To our customers,

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

April 1st, 2010
Renesas Electronics Corporation

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M16C/60 Series and M16C/20 Series
General-purpose Program for Subtracting BCD

1. Abstract
This program subtracts 8-digit BCD data using registers.
This program subtracts 8-digit BCD data between memory locations.

2. Introduction
This program subtracts 8-digit BCD data between registers by using a decimal subtract instruction (DSUB). Set the minuend in R2 and R0 and the subtrahend in R3 and R1 beginning with the upper half, respectively. The subtraction result is output to R2 and R0 beginning with the upper half. The borrow information is output to the C flag.
This program subtracts 8-digit BCD data between memory locations by using a decimal subtract instruction (DSUB). Set the least significant memory address of the minuend and that of the subtrahend in the address registers. The subtraction result is output to the minuend’s memory location. The borrow information is output to the C flag.

<table>
<thead>
<tr>
<th>C</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>With borrow</td>
</tr>
<tr>
<td>1</td>
<td>Without borrow</td>
</tr>
</tbody>
</table>

(1) BCD subtraction (register)

<table>
<thead>
<tr>
<th>Subroutine name : BCD_SUBTRACT8</th>
<th>ROM capacity : 13 bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt during execution : Accepted</td>
<td>Number of stacks used : None</td>
</tr>
</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>Lower half of minuend</td>
<td>Lower half of subtraction result</td>
<td>←</td>
</tr>
<tr>
<td>R1</td>
<td>Lower half of subtrahend</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>R2</td>
<td>Upper half of minuend</td>
<td>Upper half of subtraction result</td>
<td>←</td>
</tr>
<tr>
<td>R3</td>
<td>Upper half of subtrahend</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>A0</td>
<td>-</td>
<td>-</td>
<td>Unused</td>
</tr>
<tr>
<td>A1</td>
<td>-</td>
<td>-</td>
<td>Unused</td>
</tr>
<tr>
<td>C flag</td>
<td>-</td>
<td>Borrow information</td>
<td>←</td>
</tr>
</tbody>
</table>

Usage precautions: The minuend is destroyed as a result of program execution.
(2) BCD subtraction (memory)

<table>
<thead>
<tr>
<th>Subroutine name: BCD_SUBTRACTmemory8</th>
<th>ROM capacity: 20 bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt during execution: Accepted</td>
<td>Number of stacks used: None</td>
</tr>
</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>Indeterminate</td>
<td>Used for calculation</td>
</tr>
<tr>
<td>R1</td>
<td>-</td>
<td>Indeterminate</td>
<td>Used for calculation</td>
</tr>
<tr>
<td>R2</td>
<td>-</td>
<td>-</td>
<td>Unused</td>
</tr>
<tr>
<td>R3</td>
<td>-</td>
<td>-</td>
<td>Unused</td>
</tr>
<tr>
<td>A0</td>
<td>Minuend address</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>A1</td>
<td>Subtrahend address</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>Memory indicated by A0</td>
<td>Minuend data</td>
<td>Subtraction result</td>
<td>←</td>
</tr>
<tr>
<td>Memory indicated by A1</td>
<td>Subtrahend data</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>C flag</td>
<td>-</td>
<td>Borrow information</td>
<td>←</td>
</tr>
</tbody>
</table>

Usage precautions: The minuend is destroyed as a result of program execution.

3. Flowchart

```
ENTER

Subtract low-order bits

Move subtracted data

Subtract high-order bits including borrow

Move subtracted data

EXIT
```
4. The example of a reference program

```
;************************************************************************
; M16C General-purpose Programs *
; CPU : M16C *
;************************************************************************
VromTOP .EQU 0F0000H ; Declares start address of ROM
;
;==============================================================
; Title : Subtracting 8-digit BCD
; Outline : Subtracts 8-digit BCD using registers
; Input : ------------------------------------------> Output:
; R0 (Lower half of minuend) R0 (Lower half of subtraction result)
; R1 (Lower half of subtrahend) R1 (Does not change)
; R2 (Upper half of minuend) R2 (Upper half of addition result)
; R3 (Upper half of subtrahend) R3 (Does not change)
; A0 ( ) A0 (Unused)
; A1 ( ) A1 (Unused)
; Notes : Borrow information in C flag
;==============================================================

.SECTION PROGRAM,CODE
.ORG VromTOP ; ROM area

BCD_SUBTRACT8: ;
DSUB.W R1,R0 ; Subtracts low-order bits
XCHG.W R2,R0 ; Moves subtracted data
XCHG.W R3,R1 ;
DSBB.W R1,R0 ; Subtracts high-order bits
XCHG.W R2,R0 ; Moves subtracted data
XCHG.W R3,R1 ;
RTS ;
;
;==============================================================

BCD_SUBTRACTmemory8: ;
MOV.W [A0],R0 ;
MOV.W [A1],R1 ;
DSUB.W R1,R0 ; Subtracts low-order bits
MOV.W R0,[A0] ;
MOV.W 2[A0],R0 ;
MOV.W 2[A1],R1 ;
DSBB.W R1,R0 ; Subtracts high-order bits
MOV.W R0,2[A0] ;
RTS ;
;
.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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