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Old Company Name in Catalogs and Other Documents

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April 1\textsuperscript{st}, 2010
Renesas Electronics Corporation

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SH7000 Series
Block Transfer (4 Bytes Not Aligned)

Label: MOVE

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

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1. **Function**

Transfers a block of data. The start addresses for the block data source and destination areas, and the number of bytes to be transferred, are specified by the user.

2. **Arguments**

<table>
<thead>
<tr>
<th>Description</th>
<th>Storage Location</th>
<th>Data Length (Bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of transfer bytes</td>
<td>R0</td>
<td>4</td>
</tr>
<tr>
<td>Start address of transfer data source area</td>
<td>R1</td>
<td>4</td>
</tr>
<tr>
<td>Start address of transfer data destination area</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

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

T bit
- * : Change
- 0 : Fixed 0
- 1 : Fixed 1

— : No change
4. Programming Specifications

<table>
<thead>
<tr>
<th>Program memory (bytes)</th>
<th>142</th>
</tr>
</thead>
<tbody>
<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>429</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 (defined by user). Note that hardware limitations apply.
R1: As the input argument, set the start address of transfer data destination area (defined by user).
R2: As the input argument, set the start address of transfer data source area (defined by user).

Figure 1 shows a software MOVE execution example.

---

**Figure 1** 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.

(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 MOVE 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 MOVE 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  MOVE       ... Subroutine call to software MOVE
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'00010101
DATA3 .data.l H'00010000
```
(5) Operating Principle

(a) Since the transfer source and transfer destination addresses are both user-defined (4 bytes not aligned), data is transferred from the source to the destination one byte at a time.

(b) Post-increment register indirect addressing (@R2+) is used to specify the transfer source address, which is then automatically incremented by 1 after each byte is transferred. Register indirect addressing with displacement is used to specify the transfer destination address. The displacement is 0 to 15, so it is necessary to increment the transfer destination address by 16 after each 15 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 \( \leq \) 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.

![Data Transfer Method Diagram](image-url)
7. Flowchart

Flowchart:

1. **MOVE**
2. Save registers
3. Start address of transfer data source area + number of transfer bytes → R3
4. Transfer @R2+ data (1 byte) to R0
   - Is the data in R0 data from the transfer source area (R2 ≤ R3)?
     - Yes: Transfer data from R0 to @R1
     - No: Transfer data from R0 to @(1,R1)
5. Transfer @R2+ data (1 byte) to R0
   - Is the data in R0 data from the transfer source area (R2 ≤ R3)?
     - Yes: Transfer data from R0 to @(2,R1)
     - No: Transfer data from R0 to @(3,R1)
1
Transfer @R2+ data (1 byte) to R0

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

No

Yes
Transfer data from R0 to @4,R1

Transfer @R2+ data (1 byte) to R0

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

No

Yes
Transfer data from R0 to @5,R1

Transfer @R2+ data (1 byte) to R0

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

No

Yes
Transfer data from R0 to @6,R1

Transfer @R2+ data (1 byte) to R0

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

No

Yes
Transfer data from R0 to @7,R1

Transfer @R2+ data (1 byte) to R0

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

No

Yes
Transfer data from R0 to @8,R1

2

5

3

4
Transfer @R2+ data (1 byte) to R0

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

Yes

Transfer data from R0 to @(9,R1)

Transfer @R2+ data (1 byte) to R0

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

Yes

Transfer data from R0 to @(10,R1)

Transfer @R2+ data (1 byte) to R0

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

Yes

Transfer data from R0 to @(11,R1)

Transfer @R2+ data (1 byte) to R0

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

Yes

Transfer data from R0 to @(12,R1)

Transfer @R2+ data (1 byte) to R0

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

Yes

Transfer data from R0 to @(13,R1)

Transfer @R2+ data (1 byte) to R0

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

Yes

Transfer data from R0 to @(14,R1)

Transfer @R2+ data (1 byte) to R0

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

Yes

Transfer data from R0 to @(15,R1)
3
Transfer @R2+ data (1 byte) to R0

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

Yes
Transfer data from R0 to @(14,R1)
Transfer @R2+ data (1 byte) to R0

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

Yes
Transfer data from R0 to @(15,R1)
Increment transfer source address (R1) by 16

4

5

Restore registers

RTS
8. Program Listing

