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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/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）	连续接收模式	O	禁止
	O	外部时钟（CLKi 引脚）			允许
$\overline{\text{RTS}}$ 功能	O	$\overline{\text{RTS}}$ 功能允许	输出传送时钟到多个引脚（注 1）	O	不选择
		$\overline{\text{RTS}}$ 功能禁止			选择
CLK 极性	O	在传送时钟的上升沿输入接收数据	数据逻辑选择功能	O	不反转
		在传送时钟的下降沿输入接收数据			反转
传送时钟	O	LSB 先	TxD、RxD 的 I/O 极性反转位	O	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 $\overline{\text{RTSi}}$ 引脚的输出电平为“L”，将已成为可接收的状态通知发送方（发送方 IC 在检查到 $\overline{\text{RTS}}$ 输出变为“L”电平后，输出传送时钟）。

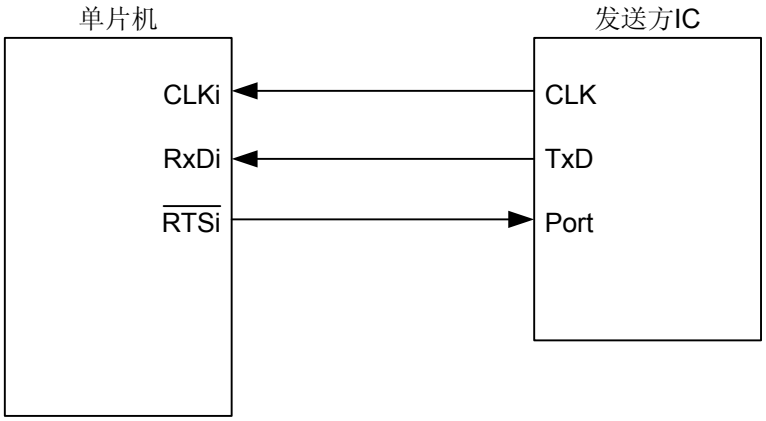
(2) 与传送时钟的第一个上升沿同步，将 RxDi 引脚的输入信号保存到 UARTi 接收寄存器的最高位。然后，与发送时钟的上升沿同步通过右移 UARTi 接收数据的内容来读取数据。

(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”。

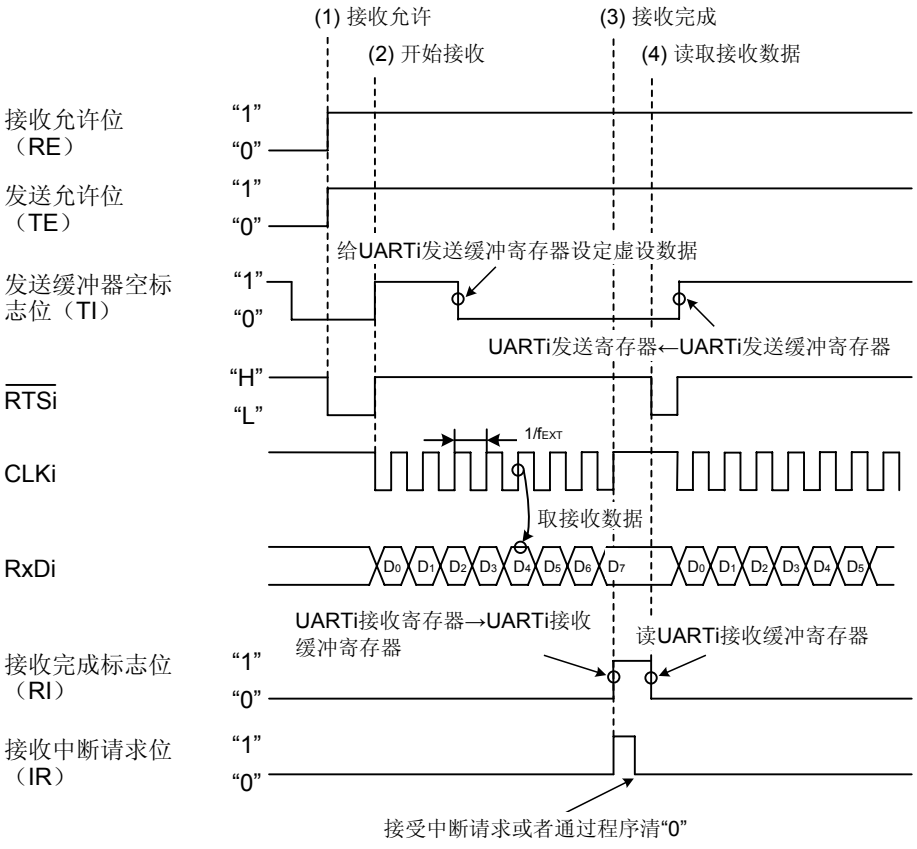
(4) 当 UARTi 接收缓冲寄存器的低字节被读取时，接收完成标志位将被置为“0”。

