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2010年4月1日
瑞萨电子公司

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M16C/26A、29 群

CRC 计算电路

1. 要点

本篇资料介绍如何使用 M16C/26A 与 M16C/29 群单片机的 CRC 计算电路，并且说明了一种使用 CRC 计算电路进行通信错误的检测方法。

2. 说明

本篇资料，适用于 M16C/26A、M16C/29 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/26A、M16C/29 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. 规格

CRC（CRC 冗余校验）是基于 CRC 码的数据块校验方法，该方法用于通信过程中的错误检测。M16C/26A 与 M16C/29 群单片机使用内置的 CRC 计算电路，从而可以生成 CRC 校验码。

3.1 CRC 计算与 CRC 校验码

在 CRC 计算过程中将通信数据当作数值处理，这些数值被称为信息多项式。CRC 计算就是用信息多项式除以固定的生成多项式（模 2 除），CRC 的计算示例如图 1 所示。以下两个表达式可以作为生成多项式使用。

- CRC-CCITT:

$$X^{16}+X^{12}+X^{5}+1$$

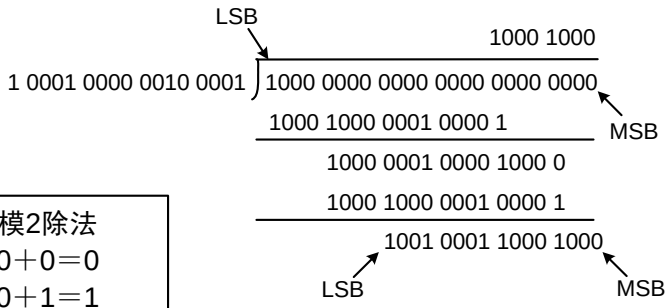
- CRC-16:

$$X^{16}+X^{15}+X^{2}+1$$

最后计算所得的余数就称为 CRC 校验码。

生成多项式: 1 0001 0000 0010 0001 ($X^{16}+X^{12}+X^5+1$)
信息多项式: 1000 0000 (由最低位发送和接收01h)

CRC校验码: 1001 0001 1000 1000 (因为从LSB开始，→1189h)



模2除法
0＋0＝0
0＋1＝1
1＋0＝1
1＋1＝0
－1＝1

生成多项式: 1 1000 0000 0000 0101 ($X^{16}+X^{15}+X^2+1$)
信息多项式: 1000 0000 (由最低位发送和接收01h)

CRC校验码: 1000 0011 0000 0011 (因为从LSB开始，→C0C1h)

