To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

H8/300H Tiny Series

Unsigned 32-Bit Binary Division (DIV)

Introduction

Carries out division in this format:
dividend (unsigned, 32 bits)/divisor (unsigned, 32 bits) = quotient (unsigned, 32 bits) … remainder (unsigned, 32 bits).
Division by 0 sets the Z flag.

Target Device

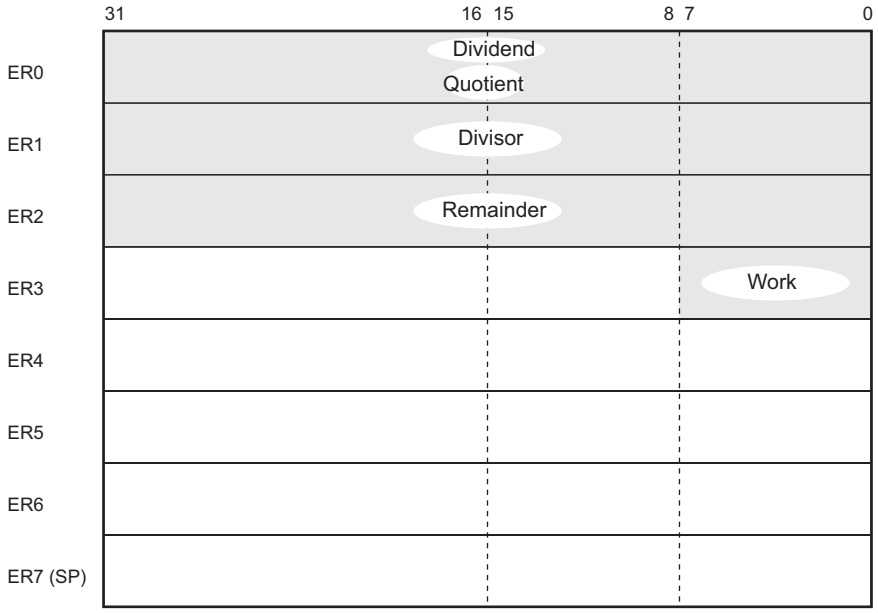
H8/300H Tiny Series

Contents

1. Arguments

Description		Storage Location	Data Length (Bytes)
Input	Dividend (unsigned, 32 bits)	ER0	4
	Divisor (unsigned, 32 bits)	ER1	4
Output	Quotient (unsigned, 32 bits)	ER0	4
	Remainder (unsigned, 32 bits)	ER2	4
	Occurrence of error (division by 0) (Yes: Z = 1; No: Z = 0)	Z flag (CCR)	—

2. Changes to Internal Registers and Flags



I	UI	H	U	N	Z	V	C
–	–	↕	–	↕	↕	↕	↕

–: No change
↕: Varies
0: Fixed to 0
1: Fixed to 1

3. Programming Specifications

Program memory (bytes)
30
Data memory (bytes)
0
Stack (bytes)
0
Number of cycles
762
Re-entrant
Yes
Relocatable
Yes
Interrupts during execution
Yes

4. Note

The number of cycles in the programming specifications is the value for calculation of H'FFFFFFFF/H'01.

5. Description

5.1 Description of Functions

1. The arguments are as follows:
   ER0: Set the dividend (unsigned, 32 bits) as an input argument. The quotient (unsigned, 32 bits) is also set here, as an output argument.
   ER1: Set the divisor (unsigned, 32 bits) as an input argument.
   ER2: The remainder (unsigned, 32 bits) is set here as an output argument.
   Z flag (CCR): Indicates error status (division by 0) after execution of DIV.
   Z flag = 1: The division was in error.
   Z flag = 0: The division was completed without error.

2. The following figure illustrates the execution of the software DIV. When the input arguments are set as shown below, execution places the quotient in ER0 and the remainder in ER1.

