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.

SH7262/SH7264 Group

Transferring Program to RAM (DMA Transfer)

Summary

This application note describes an example of transferring program to RAM using the SH7262/SH7264 Microcomputers (MCUs) Direct Memory Access Controller (DMAC).

Target Device

SH7264 MCU (In this document, SH7262/SH7264 are described as "SH7264".)

Contents

1. Introduction

1.1 Specifications

Activates the SH7264 MCU Direct Memory Access Controller (DMAC) to transfer program from an external ROM to internal RAM, and executes the program on internal RAM.

1.2 Modules Used

- Direct Memory Access Controller (DMAC)

1.3 Applicable Conditions

MCU	SH7262/SH7264
Operating Frequency	Internal clock: 144 MHz Bus clock: 72 MHz Peripheral clock: 36 MHz
Integrated Development Environment	Renesas Technology Corp. High-performance Embedded Workshop Ver.4.04.01
C compiler	Renesas Technology SuperH RISC engine Family C/C++ compiler package Ver.9.02 Release 00
Compiler options	Default setting in the High-performance Embedded Workshop (-cpu=sh2afpu -fpu=single -object="$(CONFIGDIR)\$(FILELEAF).obj" -debug -gbr=auto -chgincpath -errorpath -global_volatile=0 -opt_range=all -infinite_loop=0 -del_vacant_loop=0 -struct_alloc=1 –nologo)

1.4 Related Application Note

Refer to the related application notes as follows:

- SH7262/SH7264 Group Example of Initialization
- SH7262/SH7264 Group Transferring Program to RAM (CPU Transfer)

2. Applications

The SH7264 DMAC transfers program from an external ROM to internal RAM, and executes the program on internal RAM.

2.1 Section Alignment in the Sample Program

Use the compiler extended specifications #pragma section to change the section name of the program to transfer. The sample program changes the section of the transfer source program to PROM, and the section of the transfer destination program on internal RAM to PRAM. The following figure shows the memory map in the sample program.

