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 depends 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.

M32C/84 Group

Operation of Timer A (event counter mode, free run type selected)

1. Abstract

In event counter mode, choose functions from those listed in Table 1. Operations of the circled items are described below. Figure 1 shows the operation timing, and Figure 2 shows the set-up procedure.
A reference program is an example when using the Timer A0 interrupt based on the setting procedure of Figure 2.

2. Introduction

This application note is applied to the M32C/84 group Microcomputers.

This program can be operated under the condition of M16C family products with the same SFR(Special Function Register) as M32C/84 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. Choosed functions

Table 1. Choosed functions

Item	Set-up		Item	Set-up	
Count source	O	Input signal to TAiIN (counting falling edges)	Pulse output function	O	No pulses output
					Pulses output
		Input signal to TAiIN (counting rising edges)	Count operation type		Reload type
				O	Free-run type
		Timer overflow (TB2/TAj overflow)	Factor for switching between up and down	O	Content of up/down flag
					Input signal to TAiOUT

Note: j=i-1, but j=4 when i=0

4. Operation

(1) Setting the count start flag to “1” causes the counter to count the falling edges of the count source.
(2) Even if an underflow occurs, the content of the reload register is not reloaded, but the count continues. At this time, the timer Ai interrupt request bit goes to “1”.
(3) If switching from an up count to a down count or vice versa while a count is in progress, the switch takes effect from the next effective edge of the count source.
(4) Even if an overflow occurs, the content of the reload register is not reloaded, but the count continues. At this time, the timer Ai interrupt request bit goes to “1”.

Note

- When not using pulse output, do not select TAiOUT output function with the function select register A and B.

