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38D2 Group

ROM Correction Function

1. Abstract

- The following article introduces and shows how to use the ROM correction function of the 38D2 Group.

2. Introduction

The explanation of this issue is applied to the following conditions:

- Application MCU: 38D2 Group (such as the M38D24G4HP)
- Oscillation frequency: 10 MHz
- Memory size: ROM 16 KB, RAM 640 bytes

3. Contents

3.1 Description of the application example

- Description
  - 38D2 Group is equipped with a ROM correction function (QzROM rewrite function), in which program codes can be written once, and blank non-protected ROM areas are available to rewrite correct codes. For example, in Figure 1, the original program code can be written to protected area 1 and the operation code for ROM correction can be rewritten to the non-protected blank ROM area starting from F000H.
  - ROM correction vector 1 in the ROM area is used as an example in the following introduction. (In actual application, ROM correction vector 1 and ROM correction vector 2 can be simultaneously enabled). In the following program, output value of port 1 is corrected by ROM correction function.

- Software environment
  - High-performance Embedded Workshop (HEW) 4.0.3.1 software is used as a design program tool.
  - Flash Development Toolkit (FDT) 3.05 is used as programming software.

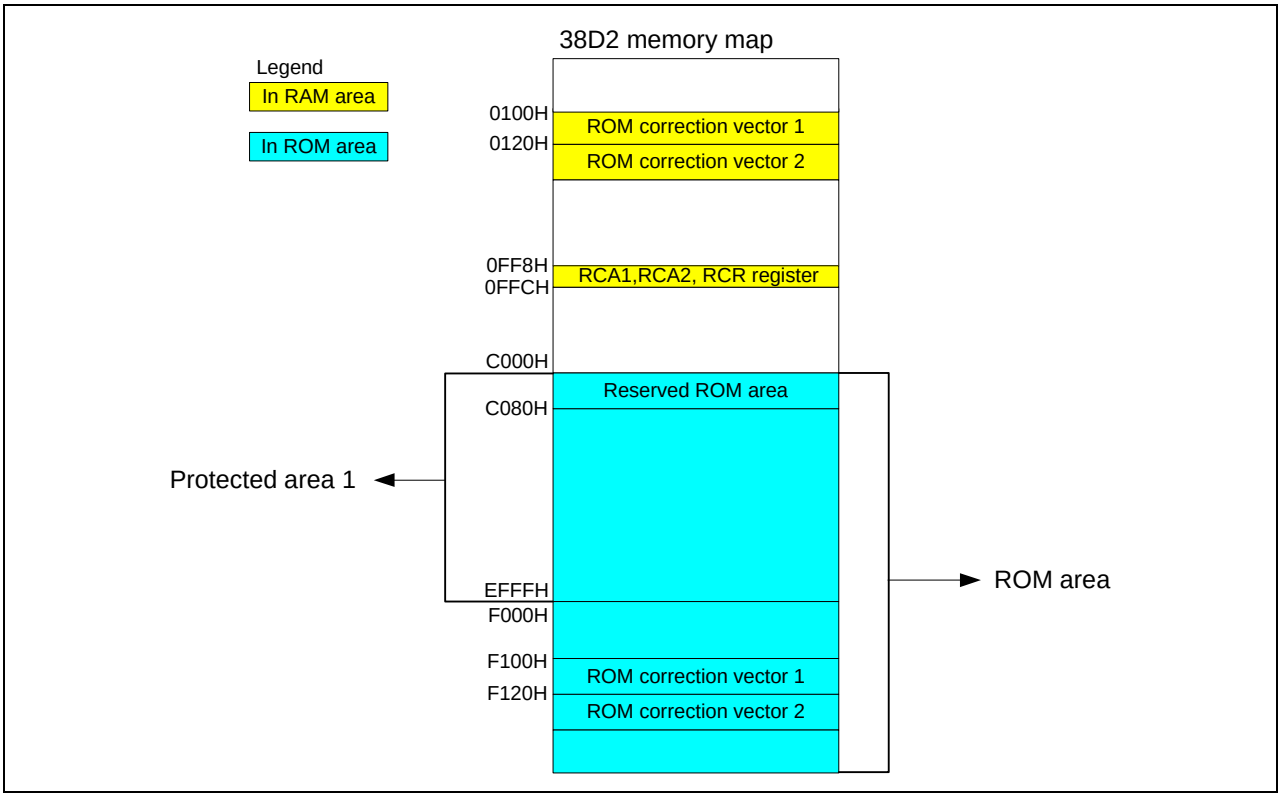


Figure 1 ROM Protected Area

- Operation
  - Write the original program code to the M38D2 MCU with a programming tool (set protection for area 1 when the program code needs to be protected).
  - After reset, port 1 outputs FFH.
  - Rewrite the operation code which enables the ROM correction function in a non-protected blank ROM area from F000H (the address can be selected optionally in the non-protected blank ROM area).
  - Rewrite the correction program code to ROM correction vector 1 from F100H ROM address.
  - After reset, port 1 outputs 0FH.

3.2 Operation code setting

- Error instruction in original program
  - In the original program, there is an error instruction to be corrected as shown in Figure 2.

