To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

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

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

H8/300L Super Low Power Series

Subtraction of Multiple-Precision BCD Numbers (SUBD2)

Introduction

The software SUBD2 subtracts a multiple-precision binary-coded decimal (BCD) number from another multiple-precision BCD number and places the result in the data memory where the minuend was set.

Target Device

H8/38024

Contents

1. Arguments

Description		Memory area	Data length (bytes)
Input	Minuend and subtrahend byte count	R0L	1
	Start address of minuend	R3	2
	Start address of subtrahend	R4	2
Output	Start address of result	R3	2
	Error	Z flag (CCR)	—
	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)
44
Data memory (bytes)
0
Stack (bytes)
0
Clock cycle count
7680
Reentrant
Possible
Relocation
Possible
Interrupt
Possible

4. Notes

The clock cycle count (7680) in the specifications is for subtraction of 255 bytes from 255 bytes.

5. Description

5.1 Details of functions

1. The following arguments are used with the software SUBD2:
   R0L: Sets, as an input argument, the byte count of the minuend and subtrahend in 2-digit hexadecimals.
   R3: Sets the start address of the data memory area where the minuend is placed. After execution of the software SUBD2, the start address of the result is placed in this register.
   R4: Sets, as an input argument, the start address of the data memory area where the subtrahend is placed.
   Z flag (CCR): Indicates an error in data length as an output argument.
   Z flag = 0: The data byte count (R0L) was not 0.
   Z flag = 1: The data byte count (R0L) was 0, indicating an error.
   C flag (CCR): Indicates whether there is or isn't a borrow after software SUBD2 execution as an output argument.
   C flag = 0: No borrow occurred in the result.
   C flag = 1: A borrow occurred in the result (see figure 1).
2. The following figure illustrates the execution of the software SUBD2. When the input arguments are set as shown in (1), the result of subtraction is placed in the data memory area as shown in (2).

