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April 1st, 2010
Renesas Electronics Corporation

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M16C/60 Series and M16C/20 Series
General-purpose Program for Indirect Subroutine Call

1. Abstract
This program executes an indirect subroutine call instruction after setting the relative jump address for indirect jump. It also executes an indirect subroutine call instruction by using a 20-bit absolute address.

2. Introduction
For indirect jump based on relative addresses, this program uses an extended access instruction (LDE) to set the relative jump address for the indirect jump. In this program, since relative addresses are within the range that can be represented with 8 bits, “.B (byte size)” is used to set the offset data.
For indirect jump based on absolute addresses, this program adds the content of the address register, with its sign ignored, to the start address of the memory area where 20-bit absolute addresses are stored and jumps to the memory location (20-bit absolute address) indicated by the result. The memory area in which to store 20-bit absolute addresses is allocated in units of 3 bytes.

(1) Indirect subroutine call (relative)

<table>
<thead>
<tr>
<th>Subroutine name : SUBIND_W</th>
<th>ROM capacity : 19 bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt during execution : Accepted</td>
<td>Number of stacks used : 3 bytes</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>-</td>
<td>Indeterminate</td>
<td>Processing status</td>
</tr>
<tr>
<td>A1</td>
<td>-</td>
<td>Indeterminate</td>
<td>Processing relative address</td>
</tr>
<tr>
<td>MODE</td>
<td>Current processing status</td>
<td>Next processing status</td>
<td>←</td>
</tr>
</tbody>
</table>

Usage precautions
The indirect jump address set here is a relative address.
## Indirect subroutine call (absolute)

<table>
<thead>
<tr>
<th>Subroutine name: SUBIND_A</th>
<th>ROM capacity: 26 bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt during execution: Accepted</td>
<td>Number of stacks used: 3 bytes</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>-</td>
<td>Indeterminate</td>
<td>Address pointer</td>
</tr>
<tr>
<td>A1</td>
<td>-</td>
<td>-</td>
<td>Unused</td>
</tr>
<tr>
<td>MODE</td>
<td>Current processing status</td>
<td>Next processing status</td>
<td>←</td>
</tr>
</tbody>
</table>

### Usage precautions

The indirect jump address set here is a 20-bit absolute address.

### 3. Flowchart

```
ENTER

Set status

Set processed addresses

Processing 1

Processing 2

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

;************************************************************************
; * M16C General-purpose Programs *
; CPU : M16C *
; *
;************************************************************************
VramTOP .EQU 000400H ; Declares start address of RAM
VromTOP .EQU 0F0000H ; Declares start address of ROM
Vsb .EQU 0400H ; Sets SB
  .SECTION RAM,DATA
  .ORG VramTOP ; RAM area
  MODE: .BLKB 1 ; Processing status
  MD_0 .EQU 0 ; Status No. 0
  MD_1 .EQU 1 ; Status No. 1

;=======================================================================
; Title : Indirect subroutine call
; Outline : Branches processing using an indirect subroutine call (relative)
; Input : ------------------------------> Output:
; R0 ( ) R0 (Unused)
; R1 ( ) R1 (Unused)
; R2 ( ) R2 (Unused)
; R3 ( ) R3 (Unused)
; A0 ( ) A0 (Indeterminate)
; A1 ( ) A1 (Indeterminate)
; Stack amount used: 3 bytes
;=======================================================================
  .SECTION PROGRAM, CODE
  .ORG VromTOP ; ROM area
  .SB Vsb ; Declares SB register value
  .SBSYM MODE ;
  LDC #Vsb,SB ; Sets initial values for SB register
  SUBIND_W:
  MOV.B MODE,A0 ;
  LDE.B JUMPaddress[A0],A1 ; Sets jump address
  JUMP_offset:
  JSRI.W A1 ; Jumps to each processing
  RTS ;
  MODE_0:
  MOV.B #MD_1,MODE ;
  RTS ;
  MODE_1:
  MOV.B #MD_0,MODE ;
  RTS ;
  JUMPaddress:
  .BYTE MODE_0-JUMP_offset ;
  .BYTE MODE_1-JUMP_offset ;
;=============================================================================
; Title       : Indirect subroutine call
; Outline     : Branches processing using an indirect subroutine call (absolute).
; Input       : ---------------------------------> Output:
; R0 ( )      : R0 (Unused)
; R1 ( )      : R1 (Unused)
; R2 ( )      : R2 (Unused)
; R3 ( )      : R3 (Unused)
; A0 ( )      : A0 (Indeterminate)
; A1 ( )      : A1 (Unused)
; Stack amount used: 3 bytes
;=============================================================================

SUBIND_A:
  MOV.B MODE,A0
  SHL.W #1,A0
  ADD.B MODE,A0 ; Sets jump pointer
  JSR1.A JSRaddress[A0] ; Jumps to each processing
  RTS

JSR_0:
  MOV.B #MD_1,MODE
  RTS

JSR_1:
  MOV.B #MD_0,MODE
  RTS

JSRaddress:
  .ADDR JSR_0
  .ADDR JSR_1
  .END

;=============================================================================

; Subroutine                
; R0  ( )                  
; R1  ( )                  
; R2  ( )                  
; R3  ( )                  
; A0  ( )                  
; A1  ( )                  
; Stack amount used: 3 bytes
;=============================================================================

MOV.B #MD_1,MODE
RTS

MOV.B #MD_0,MODE
RTS

JSR0
  .ADDR JSR_0
  .ADDR JSR_1
  .END

;=============================================================================

; Use a 3-byte immediate, and move to the next, if necessary.
;=============================================================================

MOV.B #MD_1,MODE
RTS

MOV.B #MD_0,MODE
RTS

JSR0
  .ADDR JSR_0
  .ADDR JSR_1
  .END

;=============================================================================

; An 8-bit value must be loaded in R0 for the indirect subroutine call.
; If the value is not a word, the result will be a B0 at R0.
;=============================================================================

MOV.B #MD_1,MODE
RTS

MOV.B #MD_0,MODE
RTS

JSR0
  .ADDR JSR_0
  .ADDR JSR_1
  .END

;=============================================================================

; The subroutine is called using an absolute indirect subroutine call.
;=============================================================================

MOV.B #MD_1,MODE
RTS

MOV.B #MD_0,MODE
RTS

JSR0
  .ADDR JSR_0
  .ADDR JSR_1
  .END

;=============================================================================

; An 8-bit value must be loaded in R0 for the indirect subroutine call.
; If the value is not a word, the result will be a B0 at R0.
;=============================================================================

MOV.B #MD_1,MODE
RTS

MOV.B #MD_0,MODE
RTS

JSR0
  .ADDR JSR_0
  .ADDR JSR_1
  .END

;=============================================================================

; The subroutine is called using an absolute indirect subroutine call.
;=============================================================================

MOV.B #MD_1,MODE
RTS

MOV.B #MD_0,MODE
RTS

JSR0
  .ADDR JSR_0
  .ADDR JSR_1
  .END

;=============================================================================

; An 8-bit value must be loaded in R0 for the indirect subroutine call.
; If the value is not a word, the result will be a B0 at R0.
;=============================================================================

MOV.B #MD_1,MODE
RTS

MOV.B #MD_0,MODE
RTS

JSR0
  .ADDR JSR_0
  .ADDR JSR_1
  .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

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### REVISION HISTORY

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