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April 1\(^{\text{st}}\), 2010
Renesas Electronics Corporation

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1. Abstract

This document describes an application example for discriminating between a cold start and warm start using the RAM. When determining a warm start, discriminate the reset source using the Reset Source Determine Register.

2. Introduction

The application example described in this document applies to the following microcomputers (MCUs):

• MCUs: M16C/5LD Group
  M16C/56D Group

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

Table 3.1 lists the Reset Types, Figure 3.1 shows the Reset Source Determine Register, and Table 3.2 shows the Bit Values in the RSTFR Register after Reset.

**Table 3.1  Reset Types**

<table>
<thead>
<tr>
<th>Reset Name</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware reset</td>
<td>A low-level signal is applied to the RESET pin.</td>
</tr>
<tr>
<td>Power-on reset</td>
<td>The rise in voltage on VCC</td>
</tr>
<tr>
<td>Voltage monitor 0 reset</td>
<td>The drop in voltage on VCC (reference voltage: Vdet0)</td>
</tr>
<tr>
<td>Voltage monitor 2 reset</td>
<td>The drop in voltage on VCC (reference voltage: Vdet2)</td>
</tr>
<tr>
<td>Oscillation stop detection reset</td>
<td>A stop in the main clock oscillator is detected.</td>
</tr>
<tr>
<td>Watchdog timer reset</td>
<td>The watchdog timer underflows.</td>
</tr>
<tr>
<td>Software reset</td>
<td>Setting the PM03 bit in the PM0 register to 1.</td>
</tr>
</tbody>
</table>

**Figure 3.1  Reset Source Determine Register**

Reserve bit

If necessary, set to 0. The read value is undefined.

HWR Hardware reset detection flag

0: Not detected
1: Detected

SWR Software reset detection flag

0: Not detected
1: Detected

WDR Watchdog timer reset detect flag

0: Not detected
1: Detected

LVD2R Voltage monitor 2 reset detection flag

0: Not detected
1: Detected

OSDR Oscillation stop detection reset detection flag

0: Not detected
1: Detected

Reserved bit

If necessary, set to 0. The read value is undefined.
### Table 3.2  Bit Values in the RSTFR Register after Reset

<table>
<thead>
<tr>
<th>Reset</th>
<th>RSTFR Register Bits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OSDR</td>
</tr>
<tr>
<td>Hardware reset</td>
<td>Not changed</td>
</tr>
<tr>
<td>Power-on reset</td>
<td>0</td>
</tr>
<tr>
<td>Voltage monitor 0 reset</td>
<td>0</td>
</tr>
<tr>
<td>Voltage monitor 2 reset</td>
<td>0</td>
</tr>
<tr>
<td>Oscillation stop detection reset</td>
<td>1</td>
</tr>
<tr>
<td>Watchdog timer reset</td>
<td>0</td>
</tr>
<tr>
<td>Software reset</td>
<td>0</td>
</tr>
</tbody>
</table>
4. Application Example

After reset, read the 256-byte cold start/warm start decision data (hereafter referred to as decision data) assigned to the RAM area. If the read decision data is undefined, it denotes the cold start (power source is turned ON) condition. If the decision data is written, it denotes the warm start condition.

Set the test_bss section and assign variables to be used. In the test_bss section, RAM is cleared only when in the cold start condition.

In this sample program, the test_bss section is assigned to the 000400h address.

Figure 4.1 shows the Application Example of Section Assignment.
4.1 Application Example Operation

Read the decision data and clear the RAM in the test_bss section when in the cold start condition. Then, the number of times to reset and the value in the RSTFR register are output to the port. Figure 4.2 shows the Main Program Flowchart.

---

**Figure 4.2 Main Program Flowchart**

```
main

prc2 ← 1
Set PACR register

mcu_init()
CPU initial setting

peripheral_init()
Peripheral function initial setting

i ← 0
Initialize the number of times to determine.

Read 256 bytes ?

Yes

Equal to decision data ?

Yes (warm_start[i] ≠ i)

i ← i + 1

ram_clear()
Clear RAM

reset_times ++
The number of times to reset + 1.

RESET_TIMES_OUTPUT ← reset_times
Output the number of times to reset to the port.

RSTFR_OUTPUT ← rstfr
Output the reset source determine register value to the port.

i ← 0
Initialize the number of times to write.

Wrote 256 bytes ?

No

Wait until reset is generated.

Yes

warm_start[i] ← i
Write the decision data.

i ← i + 1

No (warm_start[i] = i)
i ← i + 1
```

Note:
1. The PRC2 bit becomes 0 (write disabled) by writing to an SFR area after the PRC2 bit is set to 1 (write enabled) by a program. Set registers protected by the PRC2 bit, using the next instruction after the PRC2 bit is set to 1. Do not generate any interrupts or DMA transfers between these two instructions.
4.2 Section Setting

When declaring variables without assigning a value to them, a compiler usually assigns them to the bss_NO and bss_NE sections, and clears the sections to 0.

