To our customers,

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Renesas Electronics website: [http://www.renesas.com](http://www.renesas.com)

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April 1\(^{st}\), 2010
Renesas Electronics Corporation

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

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APPLICATION NOTE

M16C/60 Series and M16C/20 Series
General-purpose Program for Subtracting 32 Bits

1. Abstract

This program performs a 32-bit unsigned subtraction using registers.
This program performs a 32-bit unsigned subtraction between memory locations.

2. Introduction

This program performs a 32-bit unsigned subtraction using registers. 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 and borrow information to the C flag, respectively.

This program performs a 32-bit unsigned subtraction between memory locations. 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 and borrow information to the C flag, respectively.

<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) 32-bit subtraction (register)

<table>
<thead>
<tr>
<th>Subroutine name : SUBTRACT32</th>
<th>ROM capacity : 5 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.
### 32-bit subtraction (memory)

**Subroutine name:** SUBTRACTmemory32  
**ROM capacity:** 7 bytes  
**Interrupt during execution:** Accepted  
**Number of stacks used:** None

<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>-</td>
<td>Unused</td>
</tr>
<tr>
<td>R1</td>
<td>-</td>
<td>-</td>
<td>Unused</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</td>
<td>Subtraction result</td>
<td>←</td>
</tr>
<tr>
<td>Memory indicated by A1</td>
<td>Subtrahend</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

Subtract high-order bits including borrow

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

;******************************************************************************
; M16C Program Collection No. 10
; CPU : M16C/60 Series, M16C/20 Series
; Version : 2.00 (2005-11-17) SUBTRACT32 ->SUBTRACT32
; SUB.W R3,R2 ->SBB.W R3,R2
; SUB.W 2[A1],2[A0] ->SBB.W 2[A1],2[A0]
; Copyright(C) 2005. Renesas Technology Corp., All rights reserved.
;******************************************************************************

VromTOP .EQU 0F0000H ; Declares start address of ROM

;******************************************************************************
; Title: Subtracting 32 bits
; Outline: Subtracts 32-bit data 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)
; Stack amount used: None
; Notes: Borrow information in C flag
; R2R0 - R3R1
;******************************************************************************

.SUBTRACT32:
; SUB.W R1,R0 ; Subtracts low-order bits
SBB.W R3,R2 ; Subtracts high-order bits
RTS
;
;******************************************************************************

SUBTRACTmemory32:
; SUB.W [A1],[A0] ; Subtracts low-order bits
SBB.W 2[A1],2[A0] ; Subtracts high-order bits
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/en/m16c

Contact for Renesas technical support
Mail to : csc@renesas.com
## REVISION HISTORY

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Jul 08, 2002</td>
<td>-</td>
<td>First edition issued</td>
</tr>
<tr>
<td>2.00</td>
<td>Nov 17, 2005</td>
<td>3</td>
<td>SUBTRACT32 -&gt; SUBTRACT32&lt;br&gt; SUB.W R3,R2 -&gt; SBB.W R3,R2&lt;br&gt; SUB.W 2[A1],2[A0] -&gt; SBB.W 2[A1],2[A0]</td>
</tr>
</tbody>
</table>
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