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Renesas Electronics Corporation

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H8/300L Series

Square Root of a 32-Bit Binary Number (SQRT)

Introduction

1. The software SQRT finds the square root of a 32-bit binary number and outputs the result as a 16-bit binary number.
2. All arguments used with the software SQRT are unsigned integers.
3. All data is manipulated in general-purpose registers.

Target Device

H8/300L Series

Contents

1. Arguments.....	2
2. Changes to Internal Registers and Flags	2
3. Specifications	2
4. Notes	2
5. Description	3
6. Flowchart.....	5
7. Program List.....	8

1. Arguments

Description		Memory area	Data length (bytes)
Input	32-bit binary number	R4, R5	4
Output	Square root	R3	2

2. Changes to Internal Registers and Flags

R0	R1	R2	R3	R4	R5	R6	R7
×	×	×	↑	×	×	×	•
I	U	H	U	N	Z	V	C
•	•	×	•	×	×	×	×

- : No change
- × : Undefined
- ↑ : Result

3. Specifications

Program memory (bytes)	94
Data memory (bytes)	0
Stack (bytes)	0
Clock cycle count	1340
Reentrant	Possible
Relocation	Possible
Interrupt	Possible

4. Notes

The clock cycle count (1340) in the specifications is for the example shown in figure 5.1.

5. Description

5.1 Details of functions

- The following arguments are used with the software SQRT:
 R4: Sets, as an input argument, the upper word of a 32-bit binary number whose square root is to be found.
 R5: Sets, as an input argument, the lower word of the 32-bit binary number whose square root is to be found.
 R3: The square root of the 32-bit binary number is placed here as an output argument.
- The following figure illustrates the execution of the software SQRT. When the input arguments are set as shown in (1), the square root is placed in R3 as shown in (2).

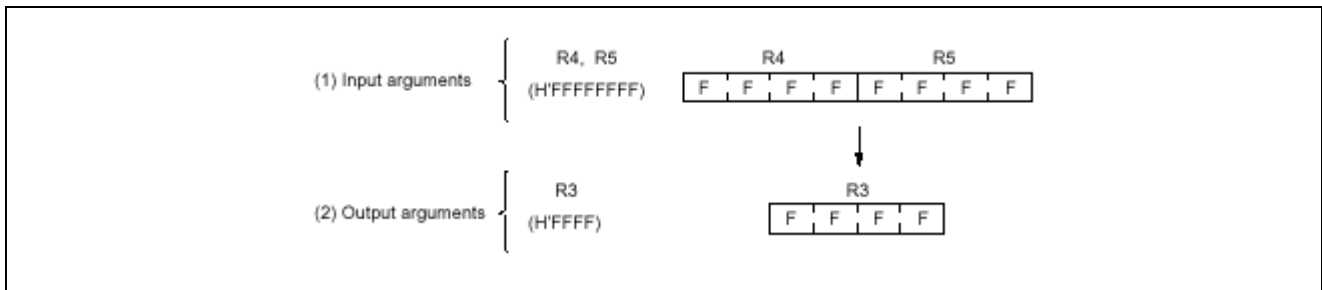


Figure 5.1 Example of Software SQRT Execution

5.2 Notes on usage

- When the upper bits are not used (see figure 5.2), set them to 0; otherwise, the correct result might not be obtained because undefined data in the higher-order bits is included in computation of the square root.

