

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.

SH7211 Group

BSC SRAM Interface Settings Examples

Introduction

This application note introduces the normal space interface functions of the SH7211 bus state controller (BSC) SRAM interface and presents a connection example.

Target Devices

SH7211

Contents

1.	Preface.....	2
2.	The Application Example	3
3.	Sample Program	8
4.	Reference Documents	10

1. Preface

1.1 Specifications

- This application uses a 2 MB (1M words × 16 bits) SRAM, and connects to it with a 16-bit bus width.
- This application uses the SH7211 normal space interface functions and initializes the SRAM.

1.2 Functions Used

- Bus state controller (BSC)

1.3 Application Conditions

- Microcontroller: SH7211
- Operating frequency: Internal clock - 160 MHz
Bus clock - 40 MHz
Peripheral clock - 40 MHz
MTU2S clock - 80 MHz
A/D converter clock - 40 MHz
- C compiler: Renesas Technology Corp.
SuperH RISC Engine Family C/C++ Compiler Package Version 9.01, Release 01
- Compiler options: The default settings in the HEW file (-cpu=sh2a -debug -gbr=auto -chgincpath -global_volatile=0 -opt_range=all -infinite_loop=0 -struct_alloc=1 -nologo)

1.4 Related Application Notes

- The sample program in this document has been verified under the setting conditions in the SH7211 Initial Settings Application Note. Refer to that document in conjunction with this application note.

2. The Application Example

2.1 Operational Overview of the Functions Used

The application uses the SH7211's bus state controller (BSC) to control externally connected SRAM. Table 1 lists the specifications of the SRAM used in this application and figure 1 shows the memory map.

Table 1 SRAM Specifications

Item	SRAM specification
Product No.	R1LV1616RSA-7
Bus width	16 bits
Capacity	2 MB (16 bits × 1 M word) × 1
Package	48 pins TSOP (20 × 12mm)

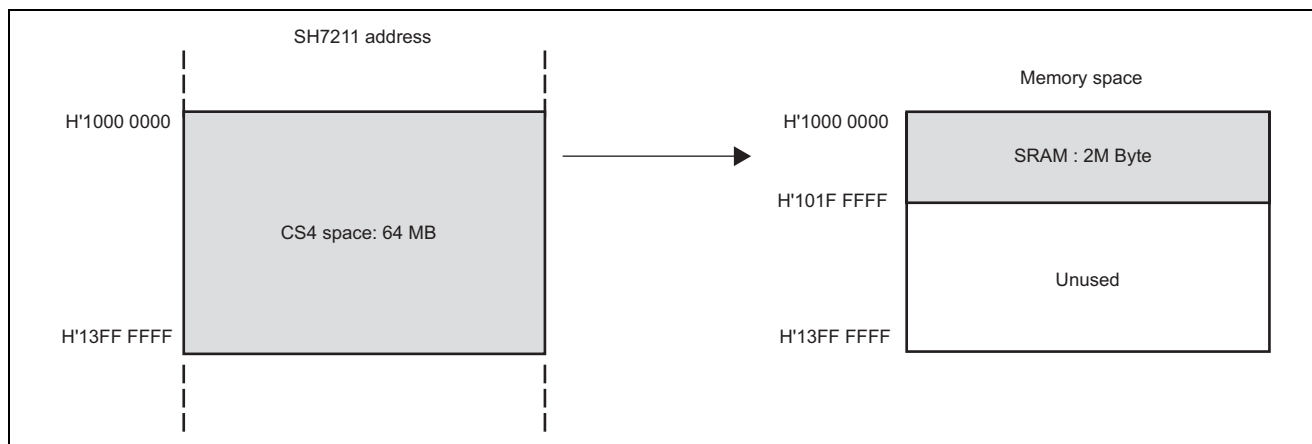


Figure 1 SRAM Related Memory Map

Figure 2 shows a sample SRAM connection circuit and table 2 lists the SH7211 pin functions. Since all pins are set to I/O port operation as the initial pin function, applications must use the pin function controller (PFC) to switch the pin functions as required.