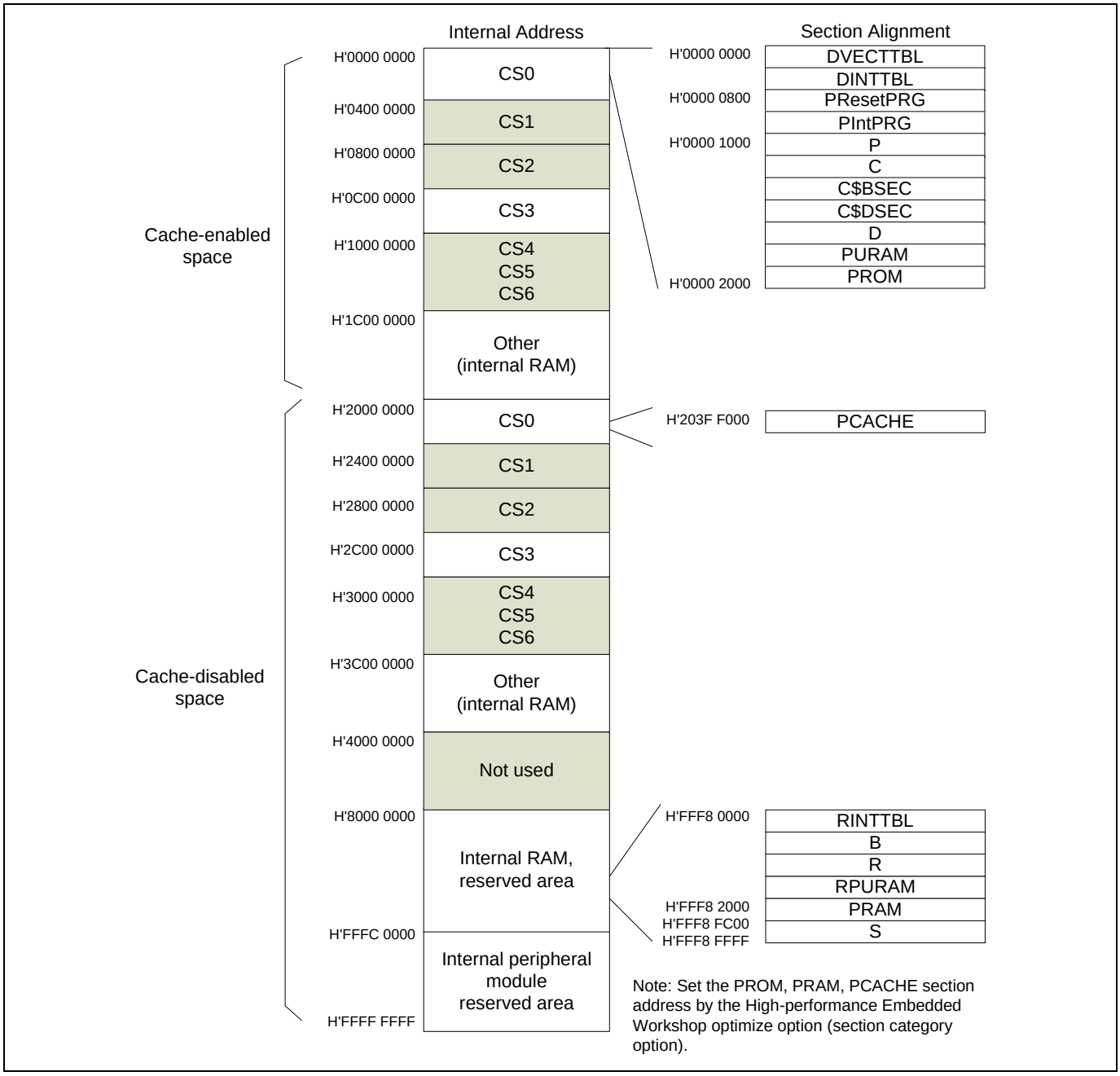

Figure 1 Memory Map

2.2 Linkage Editor Setting

Specify the section address by the linkage editor options. Table 1 lists sections to transfer in the sample program. Table 2 lists linkage editor options to use.

Table 1 Sections to Transfer

Section Name	Description
PROM	Transfer source
PRAM	Transfer destination

Note: When specifying the section address, select [Build] menu on the High-performance Embedded Workshop window, and open the [SuperH RISC engine Standard Toolchain] dialog box. For details, refer to the High-performance Embedded Workshop User's Manual.

Table 2 Linkage Editor Options

Option	Description
-rom=D=R,DINTTBL=RINTTBL, PURAM=RPURAM,**PROM=PRAM**	Specifies ROM to RAM mapped sections
start=DVECTTBL,DINTTBL/00,PResetPRG, PIntPRG/0800,P,C,C$BSEC,C$DSEC,D,PURAM, **PROM/01000**,PCACHE/0203FF000,RINTTBL,B, R,RPURAM/0FFF80000,**PRAM/0FFF82000**,S/0FFF8FC00	Specifies a section starting address

2.3 Retrieving the Section Address

Use the section address operators listed in the following table to retrieve the section address in the program.

Table 3 Address Operators

Format	Description
__sectop (" <section name> ")	Refers to the starting address of the specified <section name>.
__secend (" <section name> ")	Refers to the end address +1 of the specified <section name>.
__secsize (" <section name> ")	Generates the size of the specified <section name>.

2.4 Sample Program Operation

The sample program sets the DMAC in auto request mode, transfers the section PROM size program from the section PROM starting address in CS0 space to the section PRAM allocated on internal RAM. To verify that this works, allocate a function using the compare match timer (io_blink_led function) to the section PROM, and transfers it on internal RAM. When the transfer is completed, the sample program executes the io_blink_led function.

2.5 Note for altering the transfer procedure by CPU

When the CPU transfers the program (transfer by software) to the cache-enabled space while the operand cache (write back mode) is enabled, the program transferred may be fetched by the operand cache and the instruction fetch may not be executed. Write back the operand cache before transferring the program to the cache-enabled space by CPU.