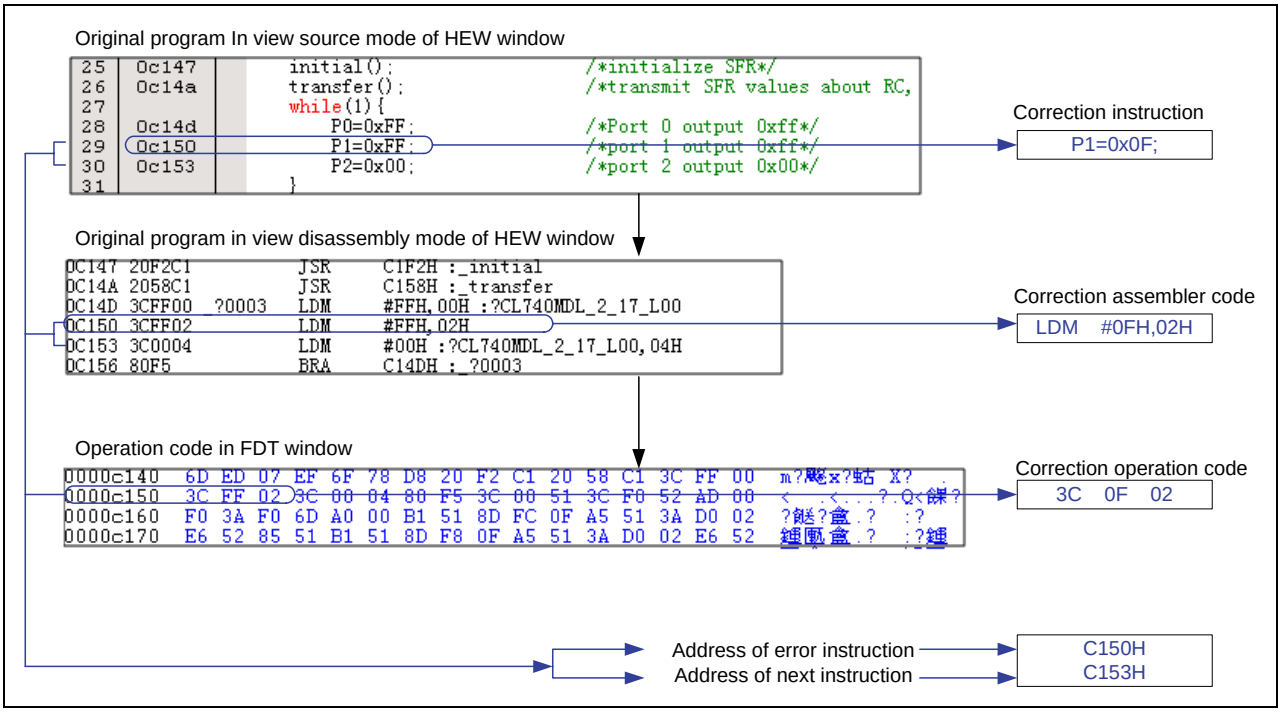


Figure 2 Error Instruction in Original Program

- Setting SFR about ROM correction function
  — To use the ROM correction function, rewrite the values of RCR, RCA1H and RCA1L to the non-protected blank ROM area starting from F000H. This operation is shown in Figure 3.