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



（）内标明的是位符号。

此图的设定条件为：
- 选择外部时钟
- 选择$\overline{\text{RTS}}$功能
- CLK极性选择位 = “0”

在数据接收前的CLKi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

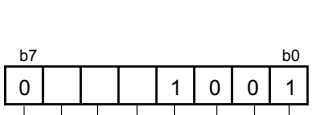
f_{EXT}：外部时钟频率

图 1. 使用 UARTi 在时钟同步 I/O 模式下接收数据的工作时序图

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/64 群的硬件手册。

设定UARTi发送/接收模式寄存器（i = 0~2、5~7）



UART0发送/接收模式寄存器 U0MR【地址 0248h】
UART1发送/接收模式寄存器 U1MR【地址 0258h】
UART2发送/接收模式寄存器 U2MR【地址 0268h】
UART5发送/接收模式寄存器 U5MR【地址 0288h】
UART6发送/接收模式寄存器 U6MR【地址 0298h】
UART7发送/接收模式寄存器 U7MR【地址 02A8h】

<SMD2~SMD0> 置为“001”

<CKDIR> 内部/外部时钟选择位
1：外部时钟

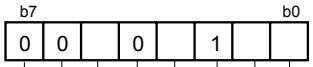
<STPS> 时钟同步I/O模式下无效

<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）



UART0发送/接收控制寄存器 U0C0【地址 024Ch】
UART1发送/接收控制寄存器 U1C0【地址 025Ch】
UART2发送/接收控制寄存器 U2C0【地址 026Ch】
UART5发送/接收控制寄存器 U5C0【地址 028Ch】
UART6发送/接收控制寄存器 U6C0【地址 029Ch】
UART7发送/接收控制寄存器 U7C0【地址 02ACh】

<CLK1~CLK0> UiBRG计数源选择位

b1 b0
0 0：选择f_{1SIO}或者f_{2SIO}
0 1：选择f_{8SIO}
1 0：选择f_{32SIO}
1 1：不能设定

<CRS> $\overline{CTS}$/$\overline{RTS}$功能选择位（在bit4 = “0”时有效）
1：选择$\overline{RTS}$功能

<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）

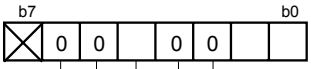
<CRD> $\overline{CTS}$/$\overline{RTS}$禁止位
0：允许$\overline{CTS}$/$\overline{RTS}$功能

<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】

<U0RRM> UART0连续接收模式允许位
0 : 禁止连续接收模式

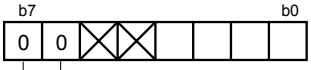
<U1RRM> UART1连续接收模式允许位
0 : 禁止连续接收模式

<CLKMD0> 在bit5 = “1”时有效

<CLKMD1> UART1的CLK/CLKS选择位1
0 : CLK输出仅为CLK1

<RCSP> UART0 $\overline{\text{CTS}}/\overline{\text{RTS}}$独立位
0 : $\overline{\text{CTS}}/\overline{\text{RTS}}$复用引脚

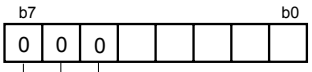
设定UARTi发送/接收控制寄存器1（i = 0~2、5~7）



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”



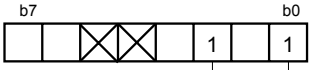
UART2发送/接收控制寄存器1 U2C1 【地址 026Dh】
UART5发送/接收控制寄存器1 U5C1 【地址 028Dh】
UART6发送/接收控制寄存器1 U6C1 【地址 029Dh】
UART7发送/接收控制寄存器1 U7C1 【地址 02ADh】

<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”