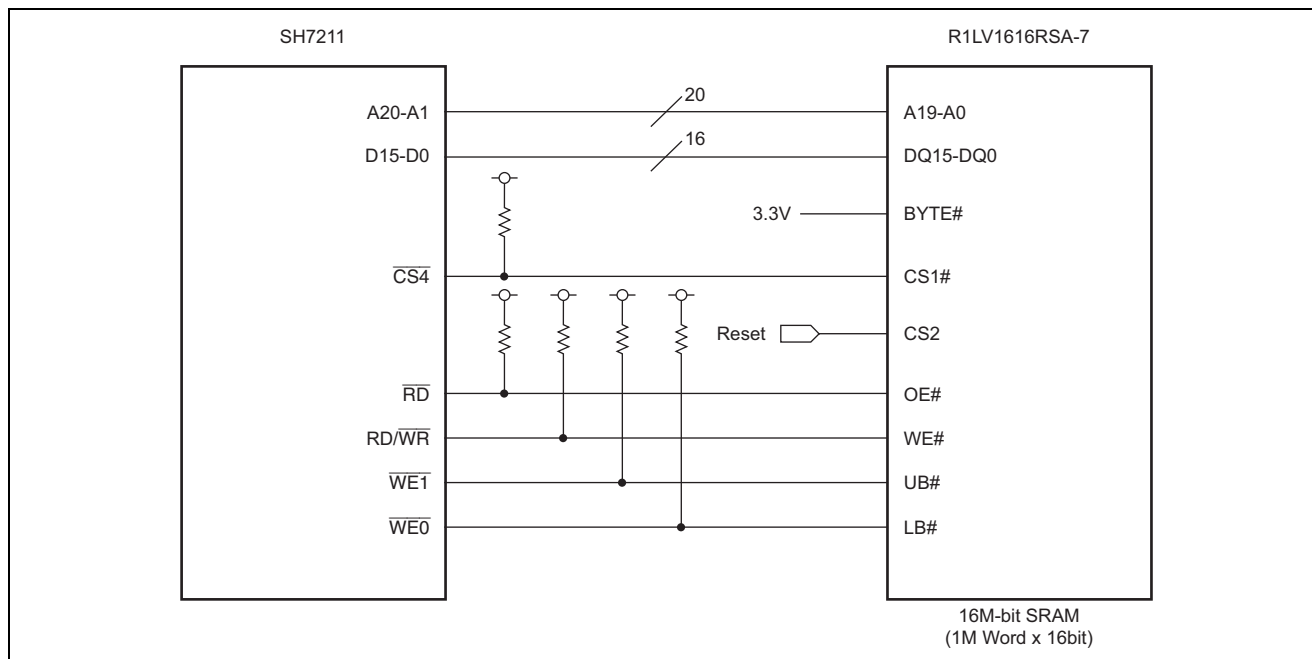


Figure 2 SRAM Connection Circuit Example

Table 2 SH7211 Pin Functions

SH7211 pin	I/O	Initial pin function	Function
A20 to A1	Output	PA14 to PA1	Address bus
D15 to D0	I/O	PD15 to PD0	Data bus
CS4	Output	PB3	Chip select
RD/WR	Output	PB4	Read or write signal
RD	Output	PB17	Read pulse signal (read data output enable signal)
WE1	Output	PB5	Byte write command for D15 to D8
WE0	Output	PB6	Byte write command for D7 to D0

2.2 Setup Procedure for the Functions Used

Table 3 lists sample settings for the bus state controller. See chapter 8, Bus State Controller, in the SH7211 Group Hardware Manual for details on the BSC module. Figure 3 shows a sample setup procedure for the bus state controller.