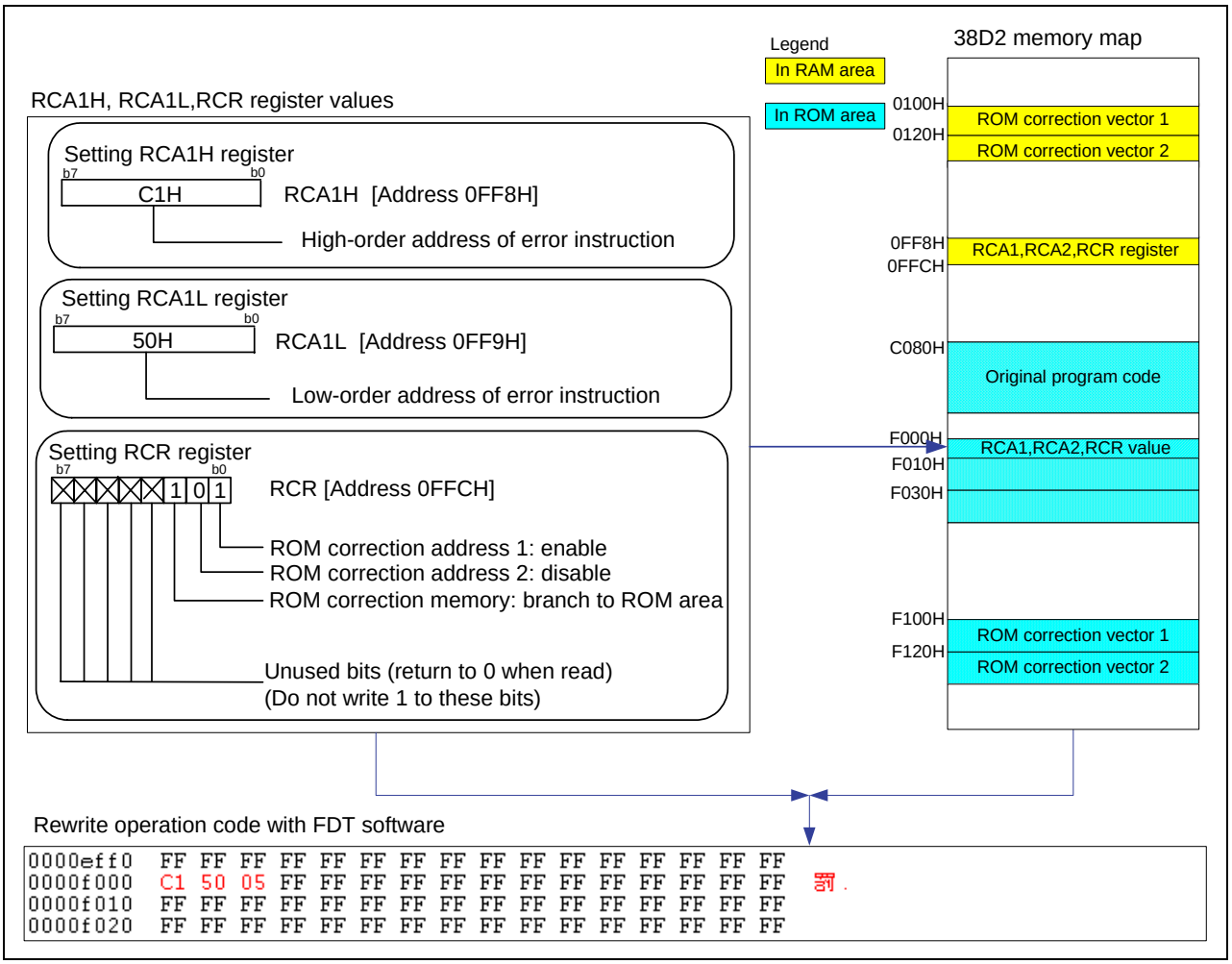
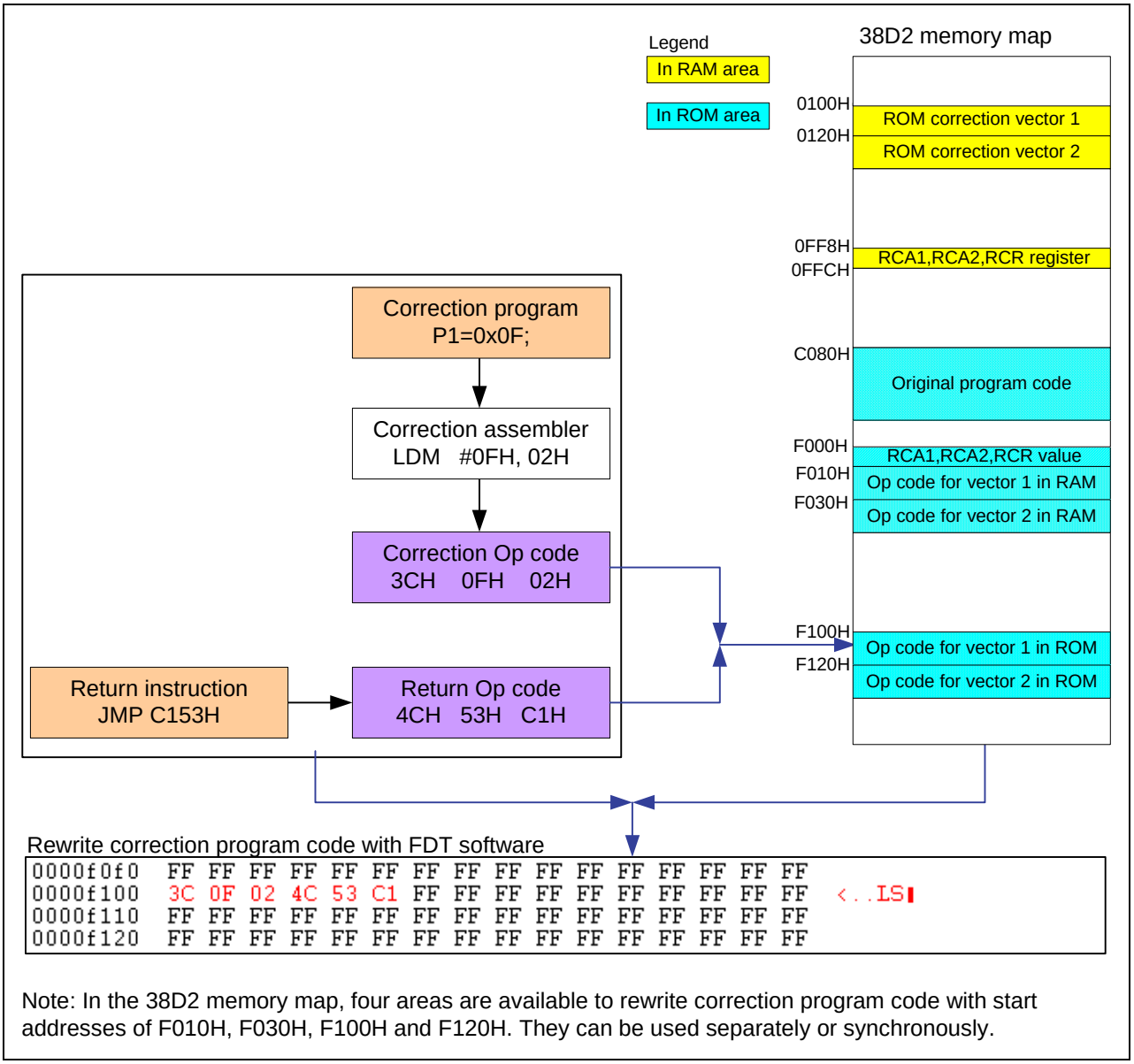


Figure 3 Setting SFR about ROM Correction Function

- Correction program code
  — In this example, ROM correction vector 1 in the ROM area is used and the correction program code is rewritten there. Note that the JMP instruction is necessary at the end of the correction program code so the program counter (PC) can return to the original program from ROM correction vector 1. This process is shown in Figure 4.



