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April 1st, 2010
Renesas Electronics Corporation

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R8C/Tiny Series

General-purpose Program for Dividing 64 Bits

1. Abstract

This program performs an unsigned division on a 64-bit dividend and a 32-bit divisor using registers.

2. Introduction

This program performs an unsigned division on a 64-bit dividend and a 32-bit divisor using registers. Set the dividend in R3, R1, R2, and R0 beginning with the most significant part, and the divisor in A1 and A0 beginning with the upper half. The quotient and the remainder are output to R3, R1, R2, and R0, and A1 and A0, respectively. The zero divide information is output to the Z flag.

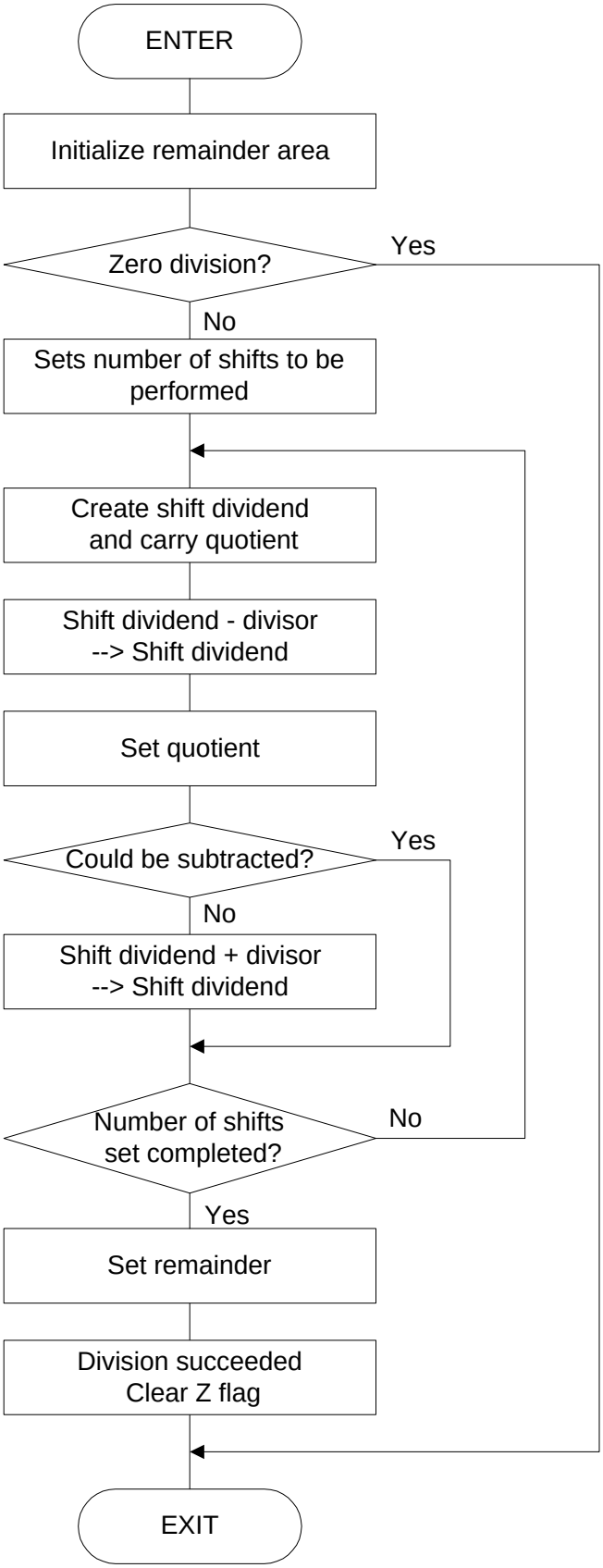
In this program, the dividend is pushed out one bit at a time beginning with the most significant bit as the program creates a dividend for calculation purposes and the divisor is subtracted from that data to get the quotient beginning with the most significant bit. The quotient and the remainder are obtained by repeating this operation as many times as the number of bits in the dividend.

Z	Meaning
0	Quotient and remainder are valid.
1	Quotient and remainder are invalid because division by zero is attempted.

Subroutine name : DIVIDE64	ROM capacity : 78 bytes
Interrupt during execution : Accepted	Number of stacks used : 8 bytes

Register/memory	Input	Output	Usage condition
R0	Lower part of dividend	Lower part of quotient	←
R1	Upper part of dividend	Upper part of quotient	←
R2	Middle part of dividend	Middle part of quotient	←
R3	Most significant part of dividend	Most significant part of quotient	←
A0	Lower half of divisor	Lower half of remainder	←
A1	Upper half of divisor	Upper half of remainder	←
JYOUYO	-	Indeterminate	Shift dividend used for calculation
CNT	-	Indeterminate	Number of shifts performed
Z flag	-	Zero divide information	←
Usage precautions	CNT and JYOUYO are allocated in a stack area by configuring stack frames as temporary variable areas in the program. Therefore, the values of CNT and JYOUYO when program execution is completed are indeterminate. The dividend is destroyed as a result of program execution.		

