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Renesas Electronics Corporation

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H8/300H Tiny Series

64-Bit Binary Subtraction (SUB)

Introduction

Performs binary subtraction in this format:
minuend (unsigned, 64 bits) – subtrahend (unsigned, 64 bits) = difference (unsigned, 64 bits).

Target Device

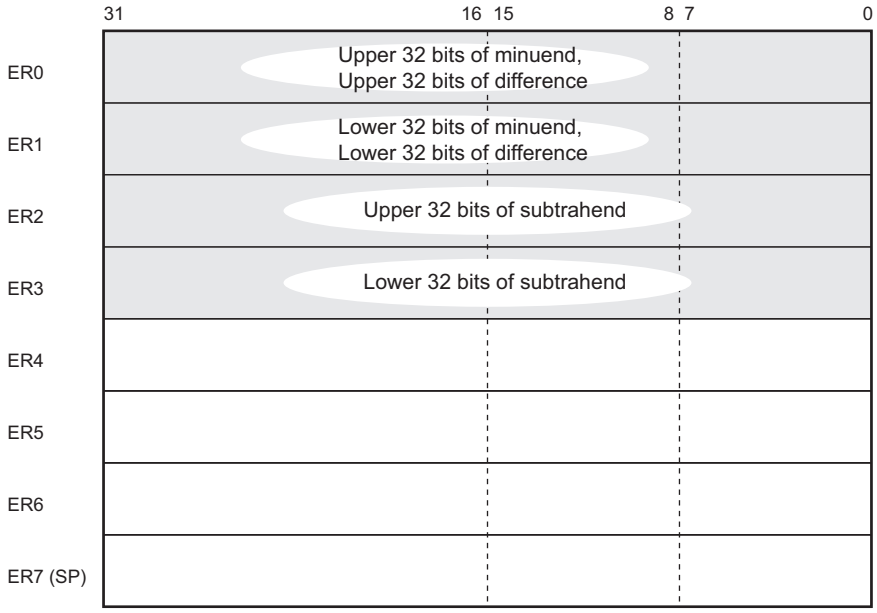
H8/300H Tiny Series

Contents

1. Arguments

Description		Storage Location	Data Length (Bytes)
Input	Upper 32 bits of minuend (unsigned 64 bits)	ER0	4
	Lower 32 bits of minuend (unsigned 64 bits)	ER1	4
	Upper 32 bits of subtrahend (unsigned 64 bits)	ER2	4
	Lower 32 bits of subtrahend (unsigned 64 bits)	ER3	4
Output	Upper 32 bits of difference (unsigned 64 bits)	ER0	4
	Lower 32 bits of difference (unsigned 64 bits)	ER1	4
	Occurrence of borrow (yes = 1, no = 0)	C flag (CCR)	—

2. Changes to Internal Registers and Flags



I	UI	H	U	N	Z	V	C
–	–	↕	–	↕	↕	0	↕

–: No change
↕: Varies
0: Fixed to 0
1: Fixed to 1

3. Programming Specifications

Program memory (bytes)
18
Data memory (bytes)
0
Stack (bytes)
0
Number of cycles
26
Re-entrant
Yes
Relocatable
Yes
Interrupts during execution
Yes

4. Description

4.1 Description of Functions

1. The arguments are as follows:
   ER0: Set the upper 32-bits of the minuend (unsigned, 64 bits) as an input argument. The upper 32 bits of the difference (unsigned, 64 bits) are also set here as an output argument.
   ER1: Set the lower 32-bits of the minuend (unsigned, 64 bits) as an input argument. The lower 32 bits of the difference (unsigned, 64 bits) are also set here as an output argument.
   ER2: Set the upper 32-bits of the subtrahend (unsigned, 64 bits) as an input argument.
   ER3: Set the lower 32-bits of the subtrahend (unsigned, 64 bits) as an input argument.
   C flag (CCR): indicates whether or not a borrow has occurred after execution of SUB.
   C flag = 1: a borrow has occurred.
   C flag = 0: no borrow has occurred.

2. The following figure illustrates the execution of the SUB subroutine.
   When the input arguments are set as shown below, the result of subtraction is placed in ER0 and ER1.