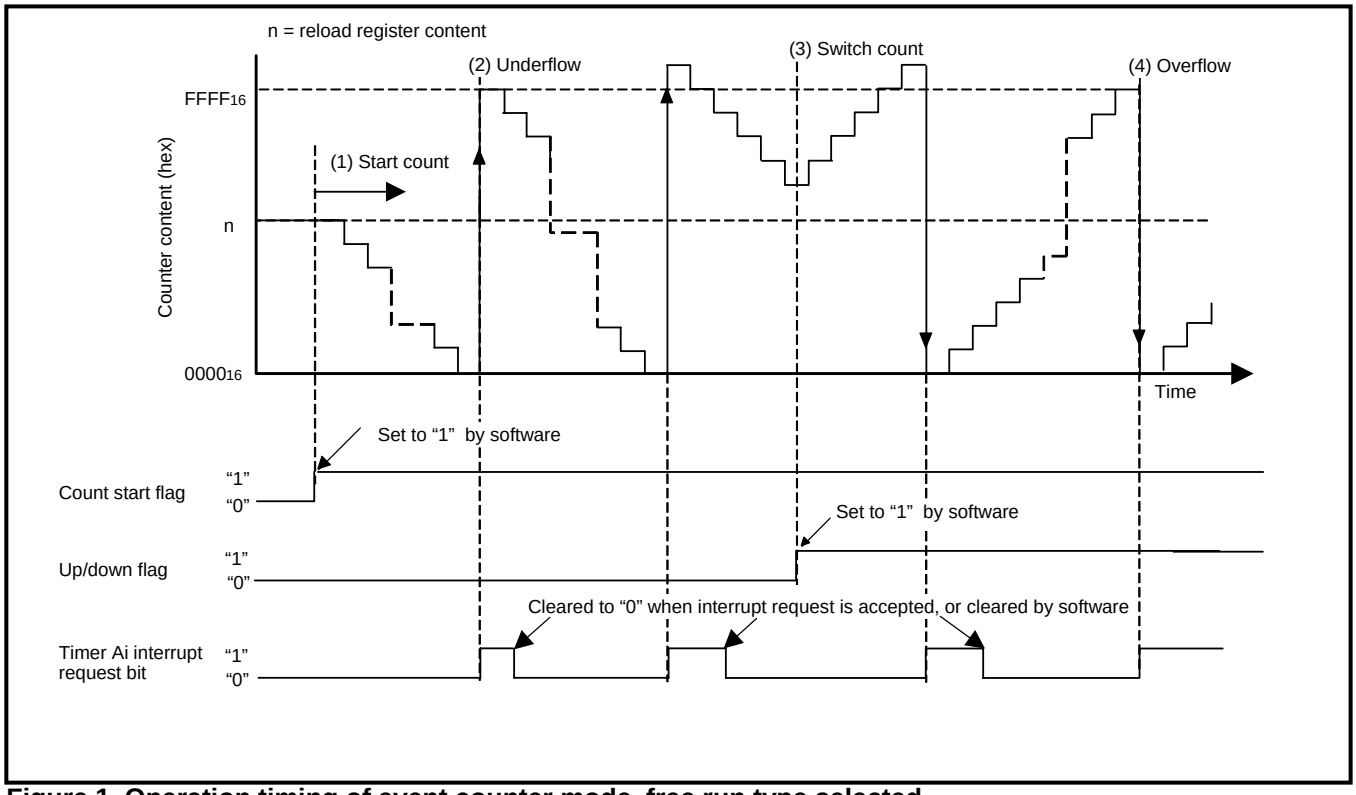

Figure 1. Operation timing of event counter mode, free run type selected

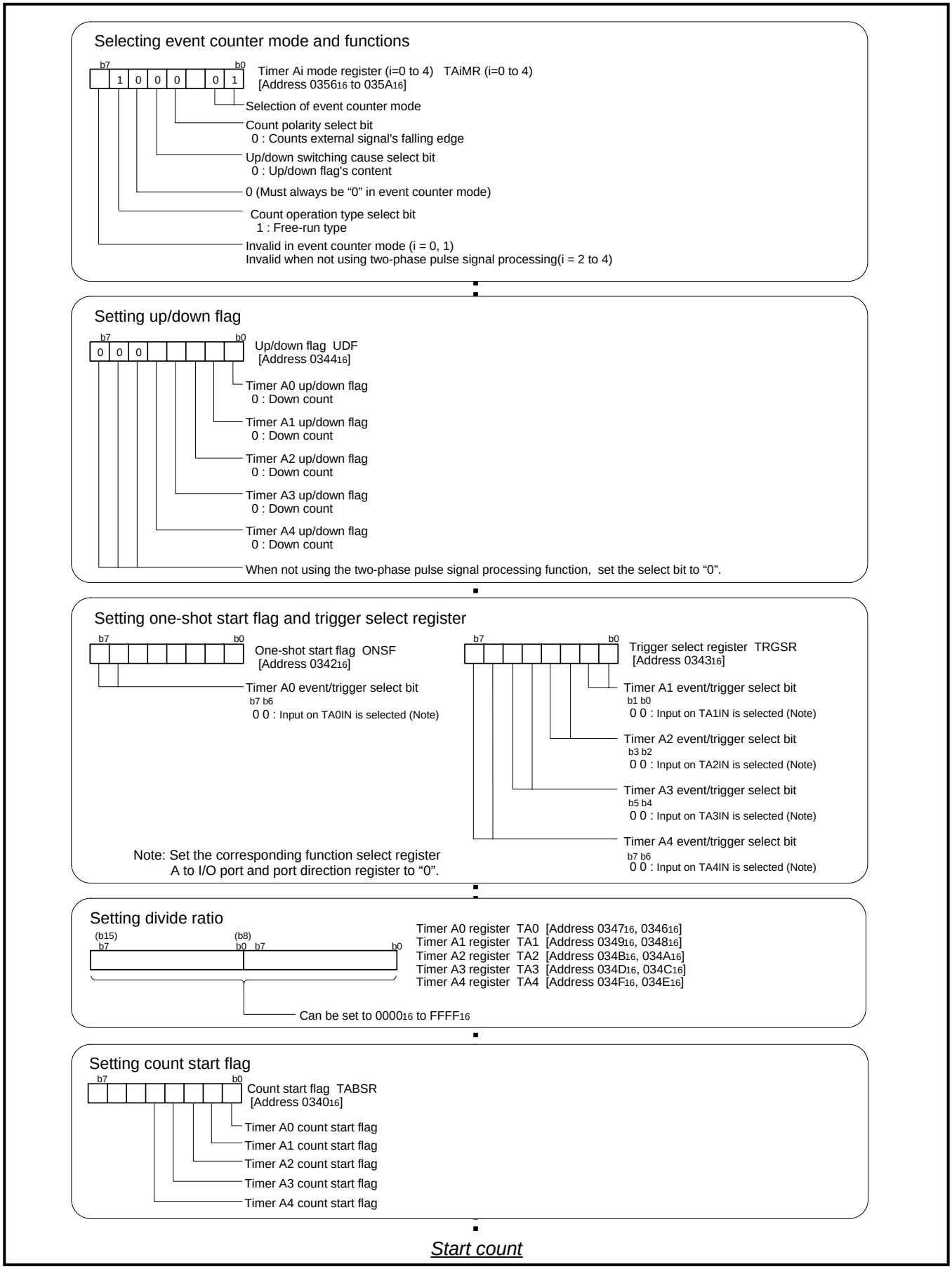

Figure 2. Set-up procedure of event counter mode, free run type selected

5. The example of reference program

```
;***************************************************************************
;
;    M32C/84 Program Collection
;
;    FILE NAME : rjj05b0711_src.a30
;    CPU       : M32C/84 Group
;    FUNCTION  : Operation of Timer A (event counter mode, free run type selected)
;    HISTORY   : 2005.1.31   Ver 1.00
;
;    Copyright(C)2005, Renesas Technology Corp.
;    Copyright(C)2005, Renesas Solutions Corp.
;    All rights reserved.
;
;***************************************************************************
;***************************************************************************
;         Include
;***************************************************************************
;
        .LIST       off                 ;Stops outputting lines to the assembler list file
        .INCLUDE    sfr32c84.inc        ;Reads the file that defined SFR
        .LIST       on                  ;Starts outputting lines to the assembler list file
;
;***************************************************************************
;         Symbol definition
;***************************************************************************
;
RAM_TOP             .equ    000400h     ;Start address of RAM
RAM_END             .equ    002affh     ;End address of RAM
ROM_TOP             .equ    0fe0000h    ;Start address of ROM
VECT_TOP            .equ    0fffe00h    ;Start address of vect_top
FIXED_VECT_TOP      .equ    0ffffdch    ;Start address of fixed_vect_top
;
;***************************************************************************
;         Program area
;***************************************************************************
;=========================================================================
;         Start up
;=========================================================================
        .SECTION    PROGRAM, CODE       ;Declares section name and section type
        .ORG        ROM_TOP             ;Declares start address
START:
        ldc         #RAM_END+1,isp      ;Sets interrupt stack pointer
        mov.b       #03h, prcr          ;Removes protect
        mov.b       #00000000b, pm0     ;Single-chip mode
        mov.b       #00000000b, pm1     ;
```

```
        mov.b       #00001000b, cm0         ;Xcin-Xcout High
        mov.b       #00100000b, cm1         ;
        mov.b       #00010010b, mcd         ;No division mode
        mov.b       #00h, prcr              ;Protects all registers
        ldc         #VECT_TOP,intb          ;Sets interrupt table register
;
;===============================================================================
;       Main program
;===============================================================================
;
        mov.b       #01000001b, ta0mr       ;Timer A0 mode register
;                     | | | | |  ++--------------------;Selection of event counter mode
;                     | | | | |                        ;
;                     | | | | +--------------------------;Count polarity select bit
;                     | | | |                          ;(0:counts external signal's falling edge)
;                     | | | +--------------------------;Up/down switching cause select bit (0:up/down flag's
;                     | | |                            ;content)
;                     | | +--------------------------;Must always be "0" in event counter mode
;                     | +--------------------------;Count operation type select bit (1:free-run type)
