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M32C/84, 85, 86, 87, 88 Group

Low Power Consumption Application Example in Flash Memory Version

1. Abstract

The document describes how to reduce power consumption in the flash memory version and shows an application example.

2. Introduction

The application example described in this document is applied to the following MCUs and parameter(s):

MCUs: M32C/84 Group
M32C/85 Group
M32C/86 Group
M32C/87 Group
M32C/88 Group

This program can be used with other M16C Family MCUs which have the same special function registers (SFRs) as the above MCUs. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

3. Application Example

3.1 Low Power Consumption Flowchart

Figure 1 shows the Flowchart to Reduce Power Consumption.

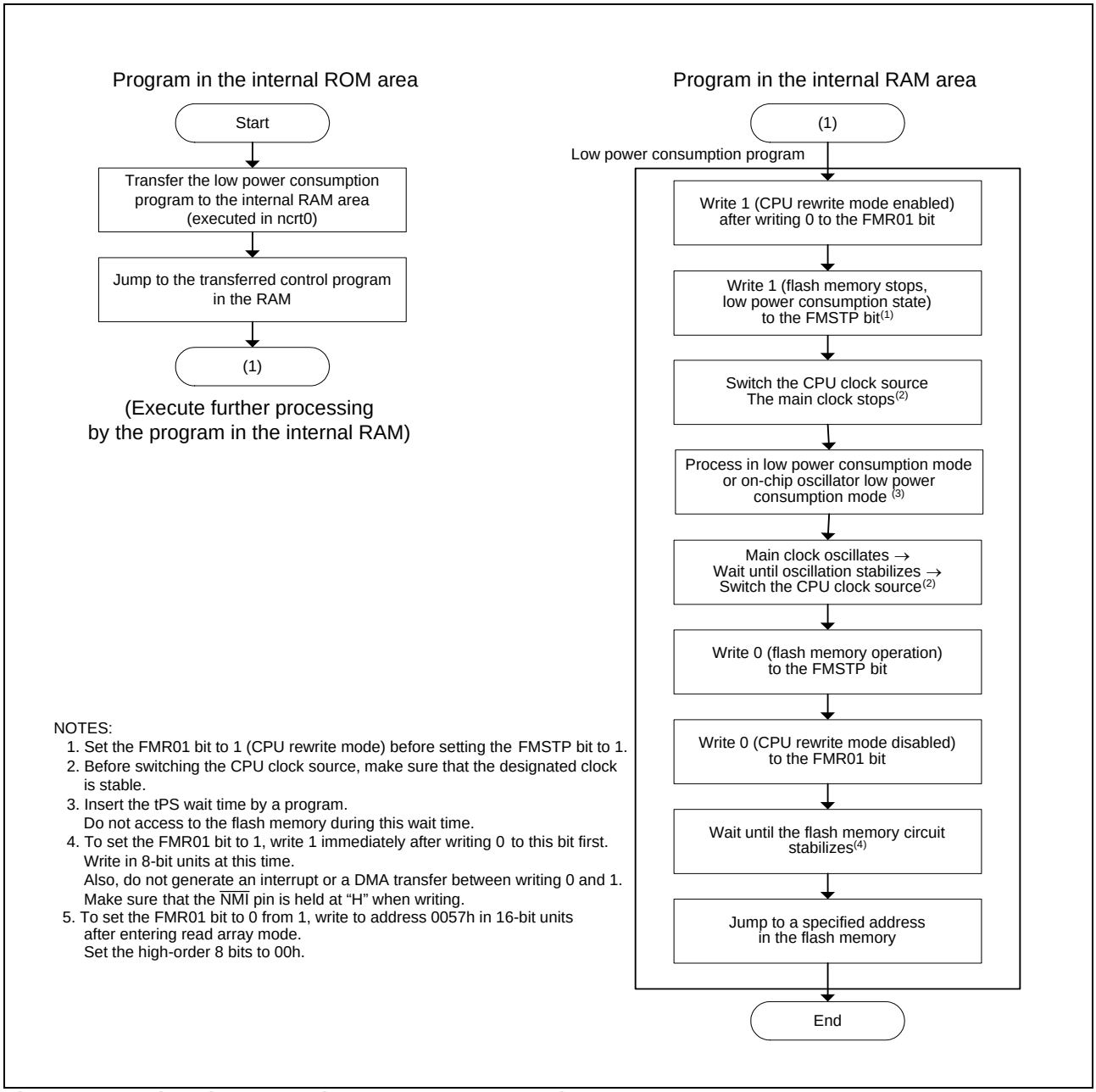


Figure 1 Flowchart to Reduce Power Consumption

3.2 Setup

3.2.1 Transfer Lower Power Consumption Program to RAM

The program to reduce power consumption must run in RAM. This section describes how to transfer the program stored in the address beginning with 0FF1000h to RAM.

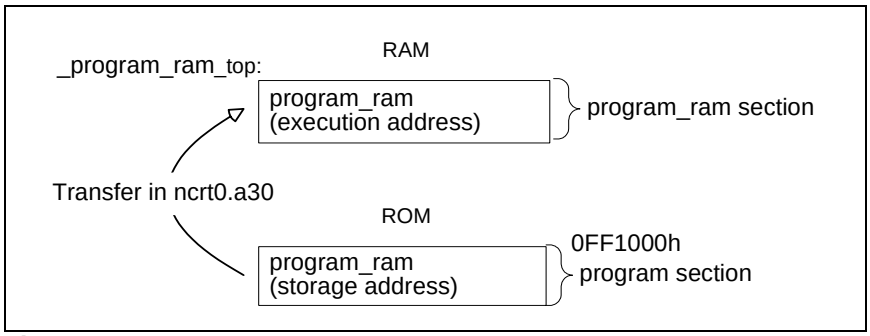


Figure 2 Program Map

(1) Change the section name.
Add “program_ram” as the section name and locate a program to run in RAM to this section.
Relocating the program from the program section to the program_ram section is described as follows:

```
void main(void)
{
        /* This program is allocated in the program section */
}
```

```
/* The program following the #pragma SECTION declaration is located in the program_ram section */
#pragma SECTION program program_ram
void low_power(void)
{
        /* This program is allocated in the program_ram section */
}
```

(2) Change sect30.inc
Add the program_ram section to sect30.inc. Here it is located behind the heap section.
Also, note that the _program _ram_top label is used when transferring the program.

```
;------------------------------------------------------------
; heap section
;------------------------------------------------------------
        .section heap,DATA
heap_top:
        .blkb   HEAPSIZE
```

```
;------------------------------------------------------------
; RAM program area
;------------------------------------------------------------
        .section program_ram,ALIGN
_program_ram_top:
        .glb    _program_ram_top
```

Add here

(3) Transfer the program.
Add a process to transfer the program to the startup routine (ncrt0.a30).

```
;=========================================================
=====
; Initialize standard I/O
;---------------------------------------------------------------------
        .glb    _init
        .call   _init,G
        jsr.a   _init
;=========================================================
====
; Program Ram initialize
;   _from_addr is defined by as308 option "-D_from_addr=ff1000h"
;---------------------------------------------------------------------
        BCOPY  _from_addr,_program_ram_top,program_ram
;
;=========================================================
====
; Call main() function
;---------------------------------------------------------------------
        ldc     #0h,fb                  ; for debugger
        .glb _main
        jsr.a   _main
```

