SH7000 Series

Find First 1 in 32-Bit Data

Label: FIND1

Functions Used: SHLL Instruction

Contents

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

Description		Storage Location	Data Length (Bytes)
Input	32-bit data for detection	R0	4
Output	Number of first detected 1 bit (0–31)	R1	4

3. Internal Register Changes and Flag Changes

	(Before Execution) → (After Execution)
R0	32-bit detection data → Change
R1	Undefined → Bit number of first 1 detection
R2	
R3	
R4	
R5	
R6	
R7	
R8	
R9	
R10	
R11	
R12	
R13	
R14	
R15	(SP)

T bit | * |

— : No change
* : Change
0 : Fixed 0
1 : Fixed 1

4. Programming Specifications

Program memory (bytes)
16
Data memory (bytes)
0
Stack (bytes)
0
Number of states
29
Reentrant
Yes
Relocation
Yes
Intermediate interrupt
Yes

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.

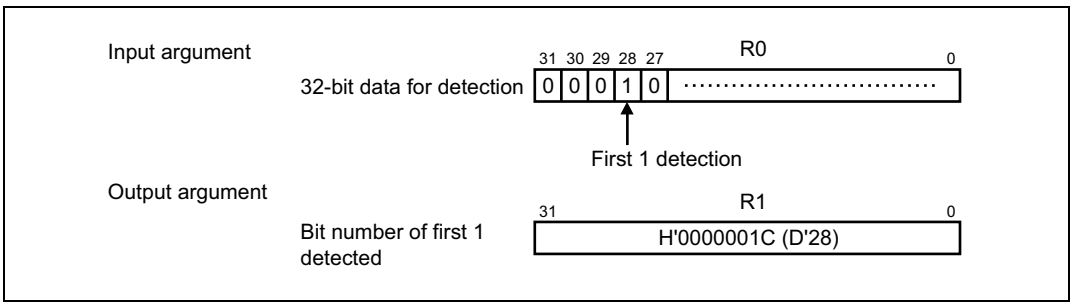


Figure 1 Software FIND1 Execution Example

(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
```

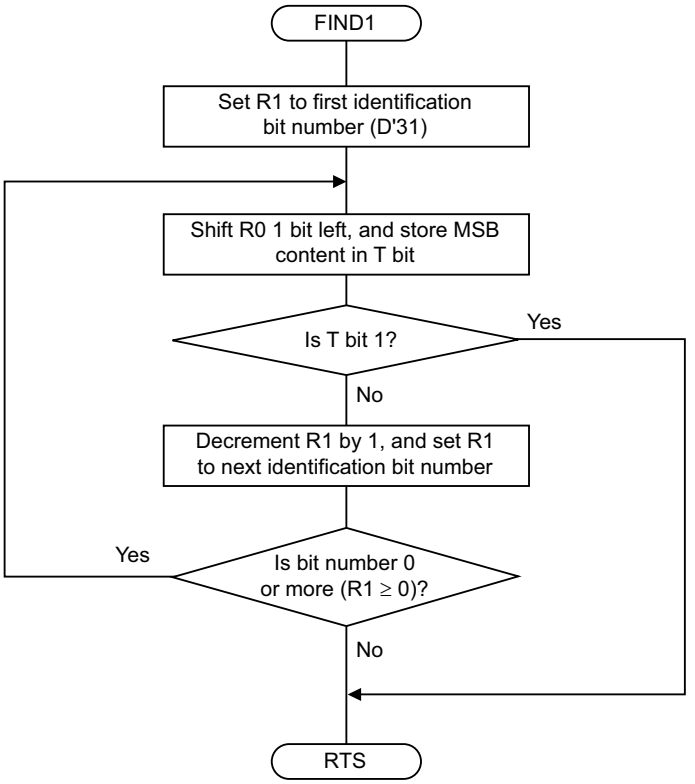
(5) Operating Principle

(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


FIND1
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
No
Decrement R1 by 1, and set R1 to next identification bit number
Is bit number 0 or more (R1 ≥ 0)?
Yes
No
RTS

8. Program Listing

```
  1                       1   ;*************************************************************
  2                       2   ;*                                                           *
  3                       3   ;*       NAME ; FIND FIRST 1 (FIND1)                         *
  4                       4   ;*                                                           *
  5                       5   ;*************************************************************
  6                       6   ;*                                                           *
  7                       7   ;*      ENTRY : R0   (32 BIT DATA)                           *
  8                       8   ;*    RETURNS : R1   (BIT NUMBER)                            *
  9                       9   ;*                                                           *
 10                      10   ;*************************************************************
 11 00001000              11           .SECTION A,CODE,LOCATE=H'1000
 12          00001000     12   FIND1   .EQU    $               ; Entry point
 13 00001000 E11F         13           MOV     #D'31,R1        ; Initialize R1
 14 00001002              14   FIND11                          ;
 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 0000100A 89FA         19           BT      FIND11          ; Yes
 20 0000100C              20   FIND_END                        ;
 21 0000100C 000B         21           RTS                     ;
 22 0000100E 0009         22           NOP                     ;
 23                       23           .END
*****TOTAL ERRORS    0
*****TOTAL WARNINGS  0
```

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