Note: In the 38D2 memory map, four areas are available to rewrite correction program code with start addresses of F010H, F030H, F100H and F120H. They can be used separately or synchronously.

Figure 4 Correction Program Code

3.3 Process of ROM correction function

- When the program is being executed and the value of the program counter matches with the set address value in the ROM correction address registers, the program is branched to the ROM correction vectors and then the correction program can be executed.
- In this example, when PC value is C150H, the program is branched to ROM correction vector 1 (start address is F100H) to correct port 1 output value. When program executes to the JMP instruction, it will return to the original C153H address. The programming process is shown in Figure 5. The ROM correction function process is shown in Figure 6.

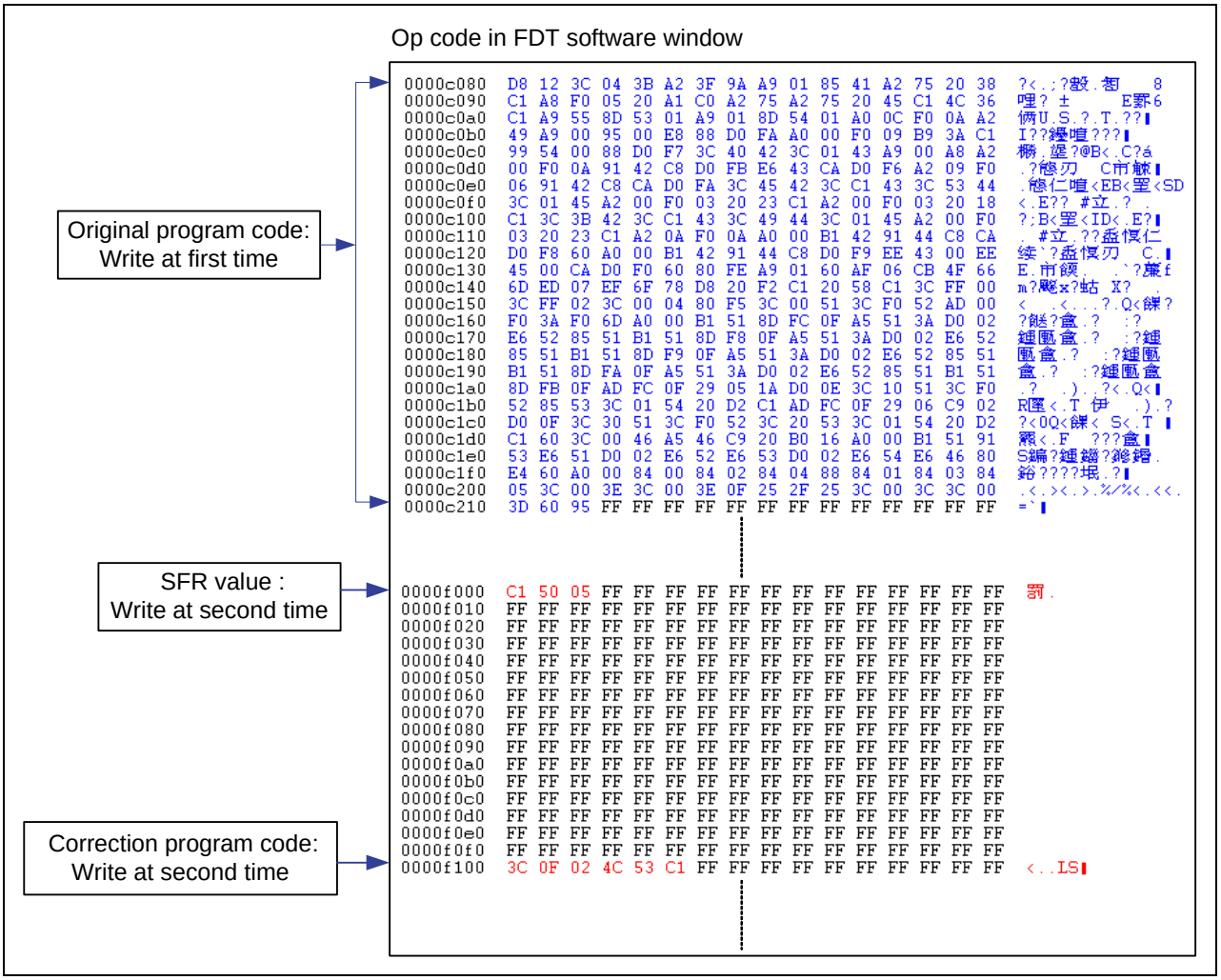


Figure 5 Programming Process

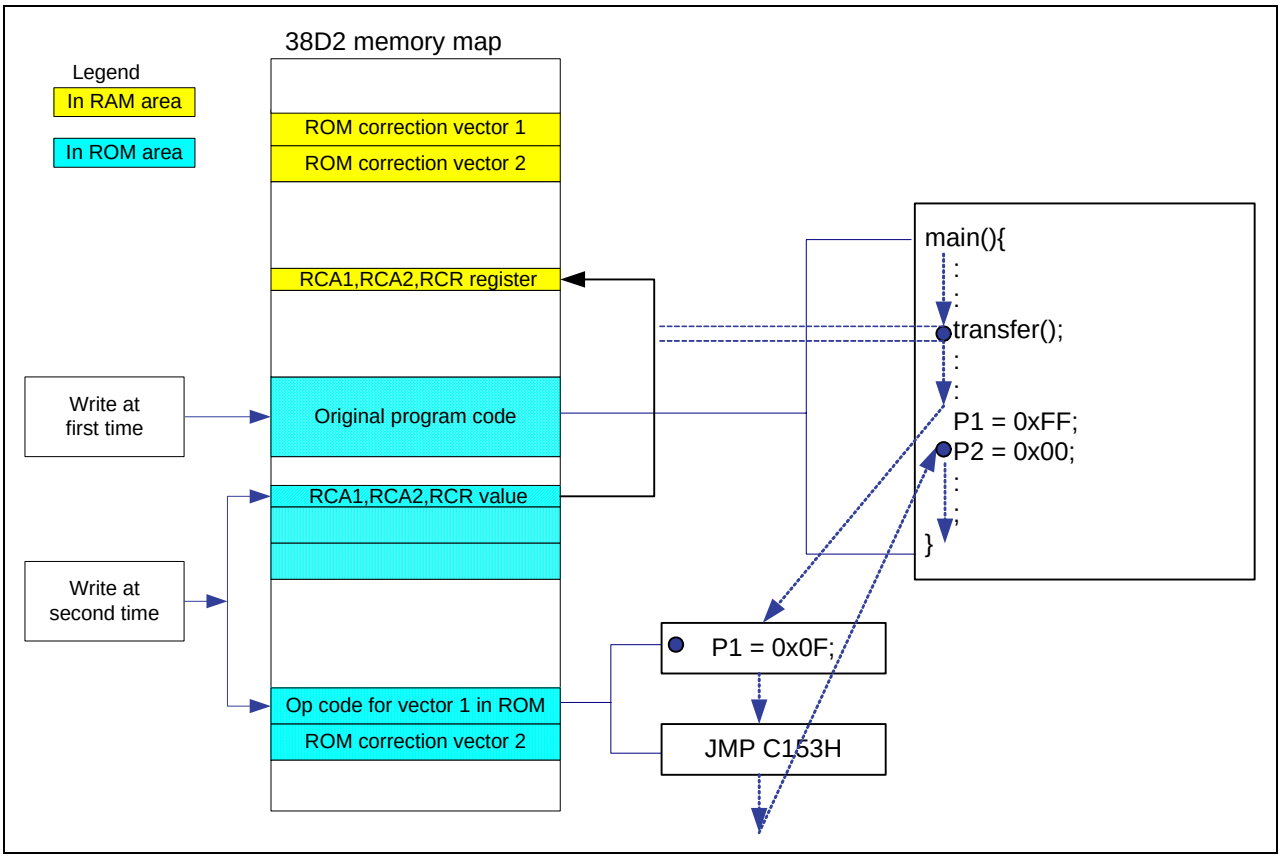
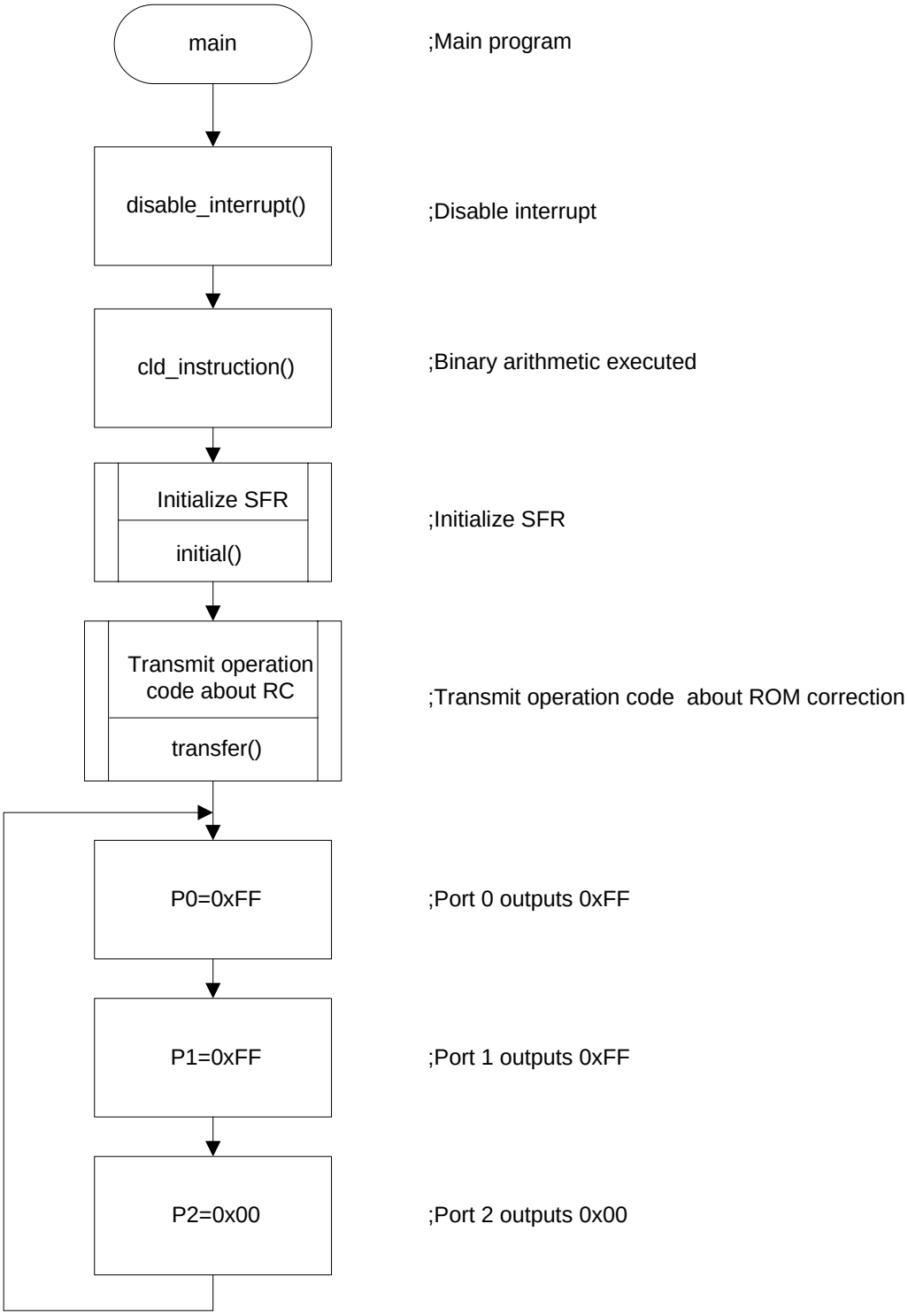


