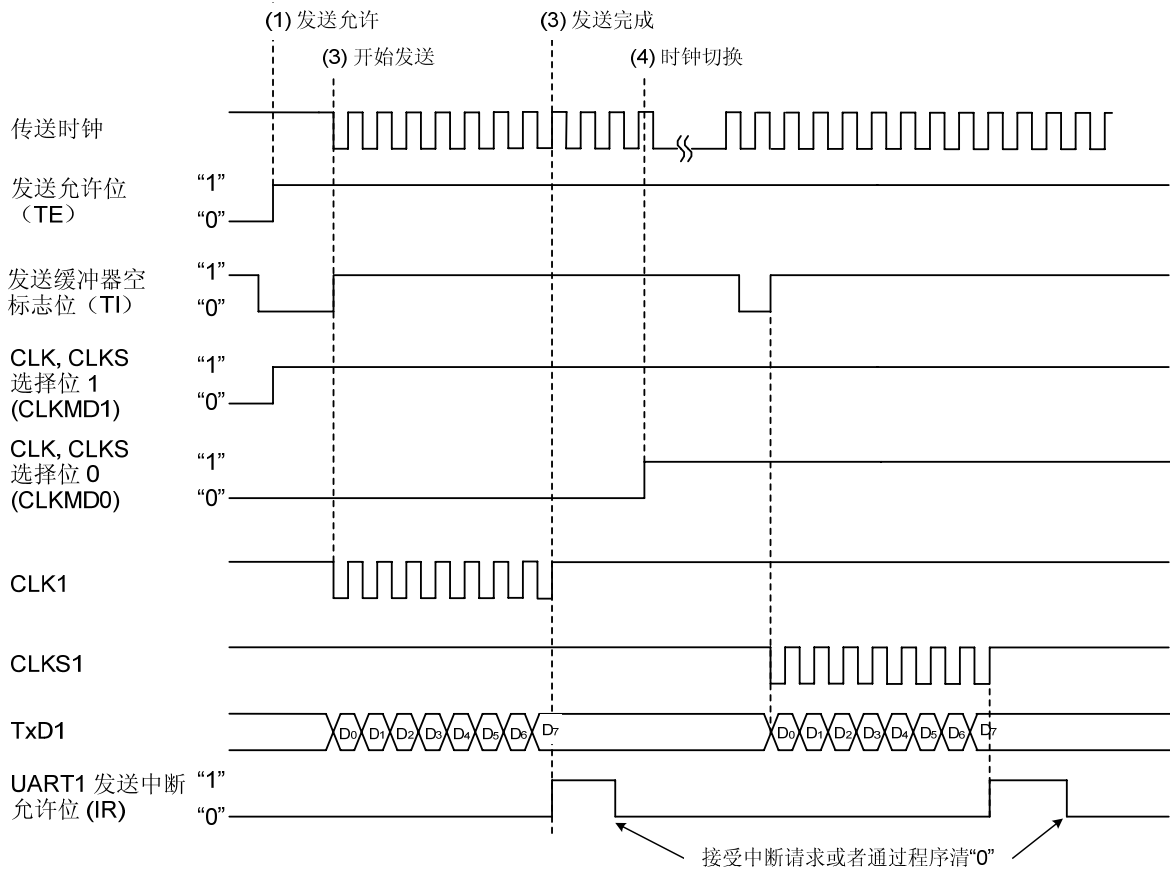


图 1. 使用 UARTi 在时钟同步 I/O 模式下发送数据、输出多路时钟的工作时序图

5. 寄存器设置

为了能够实现定义在“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/64 群的硬件手册。

**设定UART1发送/接收模式寄存器**

UART1发送/接收模式寄存器 U1MR 【地址: 0258h】

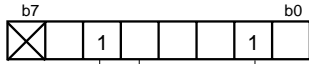
- <SMD2~SMD0> 置为“001”
- <CKDIR> 内部/外部时钟选择位  
0: 内部时钟
- <STPS> 时钟同步I/O模式下无效
- <PRY> 时钟同步I/O模式下无效
- <PRYE> 时钟同步I/O模式下无效
- <IOPOL> TxD、RxD输入/输出极性反转位  
通常情况下设置为“0”

**设置UART1发送/接收控制寄存器0**

UART1发送/接收控制寄存器 U1C0 【地址: 025Ch】

- <CLK1, CLK0> UiBRG计数源选择位  
b1 b0  
0 0: 选择f1SIO或者f2SIO  
0 1: 选择f8SIO  
1 0: 选择f32SIO  
1 1: 不能设定
- <CRS> CTS/RTS功能选择位（在bit4 = “0”时有效）
- <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  
1: 禁止CTS/RTS功能
- <NCH> 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