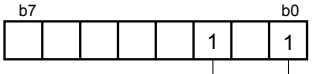
接收允许



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

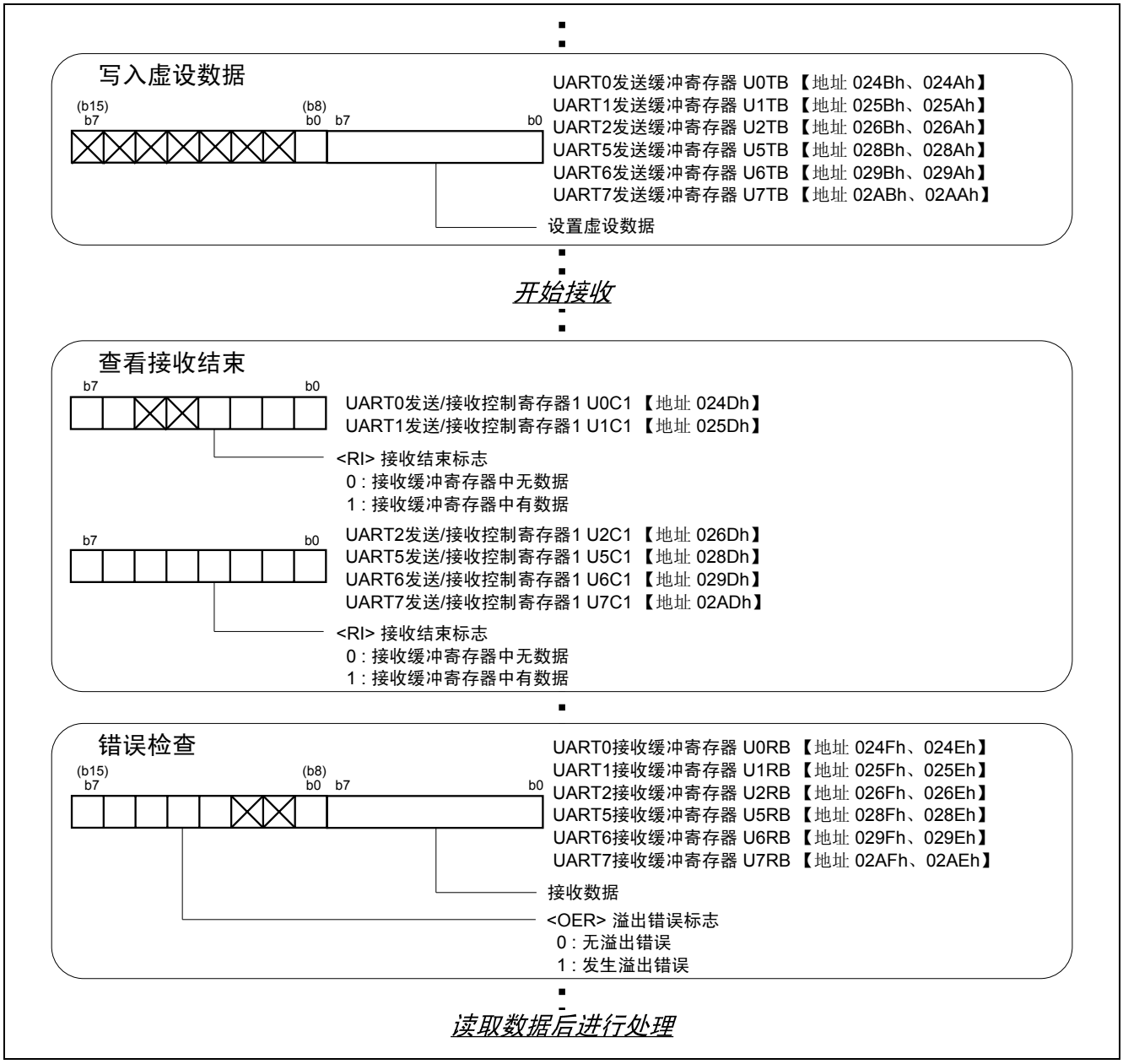
<RE> 接收允许位
1 : 允许接收



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


写入虚设数据
(b15) b7
(b8) b0 b7
b0
UART0发送缓冲寄存器 U0TB 【地址 024Bh、024Ah】
UART1发送缓冲寄存器 U1TB 【地址 025Bh、025Ah】
UART2发送缓冲寄存器 U2TB 【地址 026Bh、026Ah】
UART5发送缓冲寄存器 U5TB 【地址 028Bh、028Ah】
UART6发送缓冲寄存器 U6TB 【地址 029Bh、029Ah】
UART7发送缓冲寄存器 U7TB 【地址 02ABh、02AAh】
设置虚设数据
开始接收
查看接收结束
b7 b0
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】
<RI> 接收结束标志
0：接收缓冲寄存器中无数据
1：接收缓冲寄存器中有数据
b7 b0
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】
<RI> 接收结束标志
0：接收缓冲寄存器中无数据
1：接收缓冲寄存器中有数据
错误检查
(b15) b7
(b8) b0 b7
b0
UART0接收缓冲寄存器 U0RB 【地址 024Fh、024Eh】
UART1接收缓冲寄存器 U1RB 【地址 025Fh、025Eh】
UART2接收缓冲寄存器 U2RB 【地址 026Fh、026Eh】
UART5接收缓冲寄存器 U5RB 【地址 028Fh、028Eh】
UART6接收缓冲寄存器 U6RB 【地址 029Fh、029Eh】
UART7接收缓冲寄存器 U7RB 【地址 02AFh、02AEh】
接收数据
<OER> 溢出错误标志
0：无溢出错误
1：发生溢出错误
读取数据后进行处理

6. 参考文献

数据手册

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