Figure 6 ROM Correction Function Process

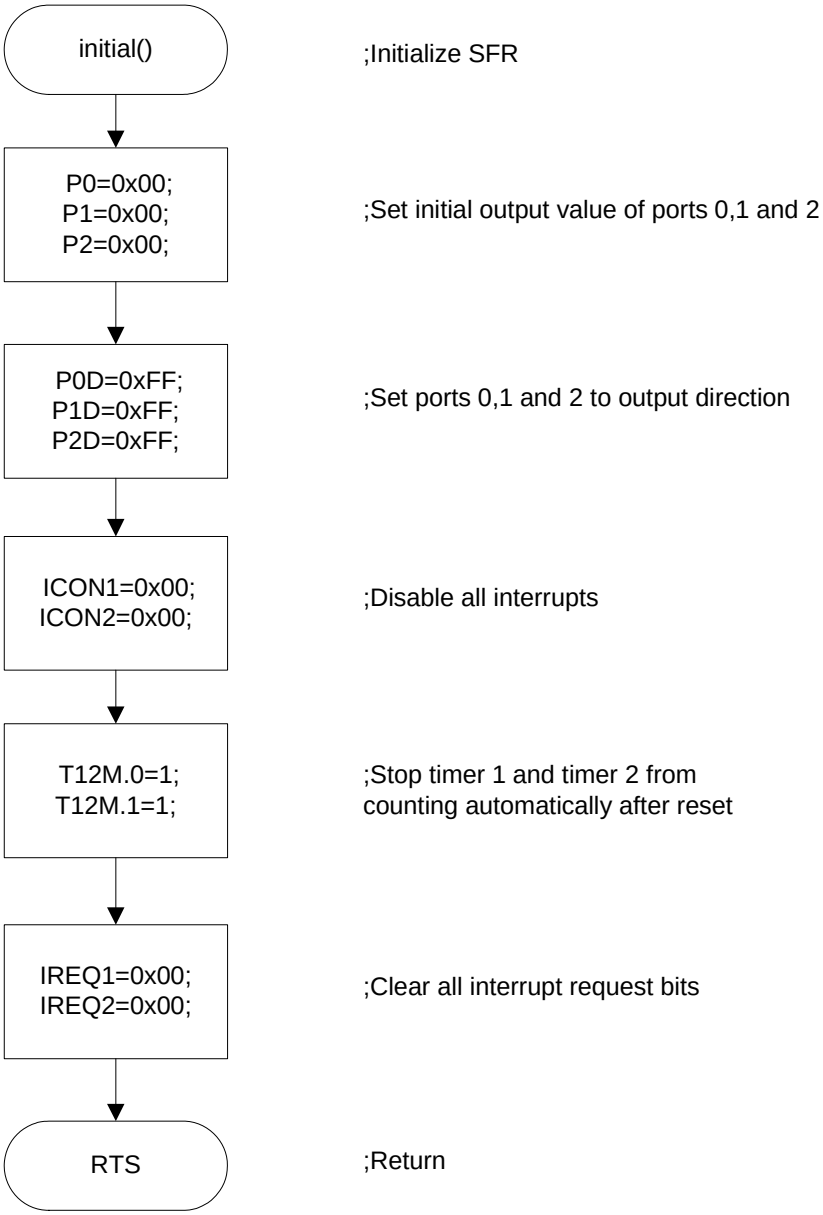
4. Flow chart

This is the flowchart of the original program.