As the sample program transfers program by the DMAC, this is not applicable.

2.6 Sample Program Flow

Table 4 shows the register settings in the sample program. Figure 2 shows flow chart of the sample program.

Table 4 Register Settings for Program Transfer

Register Name	Address	Setting	Function
Standby control register 2 (STBCR2)	H'FFFE 0018	H'00	MSTP8 = "0": DMAC is operating
DMA channel control register_0 (CHCR_0)	H'FFFE 100C	H'0000 0000	Before enabling DMA • DE = 0: Disables the DMA transfer
		H'8000 5428	DMA Configuration • TC = 1: Transfers data for number of times specified by the DMATCR, by a transfer request • RLDSAR = 0: Disables the function to reload SAR • RLDDAR = 0: Disables the function to reload DAR • TEMASK = 0: Stops transfer when TE bit is set to 1 • DM [1:0] = B'01: Increments the destination address • SM [1:0] = B'01: Increments the source address • RS [3:0] = B'0100: Auto request
		H'8000 5429	• TB = 1: Burst mode • TS [1:0] = B'01: Transfers data in words • DE = 0: Disables the DMA transfer When DMA transfer is enabled: • DE = 1: Enables the DMA transfer
DMA source address register_0 (SAR_0)	H'FFFE 1000	–	• Transfer source address: Starting address in the section PROM
DMA destination address register (DAR_0)	H'FFFE 1004	–	• Transfer destination address: Starting address in the PRAM section
DMA transfer count register_0 (DMATCR_0)	H'FFFE 1008	–	Number of times of DMA transfer: 1/2 of the section PROM size
DMA operation register (DMAOR)	H'FFFE 1200	H'0000 0001	• DME = 1: Enables the DMA transfer on all channels