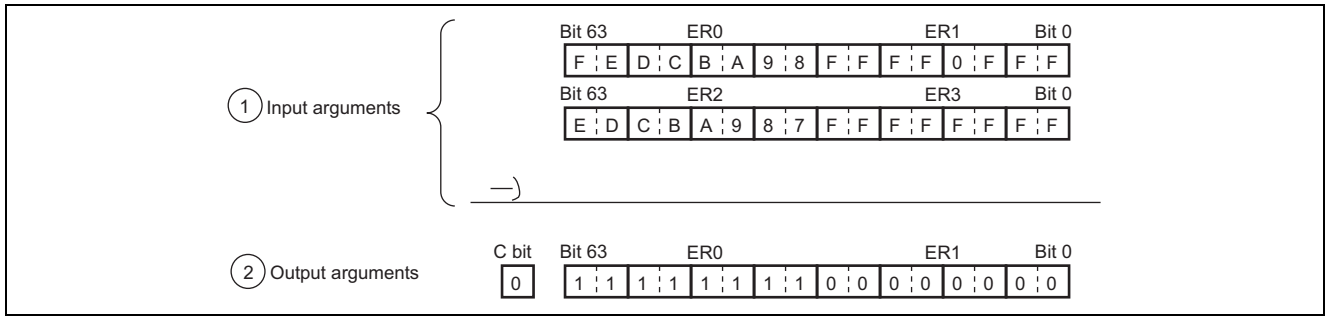


Figure 1 Example of SUB Execution

4.2 Usage Notes

Since the result of subtraction is placed in the same register as was used to set the minuend, the minuend is lost through execution of SUB. When you will still require the minuend, save it elsewhere in memory beforehand.

4.3 Description of Data Memory

No data memory is used by SUB.

4.4 Example of Usage

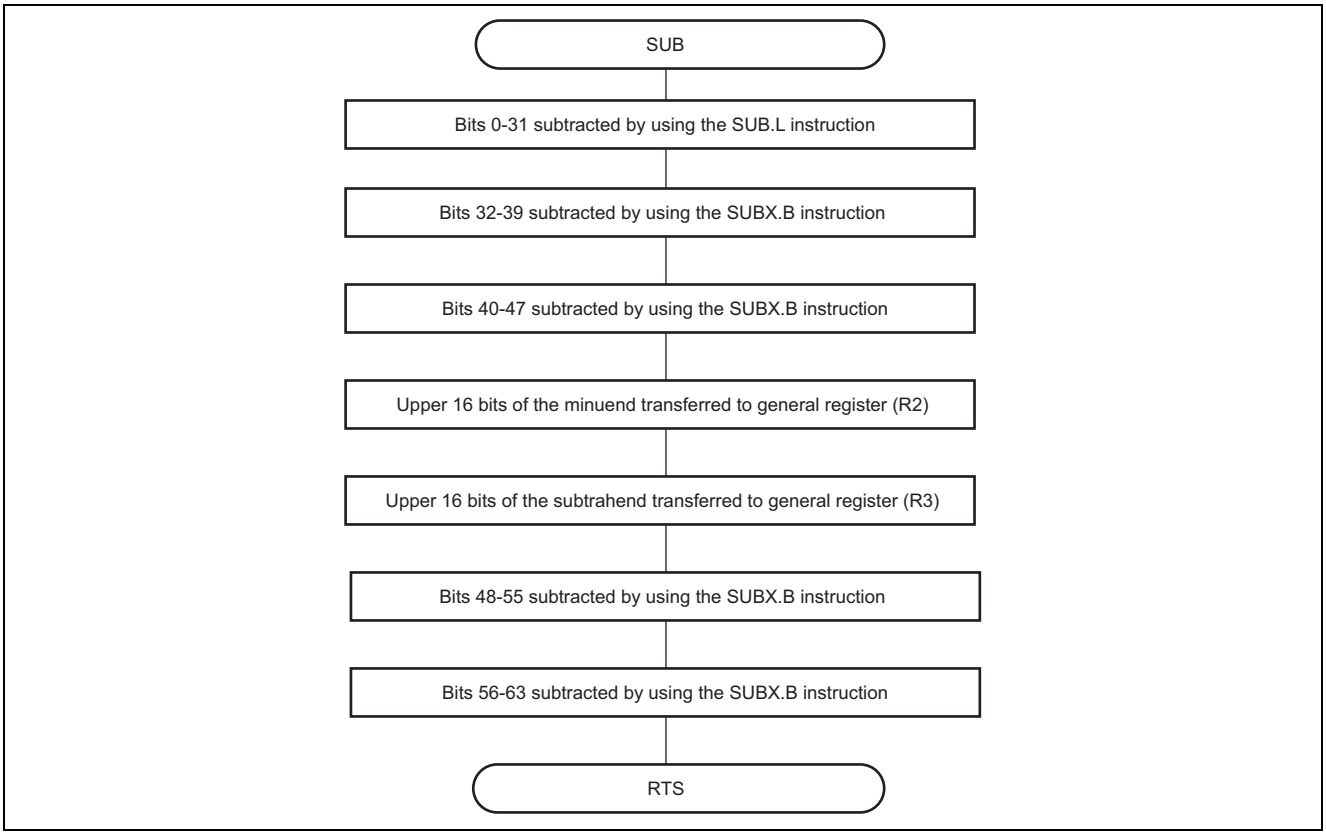
After setting the subtrahend and minuend, call the SUB subroutine.

```
WORK1   . RES. L 1          ..... Reservation of the data memory area for setting of the upper 32 bits of the minuend (unsigned, 64 bits)
                                  by the user program.
WORK2   . RES. L 1          ..... Reservation of the data memory area for setting of the lower 32 bits  of the minuend by the user program.

WORK3   . RES. L 1          ..... Reservation of the data memory area for setting of the upper 32 bits of the subtrahend (unsigned, 64 bits)
                                  by the user program.
WORK4   . RES. L 1          ..... Reservation of the data memory area for setting of the lower 32 bits of the subtrahend by the user program.


        MOV. L @WORK1, ER0  ..... Sets, in the input argument, the upper 32 bits of the minuend specified by the user program.

        MOV. L @WORK2, ER1  ..... Sets, in the input argument, the lower 32 bits of the minuend specified by the user program.

        MOV. L @WORK3, ER2  ..... Sets, in the input argument, the upper 32 bits of the subtrahend specified by the user program.

        MOV. L @WORK4, ER3  ..... Sets, in the input argument, the lower 32 bits of the subtrahend specified by the user program.
            .
            .
            .
        JSR    @SUB         ..... Subroutine call of SUB

        BCS    OVER         ..... When a borrow has occurred, branches to the routine for processing a borrow.
OVER    Processing routine for borrowing
```