3. Flowchart


ENTER
Initialize remainder area
Zero division?
Yes
No
Sets number of shifts to be performed
Create shift dividend and carry quotient
Shift dividend - divisor --> Shift dividend
Set quotient
Could be subtracted?
Yes
No
Shift dividend + divisor --> Shift dividend
Number of shifts set completed?
No
Yes
Set remainder
Division succeeded Clear Z flag
EXIT

4. The example of a reference program

```
                .include apl.inc                        ; special page include file
;****************************************************************************************
;                                                                                       *
;    R8C Program Collection No. 13                                                     *
;    CPU          : R8C/Tiny                                                            *
;                                                                                       *
;****************************************************************************************
VromTOP         .EQU        00D000H                         ; 12Kbyte Flash version
FBcnst          .EQU        001000H                         ; Assumed FB register value
;=======================================================================================
;    Title: Dividing 64 bits
;    Outline: Divides 64-bit dividend by 32-bit divisor
;    Input:    ------------------------------>  Output:
;    R0 (Lower part of dividend)                R0 (Lower part of quotient)
;    R1 (Upper part of dividend)                R1 (Upper part of quotient)
;    R2 (Middle part of dividend)               R2 (Middle part of quotient)
;    R3 (Most significant part of dividend)     R3 (Most significant part of quotient)
;    A0 (Lower half of divisor)                 A0 (Lower half of remainder)
;    A1 (Upper half of divisor)                 A1 (Upper half of remainder)
;    Stack amount used: 8 bytes
;    Notes: Division by zero is returned by Z flag.
;               R3R1R2R0 / A1A0 = R3R1R2R0 remainder A1A0
;=======================================================================================
                .SECTION    PROGRAM,CODE                ;
                .ORG        VromTOP                     ; ROM area
                .FB         FBcnst                  ; Assumes FB register value
DIVIDE64:                                           ;
;-------------------------------------------------------;
;    Declaration of temporary variables                 ;
;-------------------------------------------------------;
JYOUYO          .EQU        -6                          ; Used for remainder calculation
CNT             .EQU        -1                          ; Shift count counter
    ENTER #6                                        ; Sets stack frame
    MOV.W #0,JYOUYO[FB]                             ; Initializes remainder area
    MOV.W #0,JYOUYO+2[FB]                               ;
    MOV.B  #0,JYOUYO+4[FB]                              ;
    CMP.W  #0,A0                                    ;
    JNE         DIVIDE64_10                             ;
    CMP.W  #0,A1                                    ;
    JEQ         DIVIDE64exit                            ; --> Division by zero
DIVIDE64_10:                                        ;
    MOV.B  #64,CNT[FB]                                  ; Sets number of shifts performed (64 times)
DIVIDE64_20:                                        ;
    SHL.W  #1,R0                                    ; Pushes divided and carry quotient
    ROLC.W     R2                                       ;
    ROLC.W     R1                                       ;
    ROLC.W     R3                                       ;
    ROLC.W     JYOUYO[FB]                               ; Creates dividend
```

```
    ROLC.W      JYOUYO+2[FB]                    ;
    ROLC.BJYOUYO+4[FB]                          ;
    SUB.W  A0,JYOUYO[FB]                        ; Subtracts divisor
    SBB.W  A1,JYOUYO+2[FB]                      ;
    SBB.B  #0,JYOUYO+4[FB]                      ;
    BMC          0,R0                           ; Sets quotient
    JC         DIVIDE64_30                      ; --> Subtraction of divisor succeeded
    ADD.W  A0,JYOUYO[FB]                        ; Restored to original data because subtraction of divisor failed
    ADC.W  A1,JYOUYO+2[FB]                      ;
    ADCF.B JYOUYO+4[FB]                         ;
DIVIDE64_30:                                    ;
    ADJNZ.B     #-1,CNT[FB],DIVIDE64_20             ; --> Executes next digit
    MOV.W  JYOUYO[FB],A0                        ; Sets lower half of remainder
    MOV.W  JYOUYO+2[FB],A1                      ; Sets upper half of remainder
    FCLR    Z                                   ; Division succeeded
DIVIDE64exit:                                   ;
    EXITD                                       ; Clears stack frame
;                                               ;
            .END                                ;
```

5. Reference

SOFTWARE MANUAL
R8C/Tiny 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

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REVISION HISTORY

Rev.	Date	Description	
		Page	Summary
1.00	Dec 24, 2003	-	First edition issued

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