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2010年4月1日
瑞萨电子公司

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M16C/65 群

使用 DMAC 进行串行 I/O 连续发送/连续接收的步骤

1. 要点

在本篇资料中，介绍了使用 DMAC 进行串行 I/O 连续发送/连续接收的步骤。

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. 使用例说明

本篇资料的使用例选择串行 I/O 的发送（或者接收）产生 DMAC 请求，在串行 I/O 发送（或者接收）时，向发送缓冲器中高速写入下一个字节数据（或者从接收缓冲器中读取），由 DMAC 传送的次数完成连续的操作。

4. 连接示例

连续发送/连续接收时的连接示例图如下所示：

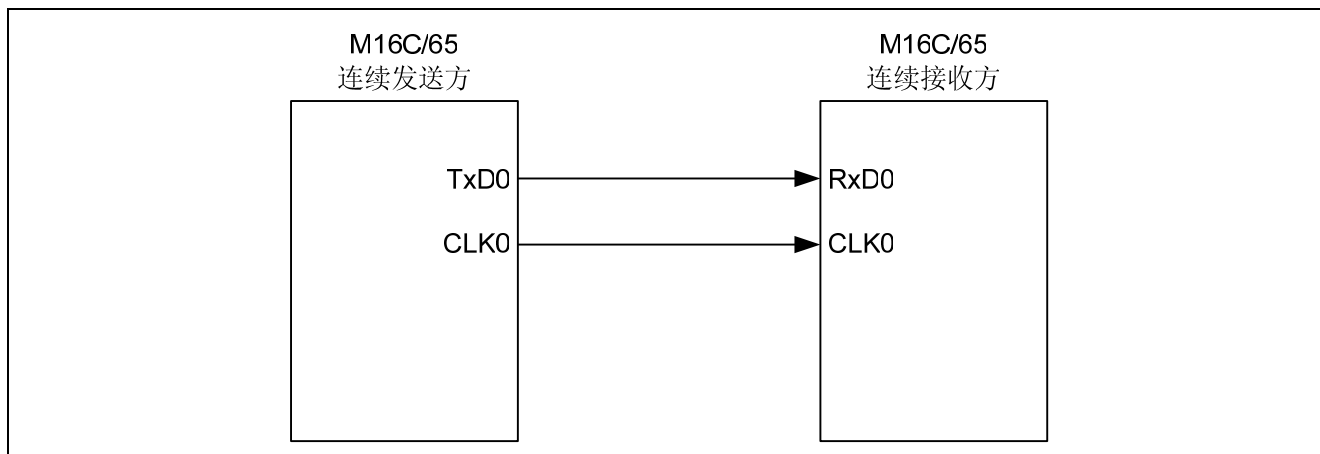


图 1. 连续发送/连续接收时的连接示例图

5. 连续发送的设定方法

8 字节数据连续发送时的设定方法如下所示。

使用例：

- 系统

VCC1 = VCC2 = 5.0V、XIN = 16MHz

- DMAC 的设定

DMAC 请求源 = UART 发送、单次传送、传送单位 = 8 位、发送源地址方向 = 正向、传送目标地址方向 = 固定 (U0TB 寄存器)

- 串行 I/O 的设定

时钟同步串行 I/O 模式、BRG 计数源 = f_{SI}O、传送速度 = 62500bps (BRG = 127)、发送中断源 = 发送寄存器空

操作：

将 DAMC 的请求源指定为 UART0 发送，向 UART0 发送缓冲器中写入第一个字节的数据后，使用 UART0 发送中断作为触发，连续发送剩余的 7 个字节的数据。

