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.
SH7000 Series
Block Transfer (4 Bytes Aligned)

Label: MOVE4

Functions Used: MOV.L Instruction
                Post-Increment Register Indirect Addressing
                Register Indirect Addressing with Displacement

Contents
1. Function ........................................................................................................ 2
2. Arguments..................................................................................................... 2
3. Internal Register Changes and Flag Changes............................................ 3
4. Programming Specifications ....................................................................... 4
5. Notes ............................................................................................................. 4
6. Description .................................................................................................... 5
7. Flowchart ..................................................................................................... 9
8. Program Listing ........................................................................................... 13
1. Function

Transfers a block of data. Note that the start addresses for the block data source and destination areas must be 4n addresses, and the number of bytes to be transferred must be 4n bytes.

2. Arguments

<table>
<thead>
<tr>
<th>Description</th>
<th>Storage Location</th>
<th>Data Length (Bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Number of transfer bytes (4n bytes)</td>
<td>R0</td>
<td>4</td>
</tr>
<tr>
<td>Start address of transfer data source area (4n address)</td>
<td>R1</td>
<td>4</td>
</tr>
<tr>
<td>Start address of transfer data destination area (4n address)</td>
<td>R2</td>
<td>4</td>
</tr>
<tr>
<td>Output</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
### 3. Internal Register Changes and Flag Changes

### Before Execution → After Execution

<table>
<thead>
<tr>
<th>Register</th>
<th>Description</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>Number of transfer bytes</td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td>Start address of transfer data destination area</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>Start address of transfer data source area</td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td>Work</td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R15</td>
<td>(SP)</td>
<td></td>
</tr>
</tbody>
</table>

T bit:

- **—**: No change
- **∗**: Change
- **0**: Fixed 0
- **1**: Fixed 1
4. Programming Specifications

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Program memory (bytes)</td>
<td>142</td>
</tr>
<tr>
<td>Data memory (bytes)</td>
<td>0</td>
</tr>
<tr>
<td>Stack (bytes)</td>
<td>4</td>
</tr>
<tr>
<td>Number of states</td>
<td>114</td>
</tr>
<tr>
<td>Reentrant</td>
<td>Yes</td>
</tr>
<tr>
<td>Relocation</td>
<td>Yes</td>
</tr>
<tr>
<td>Intermediate interrupt</td>
<td>Yes</td>
</tr>
</tbody>
</table>

5. Notes

The number of states indicated in the programming specifications is the value when the number of transfer bytes is 100.
6. Description

(1) Function

Details of the arguments are as follows.

R0: As the input argument, set the number of transfer bytes (4n bytes). Note that hardware limitations apply.
R1: As the input argument, set the start address of transfer data destination area (4n address).
R2: As the input argument, set the start address of transfer data source area (4n address).

Figure 1 shows a software MOVE execution example.
(2) Usage Notes

(a) The input arguments should be set so that the transfer data source area and transfer data destination area do not overlap. If the two areas overlap, as shown in figure 2, the data in the source area will be destroyed.

Figure 2 Block Transfer with Overlapping Data

(b) The contents of R0, R1, and R2, which set the number of transfer bytes, the start address of the transfer data destination area, and the start address of the transfer data source area, are changed using the software MOVE instruction. If the values for the number of transfer bytes, the start address of the transfer data destination area, and the start address of the transfer data source area will be needed after the software MOVE instruction is executed, they should be saved beforehand.

(3) RAM Used

No RAM is used by the software MOVE4 instruction.

(4) Usage Example

After the start address of the transfer data destination area, the start address of the transfer data source area, and the number of transfer bytes have been set in the input arguments, the software MOVE4 instruction is executed by a subroutine call.

MOV.L DATA1,R0 .... Sets number of transfer bytes in input argument (R0)
MOV.L DATA2,R1 .... Sets start address of transfer data destination area in input argument (R1)
BSR MOVE4 .... Subroutine call to software MOVE4
MOV.L DATA3,R2 .... Sets start address of transfer data source area in input argument (R2)

.align 4
DATA1 .data.l H'00000064
DATA2 .data.l H'000010100
DATA3 .data.l H'00010000
(5) Operating Principle

(a) Since the transfer source and transfer destination addresses are both 4n addresses (4 bytes aligned), data is transferred from the source to the destination 4 bytes at a time.

(b) Post-increment register indirect addressing (@R2+) is used to specify the transfer source address, which is then automatically incremented by 4 after each 4 bytes are transferred. Register indirect addressing with displacement is used to specify the transfer destination address. The displacement is 0 to 60, so it is necessary to increment the transfer destination address by 64 after each 60 bytes is transferred. No other increment processing is needed.