;                     +--------------------------;When not using the 2-phase pulse signal processing
;                                                ;function, set the select bit to "0"
        mov.b       #00000000b, udf         ;
;                     | | |       +----------------------;Timer a0 up/down flag (0:down count)
;                     +++--------------------------;When not using the 2-phase pulse signal processing
;                                                ;function, set the select bit to "0"
        mov.b       #00000000b, onsf        ;
;                     ++--------------------------;Timer a0 event/trigger select bit
;                                                ;(00:input on ta0in is selected) (note)
        bclr        pd7_1                       ;(Note)Set the corresponding port direction
;                                               ;register to "0"(TA0IN)
        bclr        ps1_1                       ;Port p7_1 is i/o port
        mov.w       #5, ta0                     ;Timer A0 register
        mov.b       #00000011b,ta0ic            ;Interrupt control register
;                           |+++----------------;Interrupt priority level select bit
;                           |                   ;(011:Level 3, interrupt disabled)
;                           +-------------------;Interrupt request bit (0:interrupt not requested)
        mov.b       #00000001b, tabsr           ;
;                             +----------------;Timer a0 count start flag
        fset        i                           ;Set interrupt enable flag
;
MAIN:
        jmp         MAIN
;
;===============================================================================
;       Interrupt program
;===============================================================================
TA0_INT:
```

```
;                   ;/ TA0 interrupt routine /
                    reit
;
;=============================================================================
;           Dummy interrupt processing program
;=============================================================================
DUMMY:
                    reit
;
;*****************************************************************************
;           Setting of variable vector table
;*****************************************************************************
;
        .SECTION        VECT,ROMDATA
        .ORG            VECT_TOP + (8*4)
;
        .lword                  DUMMY       ;DMA0 interrupt vector
        .lword                  DUMMY       ;DMA1 interrupt vector
        .lword                  DUMMY       ;DMA2 interrupt vector
        .lword                  DUMMY       ;DMA3 interrupt vector
        .lword                  TA0_INT     ;TA0 interrupt vector
        .lword                  DUMMY       ;TA1 interrupt vector
        .lword                  DUMMY       ;TA2 interrupt vector
        .lword                  DUMMY       ;TA3 interrupt vector
        .lword                  DUMMY       ;TA4 interrupt vector
        .lword                  DUMMY       ;UART0 transmit/NACK interrupt vector
        .lword                  DUMMY       ;UART0 receive/ACK interrupt vector
        .lword                  DUMMY       ;UART1 transmit/NACK interrupt vector
        .lword                  DUMMY       ;UART1 receive/ACK interrupt vector
        .lword                  DUMMY       ;TB0 interrupt vector
        .lword                  DUMMY       ;TB1 interrupt vector
        .lword                  DUMMY       ;TB2 interrupt vector
        .lword                  DUMMY       ;TB3 interrupt vector
        .lword                  DUMMY       ;TB4 interrupt vector
