To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

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

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)
Send any inquiries to http://www.renesas.com/inquiry.
Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.

2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.

3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.

4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.

5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.

6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.

7. Renesas Electronics products are classified according to the following three quality grades: “Standard”, “High Quality”, and “Specific”. The recommended applications for each Renesas Electronics product depend on the product’s quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as “Specific” without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as “Specific” or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is “Standard” unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   “Specific”: Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.

8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.

9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.

10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.

11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.

12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.
M16C/80 Group
The Software Reset Judging Method

1.0 Abstract
The following article introduces the software reset / power-on-reset judging method and its application.

2.0 Introduction
The explanation of this issue is applied in the following condition.
Applicable MCU: M16C/ 80 Group

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 how to judge which reset, software or hardware, is operated.

< Specification for software reset judgment>

The contents of internal RAM are preserved. Write the data proved to be for the software reset operation (data for software reset judgment) to the internal RAM just before software reset is operated. After the reset, the initial setting processor judges which reset, hardware or software, is operated from this data for the software reset judgment. Initialize the data after the reset is operated.

When you use this procedure, be aware of the following timing in which it cannot judge which reset, hardware or software, is operated.
- Hardware reset is operated before the completion of the data initialization in the internal RAM.
- Hardware reset is operated just before the software reset is operated.

A section on 3.1 describes an example of the reset judgment of which reset is operated after software reset is executed while the watchdog timer interrupt is processed.

3.1 Judgment Procedures

The setup procedures for “3.0 Description of the application example” will be shown. Refer to M16C/80 group datasheet for the details of each register.

(1) Set system clock control register 0 (CM0).
   - Set the watchdog timer function select bit to “watchdog timer interrupt”.

\[
\begin{array}{c}
\text{b7} \\
\text{b0}
\end{array}
\]

\[
\begin{array}{c}
0 \\
0
\end{array}
\]

CM06 : watchdog timer function select bit
"0"(watchdog timer interrupt)

(Note) : When writing this register, set bit 0 in the protect register (000A16 address) to “1”.

(2) Set the watchdog timer control register (WDC).
   - Set prescaler.

\[
\begin{array}{c}
\text{b7} \\
\text{b0}
\end{array}
\]

\[
\begin{array}{c}
0 \\
0
\end{array}
\]

Be sure to set to “0”.

WDC7 : prescaler select bit
"0"(16 dividing), "1"(128 dividing)

(3) Set the watchdog timer start register (WDTS).
   - The watchdog timer is initialized by writing to this register to be started.
(4) Occurrence of the watchdog timer interrupt
   - The watchdog timer interrupt occurs by underflow.

(5) Set the data for the software reset judgment.
   - The contents of the internal RAM are preserved. Set the data for the software reset judgment in the internal RAM.

(Note) When power-on of hardware reset is operated, the internal RAM becomes indeterminate. Use at least 20 to 30 bytes of data space for the data for the software reset judgment to avoid the accidental coincidence of the internal RAM. The more data space to be used in the internal RAM is, the more reliable the judgment is. Also, each address should have a different value in the internal RAM to improve a reliability of the judgment.

(6) Set processor mode register 0 (PM0).
   - Execute the software reset.

<table>
<thead>
<tr>
<th>b7</th>
<th>b6</th>
<th>b5</th>
<th>b4</th>
<th>b3</th>
<th>b2</th>
<th>b1</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   PM03 : software select bit
   Setting this bit to “1” resets the microcomputer.

(Note) : When writing this register, set bit 0 in the protect register (000A16 address) to “1”.

(7) The reset of the microcomputer is executed.

(8) Judging whether the software reset or hardware reset is executed.
   - Does the data for the software reset judgment in the internal RAM correspond with the data set in the process of (5) on the above?
     Yes → the software reset
     No → the hardware reset

(9) Clear the data for the software reset judgment.
   - Clear the data for the next judgment.

(10) Start each processing for the hardware reset / the software reset.

**Cautions**

The judgment cannot be performed when the hardware reset is executed before the data for the software reset judgment is completely cleared and before the software reset is executed.