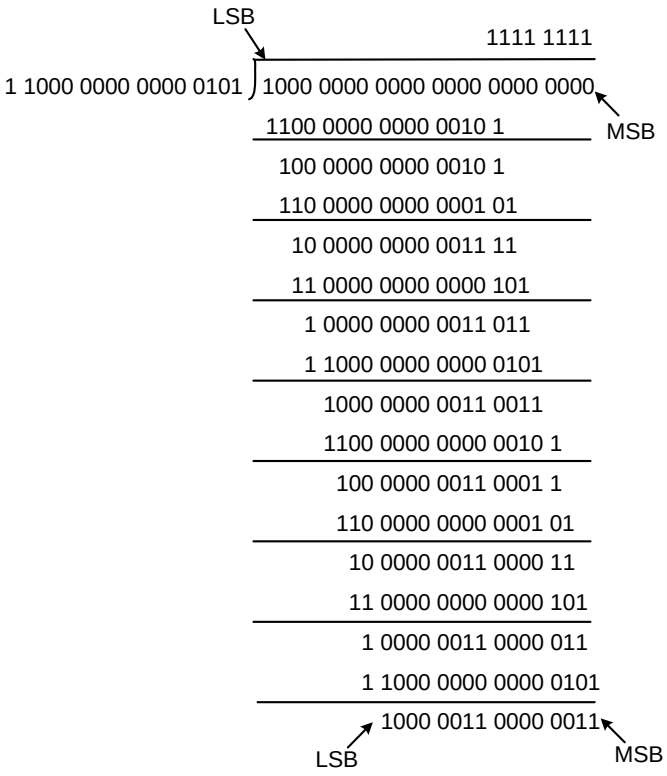


图 1. CRC 计算示例图

3.2 CRC 计算电路的硬件配置

虽然 CRC 的计算从原理上看是在做除法操作，但在硬件上是通过移位寄存器和异或电路来生成 CRC 校验码的，CRC 的计算电路示例如图 2 所示。

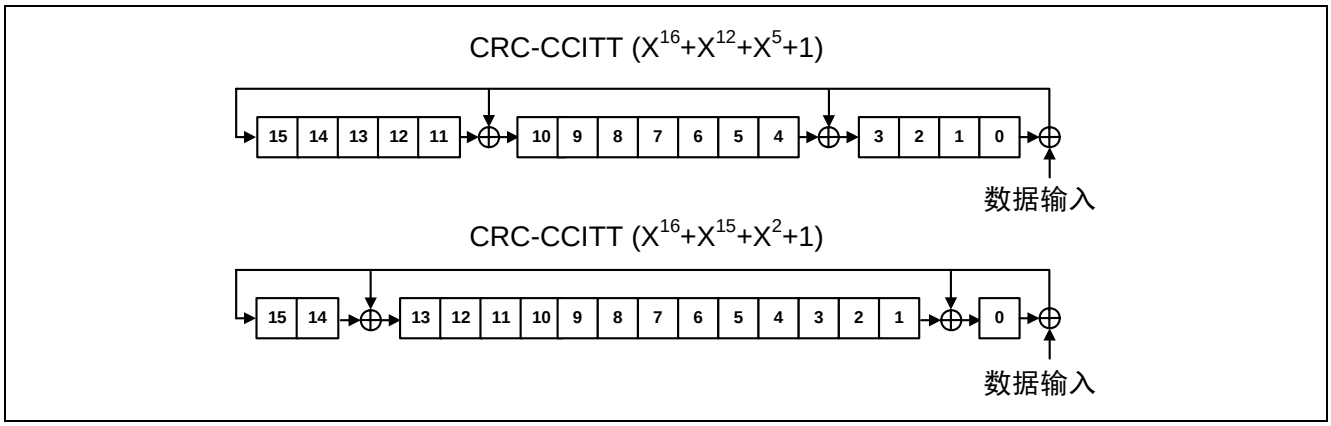


图 2. CRC 计算电路示例图

3.3 CRC 计算中的内部操作

使用 M16C/26A 与 M16C/29 群单片机的 CRC 计算方法是：当数据以字节方式写入 CRC 输入寄存器后，根据新输入的数据与 CRC 数据寄存器中的内容产生 CRC 校验码，并将计算结果存放在 CRC 数据寄存器中。因此，当传送或接收多字节数据时，传送/接收的数据依次写入 CRC 输入寄存器，而 CRC 数据寄存器最终的内容就可作为此次块校验的 CRC 校验码。

除此之外，可以通过设置 SFR 监测地址寄存器（CRCSAR）中的监测读允许位或写允许位、UART 发送缓冲寄存器或接收缓冲寄存器的地址选择位实现 CRC 计算监测功能。在监测模式下，CRC 计算与读取 UART 发送缓冲寄存器或接收缓冲寄存器是并行的，无需将发送/接收数据写入 CRC 输入寄存器中。此功能可用于通过 DMA 传送方式读取 UART 发送/接收缓冲寄存器的情况。

以下是发送/接收 12345678h（001 0010 0011 0100 0101 0110 0111 1000b）（LSB 先）并执行 CRC 计算的例子。

3.3.1 CRC-CCITT

（1）向 CRC 数据寄存器写入初始值“0000h”。

（2）向 CRC 输入寄存器写入最先发送/接收的数据“78h”。

（3）CRC 输入寄存器中的值从低有效位（LSB）开始按位依次送入 CRC 数据寄存器，算术操作的执行过程如下所示。

本次操作结束后 CRC 数据寄存器中的内容变成“FFCFh”。

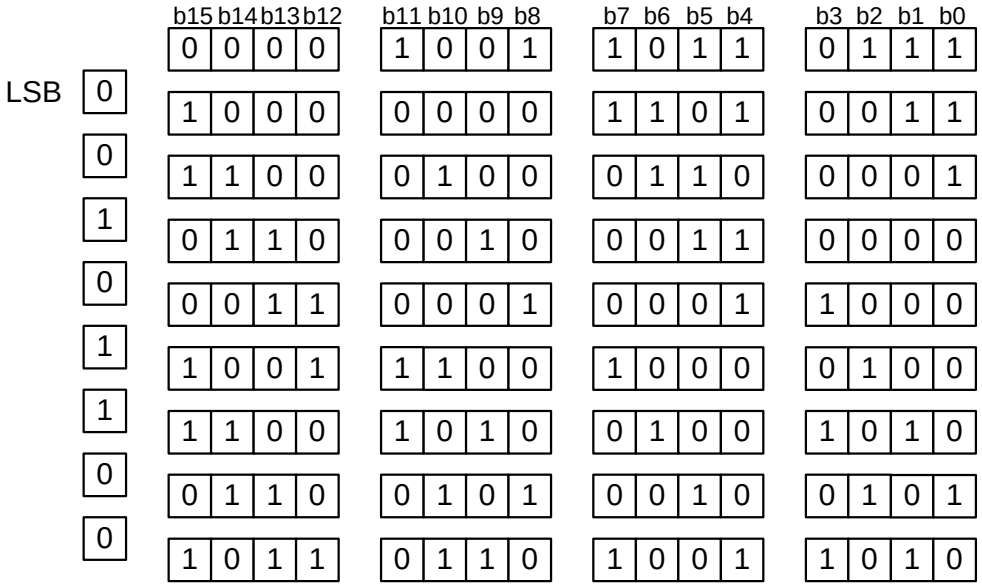
		b15 b14 b13 b12	b11 b10 b9 b8	b7 b6 b5 b4	b3 b2 b1 b0
		0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
LSB	0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
	0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
	0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
	1	1 0 0 0	0 1 0 0	0 0 0 0	1 0 0 0
	1	1 1 0 0	0 1 1 0	0 0 0 0	1 1 0 0
	1	1 1 1 0	0 1 1 1	0 0 0 0	1 1 1 0
	1	1 1 1 1	0 1 1 1	1 0 0 0	1 1 1 1
	0	1 1 1 1	1 1 1 1	1 1 0 0	1 1 1 1