(c) A value equal to the start address of the transfer data source area (R2) plus the number of transfer bytes is set in R3. After the setting is made, R0, which was previously set to the number of data bytes, is used as workspace for the data transfer. After the transfer source data is transferred to R0, it is determined whether or not R2 is less than or equal to R3. If this condition is met (R2 ≤ R3), the data in R0 is data from the transfer source area and it is transferred to the transfer destination. If the condition is not met (R2 > R3), the data in R0 is data from outside the transfer source area and the transfer terminates.
Figure 3  Data Transfer Method

- Data in transfer source area
- Data outside transfer source area
7. Flowchart

```
MOVE4

Start address of transfer data source area + number of transfer bytes → R3

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @R1

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @4,R1

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @8,R1

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @(12,R1)
```

No

No

No

No

No

Yes

Yes

Yes

Yes
Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @(16,R1)

Yes

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

No

Transfer data from R0 to @(20,R1)

Yes

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

No

Transfer data from R0 to @(24,R1)

Yes

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

No

Transfer data from R0 to @(28,R1)

Yes

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

No

Transfer data from R0 to @(32,R1)

Yes

Transfer data from R0 to @(16,R1)
Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

No

Transfer data from R0 to @(36,R1)

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @(40,R1)

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

No

Transfer data from R0 to @(44,R1)

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @(48,R1)

Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

No

Transfer data from R0 to @(52,R1)
Transfer @R2+ data (4 bytes) to R0

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @(56,R1)

Transfer @R2+ data (4 bytes) to R0

No

Is the data in R0 data from the transfer source area (R2 ≤ R3)?

Yes

Transfer data from R0 to @(60,R1)