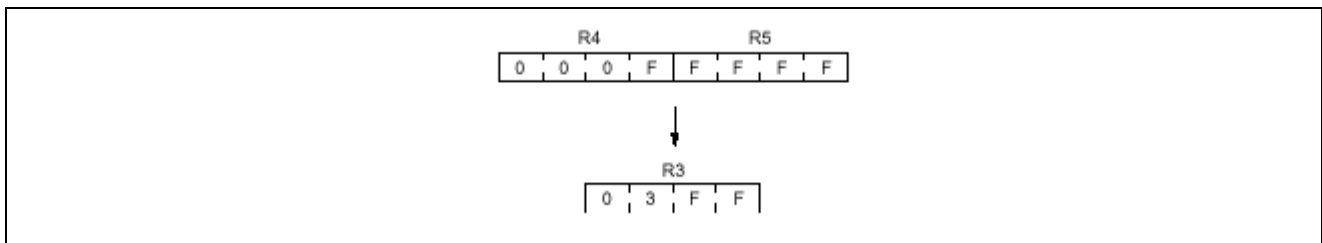


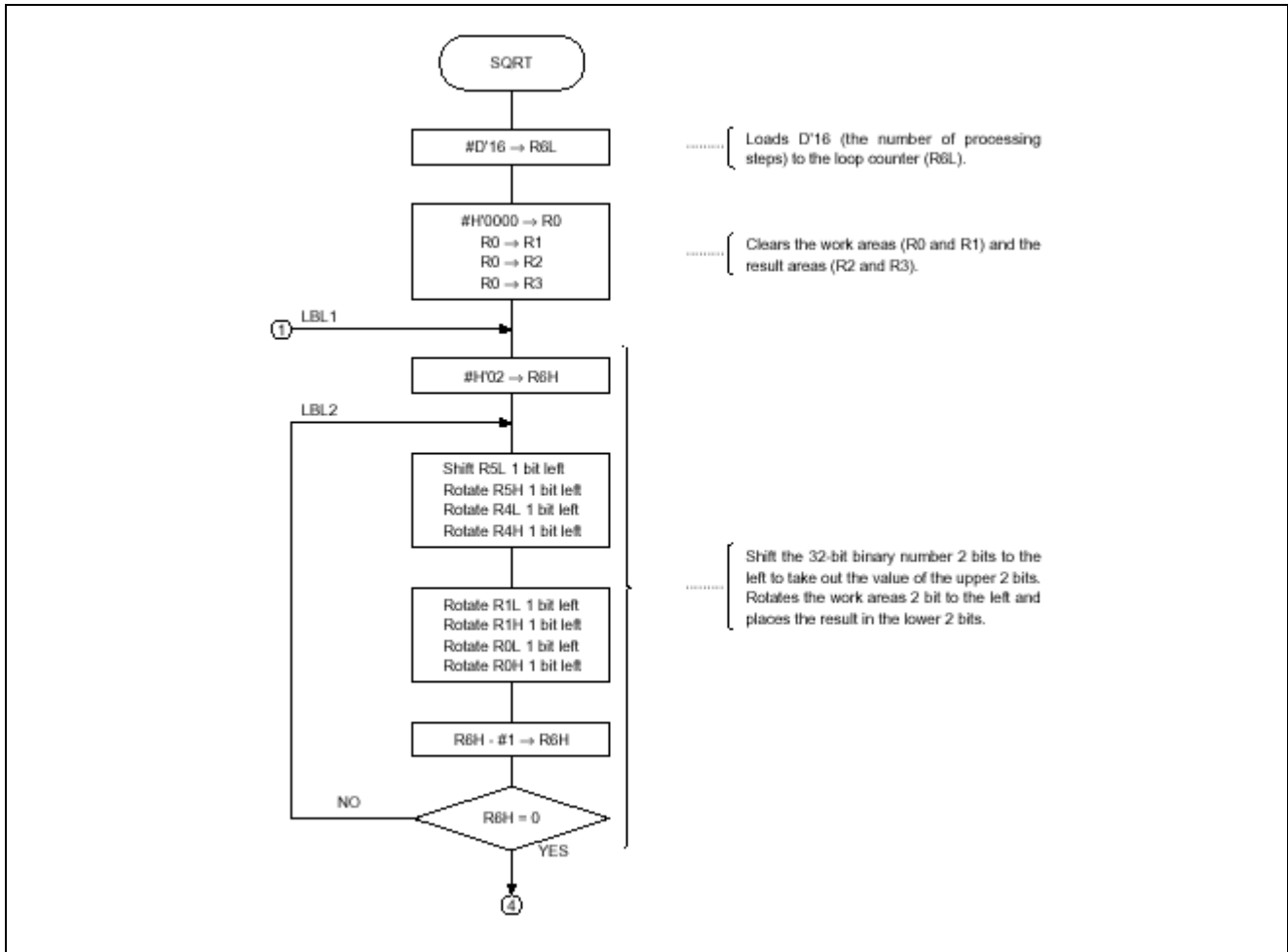
Figure 5.2 Examples of Operation with Upper Bits Unused