（4）在保持 CRC 数据寄存器内容完整的同时，向 CRC 输入寄存器写入下一个发送/接收的数据“56h”。

本次操作结束后 CRC 数据寄存器中的内容变成“09B7h”。

		b15 b14 b13 b12	b11 b10 b9 b8	b7 b6 b5 b4	b3 b2 b1 b0
		1 1 1 1	1 1 1 1	1 1 0 0	1 1 1 1
LSB	0	1 1 1 1	1 0 1 1	1 1 1 0	1 1 1 1
	1	0 1 1 1	1 1 0 1	1 1 1 1	0 1 1 1
	1	0 0 1 1	1 1 1 0	1 1 1 1	1 0 1 1
	0	1 0 0 1	1 0 1 1	0 1 1 1	0 1 0 1
	1	0 1 0 0	1 1 0 1	1 0 1 1	1 0 1 0
	0	0 0 1 0	0 1 1 0	1 1 0 1	1 1 0 1
	1	0 0 0 1	0 0 1 1	0 1 1 0	1 1 1 0
	0	0 0 0 0	1 0 0 1	1 0 1 1	0 1 1 1

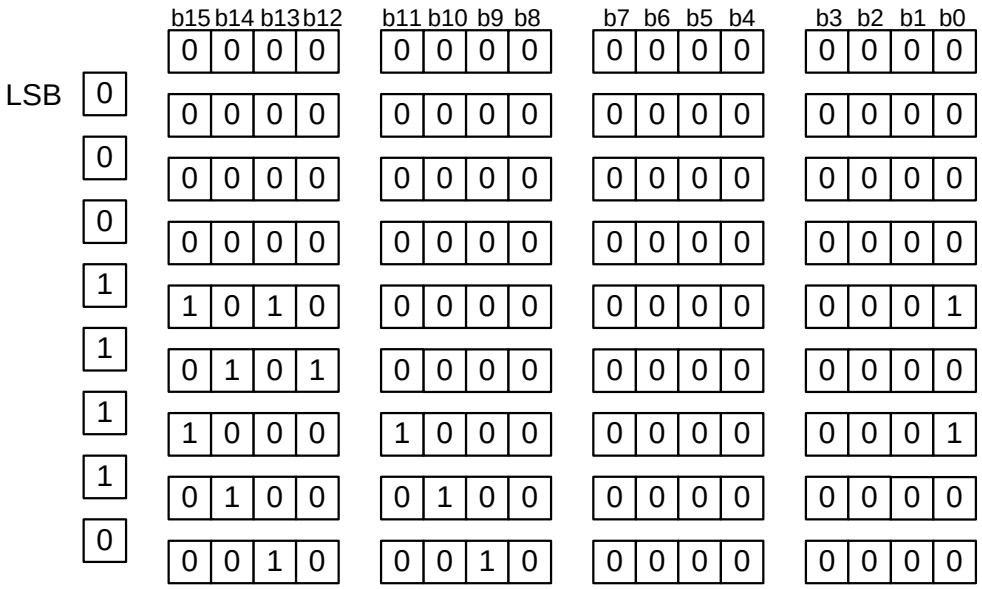
（5）在保持 CRC 数据寄存器内容完整的同时，向 CRC 输入寄存器写入下一个发送/接收的数据“34h”。
本次操作结束后 CRC 数据寄存器中的内容变成“B69Ah”。



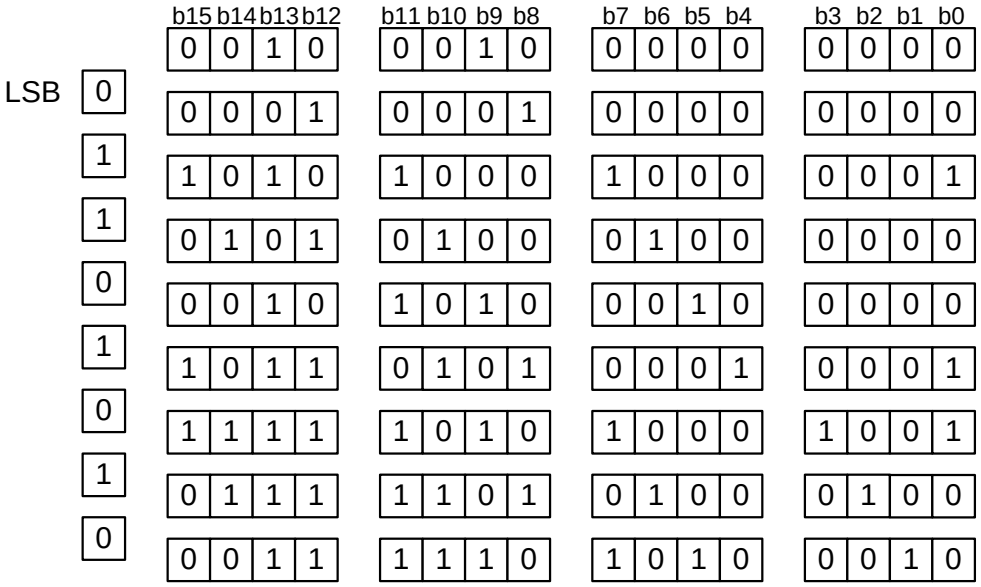
（6）在保持 CRC 数据寄存器内容完整的同时，向 CRC 输入寄存器写入下一个发送/接收的数据“12h”。
本次操作结束后 CRC 数据寄存器中的内容变成“08F6h”。