```assembly
;ốn ************************************************************
;ὸ * *
;ὸ * NAME ; MOVING MEMORY BLOCKS (MOVE) *
;ὸ * *
;ὸ * ************************************************************
;ὸ * *
;ὸ ENTRY : R0 (NUMBER OF TRANSFER) *
;ὸ R1 (DESTINATION ADDRESS) *
;ὸ R2 (SOURCE ADDRESS) *
;ὸ RETURNS : NOTHING *
;ὸ *
;ὸ ************************************************************
;ὸ 00001000 13 .SECTION A,CODE,LOCATE=H’1000
;ὸ 00001000 14 MOVE .EQU $ ; Entry point
;ὸ 00001000 2F36 15 MOV.L R3,@-R15 ; Escape register
;ὸ 00001000 6323 16 MOV R2,R3 ;
;ὸ 00001000 330C 17 ADD R0,R3 ;
;ὸ 00001000 18 MOVE1 ;
;ὸ 00001000 6024 19 MOV.B %R2+,R0 ; Load source data
;ὸ 00001000 2F36 20 CMP/HS R2,R3 ; R2 <= R3 ?
;ὸ 00001000 8B3A 21 BF MOVE_END ; No
;ὸ 00001000 2100 22 MOV.B R0,%R1 ; Yes -> Store source data
;ὸ 00001000 23 MOVE2 ;
;ὸ 00001000 6024 23 MOV.B %R2+,R0 ; Load source data
;ὸ 00001000 3322 25 CMP/HS R2,R3 ; R2 <= R3 ?
;ὸ 00001000 8B3A 26 BF MOVE_END ; No
;ὸ 00001000 8011 27 MOV.B R0,%R1 ; Yes -> Store source data
;ὸ 00001000 28 MOVE3 ;
;ὸ 00001000 6024 29 MOV.B %R2+,R0 ; Load source data
;ὸ 00001000 3322 30 CMP/HS R2,R3 ; R2 <= R3 ?
;ὸ 00001000 8B3A 31 BF MOVE_END ; No
;ὸ 00001000 8012 32 MOV.B R0,%R1 ; Yes -> Store source data
;ὸ 00001000 33 MOVE4 ;
;ὸ 00001000 6024 34 MOV.B %R2+,R0 ; Load source data
;ὸ 00001000 3322 35 CMP/HS R2,R3 ; R2 <= R3 ?
;ὸ 00001000 8B3A 36 BF MOVE_END ; No
;ὸ 00001000 8013 37 MOV.B R0,%R1 ; Yes -> Store source data
;ὸ 00001000 38 MOVE5 ;
;ὸ 00001000 6024 39 MOV.B %R2+,R0 ; Load source data
;ὸ 00001000 3322 40 CMP/HS R2,R3 ; R2 <= R3 ?
;ὸ 00001000 8B3A 41 BF MOVE_END ; No
;ὸ 00001000 8014 42 MOV.B R0,%R1 ; Yes -> Store source data
;ὸ 00001000 43 MOVE6 ;
;ὸ 00001000 6024 44 MOV.B %R2+,R0 ; Load source data
;ὸ 00001000 3322 45 CMP/HS R2,R3 ; R2 <= R3 ?
;ὸ 00001000 8B3A 46 BF MOVE_END ; No
;ὸ 00001000 8015 47 MOV.B R0,%R1 ; Yes -> Store source data
;ὸ 00001000 48 MOVE7 ;
;ὸ 00001000 6024 49 MOV.B %R2+,R0 ; Load source data
```
50 00001038 3322 50 CMP/HS R2,R3 ; R2 <= R3 ?
51 0000103A 8B26 51 BF MOVE END ; No
52 0000103C 8016 52 MOV.B R0, @(6,R1) ; Yes -> Store source data
53 0000103E 53 MOVE8 ;
54 0000103E 6024 54 MOV.B @R2+, R0 ; Load source data
55 00001040 3322 55 CMP/HS R2,R3 ; R2 <= R3 ?