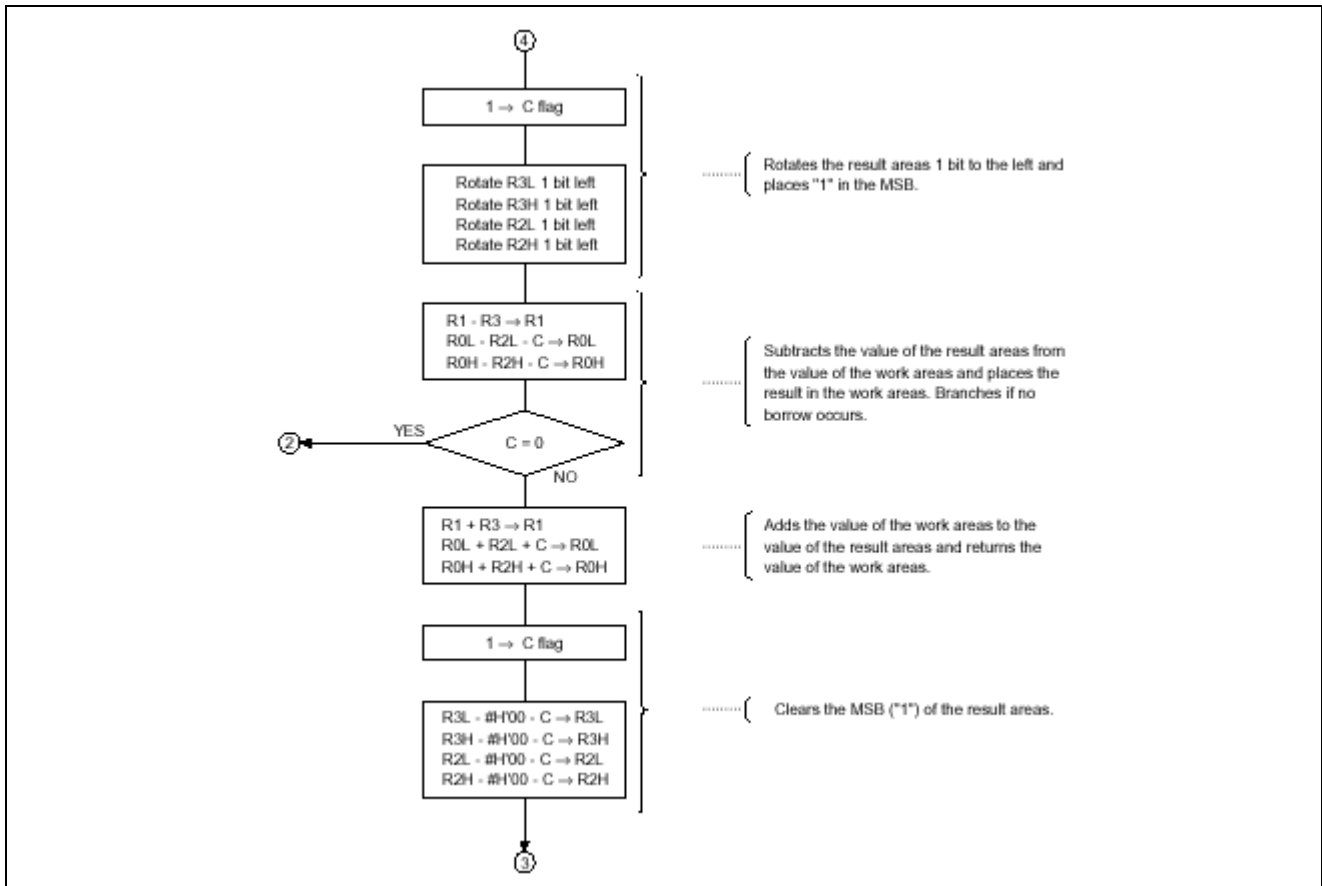
- The fractional part of the result is discarded.