3.3.2 CRC-16

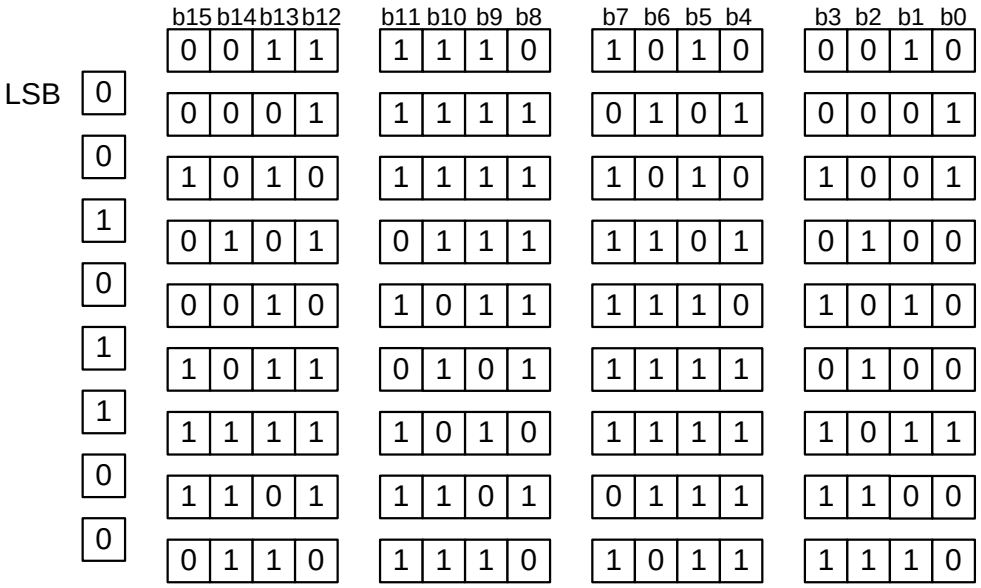
（1）向 CRC 数据寄存器写入初始值“0000h”。
（2）向 CRC 输入寄存器写入最先发送/接收的数据“78h”。
（3）CRC 输入寄存器中的值从低有效位（LSB）开始按位依次送入 CRC 数据寄存器，算术操作的执行过程如下所示。
本次操作结束后 CRC 数据寄存器中的内容变成“2200h”。



（4）在保持 CRC 数据寄存器内容完整的同时，向 CRC 输入寄存器写入下一个发送/接收的数据“56h”。本次操作结束后 CRC 数据寄存器中的内容变成“3EA2h”。



（5）在保持 CRC 数据寄存器内容完整的同时，向 CRC 输入寄存器写入下一个发送/接收的数据“34h”。本次操作结束后 CRC 数据寄存器中的内容变成“6EBEh”。

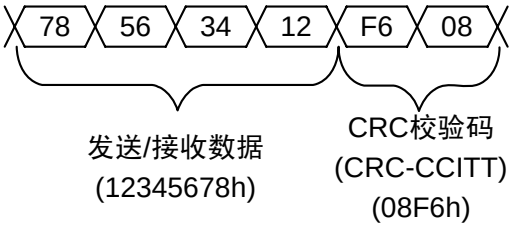


（6）在保持 CRC 数据寄存器内容完整的同时，向 CRC 输入寄存器写入下一个发送/接收的数据“12h”。本次操作结束后 CRC 数据寄存器中的内容变成“7D6Eh”。

