To our customers,

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

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April 1\textsuperscript{st}, 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 Converting from Binary Number to Floating-point Number

1. Abstract

This program converts a 32-bit signed binary number into a single-precision, floating-point number.

2. Introduction

This program converts a 32-bit signed binary number into a single-precision, floating-point number. Set the 32-bit signed binary number in R2 and R0 beginning with the upper half. A single-precision, floating-point number is output to R2 and R0.

In this program, after confirming whether the input data is "0" and adjusting the data by the sign, a maximum value is set to the exponent part that can be represented by a 32-bit signed binary number. Next, the input data is shifted left while calculating (subtracting) the exponent part to create mantissa data. Finally, the resulting data is adjusted to suit the format of single-precision, floating-point numbers.

<table>
<thead>
<tr>
<th>R3, R1</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>7FFFFFFFH</td>
<td>Magnitude of a single-precision, floating-point number is equal to or greater than $2^{31}$ (sign +)</td>
</tr>
<tr>
<td>80000000H</td>
<td>Magnitude of a single-precision, floating-point number is equal to or greater than $2^{31}$ (sign -)</td>
</tr>
<tr>
<td>00000000H</td>
<td>Magnitude of a single-precision, floating-point number is less than &quot;1&quot;</td>
</tr>
</tbody>
</table>
### Subroutine name: BINtoFLOATING

<table>
<thead>
<tr>
<th>ROM capacity</th>
<th>67 bytes</th>
</tr>
</thead>
</table>

### Interrupt during execution: Accepted

<table>
<thead>
<tr>
<th>Number of stacks used</th>
<th>None</th>
</tr>
</thead>
</table>

### Register/mem Roy

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>Usage condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower half of signed binary</td>
<td>Mid and lower parts of mantissa</td>
<td>←</td>
</tr>
<tr>
<td>-</td>
<td>Indeterminate</td>
<td>Used for format conversion</td>
</tr>
<tr>
<td>Upper half of signed binary</td>
<td>Exponent, upper part of mantissa</td>
<td>←</td>
</tr>
<tr>
<td>-</td>
<td>Indeterminate</td>
<td>Used to save sign bit</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Unused</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Unused</td>
</tr>
</tbody>
</table>

### Usage precautions

---

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3. Flowchart

ENTER

Zero ?

Yes

No

Save sign bit

Positive number ?

Yes

No

Create 2's complement

Set maximum value to exponent part

Set exponent data by searching for maximum bit position

Set floating-point format

Set exponent part

Set sign bit

EXIT
4. The example of a reference program

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

VromTOP .EQU 0F0000H ; Declares start address of ROM

;>Title: Converting from binary number to single-precision, floating-point number
;>Outline: Converts 32-bit signed binary number into single-precision, floating-point number
;>Input: ------------------------------> Output:
; R0 (Lower half of signed binary) R0 (Mid and lower parts of mantissa)
; R1 () R1 (Indeterminate)
; R2 (Upper half of signed binary) R2 (Exponent, upper part of mantissa)
; R3 () R3 (Indeterminate)
; A0 () A0 (Unused)
; A1 () A1 (Unused)
; Stack amount used: None
; Notes:
;************************************************************************

.SECTION PROGRAM, CODE
.ORG VromTOP ; ROM area

BINtoFLOATING:
;
XCHG.W R2,R0 ; Changes data
CMP.W #0,R2 ;
JNE BINtoFLOATING_10 ;
CMP.W #0,R0 ;
JEQ BINtoFLOATING_EXIT ; --> ZERO

BINtoFLOATING_10:
;
MOV.W R0,R3 ; Saves sign bit
BTST 15,R0 ; Checks sign
JEQ BINtoFLOATING_20 ; --> Positive number
NOT.W R2 ; Takes 2’s complement
NOT.W R1L ;
ADD.W #1,R2 ;
ADCF.W R0 ;

BINtoFLOATING_20:
;
MOV.B #9DH+1,R1L ; Sets maximum value to exponent part

BINtoFLOATING_30:
;
BTST 15,R0 ; Search of maximum bit position
JNE BINtoFLOATING_40 ; --> Finds maximum bit
SHL.W #1,R2 ; Pushes for search of maximum bit position

ROLC.W R0 ;
SUB.B #1,R1L ; Counts down exponent
JMP BINtoFLOATING_30 ;

BINtoFLOATING_40:
;
MOV.B #7,R1H ; Number of shifts to adjust mantissa position
BINtoFLOATING_50:
    SHL.W            # -1, R0
    ; Adjusts mantissa position
    RORC.W           R2
    ;
    ADJNZ.B          # -1, R1H, BINtoFLOATING_50
    ; --> Adjustment not completed
    MOV.B            R1L, R0H
    ; Sets exponent
    SHL.W            # -1, R0
    ; Adjusts format
    RORC.W           R2
    ;
    BTST            15, R3
    ; Sets sign bit
    BMC            15, R0
    ;
    BINtoFLOATING_EXIT:
    ;
    XCHG.W          R2, R0
    ; Changes data
    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
<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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