Add here

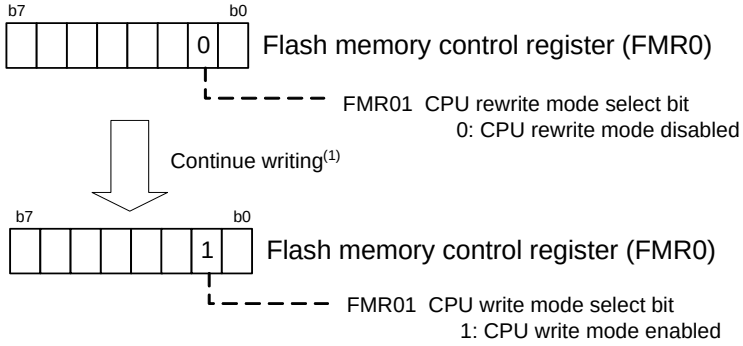
(4) Specify the program storage location.
To execute the program transferred to the RAM, it is necessary to specify with the linker (ln308) that the stored address (upper RAM) and the execution address (lower RAM) be located separately.

```
ln308 -LOC program_ram=0ff1000
```

In the above option, the program_ram section is stored beginning with address 0FF1000h.

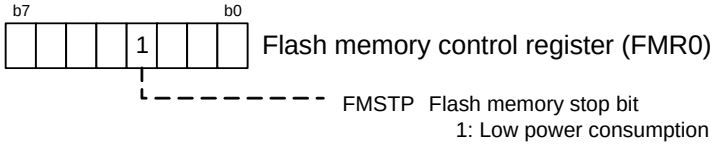
3.2.2 Process in Low Power Consumption Program

(1) Enable CPU rewrite mode



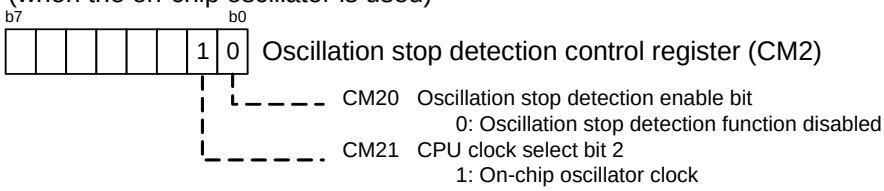
NOTE:
1. To set the FMR01 bit to 1, write 1 immediately after writing 0 to this bit.
Do not generate an interrupt, DMA transfer, or DMA II transfer between writing 0 and 1.
Write to the FMR01 bit in the areas other the internal flash memory area.
Also, make sure the $\overline{\text{NMI}}$ pin is held at "H" when writing.

(2) Stop the flash memory

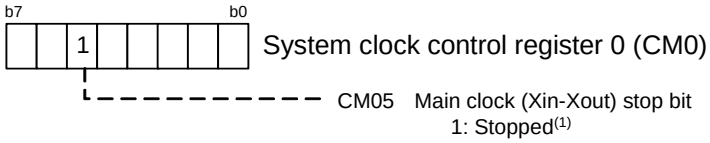


NOTE:
1. Write to this bit by a program in the areas other than the flash memory.
This bit is enabled when the FMR01 bit is set to 1 (CPU rewrite mode enabled).
When the FMA01 bit is set to 0, writing 1 to the FMSTP bit causes the FMSTP to be set to 1,
but the flash memory does not enter low power consumption state nor it is reset.

(3) Change the CPU clock source to the on-chip oscillator clock
(when the on-chip oscillator is used)



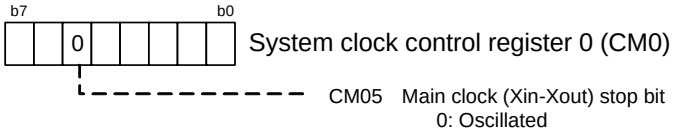
(4) Stop the main clock



NOTE:
1. This bit stops the main clock when in low power consumption mode or when in on-chip oscillator low power consumption mode is selected. Do no use this bit to detect whether the main clock is stopped.
To stop the main clock, set the following bits in the following order:
1) Set the CM07 bit to 1 (sub clock selected) or set the CM21 bit in the CM2 register to 1 (on-chip oscillator clock selected) while the sub clock oscillation is stable.
2) Set the CM20 bit in the CM2 register to 0 (oscillation stopped, re-oscillation detection function disabled).
3) Stop the CM05 bit to 1 (stopped).