3.4 如何使用 CRC

当发送/接收多字节数据时，通过发送/接收数据和 CRC 校验码一起实现通信错误的检测。

由LSB开始发送/接收12345678h (001 0010 0011 0100 0101 0110 0111 1000b)时，
发送/接收的格式为



3.4.1 发送方设置步骤

（1）向 CRC 数据寄存器写入初始值“0000h”。在 CRC 模式寄存器中设定 CRC 多项式和 CRC 模式。

（2）在 CRC 监测地址寄存器中设定发送缓冲寄存器地址作为 SFR 监测地址寄存器的值，同时将写监测允许位置“1”。

（3）将要传送的数据按字节依次写入发送缓冲器。

（4）当所有数据按字节传送完毕时，读取 CRC 数据寄存器的内容（CRC 校验码）并将该校验码写入发送缓冲寄存器中发送。

3.4.2 接收方设置步骤

（1）向 CRC 数据寄存器写入初始值“0000h”。在 CRC 模式寄存器中设定 CRC 多项式和 CRC 模式。

（2）在 CRC 监测地址寄存器中设定接收缓冲寄存器地址作为 SFR 监测地址寄存器的值，同时将读监测允许位置“1”。

（3）每次数据接收完毕，从接收缓冲寄存器读取接收数据。当全部数据按字节读取完毕，接收方的 CRC 数据寄存器的内容应该与发送方的相同。

（4）由于 CRC 校验码已经从发送方传送，用与上面同样的方法读取发送方 CRC 校验码。

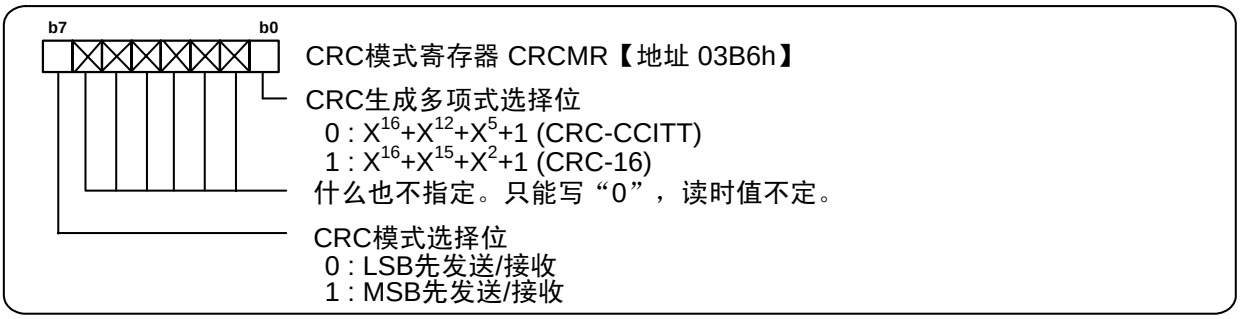
（5）当所有数据包括 CRC 校验码接收完毕时，CRC 数据寄存器的内容应该为“0000h”，表示接收过程正常。如果 CRC 数据寄存器的内容不为“0000h”，表示有通信错误发生。在此情况下，需要请求发送方重传数据。

3.5 寄存器设置

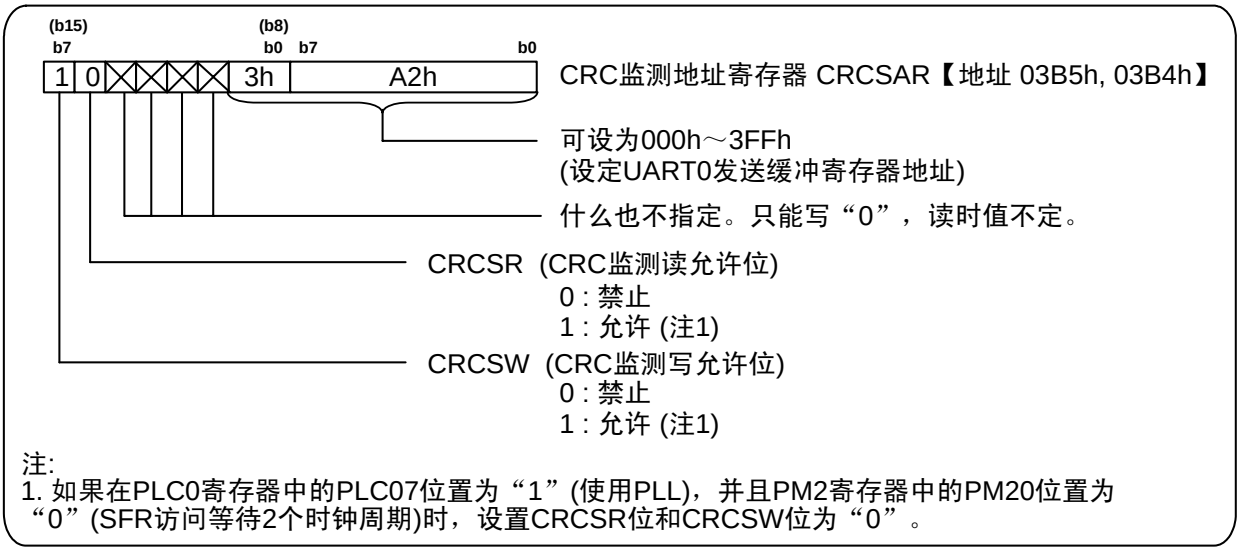
本篇应用说明中给出的操作是基于 M16C/29 群单片机产品，M16C/26A 群产品的寄存器设置步骤请参阅相关硬件手册。

3.5.1 发送方寄存器设置

(1) 设置CRC模式寄存器



(2) 设置CRC监测地址寄存器

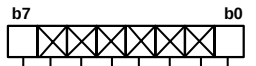


注:
1. 如果在PLC0寄存器中的PLC07位置为“1”(使用PLL)，并且PM2寄存器中的PM20位置为“0”(SFR访问等待2个时钟周期)时，设置CRCSR位和CRCSW位为“0”。

(3) 设置CRC数据寄存器

3.5.2 接收方寄存器设置

(1) 设置CRC模式寄存器



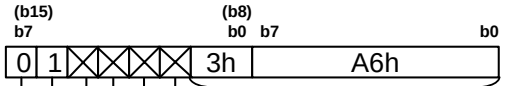
CRC模式寄存器 CRCMR【地址 03B6h】

CRC生成多项式选择位
0 : $X^{16}+X^{12}+X^{5}+1$ (CRC-CCITT)
1 : $X^{16}+X^{15}+X^{2}+1$ (CRC-16)

什么也不指定。只能写“0”，读时值不定。

CRC模式选择位
0 : LSB先发送/接收
1 : MSB先发送/接收

(2) 设置CRC监测地址寄存器



CRC监测地址寄存器 CRCSAR【地址 03B5h, 03B4h】

可设为000h～3FFh
(设定UART0接收缓冲寄存器地址)

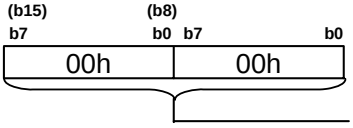
什么也不指定。只能写“0”，读时值不定。

CRCSR (CRC监测读允许位)
0 : 禁止
1 : 允许 (注1)

CRCSW (CRC监测写允许位)
0 : 禁止
1 : 允许 (注1)

注:
1. 如果在PLC0寄存器中的PLC07位置为“1”（使用PLL），并且PM2寄存器中的PM20位置为“0”（SFR访问等待2个时钟周期）时，设置CRCSR位和CRCSW位为“0”。

