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April 1st, 2010
Renesas Electronics Corporation

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

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APPLICATION NOTE

Signed 16-Bit Binary Multiplication (MULXS)

Introduction

Carries out multiplication in this format:
multiplicand (signed, 16 bits) × multiplier (signed, 16 bits) = product (signed, 32 bits).

Target Device

H8/300H Series

Contents

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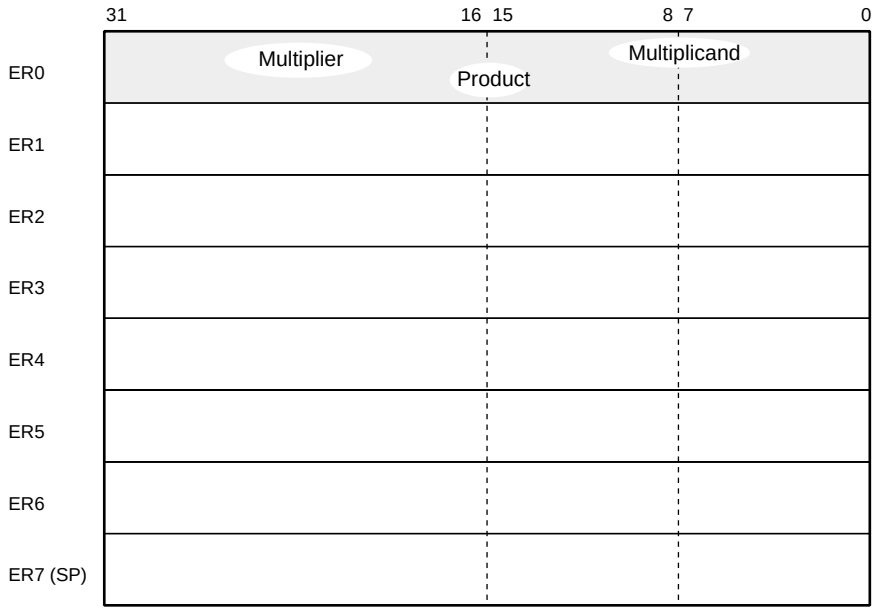
1. Arguments

Description		Storage Location	Data Length (Bytes)
Input	Multiplicand (signed, 16 bits)	R0	2
	Multiplier (signed, 16 bits)	E0	2
Output	Product (signed, 32 bits)	ER0	4

2. Changes to Internal Registers and Flags



I	UI	H	U	N	Z	V	C
–	–	–	–	↕	↕	–	–

– : No change
↕ : Varies
0 : Fixed to 0
1 : Fixed to 1

3. Programming Specifications

Program memory (bytes)
4
Data memory (bytes)
0
Stack (bytes)
0
Number of cycles
24
Re-entrant
Yes
Relocatable
Yes
Interrupts during execution
Yes

4. Description

4.1 Description of Functions

1. The arguments are as follows.
   E0: Set the multiplicand (signed, 16 bits) as an input argument.
   R0: Set the multiplier (signed, 16 bits) as an input argument.
   ER0: The product (signed, 32 bits) is set here as an output argument.
2. The following figure illustrates the execution of the MULXS subroutine. When the input arguments are set as shown below, the result of the multiplication is placed in ER0.

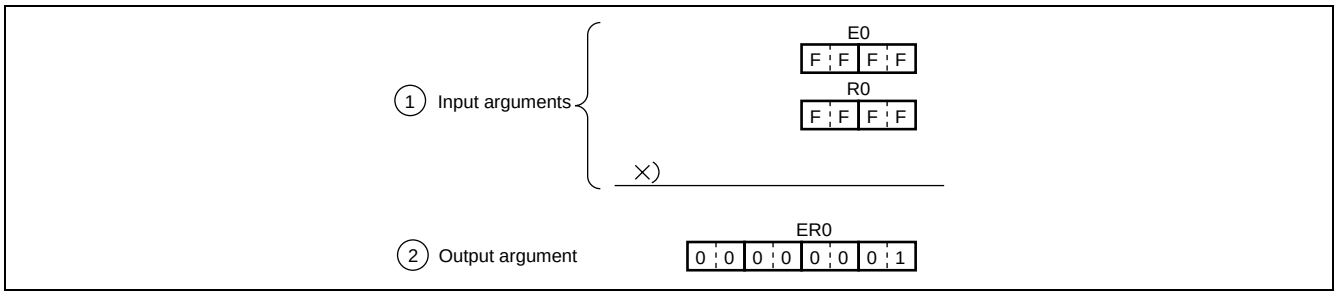


Figure 4.1 Example of MULXS Execution

4.2 Usage Notes

Since the results of multiplication are set in the register used to hold the multiplicand and multiplier, the multiplicand and multiplier are lost through execution of MULXS. When you will still require the multiplicand and multiplier, save them elsewhere in memory beforehand.

4.3 Description of Data Memory

No data memory is used by MULXS.

4.4 Examples of Usage

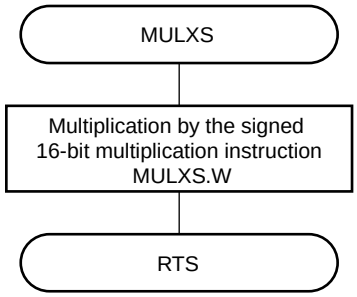
After setting the multiplicand and multiplier, call the MULXS subroutine.

```
WORK1   . RES. W 1          ..... Reservation of the data memory area for setting of the multiplicand (signed, 16 bits) by the user program.
WORK2   . RES. W 1          ..... Reservation of the data memory area for setting of the multiplier (signed, 16 bits) by the user program.
          .
          .
          .
        MOV. W @WORK1, R0   ..... Sets, as an input argument, the multiplicand (signed, 16 bits) specified by the user program.

        MOV. W @WORK2, E0   ..... Sets, as an input argument, the multiplier (signed, 16 bits) specified by the user program.

        JSR    @MULXS       ..... Subroutine call of MULXS.
```

4.5 Principle of Operation

The multiplication is implemented by the signed 16-bit multiplication instruction MULXS W.

5. Flowchart



6. Program Listing

```
 1                                1     ;*********************************************************************
 2                                2     ;*                                                                   *
 3                                3     ;*        NAME      :      16 BIT SIGNED MULTIPLICATION   (MULXS)      *
 4                                4     ;*                                                                   *
 5                                5     ;*********************************************************************
 6                                6     ;*                                                                   *
 7                                7     ;*        ENTRY     :      E0           (MULTIPLICAND)               *
 8                                8     ;*                         R0           (MULTIPLIER)                 *
 9                                9     ;*        RETURNS   :      ER0          (32 BIT PRODUCT)             *
10                               10     ;*                                                                   *
11                               11     ;*********************************************************************
12                               12     ;
13                               13               .CPU             300HA
14     001000                    14               .SECTION A,CODE,LOCATE=H'001000
15              00001000         15     MULXS     .EQU             $            ;Entry point
16     001000   01C05200         16               MULXS.W          R0,ER0
17     001004   5470             17               RTS
18                               18               .END
***** TOTAL    ERRORS      0
***** TOTAL    WARNINGS    0
```

The program listing included in this application note assumes compilation under the option for the advanced mode of H8/300H CPU. If you use this sample program with an H8/300H Tiny Series product, make the following change to the program code:

.CPU 300HA → .CPU 300HN