连续发送的时序图如下所示：

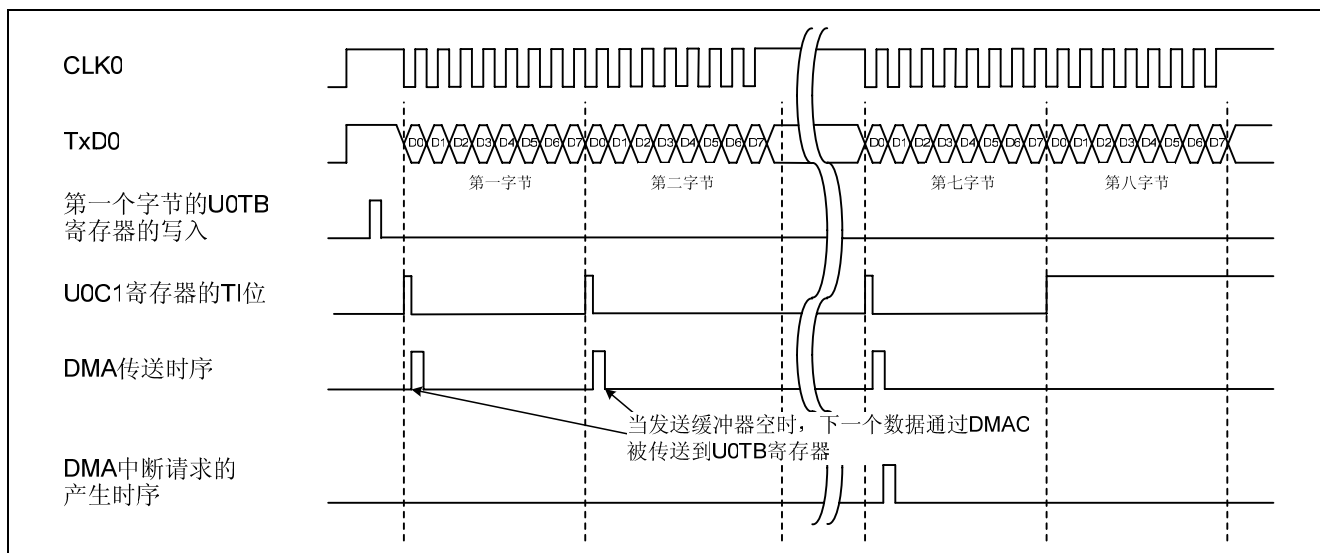


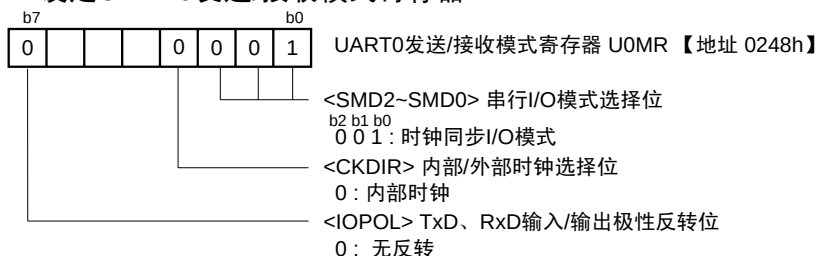
图 2. 连续发送的工作时序图

6. 寄存器设置

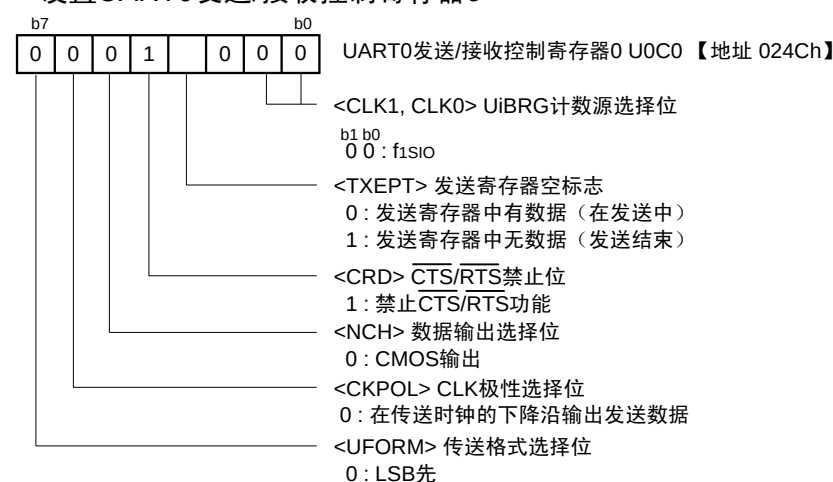
为了能够实现定义在“5. 连续发送的设定方法”的功能，下列寄存器必须按步骤顺序进行设置。对于每个寄存器的具体结构，请参考 M16C/65 群的硬件手册。

