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H8/300L Super Low Power Series

Subtraction of 32-Bit Binary Numbers (SUB1)

Introduction

The software SUB1 subtracts a 32-bit binary number from another 32-bit binary number and places the result (a 32-bit binary number) in general-purpose registers.

Target Device

H8/38024

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1. Arguments

Description		Memory area	Data length (bytes)
Input	Minuend	R0, R1	4
	Subtrahend	R2, R3	4
Output	Result of subtraction	R0, R1	4
	Borrow	C flag (CCR)	—

2. Changes to Internal Registers and Flags

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

Legend

- : No change
- ×: Undefined
- : Result

3. Specifications

Program memory (bytes)	8
Data memory (bytes)	0
Stack (bytes)	0
Clock cycle count	14
Reentrant	Possible
Relocation	Possible
Interrupt	Possible

4. Description

4.1 Details of functions

- The following arguments are used with the software SUB1:
 - R0, R1: Sets a 32-bit binary minuend as an input argument. The result of subtraction is placed in these registers after execution of the software SUB1.
 - R2, R3: Sets a 32-bit binary subtrahend as an input argument.
 - C flag (CCR): Determines the presence or absence of a borrow as an output argument after execution of the software SUB1.
 - C flag = 1: A borrow occurred in the result (see figure 1).
 - C flag = 0: No borrow occurred in the result.

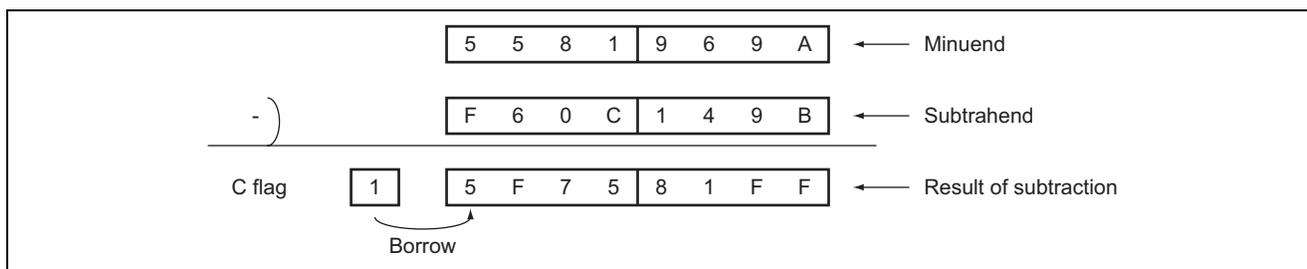


Figure 1 Example of Subtraction with a Borrow

- The following figure illustrates the execution of the software SUB1. When the input arguments are set as shown in (1), the result of subtraction is placed in R0 and R1 as shown in (2).

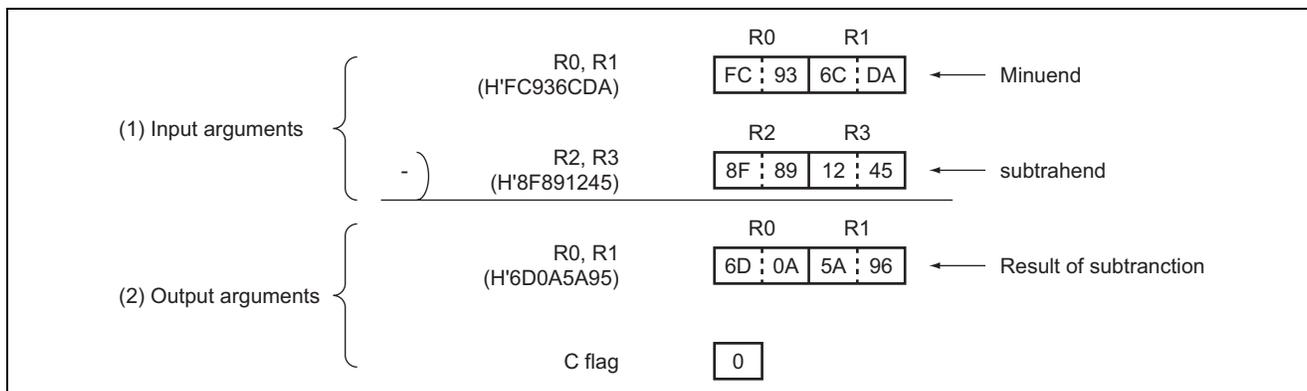


Figure 2 Example of Software SUB1 Execution

4.2 Notes on usage

1. When upper bits are not used (see figure 3), set them to 0; otherwise, a correct result cannot be obtained because subtraction is done on the numbers including indeterminate data.

