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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“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 在时钟同步模式下发送数据的例子。

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

设定项目	设定内容		设定项目	设定内容	
分频前时钟选择	O	f_1	传送格式	O	LSB 先
		f_{OCO-F}			MSB 先
外围时钟	O	f_{1SIO}	发送中断请求产生条件		发送缓冲器空
		f_{2SIO}		O	发送结束
传送时钟源	O	内部时钟（f_{1SIO}/f_{2SIO}/f_{8SIO}/f_{32SIO}）	输出传送时钟到多个引脚（注 1）		不选择
		外部时钟（CLKi 引脚）		O	选择
$\overline{CTS}$ 功能		$\overline{CTS}$ 功能允许	数据逻辑选择功能	O	不反转
	O	$\overline{CTS}$ 功能禁止			反转
CLK 极性	O	在传送时钟的下降沿输出发送数据			
		在传送时钟的上升沿输出发送数据			

注 1: 只能在 UART1 使用内部时钟时选择。

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。

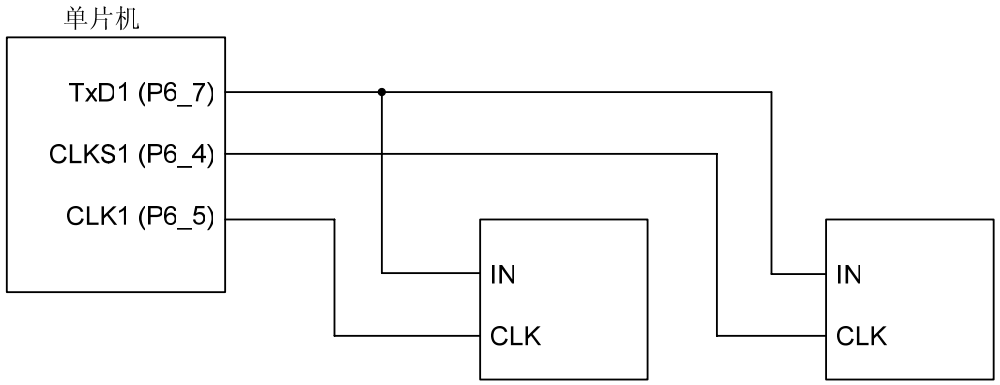
(2) 与传送时钟的第一个下降沿同步，UARTi 发送缓冲寄存器中发送数据被发送到 UARTi 发送寄存器中。此时，产生 UARTi 发送中断请求位变为“1”，发送数据的 bit0 也从 TxDi 引脚发送出去。然后，发送数据与下降沿同步按照从低到高的顺序逐位被发送出去。

