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

April 1st, 2010
Renesas Electronics Corporation

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

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R8C/Tiny Series

General-purpose Program for Multiplying BCD

1. Abstract

This program multiplies 4-digit BCD using registers.

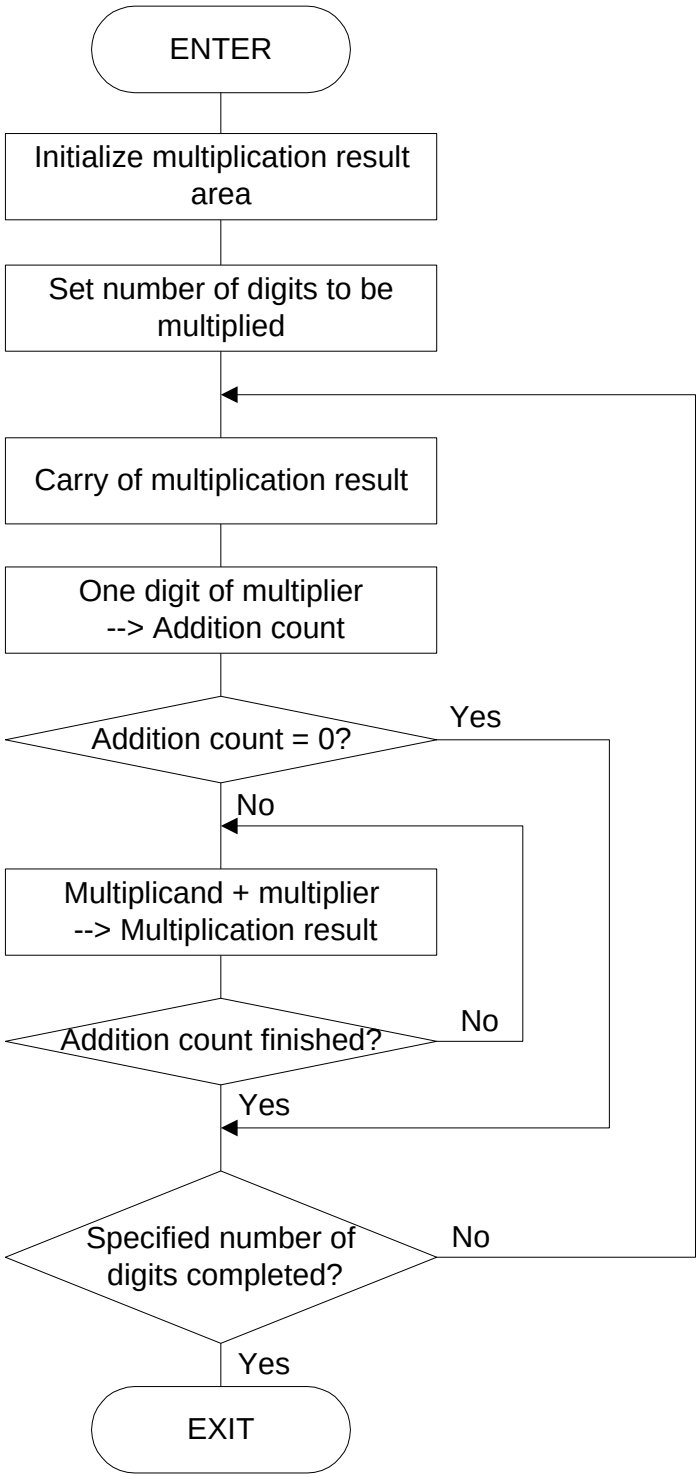
2. Introduction

This program multiplies 4-digit BCD together by using registers. Set the multiplicand in R1 and the multiplier in R3, respectively. The multiplication result is output to R2 and R0 beginning with the upper half.
In this program, data for BCD calculation is loaded from the multiplier 4 high-order bits at a time to set an addition count and the multiplicand is added to the multiplication result. The carry deriving from multiplication is shifted in units of 4 bits to the next high-order digit.