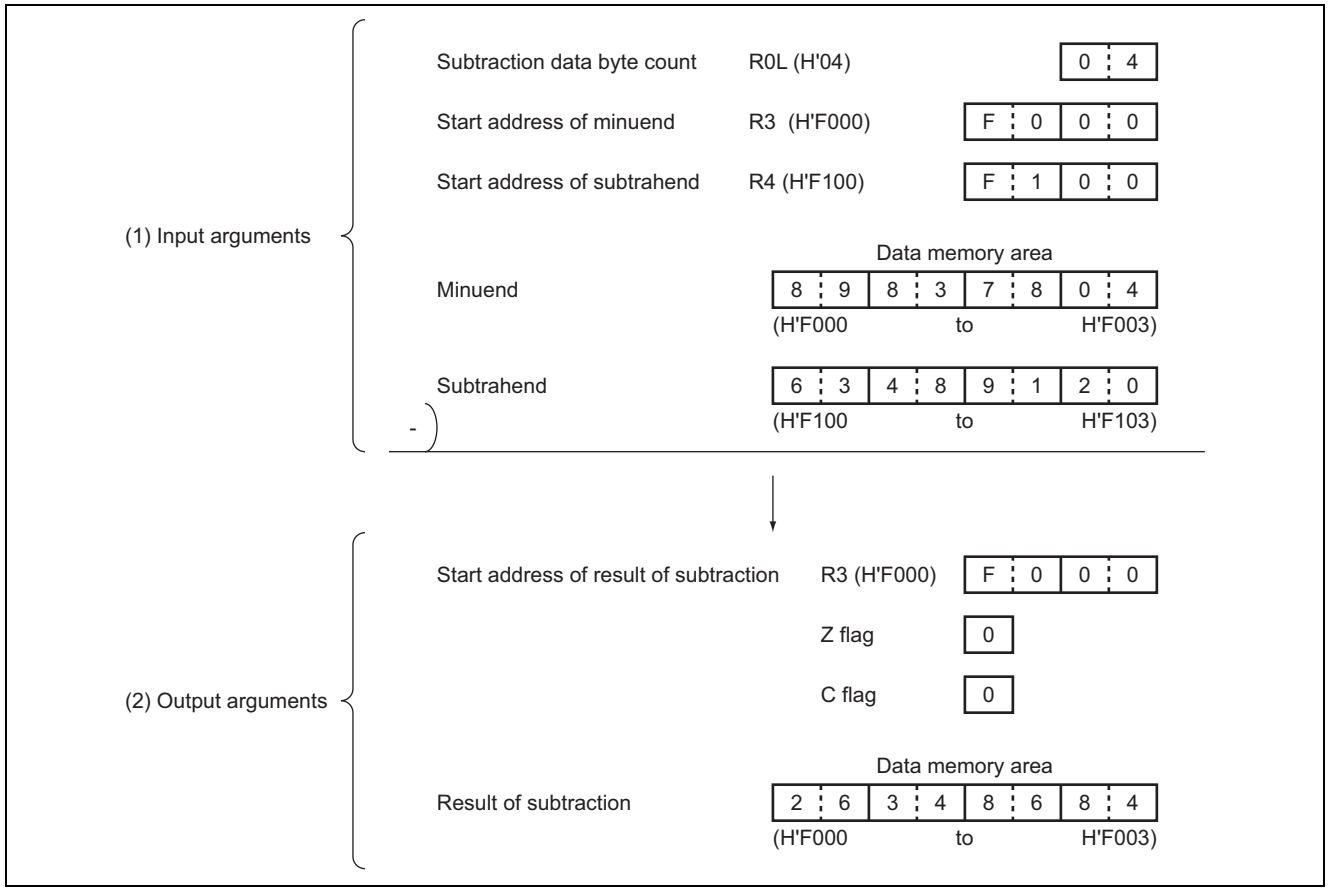


Figure 1 Example of Software SUBD2 Execution

Figure 2 shows an example of subtraction with a borrow that has occurred in the result.

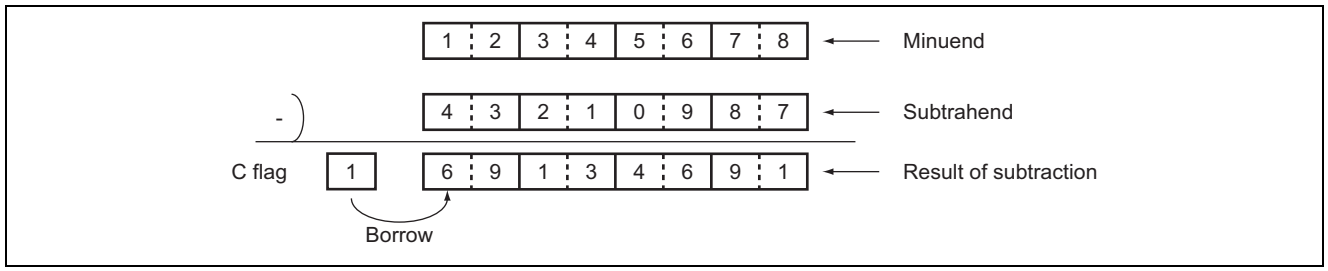


Figure 2 Example of Subtraction with a Borrow

5.2 Notes on usage

1. When the upper bits are not used (see figure 3), set them to 0. The software SUBD2 performs byte-based subtraction; when 0 are not set in the unused upper bits, a correct result cannot be obtained because the subtraction is done on the numbers including indeterminate data.