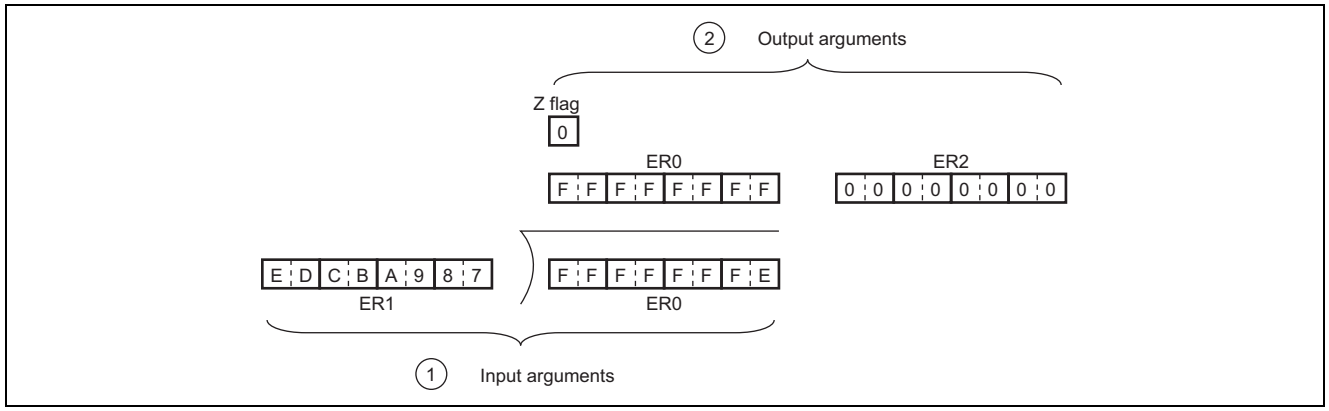


Figure 1 Example of DIV Execution

3. The DIV subroutine starts by determining whether the divisor is 0 or nonzero; if it is 0, DIV ends.

5.2 Usage Notes

Since the quotient is set in ER0, the dividend will be lost through execution of DIV. If you will still require the dividend, save it elsewhere in memory beforehand.

5.3 Description of Data Memory

No data memory is used by DIV.

5.4 Example of Usage

After setting the dividend and divisor, call the DIV subroutine.

```
WORK1   . RES. L 1          ..... Reservation of the data memory area for setting of the dividend (unsigned, 32 bits) by the user program.
WORK2   . RES. L 1          ..... Reservation of the data memory area for setting of the divisor (unsigned, 32 bits) by the user program.
          .
          .
          .
        MOV. L @WORK1, ER0  ..... Sets, as an input argument, the dividend (unsigned, 32 bits) specified by the user program.
        MOV. L @WORK2, ER1  ..... Sets, as an input argument, the divisor (unsigned, 32 bits) specified by the user program.
        JSR    @DIV         ..... Subroutine call of DIV.
```

5.5 Principles of Operation

1. In binary division, the quotient and remainder are found through repeated subtraction. In the following figure, the division of H'0D by H'03 is given as an example of this operation.