4.5 Principles of Operation

1. Subtraction of bits 0-31 is carried out by using the SUB.L instruction.
2. Subtraction of bits 32-63 is carried out in byte units, from the lowest-order byte, by the subtract-with-borrow instruction (SUBX.B). Since bits 48-55 are in an extended register, to which the subtract-with-borrow instruction is not applicable, subtraction with borrow is performed after the data in these bits have been transferred to a general register.

5. Flowchart


SUB
Bits 0-31 subtracted by using the SUB.L instruction
Bits 32-39 subtracted by using the SUBX.B instruction
Bits 40-47 subtracted by using the SUBX.B instruction
Upper 16 bits of the minuend transferred to general register (R2)
Upper 16 bits of the subtrahend transferred to general register (R3)
Bits 48-55 subtracted by using the SUBX.B instruction
Bits 56-63 subtracted by using the SUBX.B instruction
RTS

6. Program Listing

```
 1                                    1    ;*********************************************************************
 2                                    2    ;*                                                                   *
 3                                    3    ;*        NAME    :      64 BIT BINARY SUBTRACTION(SUB)               *
 4                                    4    ;*                                                                   *
 5                                    5    ;*********************************************************************
 6                                    6    ;*                                                                   *
 7                                    7    ;*        ENTRY   :      ER0          (UPPER 32 BIT MINUEND)          *
 8                                    8    ;*                       ER1          (LOWER 32 BIT MINUEND)          *
 9                                    9    ;*                       ER2          (UPPER 32 BIT SUBTRAHEND)       *
10                                   10    ;*                       ER3          (LOWER 32 BIT SUBTRAHEND)       *
11                                   11    ;*        RETURNS  :     ER0          (UPPER 32 BIT REMAINDER)        *
12                                   12    ;*                       ER1          (LOWER 32 BIT REMAINDER)        *
13                                   13    ;*                       CARRY        (C=0:TRUE , C=1:BORROW)         *
14                                   14    ;*                                                                   *
15                                   15    ;*********************************************************************
16                                   16    ;
17                                   17              .CPU          300HA
18    001000                         18              .SECTION A,CODE,LOCATE=H'001000
19             00001000              19    SUB       .EQU          $             ;Entry point
20    001000   1AB1                 20              SUB.L         ER3,ER1       ;Lower 48 bit binary subtraction
21    001002   1EA8                 21              SUBX.B        R2L,R0L       ;
22    001004   1E20                 22              SUBX.B        R2H,R0H       ;
23    001006   0D82                 23              MOV.W         E0,R2         ;Upper 16 bit binary subtraction
24    001008   0DA3                 24              MOV.W         E2,R3         ;
25    00100A   1EBA                 25              SUBX.B        R3L,R2L       ;
26    00100C   1E32                 26              SUBX.B        R3H,R2H       ;
27    00100E   0D28                 27              MOV.W         R2,E0         ;
28    001010   5470                 28              RTS
29                                   29              .END
***** TOTAL    ERRORS      0
***** TOTAL    WARNINGS    0
```

Note: The program listing included in this application note assumes compilation under the option for the advanced mode of H8/300H CPU. If you use this sample program with an H8/300H Tiny Series product, make the following change to the program code:
.CPU 300HA → .CPU 300HN

Revision Record

Rev.	Date	Description	
		Page	Summary
2.00	Feb.28.06	—	Format has been changed from Hitachi version to Renesas version.

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