Table 3 Sample Bus State Controller Settings

Register	Address	Value	Function
CS4 space bus control register (CS4BCR)	H'FFFC 0014	H'1659 3400	<ul style="list-style-type: none"> IWW[2:0] = B'001 Write-read/write-write interval idle: 1 idle cycle inserted IWRWD[2:0], IWRD[2:0] = "B'011" Read-write cycle interval between different spaces, read-read cycle interval between different spaces: 4 idle cycles inserted IWRWS2:0], IWRRS[2:0] = "B'001" Read-write cycle interval between different spaces, read-read cycle interval between the same space: 1 idle cycle inserted TYPE[2:0] = B'011: SRAM with byte selection BSZ[1:0] = B'10: 16-bit bus width
CS4 space wait control register (CS4WCR)	H'FFFC 0038	H'0010 09c1	<ul style="list-style-type: none"> BAS = 1 SRAM with byte selection byte access selection: \overline{WEn} is asserted during read/write access cycles and RDWR is asserted with the write timing. WW[2:0] = B'000 Write access wait cycle count: The same number of cycles as WR[3:0] SW[1:0] = B'01 Address, $\overline{CS4}$ assert -> \overline{RD}, \overline{WEn} assert delay cycle count: 1.5 cycles WR[3:0] = B'0001 Read access wait cycle count: 3 cycles WM = 1: External wait instruction ignored HW[1:0] = B'01 \overline{RD}, \overline{WEn} negate -> address, $\overline{CS4}$ negate delay cycle count: 1.5 cycles

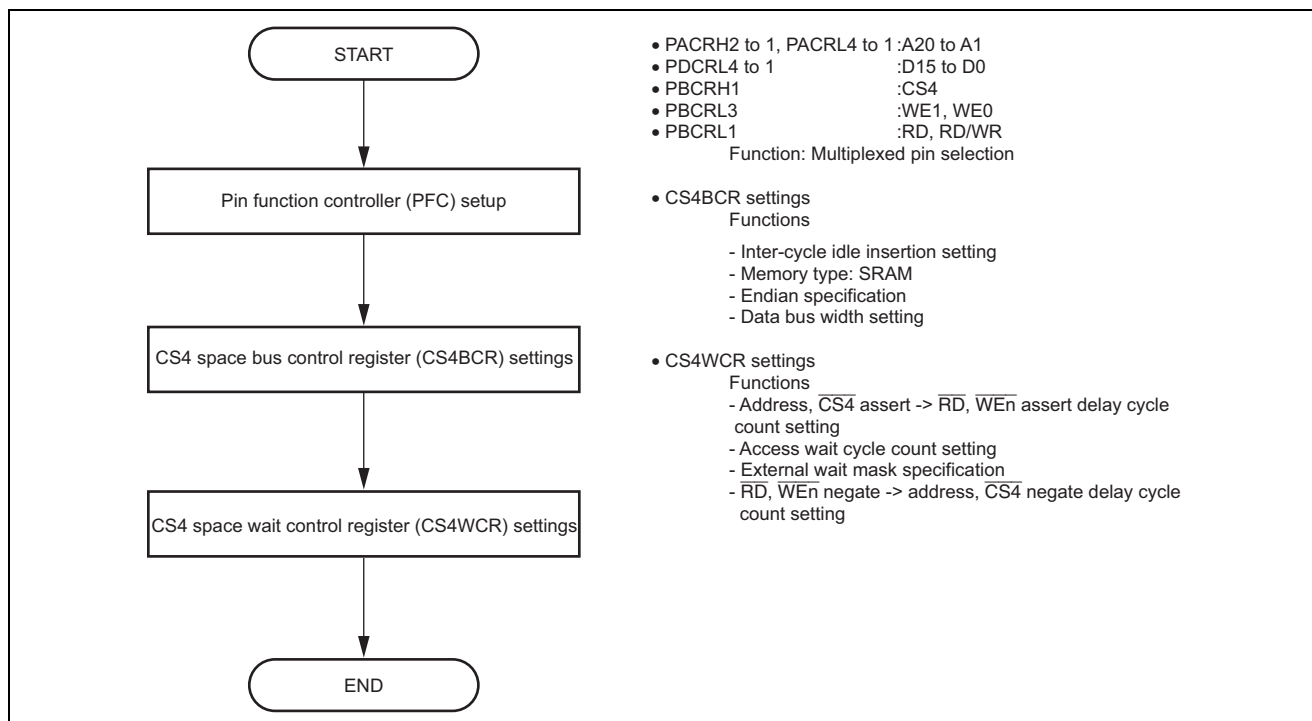


Figure 3 Bus State Controller Setup Procedure (CS4 space)

Figure 4 shows an SRAM read timing example for a 40 MHz bus clock, and figure 5 shows an SRAM write timing example for a 40 MHz bus clock.

