To our customers,

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

April 1\textsuperscript{st}, 2010
Renesas Electronics Corporation

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

1. Abstract
This program performs a 32-bit unsigned addition using registers.
This program performs a 32-bit unsigned addition between memory locations.

2. Introduction
This program performs a 32-bit unsigned addition using registers. Set the augend in R2 and R0 and the addend in R3 and R1 beginning with the upper half, respectively. The addition result is output to R2 and R0 beginning with the upper half and carry information to the C flag, respectively.
This program performs a 32-bit unsigned addition between memory locations. Set the least significant memory address of the augend and that of the addend in the address registers. The addition result is output to the augend's memory location and carry information to the C flag, respectively.

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

(1) 32-bit addition (register)

<table>
<thead>
<tr>
<th>Subroutine name : ADDITION32</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 augend</td>
<td>Lower half of addition result</td>
<td>←</td>
</tr>
<tr>
<td>R1</td>
<td>Lower half of addend</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>R2</td>
<td>Upper half of augend</td>
<td>Upper half of addition result</td>
<td>←</td>
</tr>
<tr>
<td>R3</td>
<td>Lower half of addend</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>Carry information</td>
<td>←</td>
</tr>
</tbody>
</table>

Usage precautions
The augend is destroyed as a result of program execution.
(2) 32-bit addition (memory)

<table>
<thead>
<tr>
<th>Subroutine name : ADDITIONmemory32</th>
<th>ROM capacity : 7 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>-</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>Augend address</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>A1</td>
<td>Addend address</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>Memory indicated by A0</td>
<td>Augend</td>
<td>Result of addition</td>
<td>←</td>
</tr>
<tr>
<td>Memory indicated by A1</td>
<td>Addend</td>
<td>Does not change</td>
<td>←</td>
</tr>
<tr>
<td>C flag</td>
<td>-</td>
<td>Carry information</td>
<td>←</td>
</tr>
</tbody>
</table>

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

3. Flowchart

```
ENTER

Add low-order bits

Add high-order bits including carry

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

;************************************************************************
; * M16C General-purpose Programs *
; * CPU : M16C *
; * ;************************************************************************
VromTOP .EQU 0F0000H ; Declares start address of ROM
;
;=========================================================================
; Title : Adding 32 bits
; Outline : Adds 32-bit data using registers.
; Input : ------------------------------> Output:
; R0 (Lower half of augend) R0 (Lower half of addition result)
; R1 (Lower half of addend) R1 (Does not change)
; R2 (Upper half of augend) R2 (Upper half of addition result)
; R3 (Upper half of addend) R3 (Does not change)
; A0 ( ) A0 (Unused)
; A1 ( ) A1 (Unused)
; Stack amount used: None
; Notes : Carry information in C flag
; R2R0 + R3R1
;=========================================================================

.SECTION PROGRAM, CODE
.ORG VromTOP ; ROM area
ADDITION32:
; ADD.W R1,R0 ; Adds low-order bits
ADC.W R3,R2 ; Adds high-order bits
RTS
;
;=========================================================================

.SECTION PROGRAM, CODE
.ORG VromTOP ; ROM area
ADDITIONmemory32:
; ADD.W [A1],[A0] ; Adds low-order bits
ADC.W 2[A1],2[A0] ; Adds high-order bits
RTS
;
;=========================================================================
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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