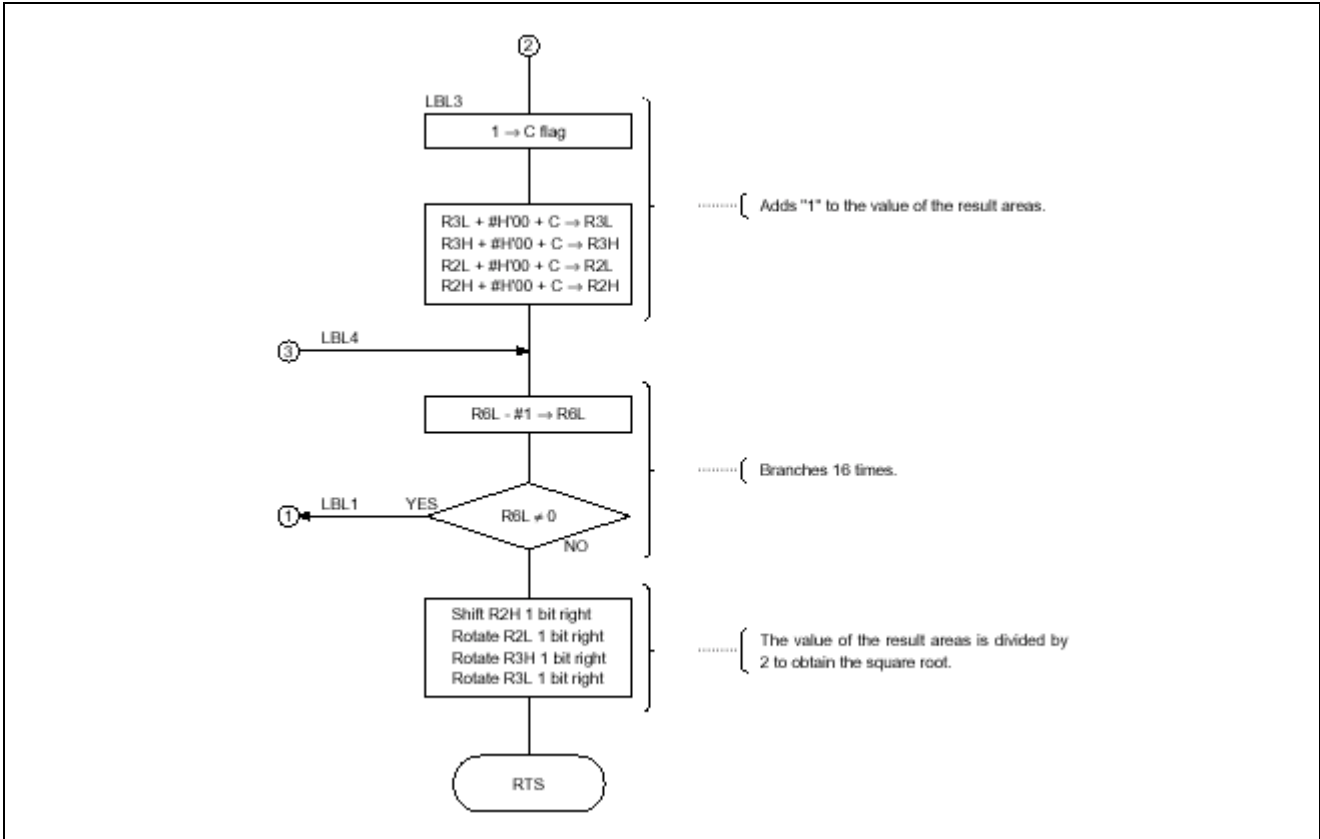
5.3 Data memory

The software SQRT uses no data memory.