56 00001042 8B22 56 BF MOVE END ; No
57 00001044 8017 57 MOV.B R0, @(7,R1) ; Yes -> Store source data
58 00001046 58 MOVE9 ;
59 00001046 6024 59 MOV.B @R2+, R0 ; Load source data
60 00001048 3322 60 CMP/HS R2,R3 ; R2 <= R3 ?
61 0000104A 8B23 61 BF MOVE END ; No
62 0000104C 8018 62 MOV.B R0, @(8,R1) ; Yes -> Store source data
63 0000104E 63 MOVE10 ;
64 0000104E 6024 64 MOV.B @R2+, R0 ; Load source data
65 00001050 3322 65 CMP/HS R2,R3 ; R2 <= R3 ?
66 00001052 8B1A 66 BF MOVE END ; No
67 00001054 8019 67 MOV.B R0, @(9,R1) ; Yes -> Store source data
68 00001056 68 MOVE11 ;
69 00001056 6024 69 MOV.B @R2+, R0 ; Load source data
70 00001058 3322 70 CMP/HS R2,R3 ; R2 <= R3 ?
71 0000105A 8B16 71 BF MOVE END ; No
72 0000105C 801A 72 MOV.B R0, @(10,R1) ; Yes -> Store source data
73 0000105E 73 MOVE12 ;
74 0000105E 6024 74 MOV.B @R2+, R0 ; Load source data
75 00001060 3322 75 CMP/HS R2,R3 ; R2 <= R3 ?
76 00001062 8B11 76 BF MOVE END ; No
77 00001064 801B 77 MOV.B R0, @(11,R1) ; Yes -> Store source data
78 00001066 78 MOVE13 ;
79 00001066 6024 79 MOV.B @R2+, R0 ; Load source data
80 00001068 3322 80 CMP/HS R2,R3 ; R2 <= R3 ?
81 0000106A 8B0E 81 BF MOVE END ; No
82 0000106C 801C 82 MOV.B R0, @(12,R1) ; Yes -> Store source data
83 0000106E 83 MOVE14 ;
84 0000106E 6024 84 MOV.B @R2+, R0 ; Load source data
85 00001070 3322 85 CMP/HS R2,R3 ; R2 <= R3 ?
86 00001072 8B0C 86 BF MOVE END ; No
87 00001074 801D 87 MOV.B R0, @(13,R1) ; Yes -> Store source data
88 00001076 88 MOVE15 ;
89 00001076 6024 89 MOV.B @R2+, R0 ; Load source data
90 00001078 3322 90 CMP/HS R2,R3 ; R2 <= R3 ?
91 0000107A 8B05 91 BF MOVE END ; No
92 0000107C 801E 92 MOV.B R0, @(14,R1) ; Yes -> Store source data
93 0000107E 93 MOVE16 ;
94 0000107E 6024 94 MOV.B @R2+, R0 ; Load source data
95 00001080 3322 95 CMP/HS R2,R3 ; R2 <= R3 ?
96 00001082 8B02 96 BF MOVE END ; No
97 00001084 801F 97 MOV.B R0, @(15,R1) ; Yes -> Store source data
98 98 ;
99 00001086 AFBE 99 BRA MOVE1 ;
100 00001088 7110 100 ADD #D'16,R1 ; R1 <= R1 + 16
101 0000108A  MOVE_END ;
102 0000108A 000B  RTS ;
103 0000108C 63F6  MOV.L @R15+,R3 ; Return register
104                .END

*****TOTAL ERRORS  0
*****TOTAL WARNINGS  0
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