        .lword                  DUMMY       ;INT5 interrupt vector
        .lword                  DUMMY       ;INT4 interrupt vector
        .lword                  DUMMY       ;INT3 interrupt vector
        .lword                  DUMMY       ;INT2 interrupt vector
        .lword                  DUMMY       ;INT1 interrupt vector
        .lword                  DUMMY       ;INT0 interrupt vector
        .lword                  DUMMY       ;TB5 interrupt vector
        .lword                  DUMMY       ;UART2 transmit/NACK interrupt vector
        .lword                  DUMMY       ;UART2 receive/ACK interrupt vector
        .lword                  DUMMY       ;UART3 transmit/NACK interrupt vector
        .lword                  DUMMY       ;UART3 receive/ACK interrupt vector
        .lword                  DUMMY       ;UART4 transmit/NACK interrupt vector
        .lword                  DUMMY       ;UART4 receive/ACK interrupt vector
```

```
        .lword                  DUMMY       ;Bus collision detection,start/stop
                                            ;condition detection (UART2) interrupt vector
        .lword                  DUMMY       ;Bus collision detection,start/stop
                                            ;condition detection (UART3) interrupt vector
        .lword                  DUMMY       ;Bus collision detection,start/stop
                                            ;condition detection (UART4) interrupt vector
        .lword                  DUMMY       ;A-D interrupt vector
        .lword                  DUMMY       ;KEY interrupt vector
        .lword                  DUMMY       ;IntelligentI/O interrupt vector0
        .lword                  DUMMY       ;IntelligentI/O interrupt vector1
        .lword                  DUMMY       ;IntelligentI/O interrupt vector2
        .lword                  DUMMY       ;IntelligentI/O interrupt vector3
        .lword                  DUMMY       ;IntelligentI/O interrupt vector4
        .lword                  DUMMY       ;IntelligentI/O interrupt vector8
        .lword                  DUMMY       ;IntelligentI/O interrupt vector9,CAN0
        .lword                  DUMMY       ;IntelligentI/O interrupt vector10,CAN1
        .lword                  DUMMY       ;CAN2
;
;*****************************************************************************
;           Setting of fixed vector
;*****************************************************************************
;
        .SECTION        F_VECT,ROMDATA
        .ORG            FIXED_VECT_TOP
;
        .lword                  DUMMY       ;Undefined instruction interrupt vector
        .lword                  DUMMY       ;Overflow interrupt vector
        .lword                  DUMMY       ;BRK instruction interrupt vector
        .lword                  DUMMY       ;Address match interrupt vector
        .lword                  DUMMY       ;
        .lword                  DUMMY       ;Watchdog timer interrupt vector
        .lword                  DUMMY       ;
        .lword                  DUMMY       ;NMI interrupt vector
        .lword                  START       ;Sets start vector
;
        .end
```

6. Referense

Hardware manual

M32C/84 group (Tentative version) Hardware Manual Rev.0.50

(Use the latest version on the web-site: http://www.renesas.com)

7. Web-site and contact for support

Renesas web-site

http://www.renesas.com/

Contact for Renesas technical support

E-mail: support_apl@renesas.com

Revision

Rev.	Issue data	Revised	
		Page	Point
1.00	2005.1.31	-	First edition issued

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.