To our customers,

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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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Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M16C/80 Series

Multiplying 32 Bits

1.0 Abstract

This program performs a 32-bit unsigned multiplication using registers.

2.0 Introduction

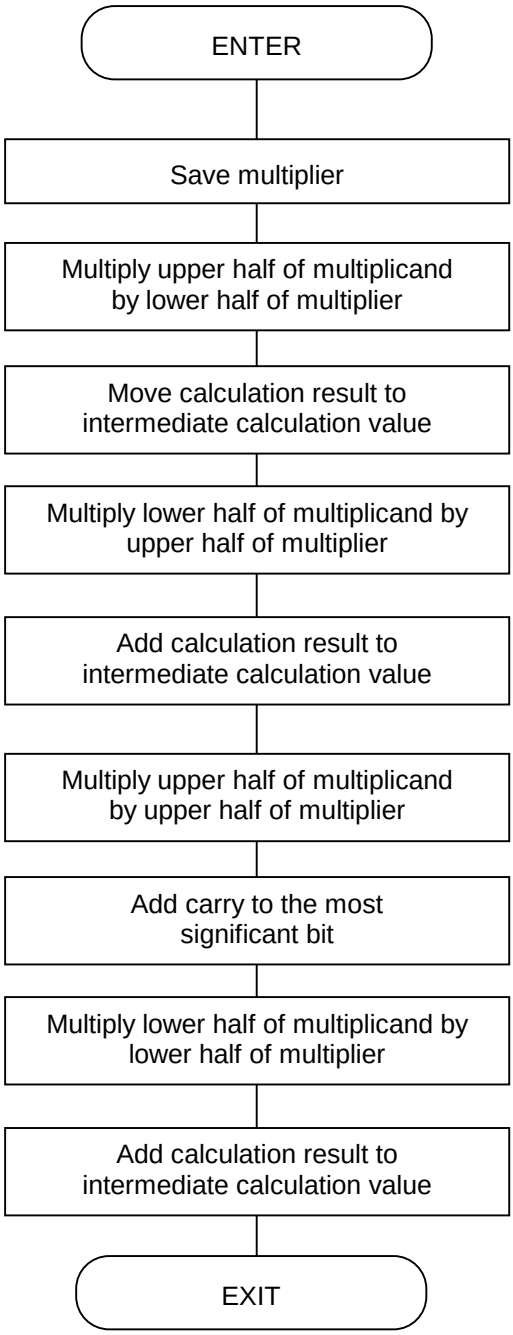
This program performs a 32-bit unsigned multiplication using registers. Set the multiplicand in R2 and R0 beginning with the upper half and the multiplier in R3 and R1, respectively. The multiplication result is output to R3, R1, R2, and R0 beginning with its most significant part.

In this program, both multiplier and multiplicand are divided into the upper and lower halves (16 bits each) as they are multiplied. The results are added to produce a 64-bit calculation result.

Subroutine name : MULTIPLE32	ROM capacity : 39byte
Interrupt during execution:Accepted	Number of stacks used : 6byte

Register/memory	Input	Output	Usage condition
R0	Lower half of multiplicand	Lower part of multiplication result	←
R1	Lower half of multiplier	Upper part of multiplication result	←
R2	Upper half of multiplicand	Middle part of multiplication result	←
R3	Upper half of multiplier	Most significant part of multiplication result	←
A0	-	Indeterminate	Used for storing data
A1	-	Indeterminate	Used for storing data
Usage precautions	The multiplication result is output to R3, R1, R2, and R0 beginning with its most significant part. Both multiplier and multiplicand are destroyed as a result of program execution.		

3.0 Flowchart



4.0 Programming Code

```
;*****************************************************************
; *
;       M16C Program Collection
;       CPU : M16C/80 series
; *
;*****************************************************************
VromTOP         .EQU    0FE0000H                ; Declares start address of ROM
;                                               ;
;===============================================================================
;    Title: Multiplying 32 bits
;    Outline: Multiplies 32-bit data together using registers
;    Input:         ------------------------------>          Output:
;    R0(Lower half of multiplicand)          R0(Lower part of multiplication result)
;    R1(Lower half of multiplier)            R1(Upper part of multiplication result)
;    R2(Upper half of multiplicand)          R2(Middle part of multiplication result)
;    R3(Upper half of multiplier)            R3(Most significant part of multiplication result)
;    A0( )                                   A0(Indeterminate)
;    A1( )                                   A1(Indeterminate)
;    Stack amount used: 6 bytes
;    Notes: R2R0 X R3R1
;           Calculation result is output in order of R3, R1, R2, and R0 beginning with the most
;           significant bits.
;===============================================================================
                .SECTION        PROGRAM,CODE
                .ORG            VromTOP                 ; ROM area
MULTIPLE32:;
  PUSH.W        R1                                      ; Saves lower half of multiplier
  PUSH.W        R3                                      ; Saves upper half of multiplier
  PUSH.W        R3                                      ; Saves upper half of multiplier
  MULU.W        R2,R1                                   ; Multiplies upper half of multiplicand by lower half of multiplier
  MOV.W         R3,A1                                   ; Saves calculation result
  MOV.W         R1,A0                                   ;
  POP.W         R1                                      ; Restores upper half of multiplier
  MULU.W        R0,R1                                   ; Multiplies lower half of multiplicand by upper half of multiplier
  ADD.W         R1,A0                                   ; Adds to intermediate calculation value and saves result
  ADC.W         R3,A1                                   ; Holds carry until next addition is made
  POP.W         R1                                      ; Restores upper half of multiplier
  MULU.W        R2,R1                                   ; Multiplies upper half of multiplicand by upper half of multiplier
  ADCF.W        R3                                      ; Adds carry to the most significant bit
  POP.W         R2                                      ; Restores lower half of multiplier
  MULU.W        R2,R0                                   ; Multiplies lower half of multiplicand by lower half of multiplier
  ADD.W         A0,R2                                   ; Adds intermediate value to middle part
  ADC.W         A1,R1                                   ; Adds intermediate value to upper part
  ADCF.W        R3                                      ; Adds carry to the most significant bit
  RTS                                                   ;
  ;                                                     ;
                .END ;
```

5.0 Reference

MCU Technical Information Homepage

http://www.infomicom.maec.co.jp/indexe.htm
(or http://www.mdece.com/ , http://www.mitsubishichips.com/products/mcu/index.html or your local Web Site.)

Technical Support

E-mail: support@apl.maec.co.jp
(or your local support E-mail address. A private e-mail address should NOT be used.)

Data Sheet

M16C/80 group
(Use the latest version on the Homepage: http://www.infomicom.maec.co.jp/indexe.htm)

User's Manual

M16C/80 group
(Use the latest version on the Homepage: http://www.infomicom.maec.co.jp/indexe.htm)

RENESAS
Renesas Technology Corp.

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