(The judgment cannot be performed when the hardware reset is executed during (5) to (9) on the above procedures.)
4.0 Program sample

#include "sfr80144.h" // SFR definition header

#pragma SECTION bss aaa // change the data section name(bss -> aaa)
#pragma SECTION program aaa_prog // change the program section name

unsigned char   wdt_flg[256];   // S/W-RESET decision table
unsigned char   reset_flg;     // S/W-RESET,H/W-RESET decision result
                                // 0:S/W-RESET, 1:H/W-RESET

void wdt_exe(void);
void ta0_init(void);
void ta0_int(void);
void wdt_int(void);
/***************************************************************
/*     main function                                          */
/*     The software reset judging method sample program    */
/***************************************************************

void main(void)
{
    pd10 = 0xff;                        // P10 is an output port.
    pd8 = 0x1f;                         // P8_0-P8_4 are output ports.
    pd6 = 0xff;                         // P6 is an output port.
    p10 = 0;                            // Port initialization.
    p8  = 0;                            //
    p6  = 1;                            //

    ta0_init();                       // TA0 initialization
    ta0s = 1;                          // TA0 start
    while(ir_ta0ic == 0)
    {
        ;                               // Timing adjustment
    }
    ta0s = 0;                          // TA0 stop

    wdt_exe();                         // Software-Rest decision & WDT execution

    while(1)
    {
        p8_0  = !p8_0;                  // Monitor
    }
}

/***************************************************************
/*     Timer-A0 initialization           */
/***************************************************************

void ta0_init(void)
{
    ta0mr = 0x80;                      // Timer-mode(132)
    ta0  = 0x8fff;                     // Timer-value set
ta0ic = 0;                          // Interruption priority level = 0
}

/****************************************/
/*    S/W-RESET decision                */
/*     &  WDT  execution                    */
/****************************************/
void wdt_exe(void)
{
    int      i;
    p10 = wdt_flg[255];                 //

    reset_flg = 0;                      // S/W-RESET
    for (i=0;i<256;i++)
    {
        if (wdt_flg[i] != i)             // S/W-RESET decision table miss-match
        {
            reset_flg = 1;              // H/W-RESET
            break;
        }
    }
    memset(wdt_flg, 0x0, 5);            // S/W-RESET decision table "0" clear

    prcr = 7;                            // protect OFF
    cm06 = 0;                            // WDT chooses interruption.
    prcr = 0;                            // protect ON
    wdc = 0x80;                           // Prescaler division ratio (128)
    wdt_s = 1;                            // WDT start
}

/****************************************/
/*    Timer-A0 interrupt routine        */
/****************************************/
#pragma INTERRUPT/B ta0_int
void ta0_int(void)
{
    p6_3 = !p6_3;                        //
/****************************************/
/*    Watch-Dog-Timer interrupt routine */
/****************************************/

#pragma INTERRUPT/B wdt_int

void wdt_int(void)
{
    int i;

    for (i=0;i<256;i++)
    {
        wdt_flg[i] = i;                 // S/W-RESET decision table set
    }

    p8_4 = 1;

    ta0_init();
    ta0s = 1;                            // TA0 start
    while(ir_ta0ic == 0)               // Timing adjustment
    {
    }

    prcr = 7;                            // protect OFF
    pm03 = 1;                            // S/W-RESET execution
    prcr = 0;                            // protect ON
    while(1)
    {
    }
}

5.0 Reference

Datasheet

- Refer to M16C/80 Group datasheet.
  (Acquire the most current version from Renesas Technology website)

6.0 Web-site and contact for support

Renesas Web-site

http://www.renesas.com

Contact for Renesas technical support

Mail to: support_apl@renesas.com
## REVISION HISTORY

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.10</td>
<td>Nov.14, 2003</td>
<td>First edition issued</td>
</tr>
</tbody>
</table>
Keep safety first in your circuit designs!

1. Renesas Technology Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corporation product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corporation or a third party.
2. Renesas Technology Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor for the latest product information before purchasing a product listed herein.
   The information described here may contain technical inaccuracies or typographical errors. Renesas Technology Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
   Please also pay attention to information published by Renesas Technology Corporation by various means, including the Renesas Technology Corporation Semiconductor home page (http://www.renesas.com).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corporation is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination. Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corporation for further details on these materials or the products contained therein.