Subroutine name : BCD_MULTIPLE4	ROM capacity : 36 bytes
Interrupt during execution : Accepted	Number of stacks used : None

Register/memory	Input	Output	Usage condition
R0	-	Lower part of multiplication result	←
R1	Multiplicand	Does not change	←
R2	-	Upper part of multiplication result	←
R3	Multiplier	Indeterminate	←
A0	-	0000_{16}	Number of digits counter
A1	-	0000_{16}	Addition count
Usage precautions	The multiplier is destroyed as a result of program execution.		

3. Flowchart


ENTER
Initialize multiplication result area
Set number of digits to be multiplied
Carry of multiplication result
One digit of multiplier --> Addition count
Addition count = 0?
Yes
No
Multiplicand + multiplier --> Multiplication result
Addition count finished?
No
Yes
Specified number of digits completed?
No
Yes
EXIT

4. The example of a reference program

```
                .include apl.inc                        ; special page include file
;***************************************************************************************
;                                                                                      *
;    R8C Program Collection No. 16                                                    *
;    CPU          : R8C/Tiny                                                           *
;                                                                                      *
;***************************************************************************************
VromTOP         .EQU        00D000H                     ; 12Kbyte Flash version
;=======================================================================================
;    Title: Multiplying 4-digit BCD
;    Outline: Multiplies 4-digit BCD using registers.
;    Input:    ----------------------------->  Output:
;    R0 ( )                                    R0 (Lower half of multiplication result)
;    R1 (Multiplicand)                         R1 (Does not change)
;    R2 ( )                                    R2 (Upper half of multiplication result)
;    R3 (Multiplier)                           R3 (Indeterminate)
;    A0 ( )                                    A0 (Indeterminate)
;    A1 ( )                                    A1 (Indeterminate)
;    Stack amount used: None
;    Notes:
;=======================================================================================
                .SECTION    PROGRAM,CODE                ;
                .ORG        VromTOP                     ; ROM area
BCD_MULTIPLE4:                                          ;
;                                                   ;
    MOV.W #0,R0                                     ; Clears multiplication result area
    MOV.W #0,R2                                     ;
    MOV.B  #4,A0                                    ; Sets number of digits to be multiplied
BCD_MULTIPLE4_10:                                       ;
    SHL.L   #4,R2R0                                     ; Carry processing
    MOV.W #0001000000000000B,A1                         ; Specifies for 4 bits to be loaded
BCD_MULTIPLE4_20:                                       ;
    SHL.W  #1,R3                                    ; Loads 4 bits
    ROLC.W      A1                                      ; Loads addition count
    JNC         BCD_MULTIPLE4_20                        ; --> Taking 4 bits not completed
    JEQ         BCD_MULTIPLE4_40                        ; --> Zero (no addition)
BCD_MULTIPLE4_30:                                       ;
    DADD.W      R1,R0                                   ;
    XCHG.W      R2,R0                                   ; Moves high-order data
    DADC.W      #0,R0                                   ; Adds C flag to next high-order digit for carry
    XCHG.W      R2,R0                                   ; Moves high-order data
    ADJNZ.W     #-1,A1,BCD_MULTIPLE4_30                 ; --> Specified addition count not completed
BCD_MULTIPLE4_40:                                       ;
    ADJNZ.W     #-1,A0,BCD_MULTIPLE4_10                 ; --> Specified digit count to be multiplied not completed
    RTS                                                 ;
;                                                   ;
                .END                                ;
```

5. Reference

SOFTWARE MANUAL
R8C/Tiny Series SOFTWARE MANUAL
(Acquire the most current version from Renesas web-site)

6. Web-site and contact for support

Renesas Web-site

http://www.renesas.com

Contact for Renesas technical support

Mail to : support_apl@renesas.com

REVISION HISTORY

Rev.	Date	Description	
		Page	Summary
1.00	Dec 24, 2003	-	First edition issued

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