To our customers,

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Renesas Electronics website: [http://www.renesas.com](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 Converting from Floating-point Number to Binary Number

1. Abstract

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

2. Introduction

This program converts a single-precision, floating-point number into a 32-bit singed binary number. Set the single-precision, floating-point number in R2 and R0. A signed binary number is output to R3 and R1 beginning with the upper half.

In this program, after confirming that the single-precision, floating-point number is convertible, the data is loaded into the registers while shifting the mantissa data left, and this operation is repeated as many times as dictated by the exponent to create a binary number. Finally, the resulting data is adjusted to make it matched to the sign bit of the input data.

If the magnitude of a single-precision, floating-point number is equal to or greater than \(2^{31}\) (sign +), the program outputs the maximum value of the same sign; if less than "1", the program outputs a "0". In either case, the result is output to R3 and R1.

<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>
### M16C/60 Series and M16C/20 Series

General-purpose Program for Converting from Floating-point Number to Binary Number

<table>
<thead>
<tr>
<th>Subroutine name</th>
<th>ROM capacity : 72 bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt during execution</td>
<td>Accepted</td>
</tr>
<tr>
<td>Number of stacks used</td>
<td>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>Mid and lower parts of mantissa</td>
<td>Indeterminate</td>
<td>←</td>
</tr>
<tr>
<td>R1</td>
<td>-</td>
<td>Lower half of signed binary</td>
<td>←</td>
</tr>
<tr>
<td>R2</td>
<td>Exponent, upper part of mantissa</td>
<td>Indeterminate</td>
<td>←</td>
</tr>
<tr>
<td>R3</td>
<td>-</td>
<td>Upper half of signed binary</td>
<td>←</td>
</tr>
<tr>
<td>A0</td>
<td>-</td>
<td>Indeterminate</td>
<td>Used to save sign bit</td>
</tr>
<tr>
<td>A1</td>
<td>-</td>
<td>-</td>
<td>Unused</td>
</tr>
</tbody>
</table>

**Usage precautions:**

If the magnitude of a single-precision, floating-point number is equal to or greater than \(2^{31}\), the program outputs the maximum value of the same sign; if less than \(1\), the program outputs a "0". The floating-point data is destroyed as a result of program execution.
3. **Flowchart**

```
ENTER

Initialize binary area

Save sign bit

0? Yes

No

Create exponent and mantissa data

Less than 1? Yes

No

Within range of binary numbers represented with 31 bits? Yes

No

Shift mantissa data 1 bit left

Load binary data into register

Number of times equal to exponent + 1 finished? Yes

No

Positive number? Yes

No

Set 2's complement

EXIT

Set maximum value of the same sign
```
4. The example of a reference program

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

VromTOP   .EQU   0F0000H     ; Declares start address of ROM
;
;==============================================================================
; Title  :Converting from single-precision, floating-point number to binary number
; Outline :Converts single-precision, floating-point number into 32-bit signed binary number
; Input  : ------------------------------> Output:
; R0 (Mid and lower parts of mantissa)   R0 (Indeterminate)
; R1 ( )             R1 (Lower half of signed binary)
; R2 (Exponent, upper part of mantissa)  R2 (Indeterminate)
; R3 ( )             R3 (Upper half of signed binary)
; A0 ( )             A0 (Indeterminate)
; A1 ( )             A1 (Unused)
; Stack amount used: None
; Notes:
;==============================================================================

.SECTION  PROGRAM,CODE
.ORG   VromTOP      ; ROM area
FLOATINGtoBIN:          ;
  XCHG.W   R0,R2        ; Changes registers
  MOV.W   #0,R1        ; Initializes binary area
  MOV.W   #0,R3        ;
  MOV.W   R0,A0        ; Saves sign bit
  BCLR   15,R0         ; Clears sign
  CMP.W   #0,R0        ;
  JNE   FLOATINGtoBIN_10
  CMP.W   #0,R2        ;\n  JEQ   FLOATINGtoBIN_EXIT     ; --> Zero
  BTSTS   7,R0         ; Sets LSB of exponent to C flag
  JNC  FLOATINGtoBIN_EXIT     ; --> Sets 0 because magnitude is less than 1
  CMP.B   #31,R0H        ; Determines whether number is within representation range
  JLTU   FLOATINGtoBIN_20
  BSET   15,R3         ; Initial sets maximum value of the same sign
  BTST  15,A0
  JNE   FLOATINGtoBIN_EXIT     ; --> Negative number (80000000)
  NOT.W   R1         ; Positive number (7FFFFFFF)
  NOT.W   R3         ;
  JMP.B   FLOATINGtoBIN_EXIT    ;
M16C/60 Series and M16C/20 Series
General-purpose Program for Converting from Floating-point Number to Binary Number

FLOATINGtoBIN_20:
    INC.B R0H ; Adjusts loop count
FLOATINGtoBIN_30:
    SHL.W #1,R2 ; Pushes mantissa data
    ROLC.B R0L ;
    ROLC.W R1 ; Loads result into register
    ROLC.W R3 ;
    ADJNZ.B #-1,R0H,FLOATINGtoBIN_30 ; --> Conversion loop
    BTST 15,A0 ; Checks sign bit
    JEQ FLOATINGtoBIN_EXIT ; --> Positive number
    NOT.W R1 ; Takes 2’s complement
    NOT.W R3 ;
    ADD.W #1,R1 ;
    ADCF.W R3 ;
FLOATINGtoBIN_EXIT:
    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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