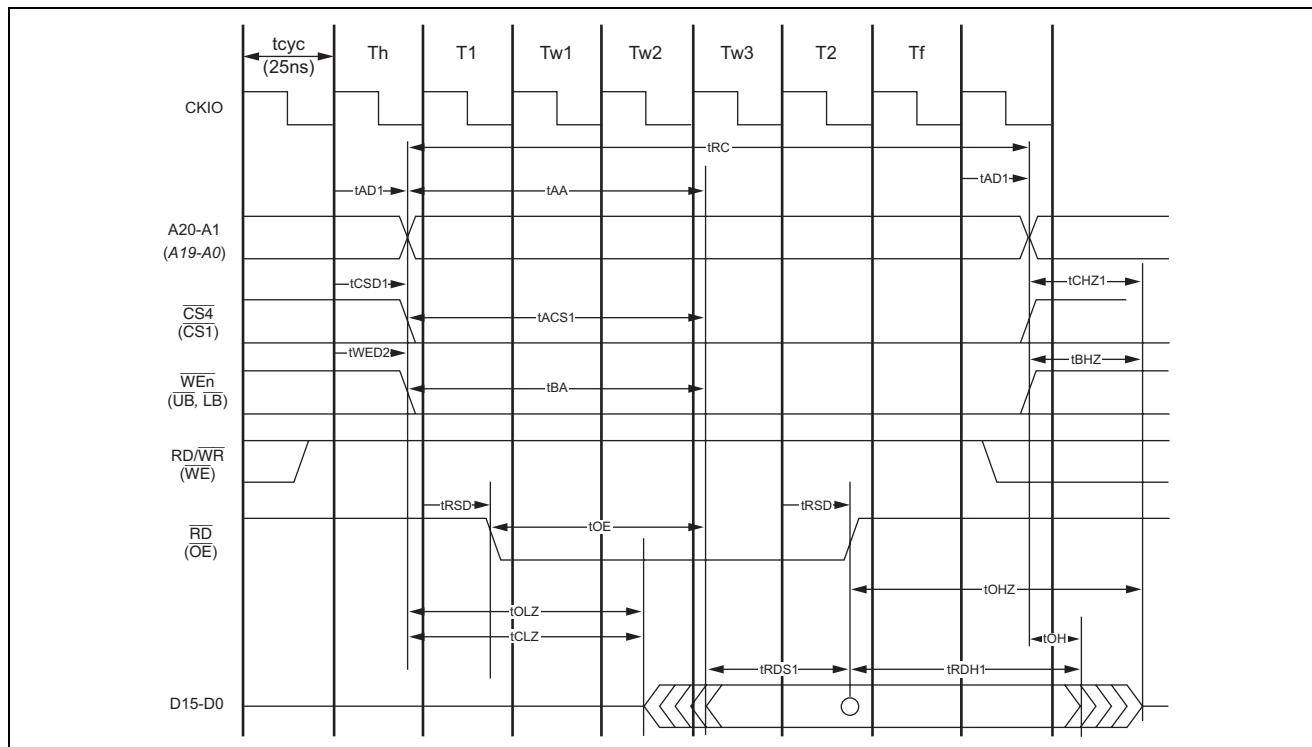


Figure 4 SRAM Read Timing Example

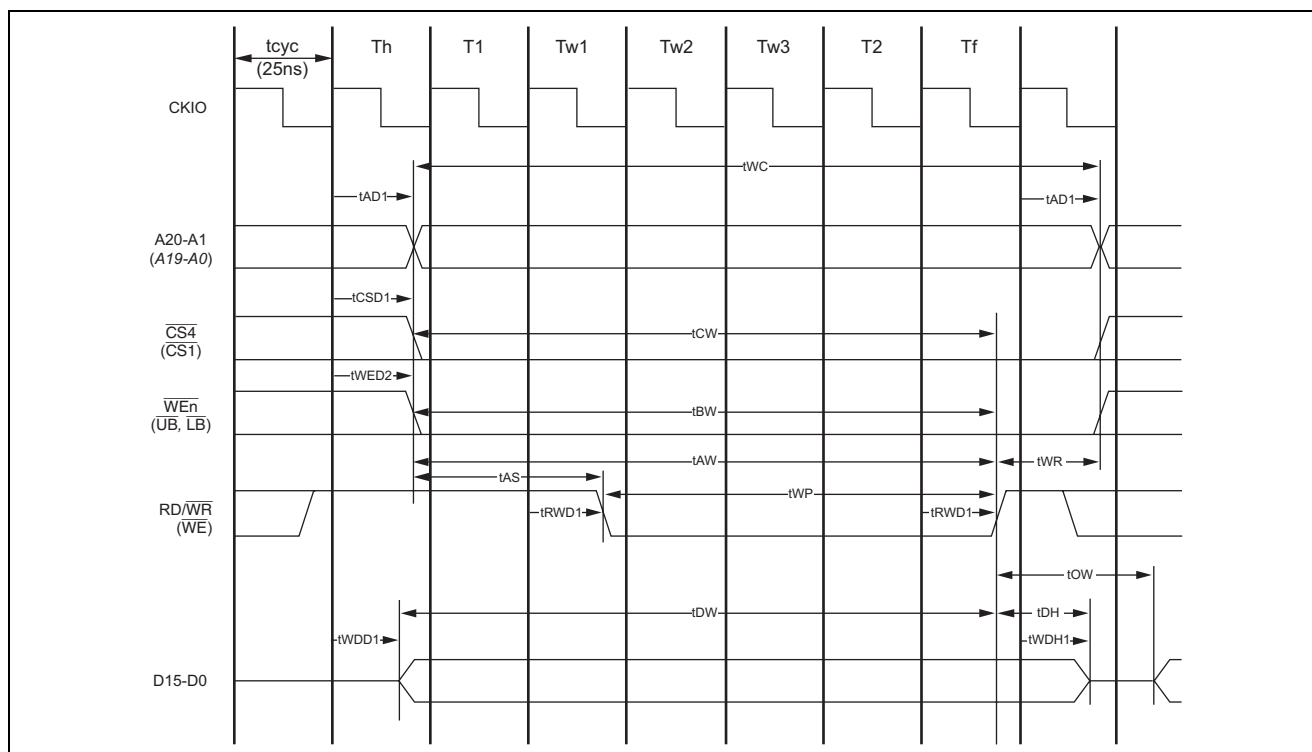


Figure 5 SRAM Write Timing Example

3. Sample Program

```

1  /*"FILE COMMENT"*****
2  *
3  *      System Name : SH7211 Sample Program
4  *      File Name   : bsc_sram.c
5  *      Version     : 1.00.00
6  *      Contents    : SH7211 SRAM Initial Setting
7  *      Model       : M3A-HS11
8  *      CPU         : SH7211
9  *      Compiler    : SHC9.1.1.0
10 *      OS          : none
11 *
12 *      note        : <Notes>
13 *                  This sample program is provided for reference
14 *                  purposes; its operation is not guaranteed.
15 *                  This sample program may be used for reference
16 *                  purposes when developing user applications.
17 *
18 *                  <Caution>
19 *                  This sample programs are all reference,
20 *                  and no one to guarantee the operation.
21 *                  Please use this sample program for the technical
22 *                  reference when customers develop softwares.
23 *
24 *      Copyright (C) 2008 Renesas Technology Corp. All Rights Reserved
25 *      AND Renesas Solutions Corp. All Rights Reserved
26 *
27 *      history     : 2008.04.02 ver.1.00.00
28 *"FILE COMMENT END"*****/
29 #include "iodefine.h"
30
31 /* ==== Prototype Declarations ==== */
32 void io_init_sram(void);
33
34 /*"FUNC COMMENT"*****
35 * ID           :
36 * Module overview: CS4 settings
37 *-----
38 * Include      : #include "iodefine.h"
39 *-----
40 * Declarations : void io_init_sram(void)
41 *-----
42 * Function     : This function sets up the pin function controller (PFC) and
43 *               : the bus state controller (BSC) and sets up the access timing
44 *               : for the CS4 space SRAM.
45 *-----