(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

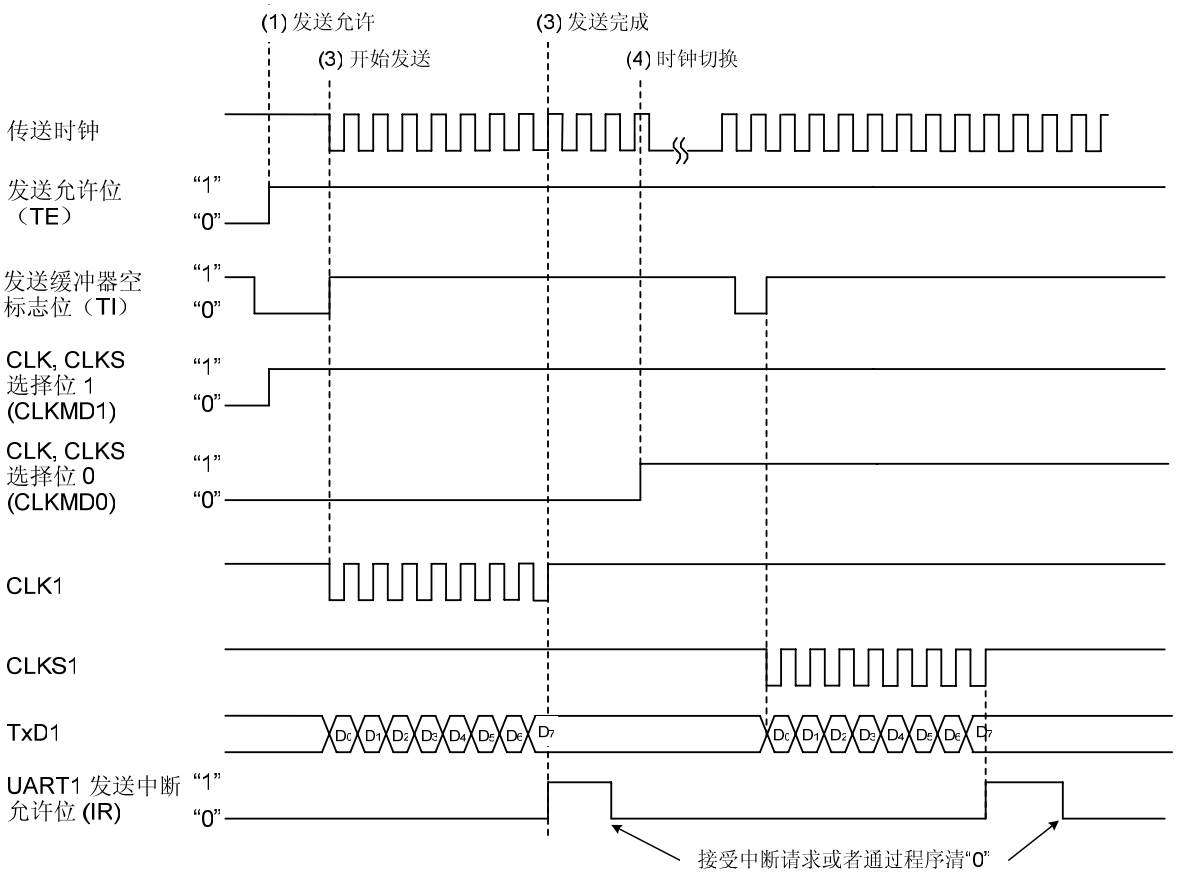
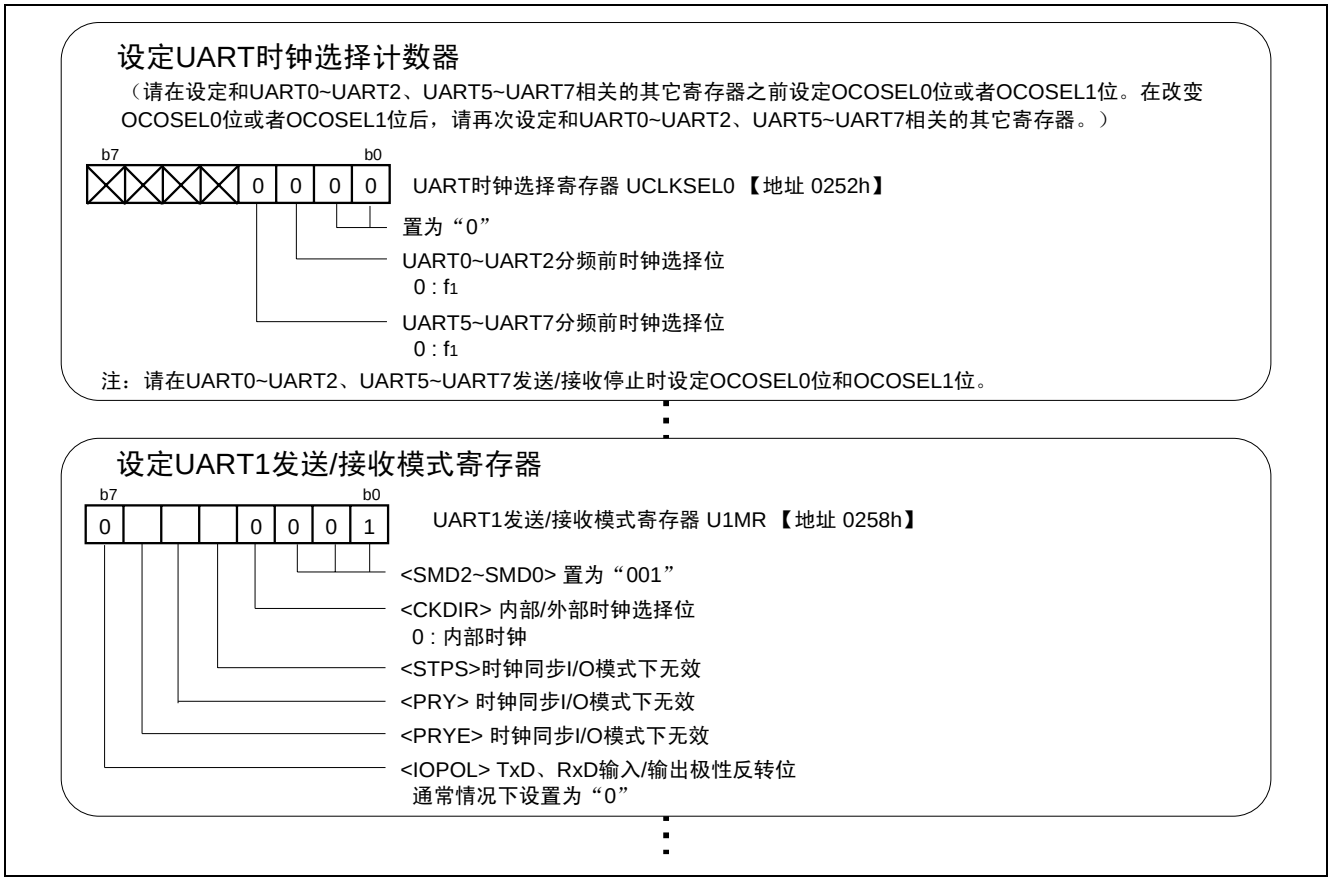