(3) 设置CRC数据寄存器



CRC数据寄存器 CRCD【地址 03BDh, 03BCh】

CRC计算结果输出

4. 参考例程

以下程序实现在异步串行 I/O 模式下 4 个字节数据的发送/接收，并且将通信数据的 CRC 校验码随后发送出去，参考例程中 CRC 实例的硬件连接如图 3 所示。

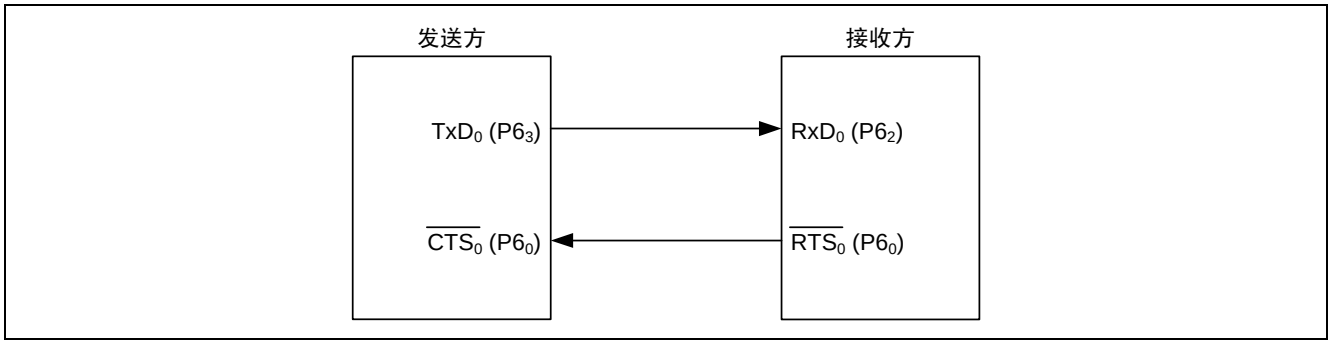


图 3 CRC 实例说明图

4.1 发送方程序

```
/************************************************************/
/*                                                          */
/* M16C/Tiny Series Program Collection                      */
/*                                                          */
/* FILE NAME   : rec05b0005-0102_snd.c                      */
/* CPU         : M16C/29 Group                              */
/* FUNCTION    : CRC Calculation Circuit                    */
/*             (Clock asynchronous serial I/O transfer)     */
/* HISTORY     : 2006.04.13 Ver 1.02                        */
/*                                                          */
/* Copyright (C) 2005. Renesas Technology Corp.             */
/* All right reserved.                                      */
/*                                                          */
/************************************************************/

/************************************************************/
/*    Include File                                          */
/************************************************************/
#include "sfr29.h"     // Special function register header file

/************************************************************/
/*    Function Definition                                   */
/************************************************************/
void init_mcu(void);   // MCU initialize
void init_uart(void);  // UART initialize
void init_crc(void);   // CRC initialize
void crc_snd(void);
void wait_10ms(void);  // Main clock oscillation stable wait routine

/************************************************************/
/*    Define Label                                          */
/************************************************************/
#define PRODUCT_TYPE 0     // 29 group: 0    26A group: 1
#define PIN_TYPE 0         // 80 pin: 0      64 pin: 1 (29 group)
                           // 48 pin: 0      42 pin: 1 (26A group)
#define PLL_ON 0           // 0: not use PLL or PM20 is 1
                           // 1: use PLL and PM20 is 0
```

```
/************************************************************/
/*    Define Const                                          */
/************************************************************/
/* port2_0 - port2_7 data : 0  1  2  3  4  5  6  7  8  9  9 */
unsigned char count_data[11] =
{0xC0,0xF9,0xA4,0xB0,0x99,0x92,0x82,0xD8,0x80,0x90,0x90};

/************************************************************/
/*    Define Variable                                       */
/************************************************************/
unsigned short trans_data[4];
unsigned int i;
unsigned char crc_data_l;
unsigned char crc_data_h;

/************************************************************/
/*    Main Program                                          */
/************************************************************/
void main(void) {
   init_mcu();
   init_uart();
   init_crc();
   crc_snd();
}

/************************************************************/
/*    MCU Initialize Program                                */
/************************************************************/
void init_mcu(void) {
   prcr = 0x03;   // Protect register off

   pm20 = 1;      // Specifying wait when accessing SFR (Note)
                  // (Note) This bit can only be rewritten while the PLC07 bit is
                  // "0" (PLL Off). Also, to select a 16MHz or higher PLL clock,
                  // set this bit to "0" (2 wait).

   wait_10ms();   // Waiting for main clock oscillation stable

   cm2 = 0x00;    // System register2 Initialize
   cm1 = 0x20;    // System register1 Xcin-Xcout: high
   cm0 = 0x08;    // System register0 Xcin-Xcout: high

   prcr = 0x00;   // Protect register on

   #if PRODUCT_TYPE        // Product selection: 26A group
      ifsr2a = 1;          // Interrupt request cause select register2 IFSR2A
                           // <IFSR20>   : Reserved bit (Must be set to "1")
      prcr = 0x04;         // Protect register off
      #if PIN_TYPE         // Port setting
         pacr = 0x01;      // 42pin type