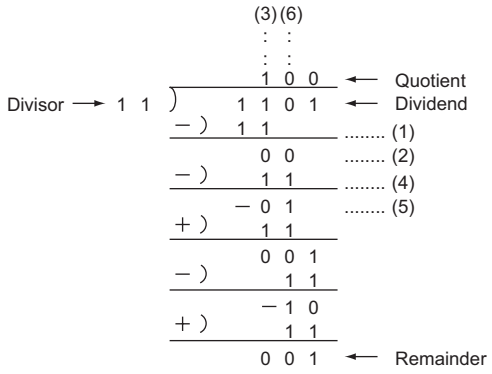
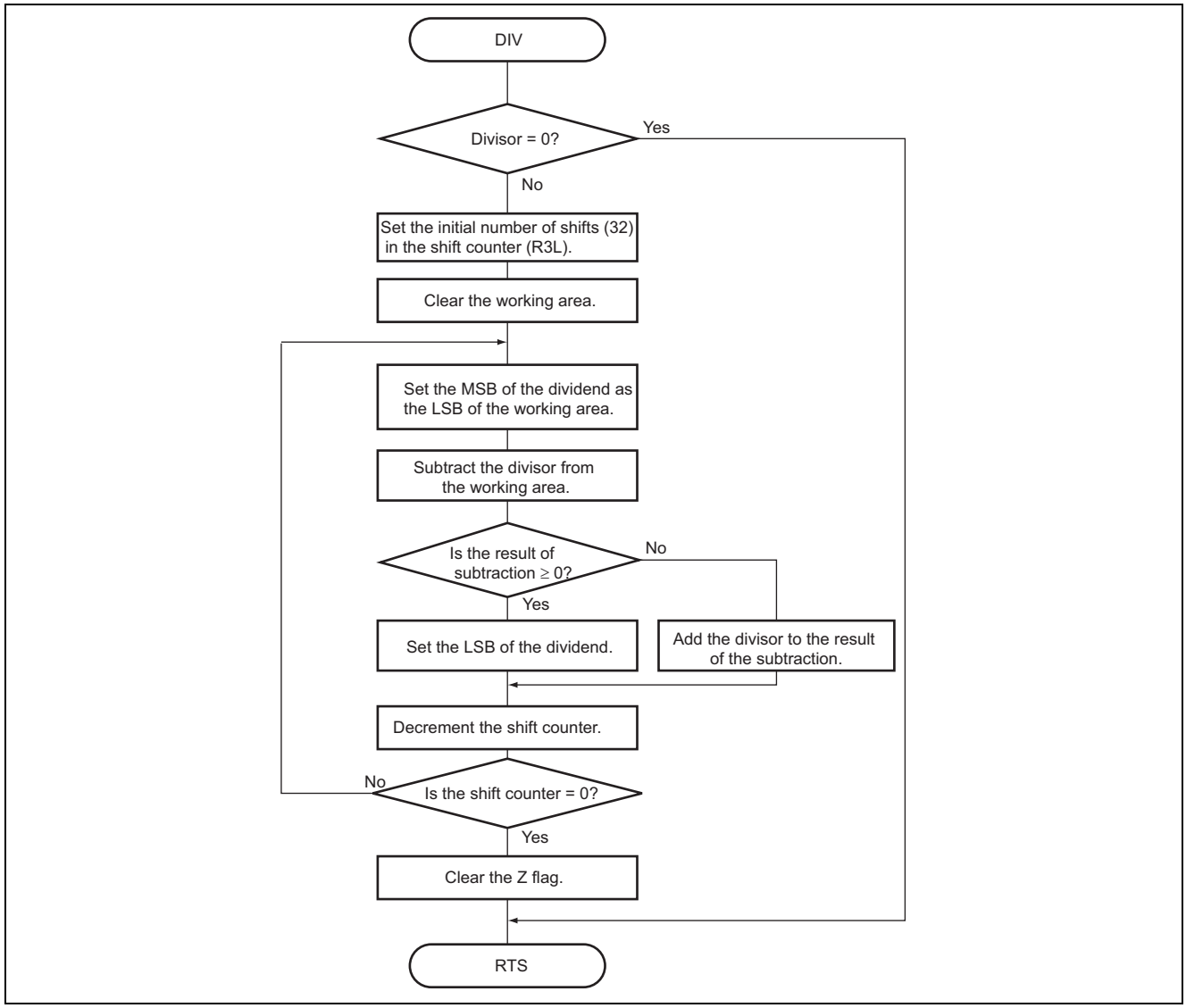


Figure 2 Division

2. Detailed description of the program:
   1) The initial number of shifts is set in the counter R3L, which indicates the number of shifts.
   2) The dividend is shifted 1 bit to the left and the MSB thus loaded to the C bit is set as the LSB of ER2, which will hold the remainder.
   3) The divisor is subtracted from ER2. When the result of subtraction is positive, the LSB of ER0 is set ((1) → (2) → (3) in the figure). When the result of subtraction is negative, the LSB of ER0 is cleared and the divisor is added to the result of subtraction, returning it to the state prior to subtraction ((4) → (5) → (6) in the figure).
   4) The shift counter set in step 1) above is decremented.
   5) Steps 2) to 4) are repeated until the shift counter reaches –1.

