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April 1\(^{st}\), 2010  
Renesas Electronics Corporation

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SH7000 Series
Find First 1 in 32-Bit Data

Label: FIND1

Functions Used: SHLL Instruction

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1. Function

Tests each bit of 32-bit data in sequence, beginning from the MSB, and determines the number of the bit (0–31) in which the first 1 occurs.

2. Arguments

<table>
<thead>
<tr>
<th>Description</th>
<th>Storage Location</th>
<th>Data Length (Bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 32-bit data for detection</td>
<td>R0</td>
<td>4</td>
</tr>
<tr>
<td>Output Number of first detected 1 bit (0–31)</td>
<td>R1</td>
<td>4</td>
</tr>
</tbody>
</table>

3. Internal Register Changes and Flag Changes

<table>
<thead>
<tr>
<th>R0</th>
<th>32-bit detection data → Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Undefined → Bit number of first 1 detection</td>
</tr>
<tr>
<td>R2</td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td></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

- : 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>16</td>
</tr>
<tr>
<td>Data memory (bytes)</td>
<td>0</td>
</tr>
<tr>
<td>Stack (bytes)</td>
<td>0</td>
</tr>
<tr>
<td>Number of states</td>
<td>29</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 32-bit data value is H'10000000.
6. Description

(1) Function

Details of the arguments are as follows.

R0: As the input argument, set the 32-bit data for detection.
R1: Holds the bit number (0–31) of the first detected 1 as the output argument.

Figure 1 shows a software FIND1 execution example.

<table>
<thead>
<tr>
<th>Input argument</th>
<th>Output argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>32-bit data for detection</td>
<td>Bit number of first 1 detected</td>
</tr>
<tr>
<td>00010</td>
<td>H'0000001C (D'28)</td>
</tr>
</tbody>
</table>

**Figure 1  Software FIND1 Execution Example**

(2) Usage Notes

The contents of R0, which sets the 32-bit data for detection, are changed when the software FIND1 instruction is executed. If the value for the 32-bit data for detection will be needed after the software FIND1 instruction is executed, it should be saved beforehand.

(3) RAM Used

No RAM is used by the software FIND1 instruction.
(4) Usage Example

After the 32-bit data for detection is set in the input argument, the software instruction FIND1 is executed by a subroutine call.

```
MOV FIND1    .... Subroutine call to FIND1
MOV.L DATA,R0 .... Sets 32-bit data for detection in input argument (R0)
.
.
.align 4
DATA .data.l H'12345678
```

(5) Operating Principle

(a) The SHLL instruction sets the T bit to match the contents of the 32-bit data for detection, in sequence beginning with bit 31, and tests each bit.

(b) R1 is used as a bit number pointer for bit testing. Bit number 31 is set as the first value in R1 for bit discrimination. After bit testing, R1 is decremented by 1, and indicates the next bit number for judgment.

(c) Execution of the software FIND1 instruction ends when the first 1 is detected or when the bit number (R1) is less than 0. When ending after 1 detection, R1 indicates the bit number of the first 1 detected. When ending after the bit number (R1) is less than 0, the value of R1 is H'FFFFFFFF.
7. Flowchart

Set R1 to first identification bit number (D’31)

Shift R0 1 bit left, and store MSB content in T bit

Is T bit 1?

Yes

Is bit number 0 or more (R1 ≥ 0)?

No

Decrement R1 by 1, and set R1 to next identification bit number

No
8. Program Listing

1 ;***************************************************************
2 ; *
3 ;* NAME: FIND FIRST 1 (FIND1)
4 ; *
5 ;***************************************************************
6 ; *
7 ;* ENTRY: R0 (32 BIT DATA)
8 ;* RETURNS: R1 (BIT NUMBER)
9 ; *
10 ;***************************************************************

11 .SECTION A,CODE,LOCATE=H'1000
12 00001000 E11F 13 MOV #D'31,R1 ; Initialize R1
14 00001002 000B 14 NOP ;
15 00001002 4000 15 SHLL R0 ; T bit = 1?
16 00001004 8902 16 BT FIND_END ; Yes
17 00001006 71FF 17 ADD #H'FF,R1 ; Decrement bit number
18 00001000 4111 18 CMP/PZ R1 ; Bit number >= 0?
19 00001002 89FA 19 BT FIND11 ; Yes
20 00001004 0009 20 NOP ;
21 0000100C 000B 21 RTS ;
22 0000100C 0009 22 NOP ;
23 .END

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