```

Figure 6 Sample Program Listing: bsc_sram.c (1)

```

46  * Arguments      : None
47  *-----
48  * Return value   : None
49  *-----
50  * Notes          :
51  * "FUNC COMMENT END"*****/
52  void io_init_sram(void)
53  {
54      /* ==== PFC settings ==== */
55
56      PFC.PBCRH1.BIT.PB18MD = 0x1;    /* Set CS4# */
57      PFC.PBCRL1.BIT.PB0MD  = 0x1;    /* Set RD */
58      PFC.PBCRL1.BIT.PB1MD  = 0x1;    /* Set RDWR */
59      PFC.PBCRL3.BIT.PB8MD  = 0x1;    /* Set WE0 */
60      PFC.PBCRL3.BIT.PB9MD  = 0x1;    /* Set WE1 */
61
62      PFC.PACRH2.BIT.PA20MD = 0x1;    /* Set A20 */
63      PFC.PACRH1.WORD = 0x1111;      /* Set A19-A16 */
64      PFC.PACRL4.WORD = 0x1111;      /* Set A15-A12 */
65      PFC.PACRL3.WORD = 0x1111;      /* Set A11-A8 */
66      PFC.PACRL2.WORD = 0x1111;      /* Set A7-A4 */
67      PFC.PACRL1.BIT.PA3MD = 0x1;    /* Set A3 */
68      PFC.PACRL1.BIT.PA2MD = 0x1;    /* Set A2 */
69      PFC.PACRL1.BIT.PA1MD = 0x1;    /* Set A1 */
70
71      PFC.PDCRL4.WORD = 0x1111;      /* Set D15-D12 */
72      PFC.PDCRL3.WORD = 0x1111;      /* Set D11-D8 */
73      PFC.PDCRL2.WORD = 0x1111;      /* Set D7-D4 */
74      PFC.PDCRL1.WORD = 0x1111;      /* Set D3-D0 */
75
76      /* ==== CS4BCR setting ==== */
77      BSC.CS4BCR.LONG = 0x16593400ul;
78          /* 0001 0110 0101 1001 0011 0100 0000 0000 */
79          /* IWW[2:0]="001" ;1Idle cycle */
80          /* IWRWD[2:0]="011" ;4Idle cycles */
81          /* IWRWS[2:0]="001" ;1Idle cycle */
82          /* IWRRD[2:0]="011" ;4Idle cycles */
83          /* IWRRS[2:0]="001" ;1Idle cycle */
84          /* TYPE[2:0]="011" ;SRAM with byte selection */
85          /* BSZ[1:0]="10" ;16bit bus width */
86
87      /* ==== CS4WCR setting ==== */
88      BSC.CS4WCR = 0x001009c1ul;
89          /* 0000 0000 0001 0000 0000 1001 1100 0001 */
90          /* BAS="1" ;RD/WR signal at the write timing */
91          /* WW[2:0]="000" ;same WR[3:0] setting
92          /* SW[1:0]="01" ;1.5 cycles
93          /* WR[3:0]="0011" ;5 wait cycles
94          /* WM="1" ;External wait input is ignored
95          /* HW[1:0]="01" ;1.5 cycles
96  }
97  /* End of File */

```

Figure 7 Sample Program Listing: bsc_sram.c (2)

4. Reference Documents

- Software Manual
SH-2A, SH2A-FPU Software Manual, Rev. 3.00
(The latest version can be downloaded from the Renesas Technology Web site.)
- Hardware Manual
SH7211 Group Hardware Manual, Rev. 2.00
(The latest version can be downloaded from the Renesas Technology Web site.)

Website and Support

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

Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Feb.17.09	—	First edition issued

All trademarks and registered trademarks are the property of their respective owners.

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.