Increment transfer source address (R1) by 64

No

Restore registers

RTS
8. Program Listing

1 1 ;********************************************************************************
2 2 ;*
3 3 ;* NAME: MOVING MEMORY BLOKS (MOVE4) *
4 4 ;*
5 5 ;********************************************************************************
6 6 ;*
7 7 ;* ENTRY: R0 (NUMBER OF TRANSFER) *
8 8 ;* R1 (DESTINATION ADDRESS) *
9 9 ;* R2 (SOURCE ADDRESS) *
10 10 ;* RETURNS: NOTHING *
11 11 ;*
12 12 ;********************************************************************************
13 13 00001000 .SECTION A,CODE,LOCATE=H'1000
14 14 00001000 MOVE4 .EQU $ ; Entry point
15 15 00001000 2F36 MOV.L R3,@-R15 ; Escape register
16 16 00001000 6323 MOV R2,R3 ;
17 17 00001000 330C ADD R0,R3 ;
18 18 00001000 18 MOVE41 ;
19 19 00001000 6026 MOV.L @R2+,R0 ; Load source data
20 20 00001000 3322 CMP/HS R2,R3 ; R2 <= R3 ?
21 21 00001000 8B3E BF MOVE4_END ; No
22 22 00001000 2102 MOV.L R0,@R1 ; Yes -> Store source data
23 23 00001000 23 MOVE42 ;
24 24 00001000 6026 MOV.L @R2+,R0 ; Load source data
25 25 00001000 3322 CMP/HS R2,R3 ; R2 <= R3 ?
26 26 00001000 8B3A BF MOVE4_END ; No
27 27 00001000 1101 MOV.L R0,@(4,R1) ; Yes -> Store source data
28 28 00001000 28 MOVE43 ;
29 29 00001000 6026 MOV.L @R2+,R0 ; Load source data
30 30 00001000 3322 CMP/HS R2,R3 ; R2 <= R3 ?
31 31 00001000 8B36 BF MOVE4_END ; No
32 32 00001000 1102 MOV.L R0,@(8,R1) ; Yes -> Store source data
33 33 00001000 33 MOVE44 ;
34 34 00001000 6026 MOV.L @R2+,R0 ; Load source data
35 35 00001000 3322 CMP/HS R2,R3 ; R2 <= R3 ?
36 36 00001000 8B32 BF MOVE4_END ; No
37 37 00001000 1103 MOV.L R0,@(12,R1) ; Yes -> Store source data
38 38 00001000 38 MOVE45 ;
39 39 00001000 6026 MOV.L @R2+,R0 ; Load source data
40 40 00001000 3322 CMP/HS R2,R3 ; R2 <= R3 ?
41 41 00001000 8B2E BF MOVE4_END ; No
42 42 00001000 1104 MOV.L R0,@(16,R1) ; Yes -> Store source data
43 43 00001000 43 MOVE46 ;
44 44 00001000 6026 MOV.L @R2+,R0 ; Load source data
45 45 00001000 3322 CMP/HS R2,R3 ; R2 <= R3 ?
46 46 00001000 8B2A BF MOVE4_END ; No
47 47 00001000 1105 MOV.L R0,@(20,R1) ; Yes -> Store source data
48 48 00001000 48 MOVE47 ;
49 49 00001000 6026 MOV.L @R2+,R0 ; Load source data
50 00001038 3322  CMP/HS R2,R3 ; R2 <= R3 ?
51 0000103A 8B26  BF MOVE4_END ; No
52 0000103C 1106  MOV.L R0,@(24,R1) ; Yes -> Store source data
53 0000103E MOV.E48 ;
54 0000103E 6026 MOV.L @R2+,R0 ; Load source data
55 00001040 3322 CMP/HS R2,R3 ; R2 <= R3 ?
56 00001042 8B22 BF MOVE4_END ; No
57 00001044 MOV.L R0,@(28,R1) ; Yes -> Store source data
58 00001046 MOV.E49 ;
59 00001046 6026 MOV.L @R2+,R0 ; Load source data
60 00001048 3322 CMP/HS R2,R3 ; R2 <= R3 ?
61 0000104A 8B1E BF MOVE4_END ; No
62 0000104C MOV.L R0,@(32,R1) ; Yes -> Store source data
63 0000104E MOV.E410 ;
64 0000104E 6026 MOV.L @R2+,R0 ; Load source data
65 00001050 3322 CMP/HS R2,R3 ; R2 <= R3 ?
66 00001052 8B1A BF MOVE4_END ; No
67 00001054 1109 MOV.L R0,@(36,R1) ; Yes -> Store source data
68 00001056 MOV.E411 ;
69 00001056 6026 MOV.L @R2+,R0 ; Load source data
70 00001058 3322 CMP/HS R2,R3 ; R2 <= R3 ?
71 0000105A 8B16 BF MOVE4_END ; No
72 0000105C 110A MOV.L R0,@(40,R1) ; Yes -> Store source data
73 0000105E MOV.E412 ;
74 0000105E 6026 MOV.L @R2+,R0 ; Load source data
75 00001060 3322 CMP/HS R2,R3 ; R2 <= R3 ?
76 00001062 8B18 BF MOVE4_END ; No
77 00001064 110B MOV.L R0,@(44,R1) ; Yes -> Store source data
78 00001066 MOV.E413 ;
79 00001066 6026 MOV.L @R2+,R0 ; Load source data
80 00001068 3322 CMP/HS R2,R3 ; R2 <= R3 ?
81 0000106A 8B0E BF MOVE4_END ; No
82 0000106C 110C MOV.L R0,@(48,R1) ; Yes -> Store source data
83 0000106E MOV.E414 ;
84 0000106E 6026 MOV.L @R2+,R0 ; Load source data
85 00001070 3322 CMP/HS R2,R3 ; R2 <= R3 ?
86 00001072 8B06 BF MOVE4_END ; No
87 00001074 110D MOV.L R0,@(52,R1) ; Yes -> Store source data
88 00001076 MOV.E415 ;
89 00001076 6026 MOV.L @R2+,R0 ; Load source data
90 00001078 3322 CMP/HS R2,R3 ; R2 <= R3 ?
91 0000107A 8B06 BF MOVE4_END ; No
92 0000107C 110E MOV.L R0,@(56,R1) ; Yes -> Store source data
93 0000107E MOV.E416 ;
94 0000107E 6026 MOV.L @R2+,R0 ; Load source data
95 00001080 3322 CMP/HS R2,R3 ; R2 <= R3 ?
96 00001082 8B02 BF MOVE4_END ; No
97 00001084 110F MOV.L R0,@(60,R1) ; Yes -> Store source data
98 MOV.E417 ;
99 00001086 AFBE BRA MOVE41 ;
100 00001088 7140 ADD @D'64,R1 ; R1 <- R1 + 64
101 0000108A  101  MOVE_END 
102 0000108A 000B  102  RTS
103 0000108C 63F6  103  MOV.L @R15+,R3  ; Return register
104 104 .END

*****TOTAL ERRORS  0
*****TOTAL WARNINGS  0
1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. 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 Corp. or a third party.

2. Renesas Technology Corp. 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 Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.

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 Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.

5. Renesas Technology Corp. 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 Corp. or an authorized Renesas Technology Corp. 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 Corp. 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 Corp. for further details on these materials or the products contained therein.