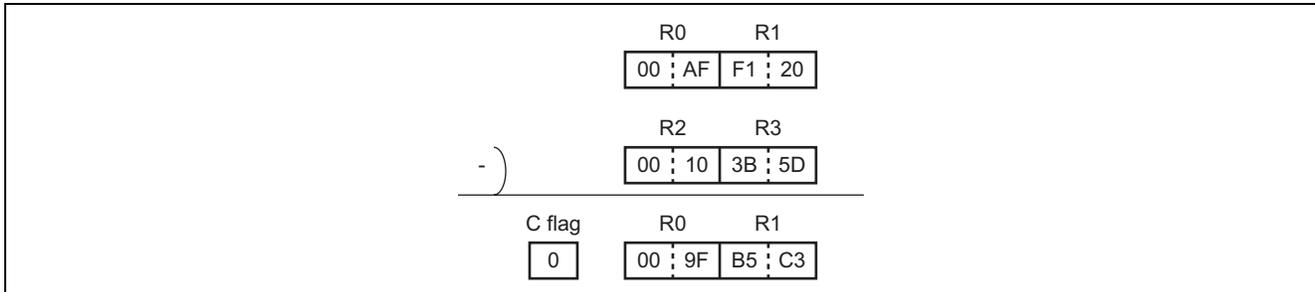


Figure 3 Example of Subtraction with Upper Bits Unused

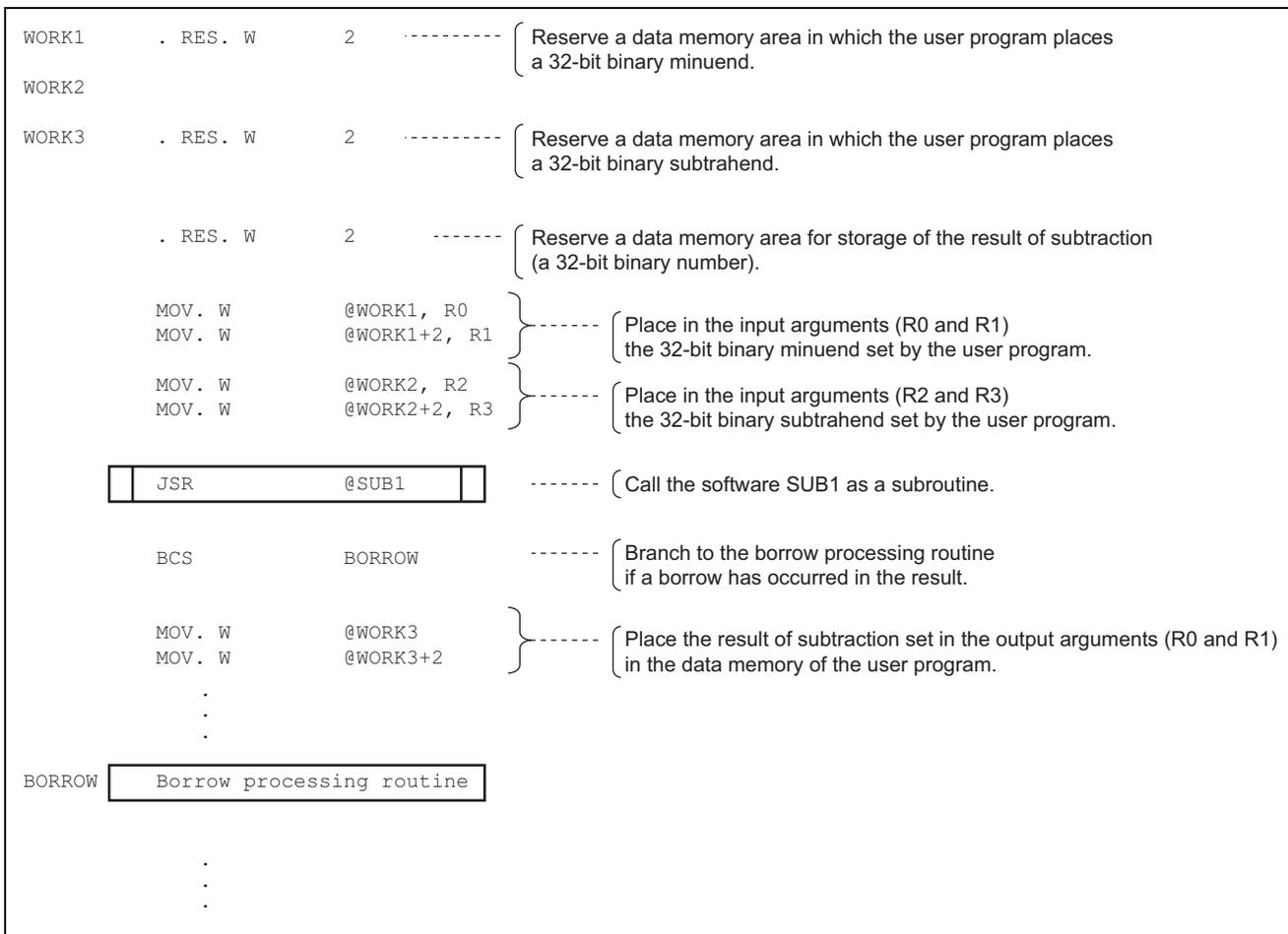
2. After execution of the software SUB1, the minuend will be lost because the result is placed in R0 and R1. When the minuend is still needed after software SUB1 execution, save it in memory.