(1) 设定串行I/O

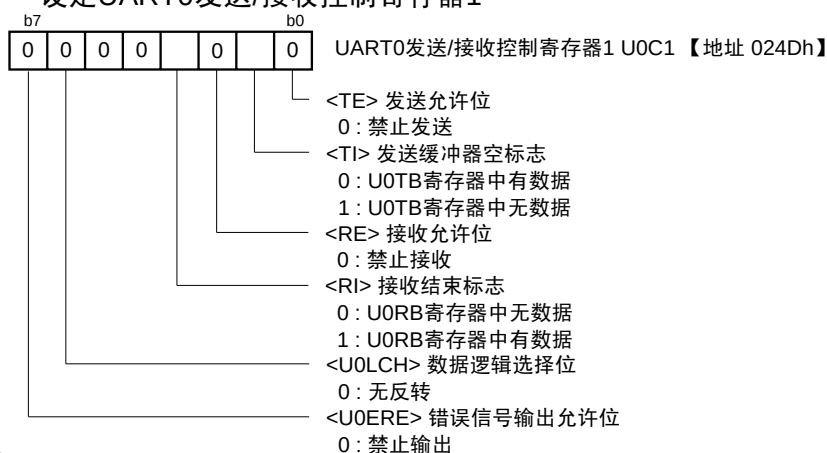
设定UART0发送/接收模式寄存器



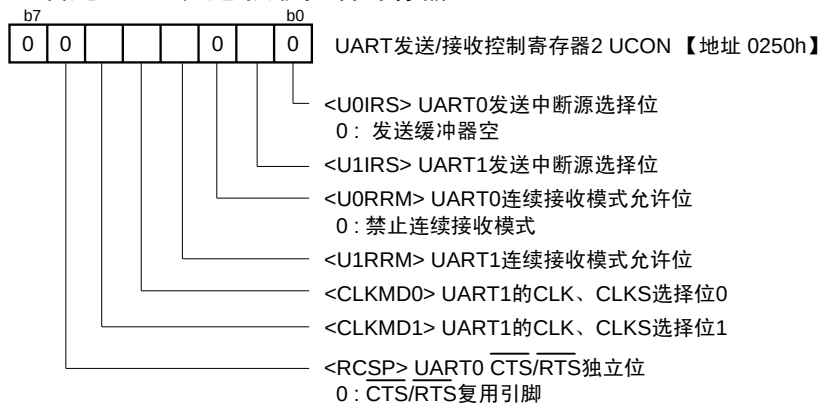
设置UART0发送/接收控制寄存器0



设定UART0发送/接收控制寄存器1

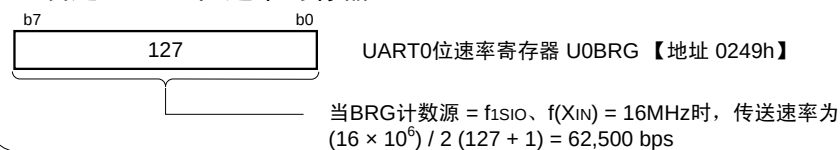


设定UART发送/接收控制寄存器2

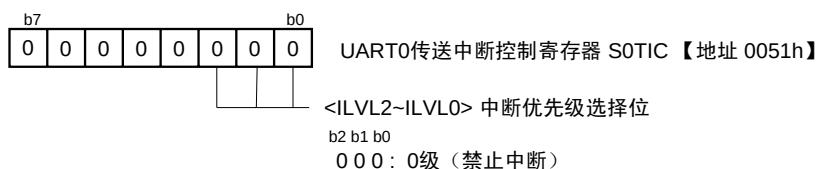


请将U0SMR寄存器（UART0特殊模式寄存器）、U0SMR2寄存器（UART0特殊模式寄存器2）、U0SMR3寄存器（UART0特殊模式寄存器3）、U0SMR4寄存器（UART0特殊模式寄存器4）设定为“00h”。