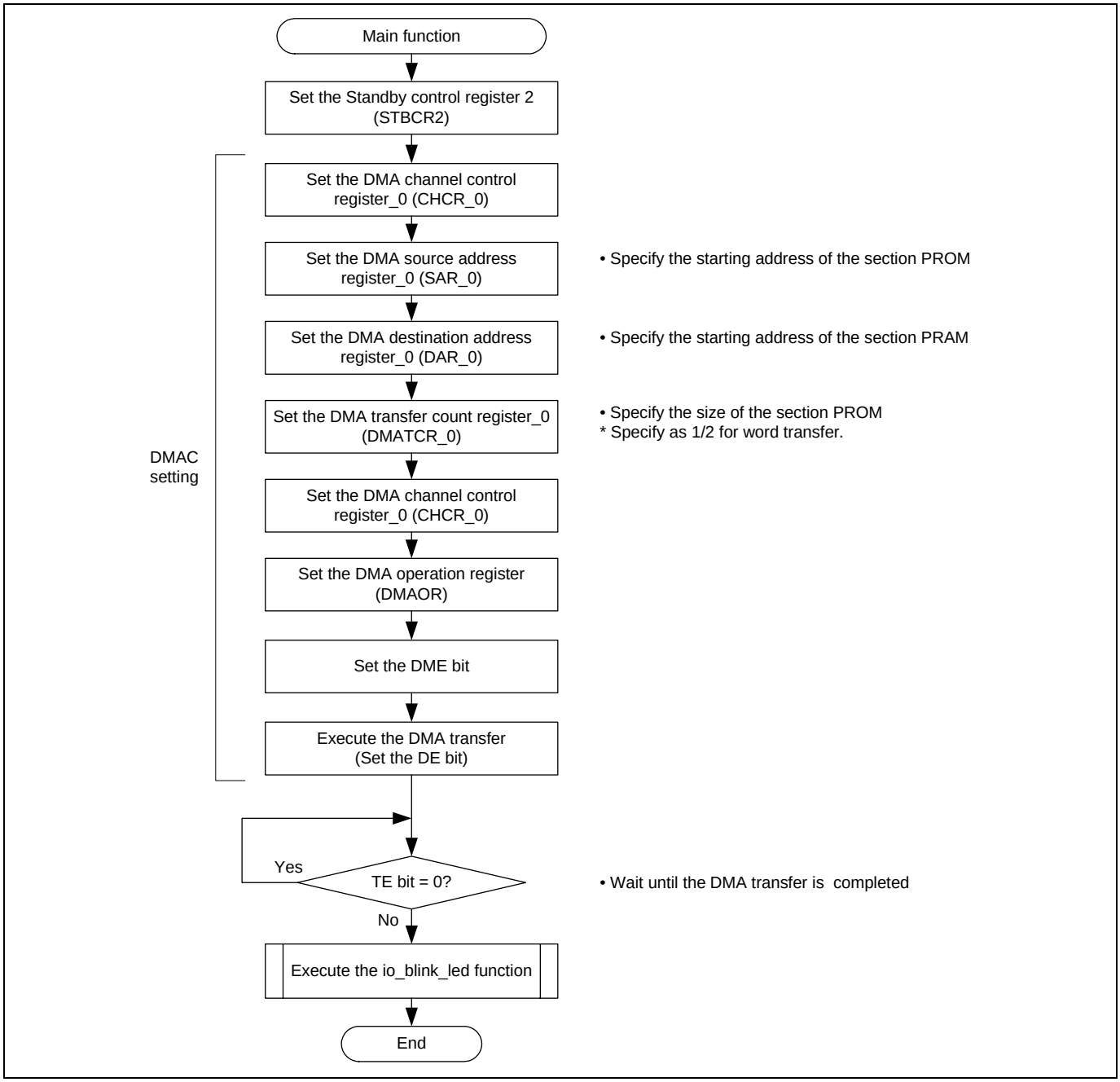

Figure 2 Sample Program Flow Chart

3. Sample Program Listing

3.1 Sample Program Listing "main.c" (1/6)

```
/***********************************************************************
*   DISCLAIMER
*
*   This software is supplied by Renesas Technology Corp. and is only
*   intended for use with Renesas products. No other uses are authorized.
*
*   This software is owned by Renesas Technology Corp. and is protected under
*   all applicable laws, including copyright laws.
*
*   THIS SOFTWARE IS PROVIDED "AS IS" AND RENESAS MAKES NO WARRANTIES
*   REGARDING THIS SOFTWARE, WHETHER EXPRESS, IMPLIED OR STATUTORY,
*   INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY, FITNESS FOR A
*   PARTICULAR PURPOSE AND NON-INFRINGEMENT.  ALL SUCH WARRANTIES ARE EXPRESSLY
*   DISCLAIMED.
*
*   TO THE MAXIMUM EXTENT PERMITTED NOT PROHIBITED BY LAW, NEITHER RENESAS
*   TECHNOLOGY CORP. NOR ANY OF ITS AFFILIATED COMPANIES SHALL BE LIABLE
*   FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES
*   FOR ANY REASON RELATED TO THE THIS SOFTWARE, EVEN IF RENESAS OR ITS
*   AFFILIATES HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.
*
*   Renesas reserves the right, without notice, to make changes to this
*   software and to discontinue the availability of this software.
*   By using this software, you agree to the additional terms and
*   conditions found by accessing the following link:
*   http://www.renesas.com/disclaimer
***********************************************************************
*   Copyright (C) 2009. Renesas Technology Corp., All Rights Reserved.
*""FILE COMMENT""*********** Technical reference data *************************
*   System Name : SH7264 Sample Program
*   File Name   : main.c
*   Abstract    : Transferring Program to RAM (DMA Transfer).
*   Version     : 1.00.00
*   Device      : SH7262/SH7264
*   Tool-Chain  : High-performance Embedded Workshop (Ver.4.04.01).
*               : C/C++ compiler package for the SuperH RISC engine family
*               :                             (Ver.9.02 Release00).
*   OS          : None
*   H/W Platform: M3A-HS64G50 (CPU board)
*   Description :
***********************************************************************
*   History     : Aug.04,2009 Ver.1.00.00
*""FILE COMMENT END""*****************************************************/
#include <machine.h>
#include "iodefine.h"
```