      #else
         pacr = 0x04;      // 48pin type
      #endif
      prcr = 0x00;         // Protect register on
   #else                   // Product selection: 29 group
      ifsr2a = 0;          // Interrupt request cause select register2 IFSR2A
                           // <IFSR20>   : Reserved bit (Must be set to "0")
```

```
      prcr = 0x04;         // Protect register off
      #if PIN_TYPE         // Port setting
         pacr = 0x02;      // 64pin type
      #else
         pacr = 0x03;      // 80pin type
      #endif
      prcr = 0x00;         // Protect register on
   #endif
}

/*******************************************************/
/*    Main Clock Oscillation Stable Wait 10ms Routine     */
/*******************************************************/
void wait_10ms(void) {
   ta0mr = 0x00;     // Set Timer A0 mode register (Timer mode, count source: f1)

   ta0 = 20000-1;    // Setting counter value (10msec @4MHz/2, f1)

   ta0ic = 0x00;     // Clear interrupt request bit

   tabsr = 0x01;     // Timer A0 start counting

   while (ir_ta0ic == 0){   }

   ir_ta0ic = 0;     // Clear interrupt request bit

   tabsr = 0x00;     // Timer A0 stops counting
}

/*******************************************************/
/*    UART Initialize Program                          */
/*******************************************************/
void init_uart(void) {
   u0mr = 0x45;   // UART0 transmit/receive mode register setting
                  // UART mode transfer data 8 bits long
                  // Internal clock select one stop bit
                  // Parity enabled (odd parity)

   u0c0 = 0x00;   // UART0 transmit/receive control register 0 setting
                  // CTS function select
                  // CTS/RTS function enabled
                  // TxD0 pin is CMOS output
                  // Transmission data is output at falling edge of transfer clock
                  // and receive data is input at rising edge LSB first

   ucon = 0x01;   // UART transmit/receive control register 2 setting
                  // UART0 transmit interrupt cause is selected to "Transmission
                  // completed (TXEPT=1)"
                  // CTS/RTS shared pin

   u0brg = 129;   // Setting UART0 bit rate generator (Approx 9600bps @20MHz f1)
   u0c1 = 0x01;   // UART transmit/receive control register 1 setting transmit
                  // enabled

   trans_data[0] = 0x78;
   trans_data[1] = 0x56;
```

```
   trans_data[2] = 0x34;
   trans_data[3] = 0x12;
}

/*******************************************************/
/*    CRC Initialize Program                           */
/*******************************************************/
void init_crc(void) {
   #if PLL_ON
      crcsw = 0;              // CRC snoop on write is disabled
      crcsr = 0;              // CRC snoop on read is disabled

      #else
                              // CRC calculation circuit
      crcps = 0;              // CRC mode polynomial selection bit is selected
                              // to "0" (CRC-CCITT)
      crcms = 0;              // CRC mode selection bit is selected to "0" (LSB
                              // first)

      crcsarl = (char)(&u0tb);    // Setting SFR snoop address
      crcsarh = (char)((unsigned long)(&u0tb) >> 8 );

      crcsw = 1;              // CRC snoop on write is enabled
      crcsr = 0;              // CRC snoop on read is disabled

      crcd = 0;               // CRC data register set to "0"

   #endif
}

/*******************************************************/
/*    CRC Send Program                                 */
/*******************************************************/
void crc_snd(void) {

   for (i=0;i<4;i++) {
      u0tb = trans_data[i];   // Writing transmit data

      while (!ti_u0c1) {
                     // Check & wait the status of UART0 transmit buffer empty flag
      }
   }

   crc_data_l = crcdl;
   crc_data_h = crcdh;
   u0tb = crc_data_l;         // Writing transmit CRC data

   while (!ti_u0c1) {
                     // Check & wait the status of UART0 transmit buffer empty flag
   }

   u0tb = crc_data_h;         // Writing transmit CRC data

   while (!ti_u0c1) {
                     // Check & wait the status of UART0 transmit buffer empty flag
   }
}
```