(5) Execute the user program to operate in on-chip oscillator low power consumption mode

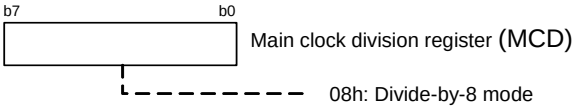
(6) Oscillate the main clock



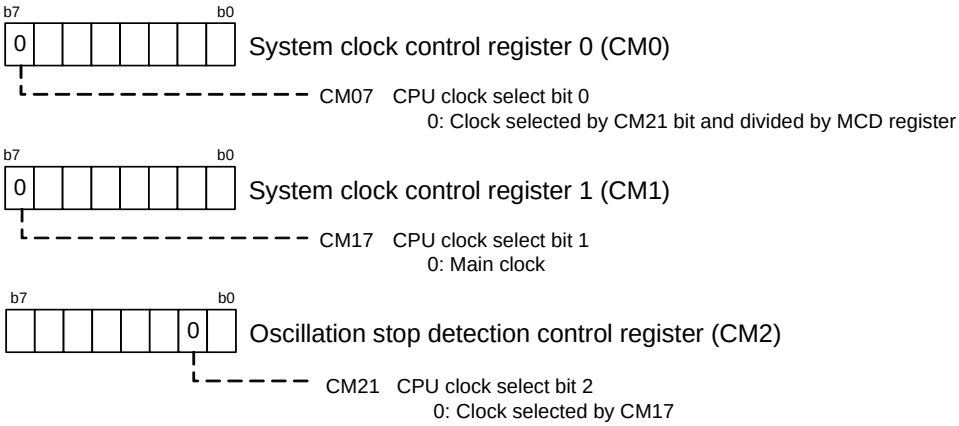
(7) Wait for approximately 1 ms(1) until the main clock oscillation stabilizes.

NOTE:
1. The oscillation stability time for the main clock is set as 1 ms in this document.
This time varies depending oscillator type, so wait until the oscillation of the oscillator used stabilizes.

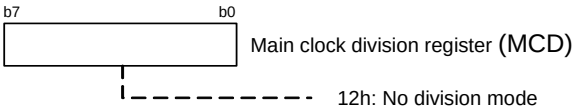
(8) Set the main clock division ratio to divide-by-8



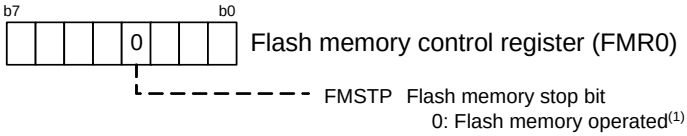
(9) Switch the CPU clock source to the main clock



(10) Set the main clock division ratio to no division mode

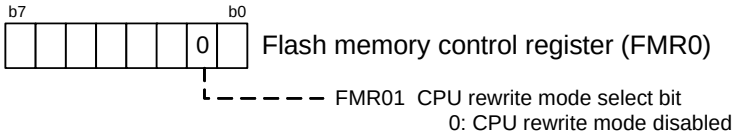


(11) Operate the flash memory



NOTE:
1. Write to this bit by a program in the areas other than the flash memory.
This bit is enabled when the FMR01 bit is set to 1 (CPU rewrite mode enabled).
When the FMA01 bit is set to 0, writing 1 to the FMSTP bit causes the FMSTP to be set to 1,
but the flash memory does not enter low power consumption state nor it is reset.

(12) Disable CPU rewrite mode



(13) Wait until the flash memory circuit stabilizes
Wait for the flash memory circuit stability time (tPS)

(14) Jump to a specified address in the flash memory

4. Sample Programming Code

A sample program can be downloaded from the Renesas Technology website.
For download, click “Application Notes” in the left-hand side menu of the M16C Family page.

5. Reference Documents

Hardware Manuals
M32C/84 Group Hardware Manual
M32C/85 Group Hardware Manual
M32C/86 Group Hardware Manual
M32C/87 Group Hardware Manual
M32C/88 Group Hardware Manual
The latest version can be downloaded from the Renesas Technology website.

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		Page	Summary
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