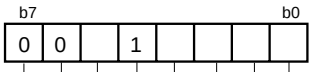
图 1. 使用 UARTi 在时钟同步 I/O 模式下发送数据、输出多路时钟的工作时序图

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 : f1SIO或f2SIO（注1）
0 1 : f8SIO
1 0 : f32SIO
1 1 : 不能设定

<CRS> $\overline{\text{CTS}}$/$\overline{\text{RTS}}$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> $\overline{\text{CTS}}$/$\overline{\text{RTS}}$禁止位
1 : 禁止CTS/RTS功能

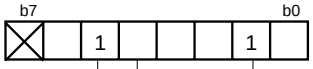
<NCH> 数据输出选择位
0 : TxD1/SDA1、SCL1引脚为CMOS输出
1 : TxD1/SDA1、SCL1引脚为N沟道漏极开路

<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 f1SIO，当PCLKR寄存器的PCLK0位为“0”时，选择时钟 f2SIO。

设定UART发送/接收控制寄存器2



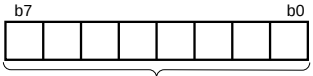
UART发送/接收控制寄存器2 UCON 【地址 0250h】

<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

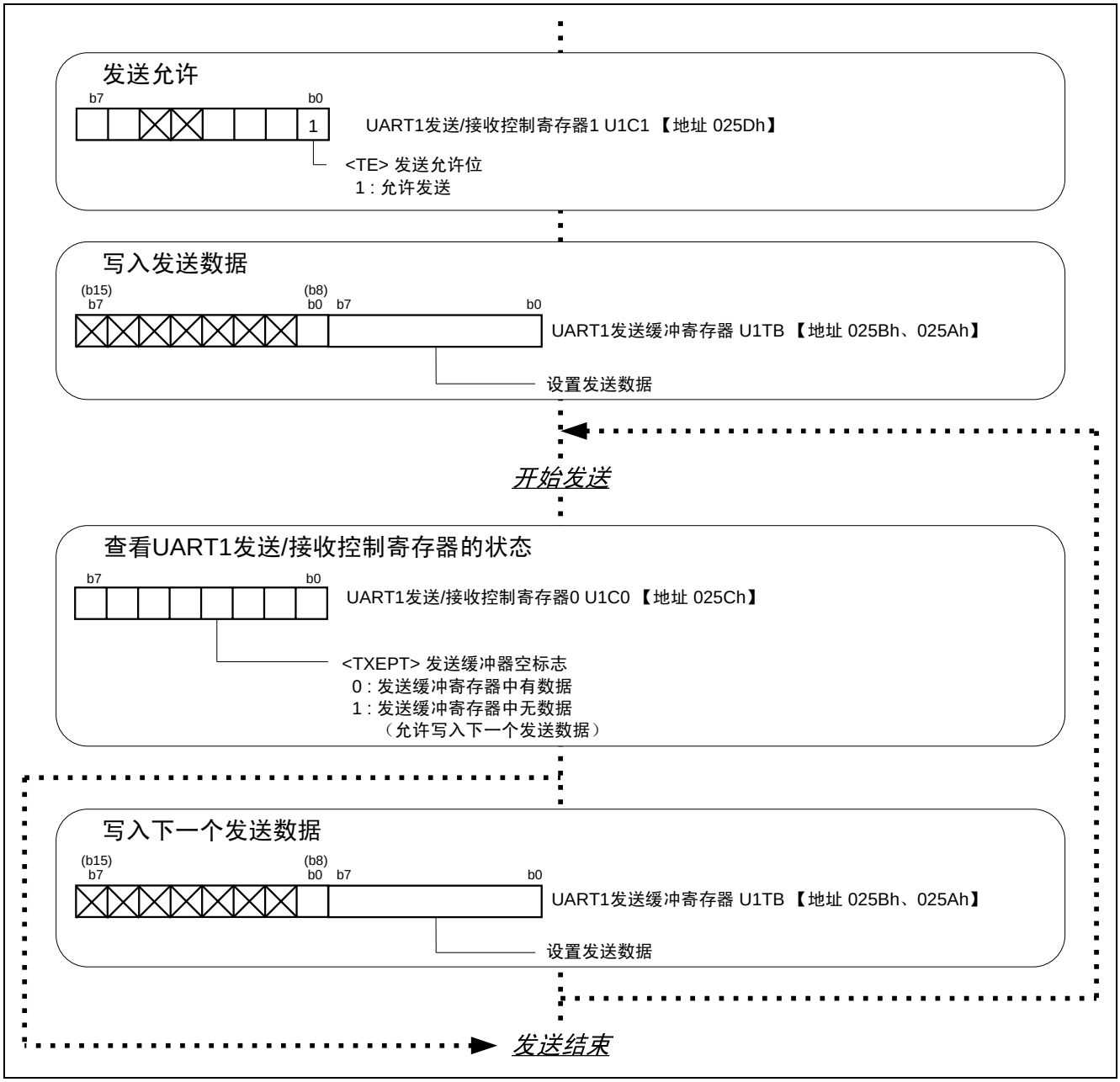
设定UART1位速率寄存器



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U1BRG寄存器进行写操作。请使用MOV指令写U1BRG寄存器。请在设定U1C0寄存器的CLK1和CLK0位后写U1BRG寄存器。


发送允许
b7
b0
1
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
(b15)
b7
(b8)
b0
b7
b0
UART1发送缓冲寄存器 U1TB 【地址 025Bh、025Ah】
设置发送数据
开始发送
查看UART1发送/接收控制寄存器的状态
b7
b0
UART1发送/接收控制寄存器0 U1C0 【地址 025Ch】
<TXEPT> 发送缓冲器空标志
0 : 发送缓冲寄存器中有数据
1 : 发送缓冲寄存器中无数据
（允许写入下一个发送数据）
写入下一个发送数据
(b15)
b7
(b8)
b0
b7
b0
UART1发送缓冲寄存器 U1TB 【地址 025Bh、025Ah】
设置发送数据
发送结束

6. 参考文献

数据手册

M16C/65 群硬件手册
（最新版本请从瑞萨科技网页上取得）

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