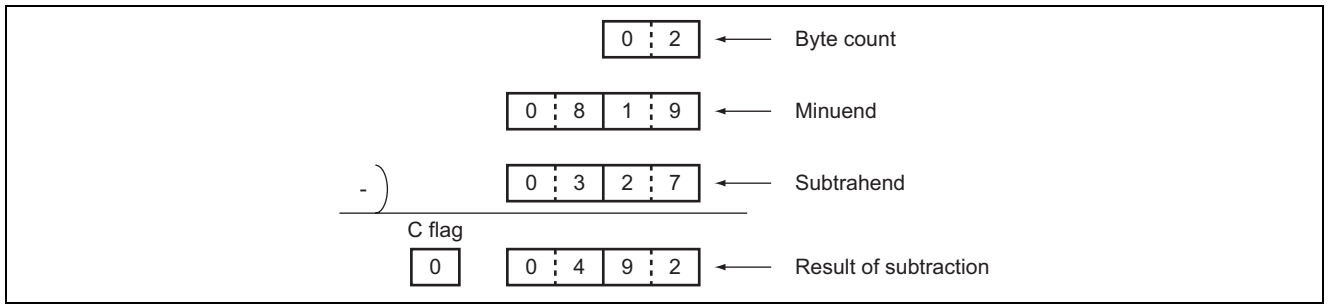


Figure 3 Example of Subtraction with Upper Bits Unused

2. After execution of the software SUBD2, the minuend will be lost because the result is placed in the data memory area where the minuend was set. When the minuend is still needed after software SUBD2 execution, save it in memory.

5.3 Data memory

The software SUBD2 uses no data memory.

5.4 Example of usage

This is an example of subtracting 8 bytes of data. Set the start addresses of a byte count, a minuend and a subtrahend in the registers and call the software SUBD2 as a subroutine.

```
WORK1    . RES. B      1      ---------  Reserve a data memory area in which the user program places
                                          a byte count.

WORK2    . RES. B      8      ---------  Reserve a data memory area in which the user program places
                                          an 8-byte (16-digit BCD) minuend.

WORK3    . RES. B      8      ---------  Reserve a data memory area in which the user program places
                                          an 8-byte (16-digit BCD) subtrahend.
             .
             .
             .
         MOV. B        @WORK1, R0L      -------  Place the byte count set by the user program
                                                   in the input argument (R0L).

         MOV. W        #WORK2, R3       -------  Place the start address of the minuend set by
                                                   the user program in the input argument (R3).

         MOV. W        #WORK3, R4       -------  Place the start address of the subtrahend set by
                                                   the user program in the input argument (R4).

         JSR           @SUBD2           -------  Call the software SUBD2 as a subroutine.

         BCS           OVER             -------  Branch to the borrow processing routine
                                                   when a borrow has occurred in the result of subtraction.
             .
             .
             .
OVER     Borrow processing routine
```