6. Flowchart


DIV
Divisor = 0?
Yes
No
Set the initial number of shifts (32) in the shift counter (R3L).
Clear the working area.
Set the MSB of the dividend as the LSB of the working area.
Subtract the divisor from the working area.
Is the result of subtraction ≥ 0?
No
Yes
Set the LSB of the dividend.
Add the divisor to the result of the subtraction.
Decrement the shift counter.
No
Is the shift counter = 0?
Yes
Clear the Z flag.
RTS

7. Program Listing

```
 1                                    1
 2                                    2     ;*********************************************************************
 3                                    3     ;*                                                                   *
 4                                    4     ;*       NAME    :   32 BIT DIVISION(DIV)                            *
 5                                    5     ;*                                                                   *
 6                                    6     ;*********************************************************************
 7                                    7     ;*                                                                   *
 8                                    8     ;*       ENTRY   :   ER0          (DIVIDEND)                         *
 9                                    9     ;*                   ER1          (DIVISOR)                          *
10                                   10     ;*       RETURNS :   ER0          (QUOTIENT)                         *
11                                   11     ;*                   ER2          (REMAINDER)                        *
12                                   12     ;*                                                                   *
13                                   13     ;*********************************************************************
14                                   14     ;
15                                   15             .CPU        300HA
16     001000                        16             .SECTION A,CODE,LOCATE=H'001000
17              00001000             17     DIV     .EQU        $             ;Entry point
18     001000   0F91                 18             MOV.L       ER1,ER1       ;
19     001002   5870001C             19             BEQ         DIV4          ;
20     001006   FB20                 20             MOV.B       #32,R3L       ;Set shift counter
21     001008   1AA2                 21             SUB.L       ER2,ER2       ;Clear remainder
22     00100A   1030                 22     DIV1    SHLL.L      ER0           ;Shift dividend 1 bit left
23     00100C   1232                 23             ROTXL.L     ER2           ;Set MSB of dividend to LSB of remainder
24     00100E   1A92                 24             SUB.L       ER1,ER2       ;Sub divisor from remainder
25     001010   58400006             25             BCC         DIV2          ;Branch if remainder>= divisor
26     001014   0A92                 26             ADD.L       ER1,ER2       ;Add divisor to remainder
27     001016   58000002             27             BRA         DIV3          ;Branch always
28     00101A   7008                 28     DIV2    BSET        #0,R0L        ;Set 1 to dividend LSB
29     00101C   1A0B                 29     DIV3    DEC.B       R3L           ;Decrement shift counter
30     00101E   46EA                 30             BNE         DIV1          ;Branch until shift counter = 0
31     001020   06FB                 31             ANDC        #B'11111011,CCR                              ;
32     001022   5470                 32     DIV4    RTS
33                                   33             .END
***** TOTAL    ERRORS      0
***** TOTAL    WARNINGS    0
```

Note: The program listing included in this application note assumes compilation under the option for the advanced mode of H8/300H CPU. If you use this sample program with an H8/300H Tiny Series product, make the following change to the program code:

.CPU 300HA → .CPU 300HN

Revision Record

Rev.	Date	Description	
		Page	Summary
2.00	Feb.28.06	—	Format has been changed from Hitachi version to Renesas version.

Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
   Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.
   The information described here may contain technical inaccuracies or typographical errors.
   Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
   Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (http://www.renesas.com).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
   Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.