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M16C/80 Group, M32C/80 Series

The Program Transmission Method to RAM

1.0 Abstract

The following article introduces the setup procedures for the program transmission to RAM using in-line assembler and its application example.

2.0 Introduction

The explanation of this issue is applied in the following condition.

Applicable MCU: M16C/80 Group

M32C/80 Series

This program can be also operated under the condition of M16C family products with the same SFR (Special Function Register) as M16C/80 Group products. Because some functions may be modified of the M16C family products, see the user's manual. When using the functions shown in this application note, evaluate them carefully for an operation.

3.0 Description of the application example

This chapter describes the procedures for transmitting the program to RAM using in-line assembler and executing the transmitted program.

3.1 Setup procedures

The setup procedures for “3.0 Description of the application example” will be shown.

(1) Make space for the program transmission on RAM.

```
int ram_program_area[1024];
```

(2) Set the program transmission source address, the destination address and the transmission size using in-line assembler.

```
asm("      pushm   R0,R1,R2,R3,A0,A1");                ← Save the content of the register.
asm("      mov.l    #_RAM_PRG_START,A0");              ← Set the transmit source address to A0 register.
asm("      mov.l    #_ram_prog_area,A1");              ← Set the transmit destination address to A1 register.
asm("      mov.w    #(_RAM_PRG_END - _RAM_PRG_START)/2,R3"); ← Set the transmit count to R3 register.
```

(Note) Define the program area to transmit in advance as shown in the following.

```
                    •
                    •
extern              RAM_PRG_START;
extern              RAM_PRG_END;
                    •
                    •
void   xxxx_sub(void)
{
       asm("      .glb      _RAM_PRG_START ");
       asm("_RAM_PRG_START:");                          ←Define in the lead of the program to transmit
                    •
                    •
}
      asm("      .glb      _RAM_PRG_END ");
      asm("_RAM_PRG_END:");                             ← Define at the last of the program to transmit.
                    •
                    •
```

(3) Transmit the program to RAM.

Transmit the program using SMOVF instruction written by in-line assembler.

```
asm("      smovf.w");
asm("      popm       R0,R1,R2,R3,A0,A1");             ← Restore the contents of the register saved in (2).
```

(4) Execute the program transmitted to RAM.

```
asm("      jmp.a      _ram_prog_area");
```

4.0 Program sample

The following shows the sample task to execute the program on ROM or on RAM alternately every time a timer counts 256 of TA1 interrupts after the transmission to RAM.

```
/***********************************************************************/
/*      FILE NAME : rjj05b0291_src.c                                   */
/*      Ver       : 1.00                                               */
/*      CPU       : M16C/80                                            */
/*      FUNCTION  : The program transmission method to RAM.            */
/*---------------------------------------------------------------------*/
/*      Copyright(C)2003, Renesas Technology Corp.                     */
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/*                                                                     */
/***********************************************************************/
/****************************************/
/*      include file                    */
/****************************************/
#include "sfr80144.h"                   //  Special Function Register Header File

/****************************************/
/*      Symbol declaration              */
/****************************************/
#define RAM_PROG_SIZE       1024/2      // A unit is 1-byte.
#define LOOP_CNT            256         //

/****************************************/
/*      Function declaration            */
/****************************************/
int     ram_prog_area[RAM_PROG_SIZE];
void    program_ram_top(void);
void    program_ram(void);
extern  RAM_PRG_START;
extern  RAM_PRG_END;

/****************************************/
/*      main function                   */
/****************************************/
void main(void)
```

```
{
    short       cnt;

    pd10     = 0xff;                        // P10 is an output port.
    p10      = 0;                           // P10 initial output.
    pd8      = 0xdf;                        // P8 is an output port.
    p8       = 0;                           // P8 initial output.
    ta1mr    = 0;                           // TA1 = Timer-mode(f1)
    ta1      = 0x4e20 - 1;                  // 50ns * (0x4e20-1) = 1ms
    ta1ic    = 0;                           // TA1 Interruption priority level = 0
    tabsr    = 0x02;                        // TA1 start!

    asm("    pushm   R0,R1,R2,R3,A0,A1"); // Store the General-purpose register, address-register.
    asm("    mov.l   #_RAM_PRG_START,A0");// Set the transmit source-address.
    asm("    mov.l   #_ram_prog_area,A1");// Set the transmit destination address.
                                          //    Set    the    transmit    count(RAM_PRG_END    -
RAM_PRG_START).
    asm("    mov.w   #(_RAM_PRG_END - _RAM_PRG_START)/2,R3");
    asm("    smovf.w");                     // A program is transmitted to internal RAM
    asm("    popm    R0,R1,R2,R3,A0,A1"); // Restore the General-purpose register, address-register.
    asm("ret_point:");                    // Label
    cnt      = 0;                           //
    while(cnt < LOOP_CNT)
    {
        if(ir_ta1ic == 1)
        {
            ta1ic       = 0;               // Set 0 to the interrupt request flag.
            cnt++;                         //
        }
    }
    p8_0     = !p8_0;                       // port reversal.
    asm("    jmp.a   _ram_prog_area");      // Jump to the internal RAM.
}

/*****************************************/
/*      RAM program-1                    */
/*****************************************/
void prog_ram_top(void)
```

```
{
    asm("    .glb   _RAM_PRG_START ");
    asm("_RAM_PRG_START:");                    // RAM program start address
    asm("    pushm R0,R1,R2,R3,A0,A1");    // Store the General-purpose register, address-register.

    program_ram();                             // Call the program_ram function.

    asm("    popm   R0,R1,R2,R3,A0,A1");    // Restore the General-purpose register, address-register.
    asm("    jmp.a ret_point");               // Jump to the ROM.
}

/****************************************/
/*      RAM program-2                   */
/****************************************/
void program_ram(void)
{
    char            port10_data;
    short           cnt;

    port10_data  = 1;                          // Initialize the automatic variable.
    cnt  = 0;

    while(cnt < LOOP_CNT)
    {
        if(ir_ta1ic == 1)
        {
            p10       = port10_data;          //
            port10_data +=1;                   // Increment the P10 output data.
            cnt++;                             //
            ta1ic           = 0;               // Set 0 to the interrupt request flag.
        }
    }
}
asm("    .glb   _RAM_PRG_END ");
asm("_RAM_PRG_END:");                          // RAM program
```

5.0 Reference

User's Manual

Refer to C compiler (NC308) user's manual for M32C/80 and M16C/80 series.

Refer to reloclatable assembler (AS308) user's manual for M32C/80 and M16C/80 series.

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REVISION HISTORY

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