3.2 Sample Program Listing "main.c" (2/6)

```
46
47    /* ==== Prototype declaration ==== */
48    void main(void);
49    void io_blink_led(void);
50    void io_init_cmt0(void);
51
52    /*""FUNC COMMENT""*****************************************************************
53     * ID           :
54     * Outline      : Sample program main (Transfer program from ROM to RAM).
55     *-------------------------------------------------------------------------------
56     * Include      : iodefine.h
57     *-------------------------------------------------------------------------------
58     * Declaration  : void main(void);
59     *-------------------------------------------------------------------------------
60     * Description  : Transfers the section PROM to the section PRAM allocated on
61     *              : internal RAM by the DMAC, and executes the transferred program
62     *              : (io_blink_led function).
63     *-------------------------------------------------------------------------------
64     * Argument     : void
65     *-------------------------------------------------------------------------------
66     * Return Value : void
67     *-------------------------------------------------------------------------------
68     * Note         :
69     *""FUNC COMMENT END""*************************************************************/
70    void main(void)
71    {
72      unsigned long dummy;
73
74      /* ==== Sets the Standby control register 2 (STBCR2) ==== */
75      CPG.STBCR2.BIT.MSTP8 = 0;       /* Enables the DMAC */
76
77      /* ---- Sets the DMA channel control register_0 (CHCR_0) ---- */
78      DMAC.CHCR0.BIT.DE = 0;          /* Disables the DMA transfer */
79
80      /* ==== Sets the DMA source address register_0 (SAR_0) ==== */
81      DMAC.SAR0.LONG = (unsigned long)__sectop("PROM");  /* Refers to the starting
82                                                            address in the section PROM */
83
84      /* ==== Sets the DMA destination address register_0 (DAR_0) ==== */
85      DMAC.DAR0.LONG = (unsigned long)__sectop("PRAM");  /* Refers to the starting
86                                                            address in the section PRAM */
87
88      /* ==== Sets the DMA transfer count register_0 (DMATCR_0) ==== */
89      DMAC.DMATCR0.LONG = __secsize("PROM") / sizeof(unsigned short);
90
```

3.3 Sample Program Listing "main.c" (3/6)

```
91      /* ==== Sets the DMA channel control regieter_0 (CHCR_0) ==== */
92      dummy = DMAC.CHCR0.LONG;
93      DMAC.CHCR0.LONG = 0x80005428ul;
94                  /*
95                          bit 31      : TC DMATCR transfer: 1----- Number of times
96                                                                   by DMATCR
97                          bit 30      : reserve 0
98                          bit 29      : RLDSAR: 0----------------- Disables the function
99                                                                   to reload SAR
100                         bit 28      : RLDDAR: 0----------------- Disables the function
101                                                                  to reload DAR
102                         bit 27      : reserve 0
103                         bit 26      : DAF: 0-------------------- Not used
104                         bit 25      : SAF: 0-------------------- Not used
105                         bit 24      : reserve 0
106                         bit 23      : DO: 0--------------------- Not used
107                         bit 22      : TL: 0--------------------- Not used
108                         bit 21      : reserve 0
109                         bit 20      : TEMASK: 0----------------- Stops transfer
110                                                                  when TE bit is 1
111                         bit 19      : HE: 0--------------------- Not used
112                         bit 18      : HIE: 0-------------------- Not used
113                         bit 17      : AM: 0--------------------- Not used
114                         bit 16      : AL: 0--------------------- Not used
115                         bit 15 to 14: DM [1:0]: B'01------------ Increments
116                                                                  the destination address
117                         bit 13 to 12: SM [1:0]: B'01------------ Increments
118                                                                  the source address
119                         bit 11 to 8 : RS [3:0]: B'0100---------- Auto request
120                         bit 7       : DL: DREQ level : 0 ------- Not used
121                         bit 6       : DS: DREQ select : 0------- Not used
122                         bit 5       : TB: 1--------------------- Burst mode
123                         bit 4 to 3  : TS [1:0]: B'01------------ Transfers data
124                                                                  in words
125                         bit 2       : IE: 0--------------------- Disables interrupts
126                         bit 1       : TE: 0--------------------- Clears the TE flag
127                         bit 0       : DE: 0--------------------- Disable the DMA transfer
128                 */
129
```