设定UART0位速率寄存器

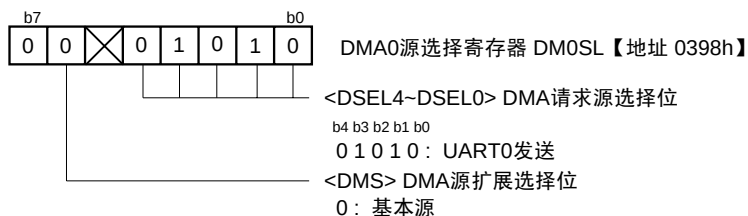


设定UART0传送中断控制寄存器

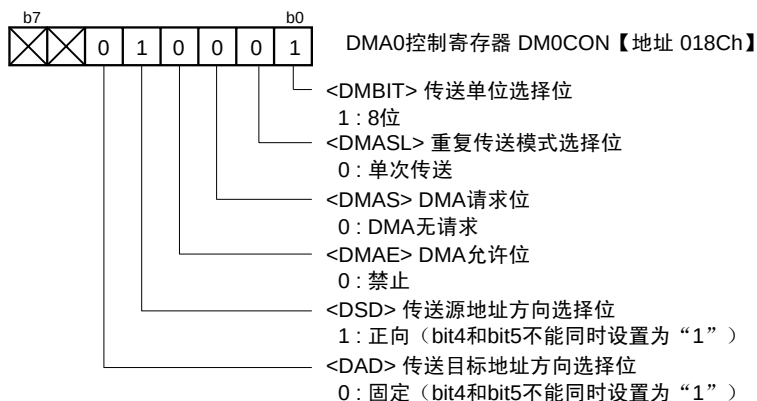


(2) 设定DMAC

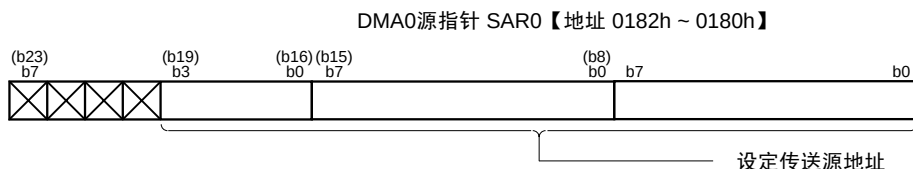
设定DMA0源选择寄存器



设定DMA0控制寄存器



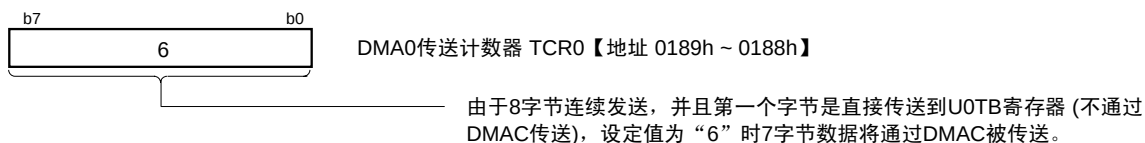
设定DMA0源指针



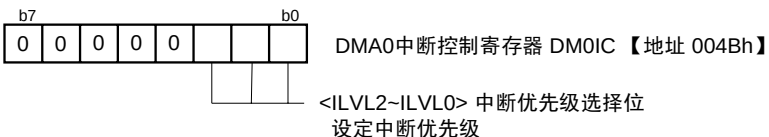
设定DMA0目标指针



设定DMA0传送计数器



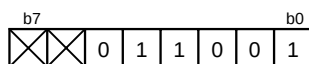
设定DMA0中断控制寄存器



(3) 允许中断（I标志 = “1”）

(4) 再次设定DMA0控制寄存器（允许DMA）

设定DMA0控制寄存器

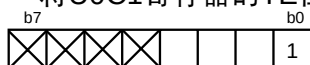


DMA0控制寄存器 DM0CON 【地址 018Ch】

<DMAE> DMA允许位
1：允许

(5) 发送允许

将U0C1寄存器的TE位设置为“1”（发送允许）



UART0发送/接收控制寄存器1 U0C1 【地址 024Dh】

发送允许位
1：允许发送

(6) 开始连续发送