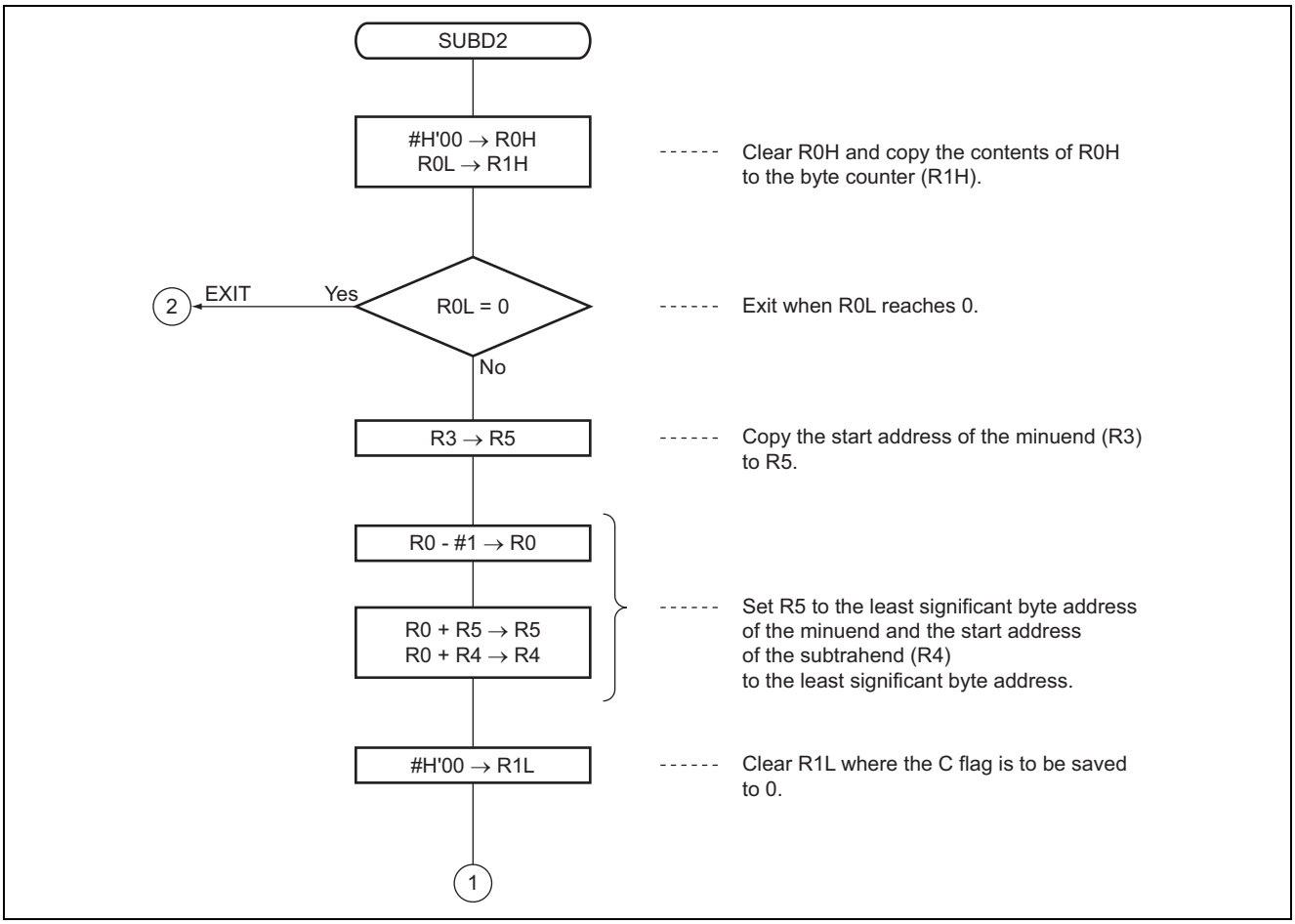
5.5 Operation

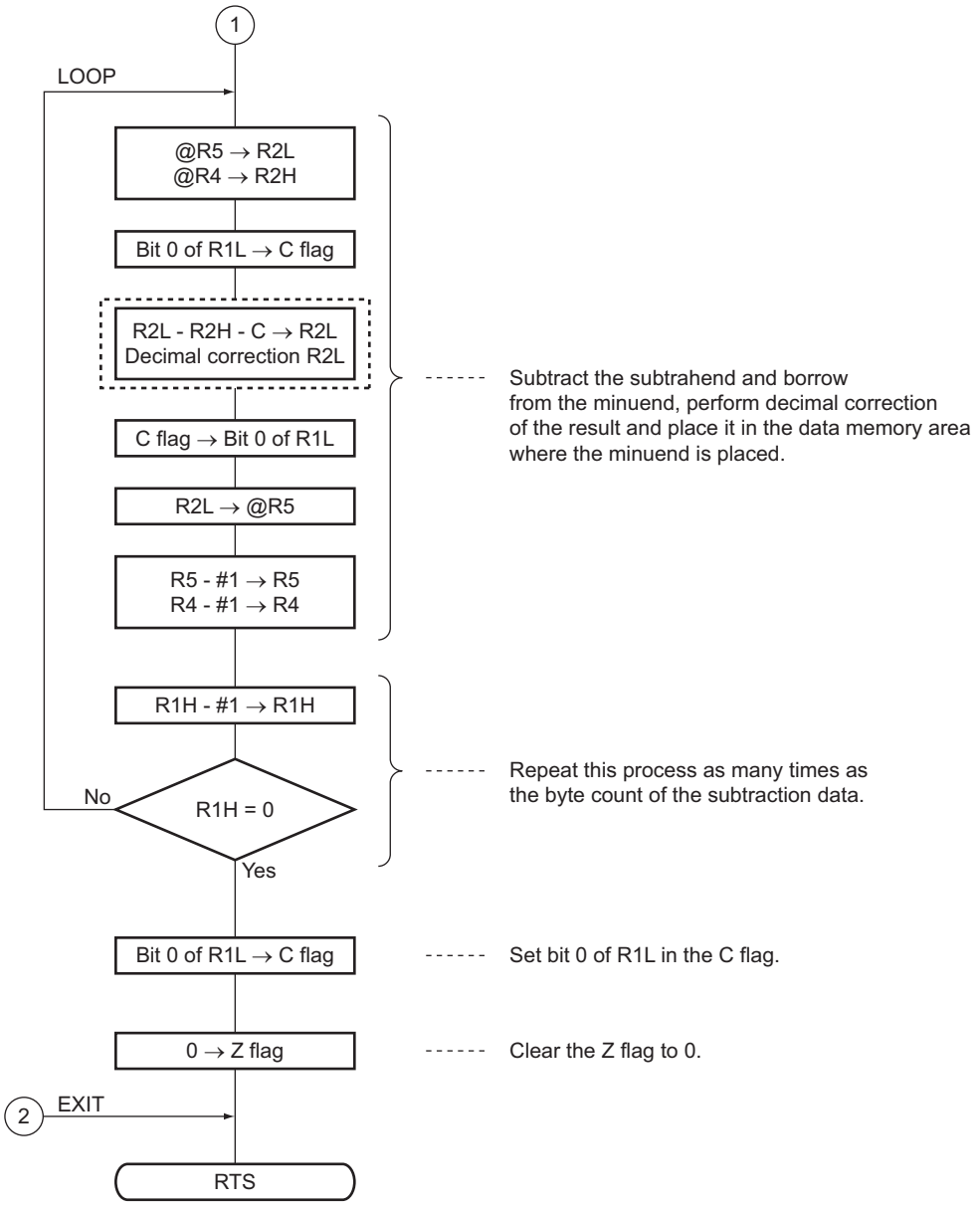
1. Since the minuend and subtrahend data are placed in registers, 2 digits in 1 byte, subtraction of multiple-precision binary numbers can be done by repeating a 1-byte subtract instruction (SUBX.B) and a decimal-correct instruction (DAA).
2. The least significant byte of the data memory area for the minuend is placed in R3, and the least significant byte of the data memory area for the subtrahend in R4.
3. R1L is cleared so that the C flag can be saved in it.
4. The minuend and subtrahend are loaded in R2L and R2H respectively, byte by byte, starting at their least significant byte and the operation given by equation 1 is executed:

   R2L (minuend) - R2H (subtrahend) - C → R2L
   Decimal correction of R2L → R2L
   R2L → @R3
   ------- equation 1

   where the C flag is subtracted to consider a borrow that may be produced as a result of subtraction of the lower bytes.
5. The result of step 4 is placed in the data memory area for the minuend.
6. R3, R4, and R0L are decremented each time the operation of steps 4 and 5 has finished. This processing is repeated until R0L reaches 0.

6. Flowchart


SUBD2
#H'00 → R0H
R0L → R1H
Clear R0H and copy the contents of R0H to the byte counter (R1H).
2
EXIT
Yes
R0L = 0
Exit when R0L reaches 0.
No
R3 → R5
Copy the start address of the minuend (R3) to R5.
R0 - #1 → R0
R0 + R5 → R5
R0 + R4 → R4
Set R5 to the least significant byte address of the minuend and the start address of the subtrahend (R4) to the least significant byte address.
#H'00 → R1L
Clear R1L where the C flag is to be saved to 0.
1



Note: SUBD2 is the same as ADD2, SUB2 and ADDD2 except for the stop surrounded by dotted lines.