3.4 Sample Program Listing "main.c" (4/6)

```
130     /* ==== Sets the DMA operation register (DMAOR) ==== */
131     dummy = DMAC.DMAOR.WORD;
132     DMAC.DMAOR.WORD = 0x0000u;
133                 /*
134                         bit 15 to 14: reserve 0
135                         bit 13 to 12: CMS [1:0]: B'00------------   Normal mode
136                         bit 11 to 10: reserve 0
137                         bit 9 to 8  : PR [1:0]: B'00-------------   Fixed mode 1
138                         bit 7 to 3  : reserve 0
139                         bit 2       : AE: 0--------------------- Clears the
140                                                                  address error flag
141                         bit 1       : NMIF: 0------------------- Clears the NMI flag
142                         bit 0       : DME: 0-------------------- Disables the DMA
143                                                                  transfer on all channels
144                 */
145     /* ==== Sets the DME bit ==== */
146     DMAC.DMAOR.BIT.DME = 1;
147
148     /* ==== Executes the DMA (sets the DE bit) ==== */
149     DMAC.CHCR0.BIT.DE = 1;
150
151     /* ==== Waits for the DMA transfer end ==== */
152     while( DMAC.CHCR0.BIT.TE == 0 ){
153       /* Wait */
154     }
155     /* ==== Executes the CMT0 function ==== */
156     io_blink_led();         /* Inverts port A0 */
157   }
158
159   #pragma section ROM    /* Following section P is handled as section PROM */
```

3.5 Sample Program Listing "main.c" (5/6)

```
160   /*""FUNC COMMENT""*****************************************************************
161    * ID           :
162    * Outline      : Count at a constant period
163    *-------------------------------------------------------------------------------
164    * Include      : iodefine.h
165    *-------------------------------------------------------------------------------
166    * Declaration  : void io_blink_led(void);
167    *-------------------------------------------------------------------------------
168    * Description  : Initializes the I/O port PA0 (connected to LED) and the
169    *              : compare match timer CMT0 at 1 ms to turn ON or OFF the LED
170    *              : connected to the PA0 once every 1000 times 1 ms flag
171    *              : (interrupt request bit) is set.
172    *-------------------------------------------------------------------------------
173    * Argument     : void
174    *-------------------------------------------------------------------------------
175    * Return Value : void
176    *-------------------------------------------------------------------------------
177    * Note         : Add the section PROM and transfer section PRAM in the linkage editor
178    *              : options and set the [ROM to RAM mapped sections].
179    *""FUNC COMMENT END""*************************************************************/
180   void io_blink_led(void)
181   {
182     volatile unsigned int CountCMT0 = 1000;    /* For 1 sec soft count */
183
184     /* ==== Initializes the LED ==== */
185     /* ---- PB22 (Control signal to enable the PA0) ---- */
186     PORT.PBCR5.BIT.PB22MD = 0;             /* Sets the function of the PB22 pin
187                                         to general-purpose I/O */
188     PORT.PBDR1.BIT.PB22DR = 1;             /* Specifies the output data as 1 */
189     PORT.PBIOR1.BIT.PB22IOR = 1;        /* Specifies the direction to output */
190     /* ---- PA0 (Signal to turn ON or OFF the LED) ---- */
191     PORT.PADR0.BIT.PA0DR = 1;              /* Specifies the output data as 1 */
192     PORT.PAIOR0.BIT.PA0IOR = 1;            /* Specifies the direction to output */
193
194     /* ====  Initializes the CMT0 (1 ms periodic timer) ==== */
195     io_init_cmt0();
196
197     while(1){
198       /* ---- Verifies the compare match (1 ms) flag ---- */
199       while (CMT.CMCSR0.BIT.CMF == 0){
200           /* Waits for 1 ms elapsed */
201       }
202       CMT.CMCSR0.BIT.CMF = 0;              /* Clears the compare match flag (CMF) to 0 */
203       CountCMT0--;                      /* Updates the 1 sec soft counter (CountCMT0) */
```