写连续发送数据的第一字节到U0TB寄存器。此后，一旦发生UART0发送中断，其他字节的数据将通过DMAC被连续发送，直到DMA传送计数器中设定的次数为止。

(7) DMAC传送完成中断处理

设定DMAC传送完成标志。

7. 连续接收的设定方法

8 字节数据连续接收时的设定方法如下所示。

使用例：

- 系统

VCC1 = VCC2 = 5.0V、XIN = 16MHz

- DMAC 的设定

DMAC 请求源 = UART 接收、单次传送、传送单位 = 16 位（包含错误标志）、传送源地址方向 = 固定（U0RB 寄存器）、传送目标地址方向 = 正向

- 串行 I/O 的设定

时钟同步串行 I/O 模式、外部时钟（注 1）、连续接收模式允许

注 1：在接收数据之前，CLK0 引脚的输入为“H”（或者在 U0C0 寄存器的 CKPOL 位为“1”时 CLK0 引脚的输入为“L”）时，请满足以下条件：

- U0C1 寄存器的 TE 位 = 1（发送允许）
- U0C1 寄存器的 RE 位 = 1（接收允许）
- 读 U0RB 寄存器

操作：

将 DAMC 的请求源指定为 UART0 接收，从 UART0 接收缓冲器中虚读数据后，使用 UART0 接收中断连续接收数据。

连续接收的时序图如下所示：

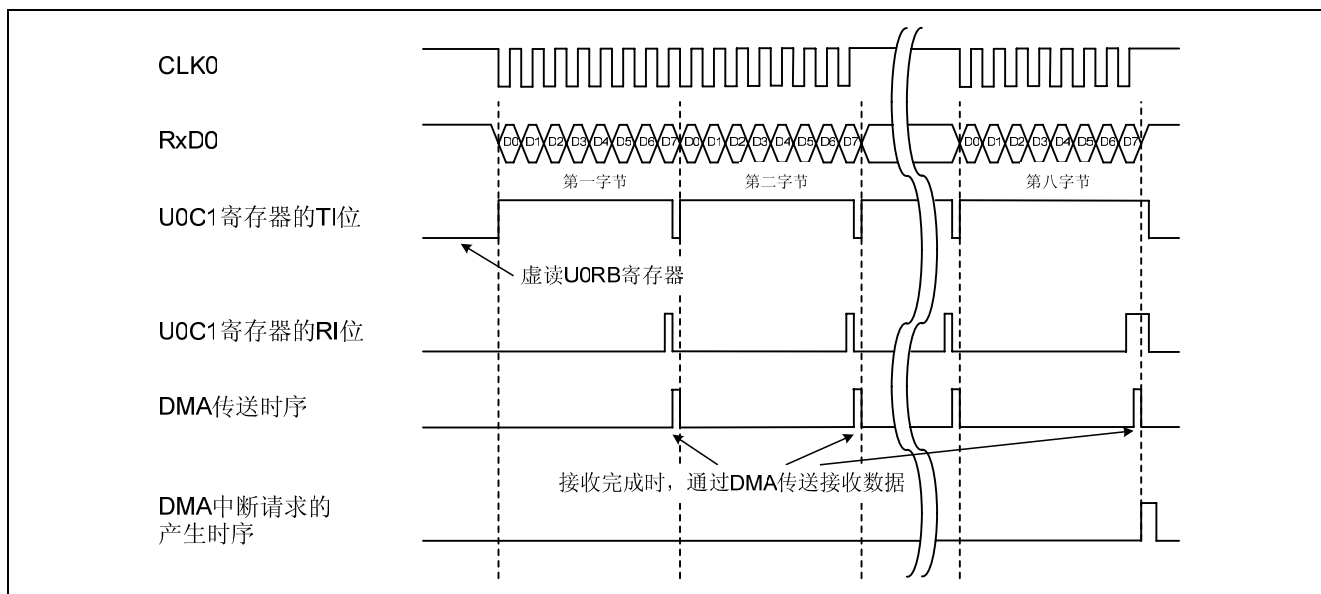


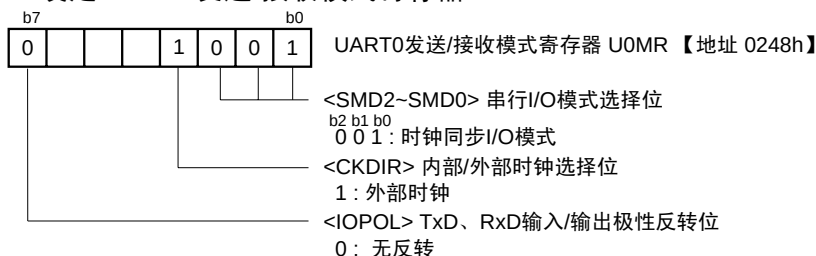
图 3. 连续接收的工作时序图

寄存器设置:

