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April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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H8/300L Series

Subtraction of 8-Digit BCD Numbers (SUBD1)

Introduction

1. The software SUBD1 subtracts an 8-digit binary-coded decimal (BCD) number from another 8-digit BCD number and places the result (an 8-digit BCD number) in general-purpose registers.
2. The arguments used with the software SUBD1 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. Description 3
5. Flowchart 5
6. Program List 6

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
•	•	×	•	×	×	×	↕

• : No change
× : Undefined
↕ : Result

3. Specifications

Program memory (bytes)
18
Data memory (bytes)
0
Stack (bytes)
0
Clock cycle count
24
Reentrant
Possible
Relocation
Possible
Interrupt
Possible

4. Description

4.1 Details of functions

1. The following arguments are used with the software SUBD1:
   R0, R1: Contain an 8-digit BCD minuend (32 bits long). After execution of the software SUBD1, the result of subtraction (an 8-digit BCD number, 32 bits long) is placed in this register.
   R2, R3: Contain an 8-digit BCD subtrahend (32 bits long) as an input argument.
   C flag (CCR): Indicates the presence or absence of a borrow, as an output argument, after execution of the software SUBD1.
   C flag = 1: A borrow occurred as a result of subtraction (see figure 4.1).
   C flag = 0: No borrow occurred as a result of subtraction.

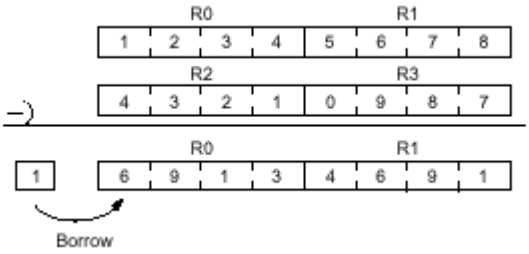


Figure 4.1 Example of Subtraction with a Borrow

2. The following figure illustrates the execution of the software SUBD1. 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 4.2 Example of Software SUBD1 Execution

4.2 Notes on usage

1. When upper bits are not used (see figure 4.3), set them to 0; otherwise, a correct result cannot be obtained because subtraction is done on the numbers including indeterminate data.

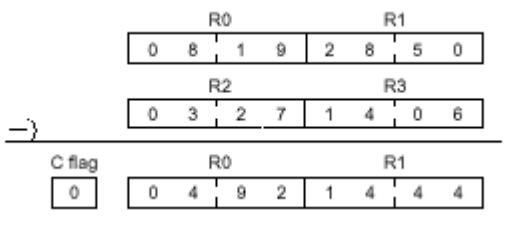


Figure 4.3 Example of Subtraction with Upper Bits Unused

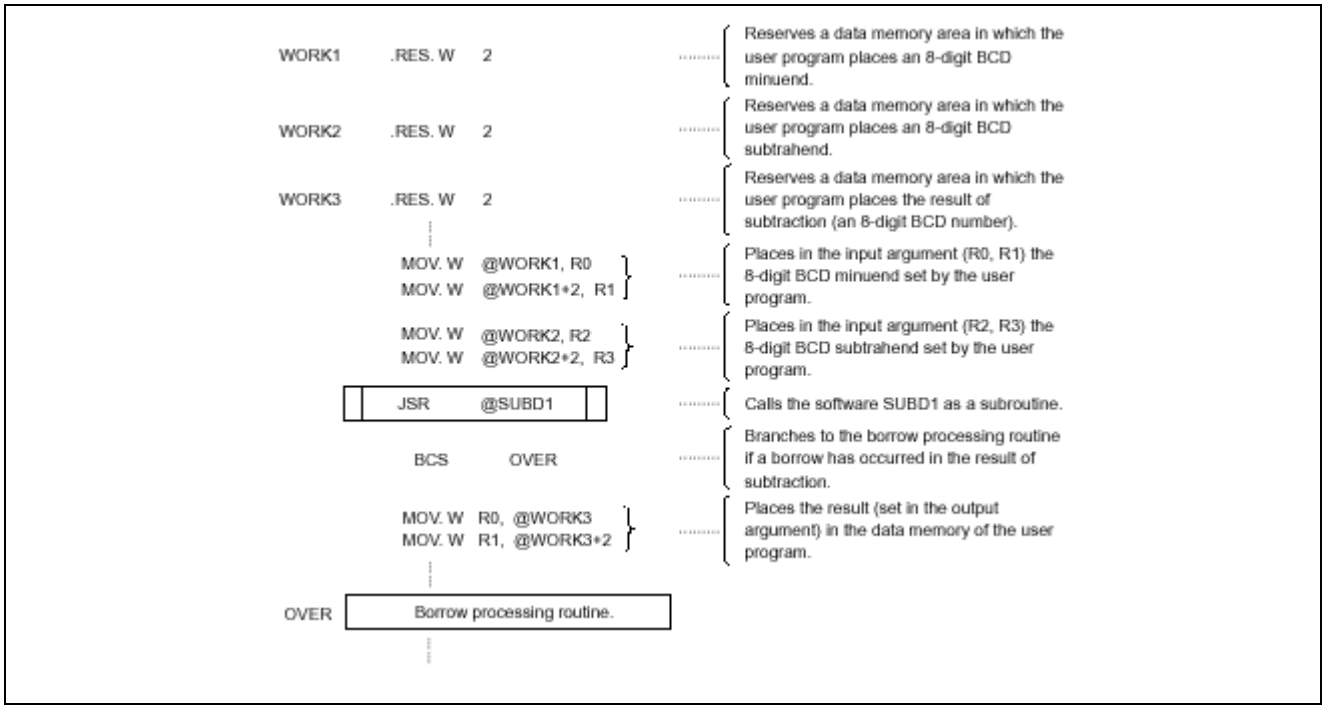
2. After execution of the software SUBD1, the minuend will be lost because the result is placed in R1 and R2. If the minuend is still needed after software SUBD1 execution, save it in memory.