3.6 Sample Program Listing "main.c" (6/6)

```
204       /* ---- Verifies the 1 sec soft counter ---- */
205       if(CountCMT0 == 0u){
206           CountCMT0 = 1000u;            /* Initializes the 1 sec soft counter again */
207           PORT.PADR0.BIT.PA0DR ^= 1u ;  /* Inverts the port A0 output */
208       }
209     }
210   }
211   /*""FUNC COMMENT""*****************************************************************
212    * ID           :
213    * Outline      : CMT0 periodic timer setting
214    *-----------------------------------------------------------------------------
215    * Include      : iodefine.h
216    *-----------------------------------------------------------------------------
217    * Declaration  : void io_init_cmt0(void);
218    *-----------------------------------------------------------------------------
219    * Description  : Sets the CMT0 to set the CMF flag at every 1 ms.
220    *-----------------------------------------------------------------------------
221    * Argument     : void
222    *-----------------------------------------------------------------------------
223    * Return Value : void
224    *-----------------------------------------------------------------------------
225    * Note         : Add the section PROM and transfer section PRAM in the linkage editor
226    *              : options and set the [ROM to RAM mapped sections].
227    *""FUNC COMMENT END""*************************************************************/
228   void io_init_cmt0(void)
229   {
230     /* ==== Configures the periodic (1 ms) timer ==== */
231     /* ---- Sets the Standby control register 7 (STBCR7) ---- */
232     CPG.STBCR7.BIT.MSTP72 = 0x0;/* Enables the CMT */
233
234     /* ---- Sets the Compare match timer start register (CMSTR) ---- */
235     CMT.CMSTR.BIT.STR0 = 0;         /* Stops channel 0 to count */
236
237     /* ---- Sets the Compare match timer control/status register (CMCSR0) ---- */
238     CMT.CMCSR0.WORD = 0x0002;       /* Disables the compare match interrupt,
239                                        specifies 1/128 of the peripheral clock */
240
241     /* ---- Sets the Compare match timer counter register (CMCNT0) ---- */
242     CMT.CMCNT0.WORD = 0x0000;       /* Clears the timer counter */
243
244     /* ---- Sets the Compare match timer constant register (CMCOR0) ---- */
245     CMT.CMCOR0.WORD = 280;          /* Sets the period to compare match (1 ms) */
246                                  /* 1ms = 1/P clock (36 MHz) * 128 * (280+1) */
247     /* ---- Sets the Compare match timer start register (CMSTR) ---- */
248     CMT.CMSTR.BIT.STR0 = 1;         /* Starts channel 0 to count */
249   }
250   /* End of File */
```

4. References

- Software Manual
  SH-2A/SH-2A-FPU Software Manual Rev. 3.00
  (Download the latest version from the Renesas website.)

- Hardware Manual
  SH7262 Group, SH7264 Group Hardware Manual Rev. 2.00
  (Download the latest version from the Renesas website.)

Website and Support

Renesas Technology Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/inquiry
csc@renesas.com

Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Sep. 30, 2009	—	First edition issued

Notes regarding these materials

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, 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 products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (http://www.renesas.com)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guaranties regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
   (1) artificial life support devices or systems
   (2) surgical implantations
   (3) healthcare intervention (e.g., excision, administration of medication, etc.)
   (4) any other purposes that pose a direct threat to human life
   Renesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas 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 applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.