6. Flowchart







7. Program List

*** H8/300 ASSEMBLER VER 1.0B ** 08/18/92 10:23:40

PROGRAM NAME =

```

1          ;*****
2          ;*
3          ;*   00 - NAME           :32 BIT SQUARE ROOT (SQRT)
4          ;*
5          ;*****
6          ;*
7          ;*   ENTRY           :R4,R5 (32 BIT BINARY)
8          ;*
9          ;*   RETURN          :R3 (SQUARE ROOT)
10         ;*
11        ;*****
12        ;
13        SQRT_cod C    0000          .SECTION  SQRT_code,CODE,ALIGN=2
14        ;
15        ;
16        SQRT_cod C    00000000     SQRT    .EQU $           ;Entry point
17        SQRT_cod C    0000    FE10     MOV.B    #D'16,R6L      ;Set shift counter
18        SQRT_cod C    0002    79000000  MOV.W    #H'0000,R0   ;Clear R0
19        SQRT_cod C    0006    0D01     MOV.W    R0,R1        ;Clear R1
20        SQRT_cod C    0008    0D02     MOV.W    R0,R2        ;Clear R2
21        SQRT_cod C    000A    0D03     MOV.W    R0,R3        ;Clear R3
22        SQRT_cod C    000C          LBL1
23        SQRT_cod C    000C    F602     MOV.B    #H'02,R6H
24        SQRT_cod C    000E          LBL2
25        SQRT_cod C    000E    100D     SHLL.B   R5L          ;Shift 32 bit binary 1 bit left
26        SQRT_cod C    0010    1205     ROTXL.B  R5H
27        SQRT_cod C    0012    120C     ROTXL.B  R4L
28        SQRT_cod C    0014    1204     ROTXL.B  R4H
29        SQRT_cod C    0016    1209     ROTXL.B  R1L
30        SQRT_cod C    0018    1201     ROTXL.B  R1H
31        SQRT_cod C    001A    1208     ROTXL.B  R0L
32        SQRT_cod C    001C    1200     ROTXL.B  R0H
33        SQRT_cod C    001E    1A06     DEC.B    R6H          ;Decrement R6H
34        SQRT_cod C    0020    46EC     BNE     LBL2          ;Branch if Z=0
35        SQRT_cod C    0022    0401     ORC.B    #H'01,CCR    ;Set C flag of CCR
36        SQRT_cod C    0024    120B     ROTXL.B  R3L          ;Rotate square root
37        SQRT_cod C    0026    1203     ROTXL.B  R3H
38        SQRT_cod C    0028    120A     ROTXL.B  R2L
39        SQRT_cod C    002A    1202     ROTXL.B  R2H
40        SQRT_cod C    002C    1931     SUB.W    R3,R1        ;R1 - R3 -> R1
41        SQRT_cod C    002E    1EA8     SUBX.B   R2L,R0L      ;R0L - R2L - C -> R0L
42        SQRT_cod C    0030    1E20     SUBX.B   R2H,R0H      ;R0H - R2H - C -> R0H
43        SQRT_cod C    0032    4412     BCC     LBL3          ;Branch if C = 0
44        SQRT_cod C    0034    0931     ADD.W    R3,R1        ;R1 + R3 -> R1
45        SQRT_cod C    0036    0EA8     ADDX.B   R2L,R0L      ;R0L + R2L + C -> R0L
46        SQRT_cod C    0038    0E20     ADDX.B   R2H,R0H      ;R0H + R2H + C -> R0H
47        SQRT_cod C    003A    0401     ORC.B    #H'01,CCR    ;Bit set C flag of CCR
48        SQRT_cod C    003C    BB00     SUBX.B   #H'00,R3L    ;R3L - #H'00 - C -> R3L

```

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49      SQRT_cod C      003E      B300                      SUBX.B      #H'00,R3H          ;R3H - #H'00 - C -> R3H
50      SQRT_cod C      0040      BA00                      SUBX.B      #H'00,R2L          ;R2L - #H'00 - C -> R2L
51      SQRT_cod C      0042      B200                      SUBX.B      #H'00,R2H          ;R2H - #H'00 - C -> R2H
52      SQRT_cod C      0044      400A                      BRA          LBL4              ;Branch always
53      SQRT_cod C      0046                      LBL3
54      SQRT_cod C      0046      0401                      ORC.B      #H'01,CCR          ;Bit set C flag of CCR
55      SQRT_cod C      0048      9B00                      ADDX.B      #H'00,R3L          ;R3L + #H'00 + C -> R3L
56      SQRT_cod C      004A      9300                      ADDX.B      #H'00,R3H          ;R3H + #H'00 + C -> R3H
57      SQRT_cod C      004C      9A00                      ADDX.B      #H'00,R2L          ;R2L + #H'00 + C -> R2L
58      SQRT_cod C      004E      9200                      ADDX.B      #H'00,R2H          ;R2H + #H'00 + C -> R2H
59      SQRT_cod C      0050                      LBL4
60      SQRT_cod C      0050      1A0E                      DEC.B      R6L                ;Decrement shift counter
61      SQRT_cod C      0052      46B8                      BNE        LBL1              ;Branch if Z=0
62      SQRT_cod C      0054      1102                      SHLR.B      R2H
63      SQRT_cod C      0056      130A                      ROTXR.B     R2L
64      SQRT_cod C      0058      1303                      ROTXR.B     R3H              ;Rotate square root
65      SQRT_cod C      005A      130B                      ROTXR.B     R3L
66      SQRT_cod C      005C      5470                      RTS
67
68
*****TOTAL ERRORS 0
*****TOTAL WARNINGS 0

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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Sep.18.03	—	First edition issued

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