4.3 Data memory

The software SUB1 uses no data memory.

4.4 Example of usage

Set a minuend and a subtrahend in the input arguments and call the software SUB1 as a subroutine.



4.5 Operation

1. Subtraction of 3 bytes or more can be done by repeating 1-byte subtractions.
2. A 1-word subtract instruction (SUB.W), which does not consider the state of the C flag, is used to subtract the lower word shown by equation 1. The C flag is set when a borrow occurs after execution of the equation.

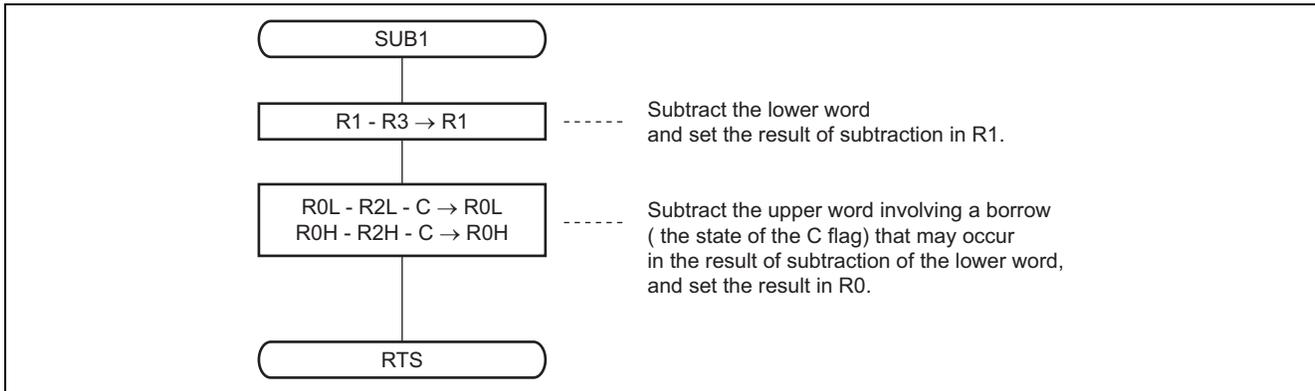
$$R1 - R3 \rightarrow R1 \text{ equation 1}$$

3. A 1-byte subtract instruction (SUBX.B), which considers the state of the C flag, is used twice to subtract the upper word shown by equation 2.

$$\left. \begin{array}{l} R0L - R2L - C \rightarrow R0 \\ R0H - R2H - C \rightarrow R0 \end{array} \right\} \text{ equation 2}$$

The C flag indicates a borrow that may occur as a result of the subtraction of the lower word executed in step 2 and the subtraction of the lower bytes of the upper word.

5. Flowchart



6. Program List

```

*** H8/300 ASSEMBLER VER 1.0B ** 08/18/92 09:53:37
PROGRAM NAME =
1          ;*****
2          ;*
3          ;*      00 - NAME      :32 BIT BINARY SUBTRUCTION (SUB1)
4          ;*
5          ;*****
6          ;*
7          ;*      ENTRY        :R0,R1 (MINUEND)
8          ;*                      R2,R3 (SUBTRAHEND)
9          ;*
10         ;*      RETURNS      :R0,R1 (RESULT)
11         ;*                      C flag OF CCR (C = 0;TRUE,C = 1;BORROW)
12         ;*
13         ;*****
14         ;
15 SUB1_cod C    0000          .SECTION          SUB1_code,CODE,ALIGN=2
16                                .EXPORT          SUB1
17         ;
18 SUB1_cod C    00000000 SUB1 .EQU $            ;Entry point
19 SUB1_cod C    0000 1931     SUB.W      R3,R1     ;Subtract lower word
20 SUB1_cod C    0002 1EA8     SUBX.B   R2L,R0L     ;Subtract upper word
21 SUB1_cod C    0004 1E20     SUBX.B   R2H,R0H
22         ;
23 SUB1_cod C    0006 5470     RTS
24         ;
25                                .END
****TOTAL ERRORS 0
****TOTAL WARNINGS 0

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Revision Record

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		Page	Summary
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