To our customers,

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April 1st, 2010
Renesas Electronics Corporation

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

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M16C/60 Series and M16C/20 Series

General-purpose Program for Dividing BCD

1. Abstract

This program divides 8-digit BCD by using registers.

2. Introduction

This program divides 8-digit BCD together by using registers. Set the dividend in A1 and A0 and the divisor in R3 and R1 beginning with the upper half, respectively. The quotient and the remainder are output to A1 and A0, and to R2 and R0, beginning with the upper half, respectively. The zero divide information is output to the Z flag.

In this program, data for BCD calculation is loaded from the dividend 4 high-order bits at a time to create the dividend to be operated on and the divisor count can be subtracted is counted to obtain the quotient. A carry deriving from the divide operation is shifted in units of 4 bits to the next high-order digit.

<table>
<thead>
<tr>
<th>Z</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Quotient and remainder are valid.</td>
</tr>
<tr>
<td>1</td>
<td>Quotient and remainder are invalid because division by zero is attempted.</td>
</tr>
</tbody>
</table>

Subroutine name: BCD_DIVIDE8  ROM capacity: 67 bytes

Interrupt during execution: Accepted  Number of stacks used: 3 bytes

<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 half of remainder</td>
<td>←</td>
</tr>
<tr>
<td>R1</td>
<td>Lower half of divisor</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>R2</td>
<td>-</td>
<td>Upper half of remainder</td>
<td>←</td>
</tr>
<tr>
<td>R3</td>
<td>Upper half of divisor</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>A0</td>
<td>Lower half of dividend</td>
<td>Lower half of quotient</td>
<td>←</td>
</tr>
<tr>
<td>A1</td>
<td>Upper half of dividend</td>
<td>Upper half of quotient</td>
<td>←</td>
</tr>
<tr>
<td>CNT</td>
<td>-</td>
<td>Indeterminate</td>
<td>Shift count</td>
</tr>
<tr>
<td>Z flag</td>
<td>-</td>
<td>Zero divide information</td>
<td>←</td>
</tr>
</tbody>
</table>

Usage precautions

CNT is allocated in a stack area by configuring a stack frame as a temporary variable area in the program. Therefore, the value of CNT when program execution is completed is indeterminate.

The dividend is destroyed as a result of program execution.
3. Flowchart

ENTER

Initialize remainder area

Zero division? Yes
No

Set shift count

Create shift dividend and carry 1 into next position of quotient (done in units of 4 bits because of BCD)

Count quotient

Subtraction succeeded? Yes
No

Correct quotient

Shift dividend - divisor --> Shift divided

Subtraction succeeded? Yes
No

Shift dividend + divisor --> Shift divided

Shift count finished? No

Division succeeded Clear Z flag

EXIT
4. The example of a reference program

;************************************************************************
; * M16C General-purpose Programs *
; CPU : M16C *
; *
;************************************************************************

VromTOP .EQU 0F0000H ; Declares start address of ROM
FBcnst .EQU 001000H ; Assumed FB register value

;=========================================
; Title : Dividing 8-digit BCD
; Outline : Divides 8-digit BCD using registers
; Input : ------------------------------> Output:
; R0 ( ) R0 (Lower half of remainder)
; R1 (Lower half of divisor) R1 (Lower half of divisor)
; R2 ( ) R2 (Upper half of remainder)
; R3 (Upper half of divisor) R3 (Upper half of divisor)
; A0 (Lower half of dividend) A0 (Lower half of quotient)
; A1 (Upper half of dividend) A1 (Upper half of quotient)
; Stack amount used: 3 bytes
; Notes : A1A0 ÷ R3R1
; Zero division is returned by Z flag
;=========================================

.SECTION PROGRAM, CODE
.ORG VromTOP ; ROM area
.FB FBcnst ; Sets provisional FB register value

BCD_DIVIDE8:

;----------------------------------------
; Declaration of temporary variables ;
;----------------------------------------

CNT .EQU -1 ; Shift count counter
ENTER #1 ; Sets stack frame
MOV.W #0,R0 ; Initializes remainder area
MOV.W #0,R2 ;
CMP.W #0,R1 ;
JNE BCD_DIVIDE8_10 ;
CMP.W #0,R3 ;
JEQ BCD_DIVIDE8exit ; --> Zero division

BCD_DIVIDE8_10:

MOV.B #8,CNT[FB] ; Sets number of digits to be divided

BCD_DIVIDE8_20:

BSET 12,R2 ; Specifies 4-bit carry

BCD_DIVIDE8_30:

SHL.W #1,A0 ; Pushes dividend and carries 1 in quotient
ROLC.W A1 ; Pushes dividend and carries 1 in quotient
ROLC.W R0 ; Creates dividend
ROLC.W R2 ;
JNC BCD_DIVIDE8_30 ; --> 4-bit carry not completed
BCD_DIVIDE8_40:
  INC.W  A0 ; Quotient + 1
  DSUB.W R1,R0 ; Subtraction by divisor
  XCHG.W R2,R0 ; Moves data
  XCHG.W R3,R1 ;
  DSBB.W R1,R0 ;
  XCHG.W R2,R0 ; Moves data
  XCHG.W R3,R1 ;
  JGEU  BCD_DIVIDE8_40 ; --> Subtraction by divisor succeeded
  DEC.W  A0 ; Quotient corrected
  DADD.W R1,R0 ; Restored to original data because
                ; divisor subtraction failed
  XCHG.W R2,R0 ; Moves data
  XCHG.W R3,R1 ;
  DADC.W R1,R0 ;
  XCHG.W R2,R0 ; Moves data
  XCHG.W R3,R1 ;
  ADJNZ.B #-1,CNT[FB],BCD_DIVIDE8_20 ; --> Executes next digit
  FCLR  Z ; Division succeeded
BCD_DIVIDE8exit:
  EXITD ; Clears stack frame
; .END
5. Reference

SOFTWARE MANUAL
M16C/60 M16C/20 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>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Jul 08, 2002</td>
<td>First edition issued</td>
</tr>
</tbody>
</table>
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