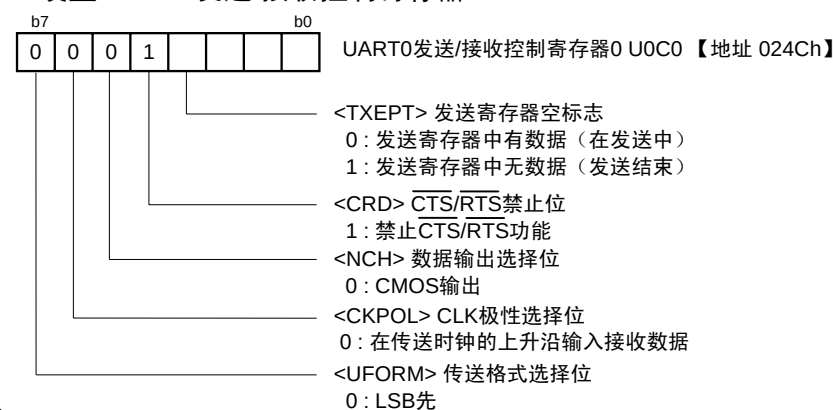
为了能够实现定义在“7. 连续接收的设定方法”的功能，下列寄存器必须按步骤顺序进行设置。对于每个寄存器的具体结构，请参考 M16C/65 群的硬件手册。

(1) 设定串行I/O

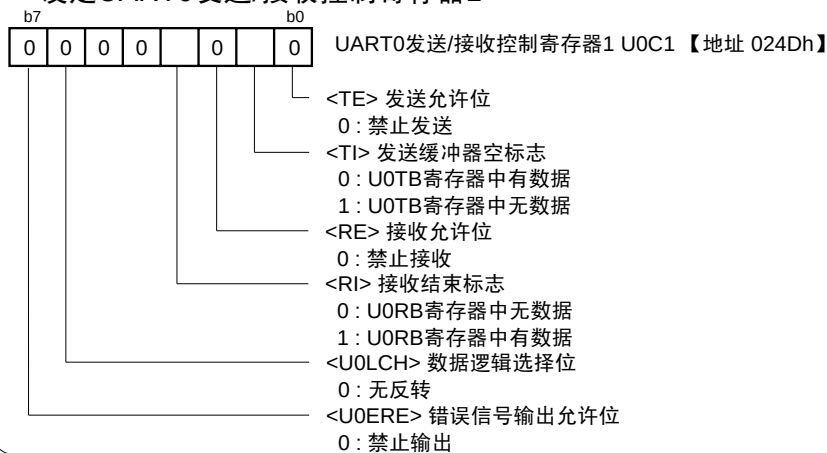
设定UART0发送/接收模式寄存器



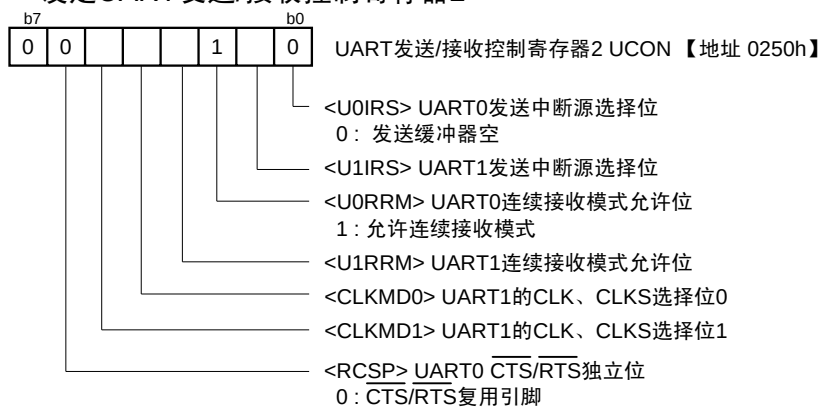
设置UART0发送/接收控制寄存器0



设定UART0发送/接收控制寄存器1

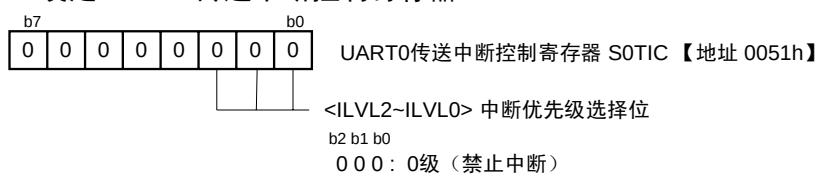


设定UART发送/接收控制寄存器2



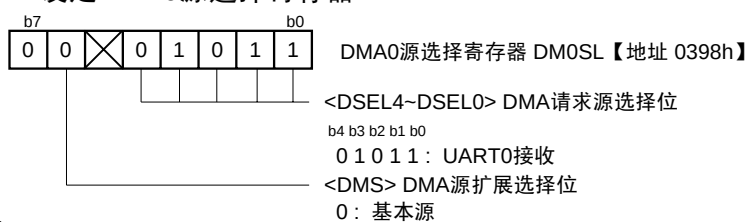
请将U0SMR寄存器（UART0特殊模式寄存器）、U0SMR2寄存器（UART0特殊模式寄存器2）、U0SMR3寄存器（UART0特殊模式寄存器3）、U0SMR4寄存器（UART0特殊模式寄存器4）设定为“00h”。