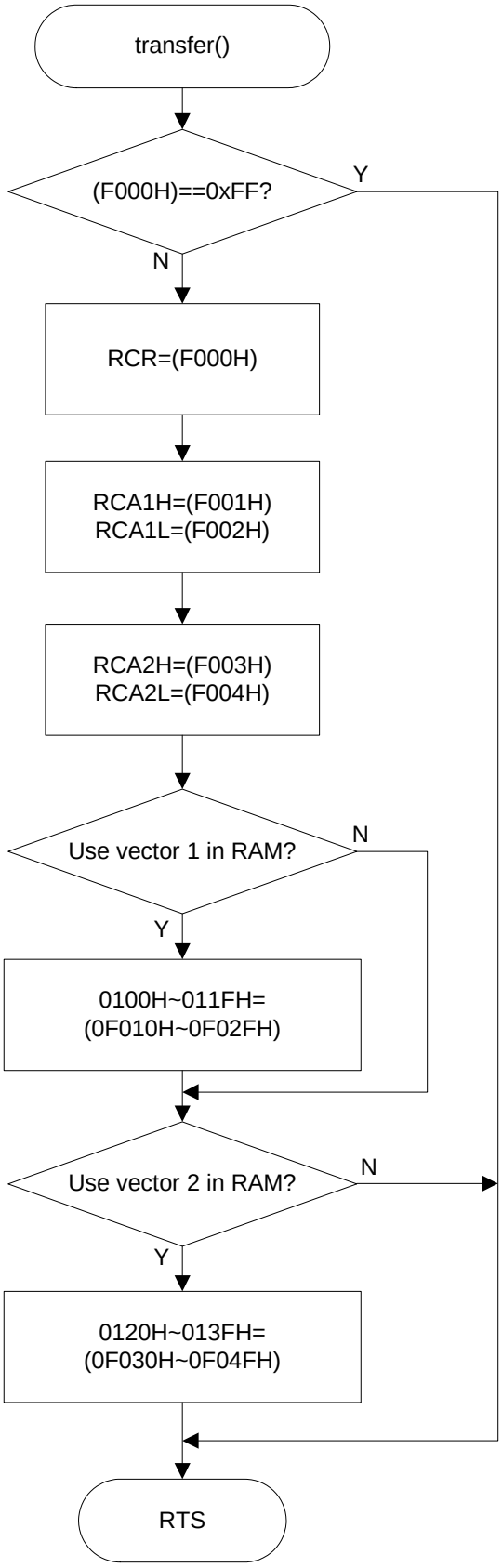
4.1 Following is the main loop program chart:



4.2 Flow chart of initial setting subroutine:



4.3 Flow chart of transfer operation code subroutine:



;Transfer operation code subroutine

;Evaluate whether values are rewritten for ROM correction

;Read out value from rewritten ROM area, write it to RCR register

;Read out values from rewritten ROM area, write it to RCA1H and RCA1L register

;Read out values from rewritten ROM area, write it to RCA1H and RCA1L register

;Evaluate by RCR whether vector 1 in RAM is used

;Read out program code from rewritten ROM area, write them to vector 1 in RAM

;Evaluate by RCR whether vector 2 in RAM is used

;Read out program code from rewritten ROM area, write them to vector 2 in RAM

;Return

4.4 Explanation of transfer subroutine

- The location of the rewrite operation codes and the process of value transmission are shown in Figure 7. Select one of the correction vectors and set the corresponding RCR register value and write the program code there.