In this sample program, assign the variables for use to the test_bss section made by user.

This section describes the program section setting. Refer to the C Compiler User’s Manual for details of the section.

As shown in Figure 4.3, the Section Name is comprised of the section base name followed by an attribute.

Section base name_attribute

Figure 4.3 Section Name

<table>
<thead>
<tr>
<th>Section Base Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>data</td>
<td>Store data with initial values.</td>
</tr>
<tr>
<td>bss</td>
<td>Store data without initial values.</td>
</tr>
<tr>
<td>rom</td>
<td>Store data specified by character strings, #pragma ROM and const modifiers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Meaning</th>
<th>Corresponding Section Base Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Section to hold the initial value in data</td>
<td>data</td>
</tr>
<tr>
<td>N/F/S</td>
<td>N near attribute</td>
<td>data, bss, rom</td>
</tr>
<tr>
<td></td>
<td>F far attribute</td>
<td>data, bss</td>
</tr>
<tr>
<td></td>
<td>S SBDATA attribute</td>
<td></td>
</tr>
<tr>
<td>E/O</td>
<td>E Even-sized data</td>
<td>data, bss, rom</td>
</tr>
<tr>
<td></td>
<td>O Odd-sized data</td>
<td></td>
</tr>
</tbody>
</table>

RAM is cleared using the start-up program as follows:

- Initialize the data near area.
  - bss_NE, bss_NO, bss_SE, bss_SO sections are cleared to 0.
  - Also, the initial values in the ROM areas (data_NEI, data NOI, data_SEI, data_SOI) are transferred to RAM (data_NE, data_NO, data_SE, data_SO).

- Initialize the data far area.
  - bss_FE and bss_FO sections are cleared to 0.
  - Also, the initial values in the ROM areas (data_FEI, data_FOI) are transferred to RAM (data_FE, data_FO).
4.3 Section Setting in HEW

This section describes the method for setting sections in HEW. In the section, “C source startup Application” must be selected when creating a work space.

The test_bss section is already set in this sample program.

(1) Display the Map window. Select MAP from the View pull-down menu.

(2) Select “Map Section Information” from the type of maps. Use the same procedure to select “Map Symbol Information”.

![Map window](image-url)
(3) Click the “Edit Mode” button to edit the section name.
(4) Click the “Add Section Group” button to add “test_bss_NO”.
(5) Use the same procedure to add "test_bss_NE".
(6) Click the "Edit Mode" button to verify the changed linker section information.
(7) test_bss_NE and test_bss_NO sections are assigned.
The variables without initial values described after the #pragma SECTION declaration are assigned to the test_bss section.

Figure 4.5 shows an Example of Section Assignment by Variable Declaration Area.

```c
#pragma SECTION bss test_bss
unsigned char reset_times;
unsigned char warm_start[256];
```

**Figure 4.4 Assigning the Variable and Array to the test_bss Section**

The variables without initial values described after the #pragma SECTION declaration are assigned to the test_bss section.

Figure 4.5 shows an Example of Section Assignment by Variable Declaration Area.

```c
int i;
#pragma SECTION bss test_bss
⇒ Assigned to the bss section.
```

```c
int j;
#pragma SECTION bss test_bss ⇒ Variable without initial values not described after this (variable assigned to bss section) is assigned to the test_bss section.
```

```c
int k=10;
⇒ Assigned to the test_bss section.
```

```c
⇒ Variables with initial values are assigned to the data section.
```
(9) When executing the build, the variable `reset_times` and array `warm_start [256]` are, respectively assigned to the `test_bss_NO` section and the `test_bss_NE` section.
5. Sample Program

A sample program can be downloaded from the Renesas Technology website. To download, click “Application Notes” in the left-hand side menu of the M16C Family page. This sample program is created by using the following versions of the tools.

HEW version: 4.06
NC30 version: 5.45.00

6. Reference Documents

Hardware Manual
M16C/5LD Group, M16C/56D Group Hardware Manual
The latest version can be downloaded from the Renesas Technology website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Technology website.

C Compiler User’s Manual
C compiler package V.5.45 for M16C Series and R8C Family.
The latest information can be downloaded from the Renesas Technology website.
## REVISION HISTORY

<table>
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<th>Rev.</th>
<th>Date</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1.00</td>
<td>Dec. 29, 2009</td>
<td>– First Edition issued</td>
</tr>
</tbody>
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