设定UART0传送中断控制寄存器

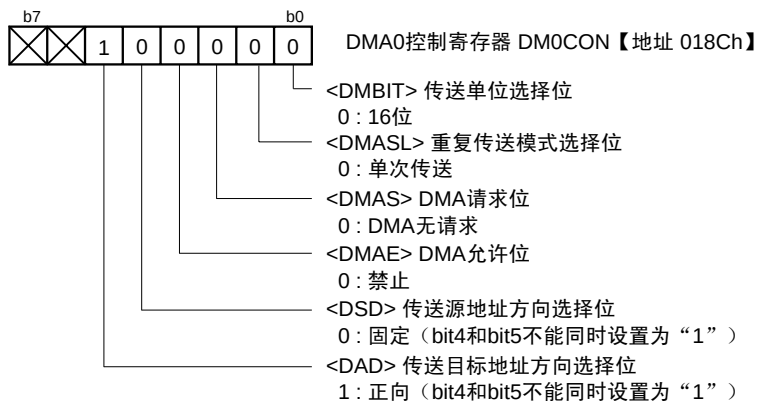


(2) 设定DMAC

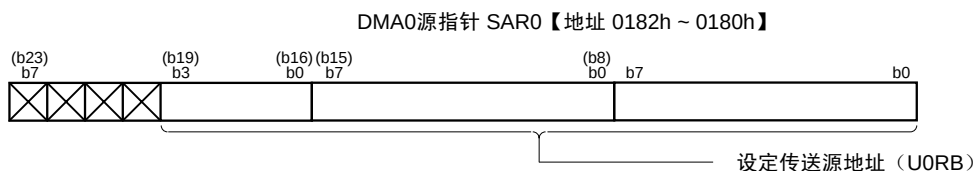
设定DMA0源选择寄存器



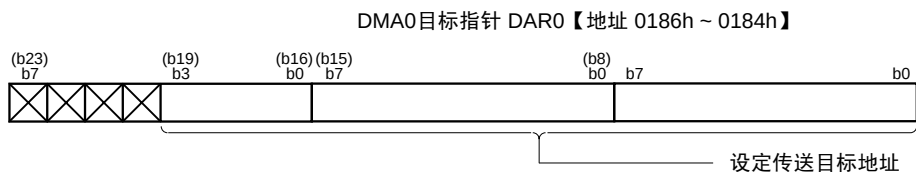
设定DMA0控制寄存器



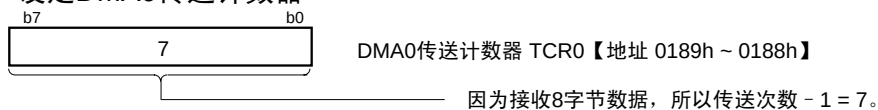
设定DMA0源指针



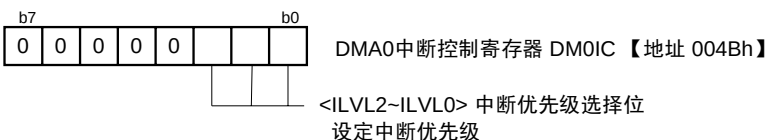
设定DMA0目标指针



设定DMA0传送计数器



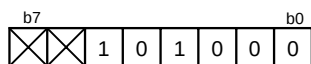
设定DMA0中断控制寄存器



(3) 允许中断（I标志 = “1”）

(4) 再次设定DMA0控制寄存器（允许DMA）

设定DMA0控制寄存器



DMA0控制寄存器 DM0CON【地址 018Ch】

<DMAE> DMA允许位
1：允许

(5) 发送/接收允许

U0C1寄存器的TE位和RE位设置为“1”（发送/接收允许）



UART0发送/接收控制寄存器1 U0C1【地址 024Dh】

<TE> 发送允许位
1：允许发送
<RE> 接收允许位
1：允许接收

(6) 开始连续接收

通过虚读U0RB寄存器开始连续接收。

(7) DMAC传送完成中断处理

进行接收数据的错误检查，必要时进行错误处理，并初始化串行I/O。

8. 参考文献

数据手册

M16C/65 群硬件手册

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