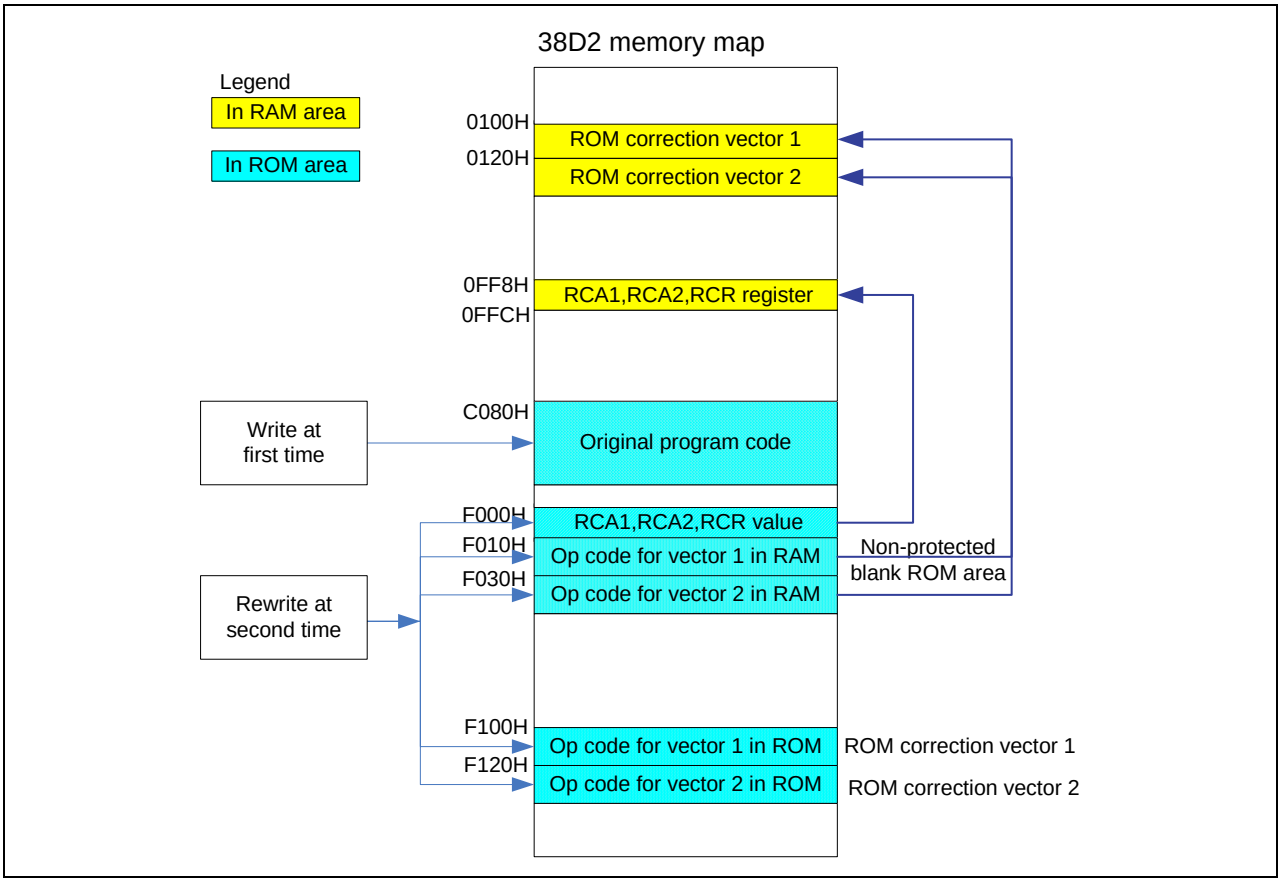


Figure 7 Explanation of Transfer Subroutine

5. Sample program code

```
/************************************************************************
*   File Name   : rec05b0017_0100_source.c
* CPU        : M38D24 Group
* Function      : ROM Correction Function
*                 (use ROM correction vector 1)
*   Version     : 1.00 (2006-04-18)
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************************************************************************/

/************************************************************************
*  Include File
************************************************************************/
#include <intr740.h>
#include "io38d2.h"

/************************************************************************
*  Define Variable
************************************************************************/
zpage unsigned char *pt1_RC = 0x00;    /*address point in blank ROM area */
zpage unsigned char *pt2_RC = 0x00;    /*address point in SFR or RC vector*/

/************************************************************************
*  Function Declaration
************************************************************************/
void initial(void);                       /*initialize SFR subroutine*/
void transfer(void);                      /*transmit operation code subroutine*/
void transmit_pro_code(void);       /*transmit program code subroutine*/

/************************************************************************
Name        : Main
************************************************************************/
void main(void)
{
  disable_interrupt();              /* Disable interrupt  */
  cld_instruction();                /* Binary Arithmetic Executed */

  initial();                        /*initialize SFR*/
  transfer();                          /*transmit operation code subroutine*/
  while(1){
    P0 = 0xFF;                      /*Port 0 outputs 0xff*/
    P1 = 0xFF;                      /*port 1 outputs 0xff*/
    P2 = 0x00;                      /*port 2 outputs 0x00*/
  }
}
/************************************************************************
Name        : initial
Function    : initialize SFR
************************************************************************/
void initial(void){
  P0 = 0x00;                        /*port 0 outputs 0x00*/
  P1 = 0x00;                        /*port 1 outputs 0x00*/
  P2 = 0x00;                        /*port 2 outputs 0x00*/
  P0D = 0xFF;                          /*set port 0 to output direction*/
  P1D = 0xFF;                          /*set port 1 to output direction*/
  P2D = 0xFF;                          /*set port 2 to output direction*/
  ICON1 = 0x00;                     /*disable all interrupt*/
```

```
  ICON1 = 0x00;
  T12M.0 = 1;                           /*stop Timer 1*/
  T12M.1 = 1;                           /*stop Timer 2*/
  IREQ1 = 0x00;                       /*clear all interrupt request bits*/
  IREQ2 = 0x00;
}
/************************************************************************
Name        : transfer
Function    : transmit operation code
************************************************************************/
void transfer(void){
  pt1_RC = (char *)0xF000;          /*set the blank ROM area address*/

  if (*pt1_RC!=0xFF){             /*if there are values, transmit them*/

   RCR    = *pt1_RC;              /*set RCR register*/
   pt1_RC = pt1_RC+1;

   RCA1H  = *pt1_RC;              /*set RCA1H register*/
      pt1_RC = pt1_RC+1;
      RCA1L  = *pt1_RC;             /*set RCA1L register*/
   pt1_RC = pt1_RC+1;

   RCA2H  = *pt1_RC;              /*set RCA2H register*/
      pt1_RC = pt1_RC+1;
      RCA2L  = *pt1_RC;             /*set RCA2L register*/

   if ((RCR&0x05)==0x01){           /*if use RC vector 1 in RAM area*/
      pt1_RC = (char *)0xF010;    /*set program code address in F010H*/
      pt2_RC = (char *)0x0100;    /*point to RC vector 1 address*/
      transmit_pro_code();        /*transmit program code to RC vector 1*/
   }
   if ((RCR&0x06)==0x02){           /*if use RC vector 2 in RAM area*/
      pt1_RC = (char *)0xF030;    /*set program code address in F030H*/
      pt2_RC = (char *)0x0120;    /*point to RC vector 2 address*/
      transmit_pro_code();        /*transmit program code to RC vector 2*/
   }
  }
}
/************************************************************************
Name        : transmit_pro_code
Function    : transmit program code to RC vector in RAM if use them
************************************************************************/
void transmit_pro_code(void){

zpage unsigned char k = 0x00;
  for(k=0;k<32;k++){                    /*loop for transmitting program code*/
  *pt2_RC = *pt1_RC;              /*execute transmitting*/
      pt1_RC++;                     /*blank ROM area address increase*/
   pt2_RC++;                      /*RC vector address increase*/
  }
}
```

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Rev.	Date	Description	
		Page	Summary
1.00	Aug.21.06	-	First edition issued

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