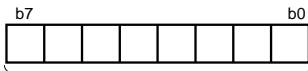
设定UART发送/接收控制寄存器2



UART发送/接收控制寄存器2 UCON 【地址: 0250h】

- <U1IRS> UART1发送中断源选择位  
0: 发送缓冲器空 (TI = 1)
- <CLKMD1> CLK/CLKS选择位0  
0: 时钟输出到CLK1  
1: 时钟输出到CLKS1
- <RCSP> UART1的CLK/CLKS选择位1  
1: 传送时钟输出多引脚选择位

设定UART1位速率寄存器



UART1位速率寄存器 U1BRG 【地址: 0259h】

在00h~FFh范围内进行设定（注1）

注1: 请在发送/接收停止时对UARTi位速率寄存器进行写操作。

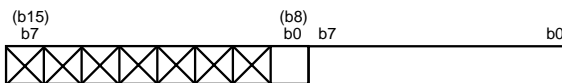
发送允许



UART1发送/接收控制寄存器1 U1C1 【地址: 025Dh】

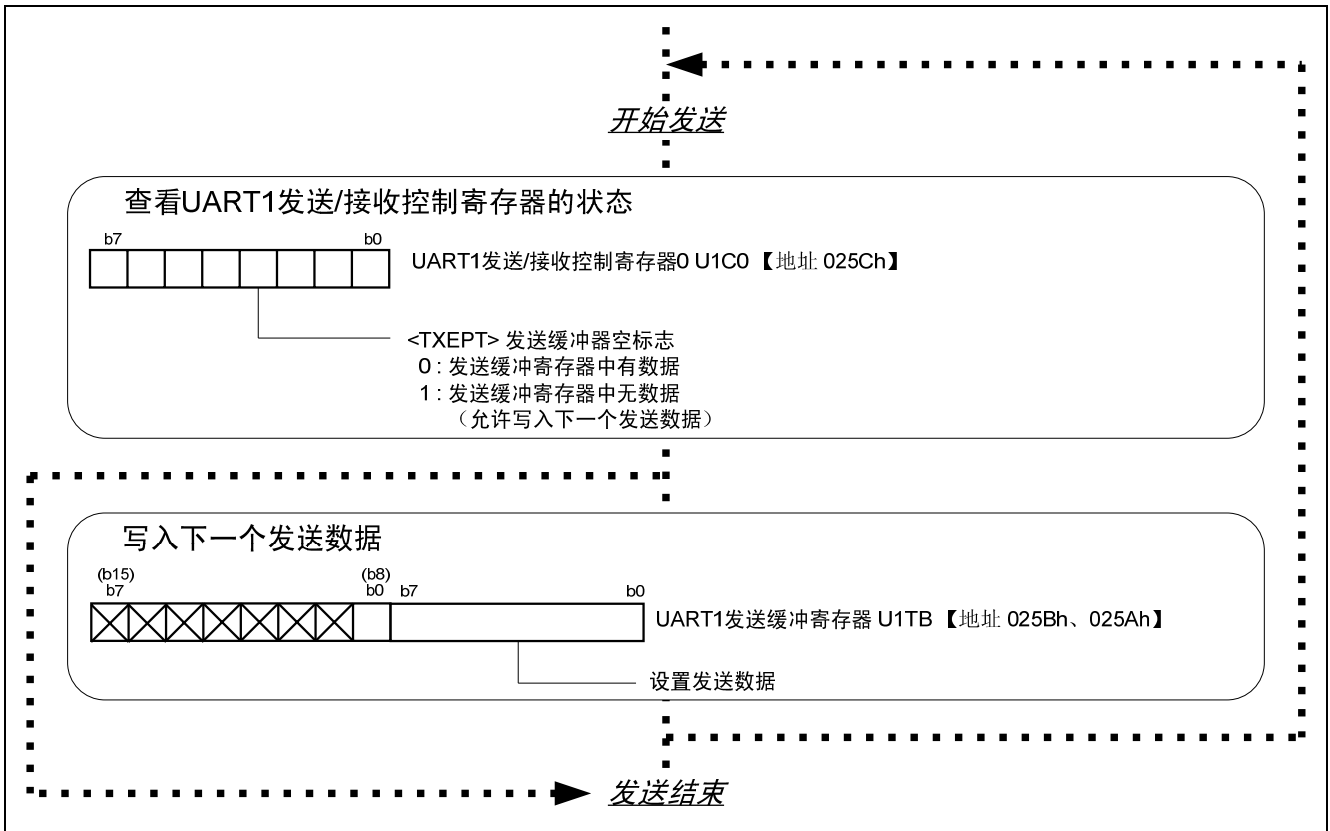
- <TE> 发送允许位  
1: 允许发送

写入发送数据



UART1发送缓冲寄存器 U1TB 【地址: 025Bh、025Ah】

设置发送数据





## 6. 参考文献

数据手册

M16C/64 群硬件手册

（最新版本请从瑞萨科技网页上取得）

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		页	要点
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