Abstract

This document describes a method to use oscillator stop detection in the R32C/100 Series.

Products

MCUs: R32C/116 Group
   R32C/117 Group
   R32C/118 Group

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.
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1. Specifications

The oscillator stop detection function detects when the main clock is stopped by an external source. This application note describes a method for turning on an error warning LED when the main clock stops and an oscillator stop detection interrupt is generated.

Table 1.1 lists the Peripheral Function and Its Application. Figure 1.1 shows an Operation Example.

<table>
<thead>
<tr>
<th>Peripheral Function</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillator stop detection</td>
<td>Detects when the main clock stops</td>
</tr>
</tbody>
</table>

![Figure 1.1 Operation Example](image-url)
2. Operation Confirmation Conditions

The sample code accompanying this application note has been run and confirmed under the conditions below.

Table 2.1 Operation Confirmation Conditions

<table>
<thead>
<tr>
<th>Item</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCU used</td>
<td>R5F64189DFD (R32C/118 Group)</td>
</tr>
<tr>
<td>Operating frequencies</td>
<td>• Main clock: 16 MHz&lt;br&gt;• PLL clock: 100 MHz&lt;br&gt;• Base clock: 50 MHz&lt;br&gt;• CPU clock: 50 MHz&lt;br&gt;• Peripheral bus clock: 25 MHz&lt;br&gt;• Peripheral function clock source: 25 MHz</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>5 V</td>
</tr>
<tr>
<td>Integrated development environment</td>
<td>Renesas Electronics Corporation&lt;br&gt;High-performance Embedded Workshop Version 4.07</td>
</tr>
</tbody>
</table>
| C compiler                  | Renesas Electronics Corporation<br>R32C/100 Series C Compiler V.1.02 Release 01<br>Compile options<br>-D__STACKSIZE__=0X300 -D__ISTACKSIZE__=0X300<br>-DVECTOR_ADR=0xFFFFFBDC -c -finfo -dir "$(CONFIGDIR)"
  (Default setting is used in the integrated development environment.) |
| Sample code version         | Version 1.00                                                              |

3. Reference Application Note

The application note associated with this application note is listed below. Refer to this application note for additional information.

- R32C/100 Series Configuring PLL Mode (REJ05B1221-0100)

4. Hardware

4.1 Pin Used

Table 4.1 lists the Pin Used and Its Function.

Table 4.1 Pin Used and Its Function

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>I/O</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>P4_0</td>
<td>Output</td>
<td>This pin connects to the error warning LED.</td>
</tr>
</tbody>
</table>
5. Software

5.1 Operation Overview

When the main clock is stopped, an oscillator stop detection interrupt is generated. In the oscillator stop detection interrupt handling, after setting the base clock divided by 4 and the peripheral function clock source divided by 8, confirm that the CM23 bit in the CM2 register is 1 (main clock oscillator stopped) three times before turning on the error warning LED.

Figure 5.1 shows the Timing Diagram.

![Timing Diagram](image_url)

**Figure 5.1 Timing Diagram**

5.2 Variable

Table 5.1 lists the static Variable.

<table>
<thead>
<tr>
<th>Type</th>
<th>Variable Name</th>
<th>Contents</th>
<th>Function Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>unsigned char</td>
<td>stop_cnt</td>
<td>Main clock stop counter</td>
<td>wdt_int</td>
</tr>
</tbody>
</table>

Note:
1. The PLL frequency synthesizer uses a fixed oscillation frequency to self-oscillate.
5.3 Flowcharts

5.3.1 Main Processing

Figure 5.2 shows the Main Processing.

```
main

(1) Disable maskable interrupts  I flag ← 0

(2) PLL clock setting
    SetPLLClock()  Set clock frequencies in PLL mode.

(3) Enable oscillator stop detection
    Disable protection
    PRCR register ← 01h
    PRC0 bit = 1  : Writing to the CM2 register enabled
    CM2 register ← 01h
    CM20 bit = 1  : Oscillator stop detection enabled
    Enable protection
    PRCR register ← 00h
    PRC0 bit = 0  : Writing to the CM2 register disabled

(4) Set output ports
    P4 register ← 00h
    P4_0S register ← 00h
    PD4 register ← 01h

(5) Enable maskable interrupts  I flag ← 1
```
### 5.3.2 Oscillator Stop Detection Interrupt Handling

Figure 5.3 shows the Oscillator Stop Detection Interrupt Handling.

![Diagram of Oscillator Stop Detection Interrupt Handling]

1. **Low voltage detection interrupt**
   - There is no low voltage detection interrupt handling in this application note.

2. **Main clock stop detected?**
   - **No**

3. **Set base clock divided by 4**
   - **Enable protection**
   - **Disable protection**

4. **Set peripheral clock source divided by 8**
   - **Enable protection**

5. **Main clock stopped?**
   - **No**

6. **Increment the main clock oscillator stop counter**
   - **Yes**

7. **Confirmed main clock oscillator has stopped 3 or more times?**
   - **Yes**

8. **Turn on error warning LED**
   - **P4 register**
   - **P4_0 bit ← 1**

9. **Set main clock oscillator stop counter to 0**
   - **Disable protection**

10. **Clear oscillator stop detection flag**
    - **Enable protection**

---

Figure 5.3 Oscillator Stop Detection Interrupt Handling
6. **Sample Code**

Sample code can be downloaded from the Renesas Electronics website.

7. **Reference Documents**

R32C/118 Group User's Manual: Hardware Rev.1.10
The latest versions can be downloaded from the Renesas Electronics website.

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

C Compiler Manual
R32C/100 Series C Compiler Package V.1.02
C Compiler User's Manual Rev.2.00
The latest version can be downloaded from the Renesas Electronics website.

**Website and Support**

Renesas Electronics website
http://www.renesas.com/

Inquiries
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<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>June 30, 2011</td>
<td>First edition issued</td>
</tr>
</tbody>
</table>
General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins
   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.
   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on
   The state of the product is undefined at the moment when power is supplied.
   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses
   Access to reserved addresses is prohibited.
   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals
   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.
   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products
   Before changing from one product to another, i.e. to one with a different part number, confirm that the change will not lead to problems.
   — The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.
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Renesas Electronics America Inc.
2890 South Boulevard, Santa Clara, CA 95050-3554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
1231 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-3441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Boynoe End, Buckinghamshire, SL8 5FH, UK
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadialage 10, 40472 Düsseldorf, Germany
Tel: +49-211-6687-1530, Fax: +49-211-6687-5670

Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited
12/F, 20th Floor, APL Estate, 1000 Queen’s Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852-2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No.363, Fu Shing North Road, Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics (China) Co., Ltd.
Unit 2201, 2203, 12th Floor, Times Tower, 273, Oulanhai Road, Nei Mongol, China
Tel: +86-10-8325-1193, Fax: +86-10-8325-7679

Renesas Electronics Malaysia Sdn Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46500 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
11/F, Samseol Dong in Bldg., 220-2, Yeoksam-dong, Gangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

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