7. Program List

```
*** H8/300 ASSEMBLER VER 1.0B ** 08/18/92 10:03:31
PROGRAM NAME =
 1                              ;*************************************************************
 2                              ;*
 3                              ;*      00 - NAME  :MULTIPLE-PRECISION DECIMAL SUBSTRUCTION
 4                              ;*                  (SUBD2)
 5                              ;*
 6                              ;*************************************************************
 7                              ;*
 8                              ;*      ENTRY      :R0L (BYTE LENGTH OF DATA)
 9                              ;*                  R3 (START ADDRESS OF MINUEND)
10                              ;*                  R4 (START ADDRESS OF SUBSTRAHEND)
11                              ;*
12                              ;*      RETURNS    :R3 (START ADDRESS OF RESULT)
13                              ;*                  Z BIT OF CCR (Z=0;TRUE , Z=1;FALSE)
14                              ;*                  C BIT OF CCR (C = 0;TRUE , C = 1;OVERFLOW)
15                              ;*
16                              ;*************************************************************
17                              ;
18  SUBD2_co C    0000                      .SECTION              SUBD2_code,CODE,ALIGN=2
19                                          .EXPORT  SUBD2
20                              ;
21  SUBD2_co C          00000000  SUBD2     .EQU $                ;Entry point
22  SUBD2_co C    0000  F000                MOV.B    #H'00,R0H    ;Clear R0H
23  SUBD2_co C    0002  0C81                MOV.B    R0L,R1H      ;Set byte counter
24  SUBD2_co C    0004  4724                BEQ      EXIT         ;Branch if Z=1 then exit
25  SUBD2_co C    0006  0D35                MOV.W    R3,R5
26  SUBD2_co C    0008              MAIN
27  SUBD2_co C    0008  1B00                SUBS.W   #1,R0        ;Decrement byte length
28  SUBD2_co C    000A  0905                ADD.W    R0,R5        ;Set end address of minuend
29  SUBD2_co C    000C  0904                ADD.W    R0,R4        ;Set end address of substrahend
30  SUBD2_co C    000E  F900                MOV.B    #H'00,R1L    ;Clear R1L
31  SUBD2_co C    0010              LOOP
32  SUBD2_co C    0010  685A                MOV.B    @R5,R2L      ;Load minuend data
33  SUBD2_co C    0012  6842                MOV.B    @R4,R2H      ;Load substrahend data
34  SUBD2_co C    0014  7709                BLD      #0,R1L       ;Bit load bit 0 of R1L
35  SUBD2_co C    0016  1E2A                SUBX.B   R2H,R2L      ;R2L - R2H - C -> R2L
36  SUBD2_co C    0018  1F0A                DAS      R2L          ;Decimal adjust R2L
37  SUBD2_co C    001A  6709                BST      #0,R1L       ;Bit store bit 0 of R1L
38  SUBD2_co C    001C  68DA                MOV.B    R2L,@R5      ;Store result
39  SUBD2_co C    001E  1B05                SUBS.W   #1,R5        ;Decrement minuend pointer
40  SUBD2_co C    0020  1B04                SUBS.W   #1,R4        ;Decrement substrahend pointer
41  SUBD2_co C    0022  1A01                DEC.B    R1H          ;Decrement byte counter
42  SUBD2_co C    0024  46EA                BNE      LOOP         ;Branch if Z=0
43                              ;
44  SUBD2_co C    0026  7709                BLD      #0,R1L       ;Bit load bit 0 of R1L
45  SUBD2_co C    0028  06FB                ANDC.B   #H'FB,CCR    ;Clear Z bit
46  SUBD2_co C    002A              EXIT
47  SUBD2_co C    002A  5470                RTS
48                              ;
49                                          .END
*****TOTAL ERRORS 0
*****TOTAL WARNINGS 0
```

Website and Support

Renesas Technology Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/inquiry
csc@renesas.com

Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Sep.18.03	—	First edition issued
2.00	Nov.30.06	All pages	Content correction

Notes regarding these materials

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (http://www.renesas.com)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guaranties regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
   (1) artificial life support devices or systems
   (2) surgical implantations
   (3) healthcare intervention (e.g., excision, administration of medication, etc.)
   (4) any other purposes that pose a direct threat to human life

   Renesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.