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

April 1st, 2010
Renesas Electronics Corporation

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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.

<table>
<thead>
<tr>
<th>Subroutine name</th>
<th>ROM capacity : 36 bytes</th>
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</thead>
<tbody>
<tr>
<td>Interrupt during execution</td>
<td>Accepted</td>
</tr>
<tr>
<td></td>
<td>Number of stacks used : None</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Register/memory</th>
<th>Input</th>
<th>Output</th>
<th>Usage condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>-</td>
<td>Lower part of multiplication result</td>
<td>←</td>
</tr>
<tr>
<td>R1</td>
<td>Multiplicand</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>R2</td>
<td>-</td>
<td>Upper part of multiplication result</td>
<td>←</td>
</tr>
<tr>
<td>R3</td>
<td>Multiplier</td>
<td>Indeterminate</td>
<td>←</td>
</tr>
<tr>
<td>A0</td>
<td>-</td>
<td>0000_{16}</td>
<td>Number of digits counter</td>
</tr>
<tr>
<td>A1</td>
<td>-</td>
<td>0000_{16}</td>
<td>Addition count</td>
</tr>
</tbody>
</table>

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

Multiplicand + multiplier
  --> Multiplication result

Addition count finished?

No

No

Yes

Specified number of digits completed?

No

Yes

EXIT
4. The example of a reference program

```assembly
.include apl.inc ; special page include file

; 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_MULTIPL3E4: ;

; MOV.W #0,R0 ; Clears multiplication result area
MOV.W #0,R2 ;
MOV.B #4,A0 ; Sets number of digits to be multiplied

BCD_MULTIPL3E4_10: ;

SHL L #4,R2R0 ; Carry processing
MOV.W #000100000000000B,A1 ; Specifies for 4 bits to be loaded

BCD_MULTIPL3E4_20: ;

SHL W #1,R3 ; Loads 4 bits
ROLC.W A1 ; Loads addition count
JNC BCD_MULTIPL3E4_20 ; --> Taking 4 bits not completed
JEQ BCD_MULTIPL3E4_40 ; --> Zero (no addition)

BCD_MULTIPL3E4_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_MULTIPL3E4_30 ; --> Specified addition count not completed

BCD_MULTIPL3E4_40: ;

ADJNZ.W #1,A0,BCD_MULTIPL3E4_10 ; --> Specified digit count to be multiplied not completed
RTS

.END
```

Notes:

- The example of a reference program
- Input:
  - R0 ( )
  - R1 (Multiplicand)
  - R2 ( )
  - R3 (Multiplier)
  - A0 ( )
  - A1 ( )
- Stack amount used: None
- Title: Multiplying 4-digit BCD
- Outline: Multiplies 4-digit BCD using registers.
- Notes:
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

<table>
<thead>
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<th>Rev.</th>
<th>Date</th>
<th>Description</th>
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<tr>
<td>1.00</td>
<td>Dec 24, 2003</td>
<td>First edition issued</td>
</tr>
</tbody>
</table>
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