4.2 接收方程序

```
/************************************************************/
/*                                                          */
/* M16C/Tiny Series Program Collection                      */
/*                                                          */
/* FILE NAME   : rec05b0005-0102_rcv.c                      */
/* CPU         : M16C/29 Group                              */
/* FUNCTION    : CRC Calculation Circuit                    */
/*               (Clock asynchronous serial I/O receive)    */
/* HISTORY     : 2006.04.13 Ver 1.02                        */
/*                                                          */
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/*                                                          */
/************************************************************/

/************************************************************/
/*    Include File                                          */
/************************************************************/
#include "sfr29.h"     // Special function register header file

/************************************************************/
/*    Function Definition                                   */
/************************************************************/
void init_mcu(void);   // MCU initialize
void init_uart(void);  // UART initialize
void init_crc(void);   // CRC initialize
void crc_rcv(void);
void wait_10ms(void);  // Main clock oscillation stable wait routine

/************************************************************/
/*    Define Label                                          */
/************************************************************/
#define PRODUCT_TYPE 0     // 29 group: 0    26A group: 1
#define PIN_TYPE 0         // 80 pin: 0      64 pin: 1 (29 group)
                           // 48 pin: 0      42 pin: 1 (26A group)
#define PLL_ON 0           // 0: not use PLL or PM20 is 1
                           // 1: use PLL and PM20 is 0

/************************************************************/
/*    Define Const                                          */
/************************************************************/
/* port2_0 - port2_7 data : 0  1  2  3  4  5  6  7  8  9  9 */
unsigned char count_data[11] =
{0xC0,0xF9,0xA4,0xB0,0x99,0x92,0x82,0xD8,0x80,0x90,0x90};

unsigned short recv_data[6];
unsigned int i;

/************************************************************/
/*    Main Program                                          */
/************************************************************/
void main(void) {
   init_mcu();
   init_uart();
   init_crc();
```

```
   crc_rcv();
}

/*****************************************************/
/*    MCU Initialize Program                         */
/*****************************************************/
void init_mcu(void) {
   prcr = 0x03;   // Protect register off

   pm20 = 1;      // Specifying wait when accessing SFR (Note)
                  // (Note) This bit can only be rewritten while the PLC07 bit is
                  // "0" (PLL Off). Also, to select a 16MHz or higher PLL clock,
                  // set this bit to "0" (2 wait).

   wait_10ms();   // For waiting 10ms, initialize Time A0 and start counting.

   cm2 = 0x00;    // System register2 Initialize
   cm0 = 0x08;    // System register0 Xcin-Xcout: high
   cm1 = 0x20;    // System register1 Xcin-Xcout: high

   prcr = 0x00;   // Protect register on

   #if PRODUCT_TYPE        // Product selection: 26A group
      ifsr2a = 1;          // Interrupt request cause select register2 IFSR2A
                           // <IFSR20>   : Reserved bit (Must be set to "1")
      prcr = 0x04;         // Protect register off
      #if PIN_TYPE         // Port setting
         pacr = 0x01;      // 42pin type
      #else
         pacr = 0x04;      // 48pin type
      #endif
      prcr = 0x00;         // Protect register on
   #else                   // Product selection: 29 group
      ifsr2a = 0;          // Interrupt request cause select register2 IFSR2A
                           // <IFSR20>   : Reserved bit (Must be set to "0")
      prcr = 0x04;         // Protect register off
      #if PIN_TYPE         // Port setting
         pacr = 0x02;      // 64pin type
      #else
         pacr = 0x03;      // 80pin type
      #endif
      prcr = 0x00;         // Protect register on
   #endif
}

/*****************************************************/
/*    Main Clock Oscillation Stable Wait 10ms Routine     */
/*****************************************************/
void wait_10ms(void) {
   ta0mr = 0x00;     // Set Timer A0 mode register (Timer mode, count source: f1)

   ta0 = 20000-1;    // Setting counter value (10msec @4MHz/2, f1)

   ta0ic = 0x00;     // Clear interrupt request bit

   tabsr = 0x01;     // Timer A0 start counting
```

```
   while (ir_ta0ic == 0){   }

   ir_ta0ic = 0;     // Clear interrupt request bit

   tabsr = 0x00;     // Timer A0 stops counting
}

/*********************************************************/
/*    UART Initialize Program                            */
/*********************************************************/
void init_uart(void) {
   u0mr = 0x45;   // UART0 transmit/receive mode register setting
                  // UART mode transfer data 8 bits long
                  // Internal clock select one stop bit
                  // Parity enabled (odd parity)

   u0c0 = 0x04;   // UART0 transmit/receive control register 0 setting
                  // RTS function select
                  // CTS/RTS function enabled
                  // TxD0 pin is CMOS output
                  // Transmission data is output at falling edge of transfer clock
                  // and reception data is input at rising edge LSB first

   ucon = 0x01;   // UART transmit/receive control register 2 setting
                  // UART0 transmit interrupt cause is selected to "Transmission
                  // completed (TXEPT=1)"
                  // CTS/RTS shared pin

   u0brg = 129;   // Setting UART0 bit rate generator (Approx 9600bps @20MHz f1)

   u0c1 = 0x04;   // UART transmit/receive control register 1 setting Receive
                  // enabled
}

/*********************************************************/
/*    CRC Initialize Program                             */
/*********************************************************/
void init_crc(void) {
   #if PLL_ON
      crcsw = 0;              // CRC snoop on write is disabled
      crcsr = 0;              // CRC snoop on read is disabled

   #else
                              // CRC calculation circuit
      crcps = 0;              // CRC mode polynomial selection bit is selected
                              // to "0" (CRC-CCITT)
      crcms = 0;              // CRC mode selection bit is selected to "0" (LSB
                              // first)

      crcsarl = (char)(&u0rb);    // Setting SFR snoop address
      crcsarh = (char)((unsigned long)(&u0rb) >> 8 );

      crcsw = 0;              // CRC snoop on write is disabled
      crcsr = 1;              // CRC snoop on read is enabled

      crcd = 0;               // CRC data register set to "0"
```

```
   #endif
}

/*********************************************************/
/*    CRC Receive Program                                */
/*********************************************************/
void crc_rcv(void) {

   for (i=0;i<6;i++) {
      while (!ri_u0c1) {
                     // Check & wait the status of UART0 receive complete flag
      }
      recv_data[i] = u0rbl;   // Reading receive data
   }

   if ( crcd == 0 ) {
                     // CRC data check CRCD == 0x00?
      while (1) {
                     // Normal end loop
      }
   }

   else {
      while (1) {
                     // Error end loop
      }
   }
}
```

5. 参考文献

数据手册

M16C/26A 群（M16C/26A、M16C/26T）硬件手册 Rev.1.00

M16C/29 群硬件手册 Rev.1.00

（最新版本请从瑞萨科技网页上取得）

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