4.3 Data memory

The software SUBD1 uses no data memory.

4.4 Example of use

Set a minuend and a subtrahend in the registers and call the software SUBD1 as a subroutine.



4.5 Operation

1. Subtraction of 2 bytes or more of BCD numbers can be done by performing a series of 1-byte subtractions with decimal correction.
2. A 1-byte subtract instruction (SUB.B), which does not consider the state of the C flag, is used to carry out the subtraction of the lowest byte given in equation 1. If there is a borrow after execution of equation 1, the C flag is set. Then a decimal correct instruction (DAS) is used to perform decimal correction.

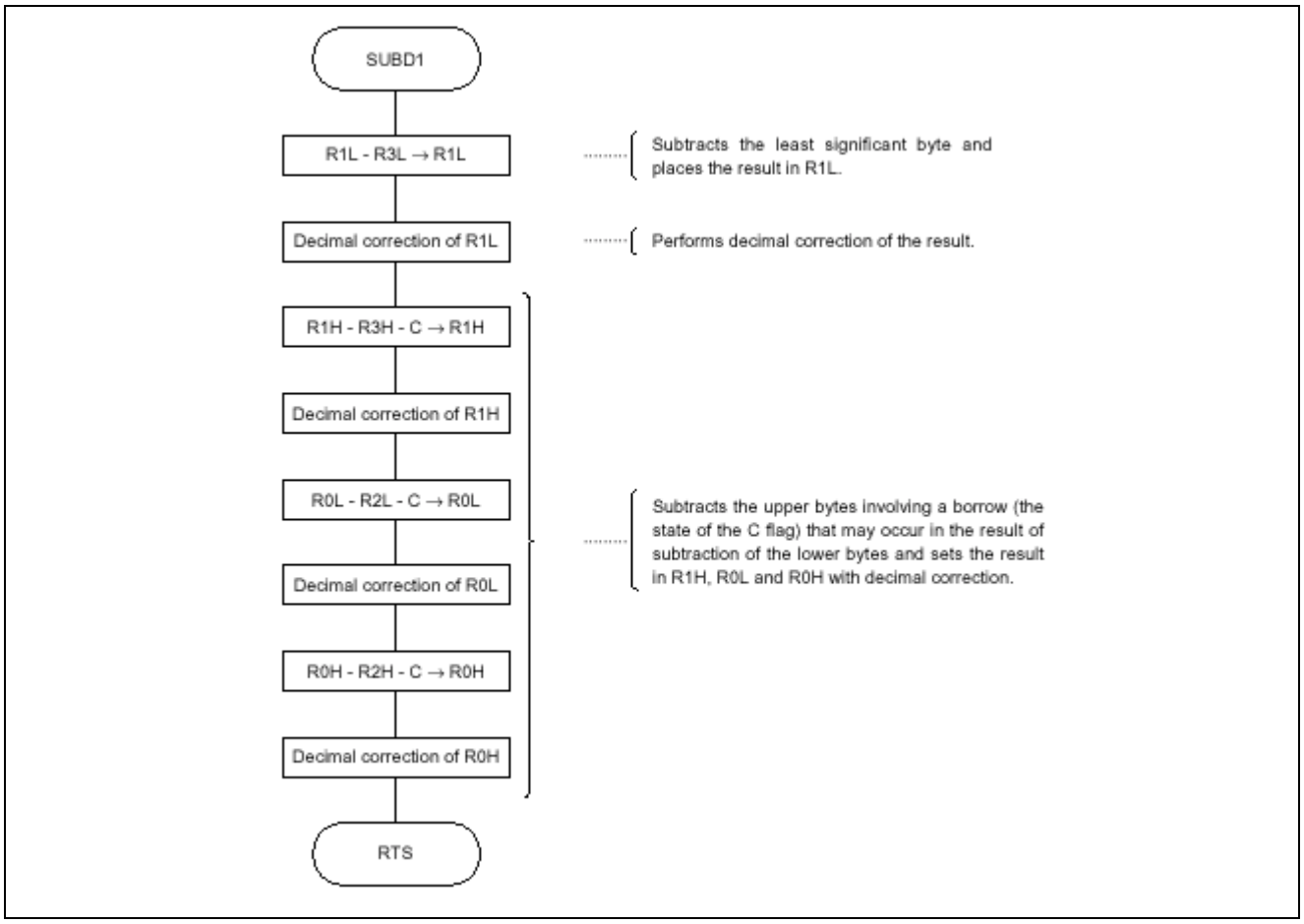
   R1L – R3L → R1L .... equation 1
   Decimal correction of R1L → R1L

3. A 1-byte subtract instruction (SUBX.B), which considers the state of the C flag, and a decimal-correct instruction (DAS) are executed three times to carry out the subtraction of the upper bytes, which is given by equation 2.

   R1H – R3H – C → R1H Decimal correction of R1H → R1H
   R0H – R2L – C → R0L Decimal correction of R0L → R0L
   R0H – R2H – C → R0H Decimal correction of R0H → R0H
   ..... equation 2

   In equation 2, the C flag indicates a borrow that may be produced as a result of the subtraction of the lowest byte that was executed in step 2, the subtraction of the upper bytes of the lower word, and the subtraction of the lower bytes of the upper word, respectively.

5. Flowchart


SUBD1
R1L - R3L → R1L
Decimal correction of R1L
R1H - R3H - C → R1H
Decimal correction of R1H
R0L - R2L - C → R0L
Decimal correction of R0L
R0H - R2H - C → R0H
Decimal correction of R0H
RTS
Subtracts the least significant byte and places the result in R1L.
Performs decimal correction of the result.
Subtracts the upper bytes involving a borrow (the state of the C flag) that may occur in the result of subtraction of the lower bytes and sets the result in R1H, R0L and R0H with decimal correction.

6. Program List

```
*** H8/300 ASSEMBLER VER 1.0B ** 08/18/92 10:01:03
PROGRAM NAME =
 1                                          ;*******************************************************************************
 2                                          ;*
 3                                          ;*      00 - NAME               :DECIMAL SUBTRUCTION (SUBD1)
 4                                          ;*
 5                                          ;*******************************************************************************
 6                                          ;*
 7                                          ;*      ENTRY                   :R0 (UPPER WORD MINUEND)
 8                                          ;*                               R1 (LOWER WORD MINUEND)
 9                                          ;*                               R2 (UPPER WORD SUBTRAHEND)
10                                          ;*                               R3 (LOWER WORD SUBTRAHEND)
11                                          ;*
12                                          ;*      RETURNS                 :R0 (UPPER WORD RESULT)
13                                          ;*                               R1 (LOWER WORD RESULT)
14                                          ;*                               C flag OF CCR (C = 0;TRUE,C = 1;UNDER FLOW)
15                                          ;*
16                                          ;*******************************************************************************
17                                          ;
18       SUBD1_co C       0000                      .SECTION                SUBD1_code,CODE,ALIGN=2
19                                                  .EXPORT                 SUBD1
20                                          ;
21       SUBD1_co C              00000000   SUBD1   .EQU $                  ;Entry point
22       SUBD1_co C       0000   18B9                SUB.B   R3L,R1L         ;R1L - R3L -> R1L
23       SUBD1_co C       0002   1F09                DAS     R1L             ;Decimal adjust R1L
24       SUBD1_co C       0004   1E31                SUBX.B  R3H,R1H         ;R1H - R3H - C -> R1H
25       SUBD1_co C       0006   1F01                DAS     R1H             ;Decimal adjust R1H
26       SUBD1_co C       0008   1EA8                SUBX.B  R2L,R0L         ;R0L - R2L - C -> R0L
27       SUBD1_co C       000A   1F08                DAS     R0L             ;Decimal adjust R0L
28       SUBD1_co C       000C   1E20                SUBX.B  R2H,R0H         ;R0H - R2H - C -> R0H
29       SUBD1_co C       000E   1F00                DAS     R0H             ;Decimal adjust R0H
30       SUBD1_co C       0010   5470                RTS
31                                          ;
32                                                  .END
*****TOTAL ERRORS 0
*****TOTAL WARNINGS 0
```

Revision Record

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

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