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.

H8/300L Super Low Power Series

Converting an 8-Bit Binary Number to a 2-Byte ASCII Code (COBYTE)

Introduction

The software COBYTE converts an 8-bit binary number to a corresponding 2-byte ASCII code.

Target Device

H8/38024

Contents

1. Arguments

Description		Memory area	Data length (bytes)
Input	8-bit binary number	R0L	1
Output	2-byte ASCII code	R1	2

2. Changes to Internal Registers and Flags

R0	R1	R2	R3	R4	R5	R6	R7
×	×	○	—	×	—	—	—	—	—

I	U	H	U	N	Z	V	C
—	—	×	—	×	×	×	×

Legend
—: No change
×: Undefined
○: Result

3. Specifications

Program memory (bytes)
38
Data memory (bytes)
0
Stack (bytes)
0
Clock cycle count
72
Reentrant
Possible
Relocation
Possible
Interrupt
Possible

4. Description

4.1 Details of functions

1. The following arguments are used with the software COBYTE:
   R0L: Sets an 8-bit binary number after changing to a corresponding ASCII code.
   R1: As an output argument, 1-byte ASCII codes are set here, each corresponds to the upper 4 bits and the lower 4 bits of the 8-bit binary number.
2. The following figure illustrates the execution of the software COBYTE. When the input argument is set as shown in (1), 2-byte ASCII code data is placed in R1 as shown in (2).

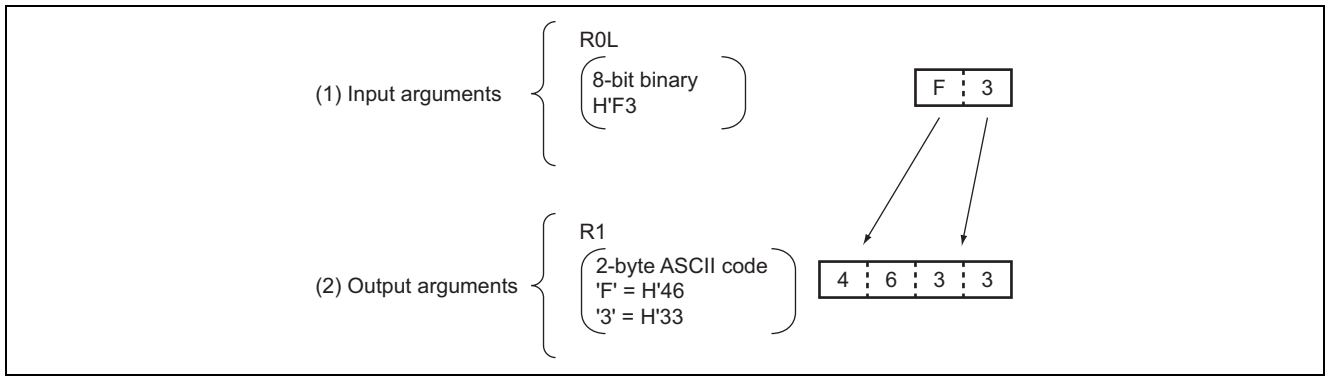


Figure 1 Example of Software COBYTE Execution

4.2 Note on usage

The 8-bit binary number set in R0L will be lost after execution of the software COBYTE.

4.3 Data memory

The software COBYTE uses no data memory.

4.4 Example of usage

Set an 8-bit binary number in the input argument and call the software COBYTE as a subroutine.

```
WORK1    . RES. B     1      ---------  Reserve a data memory area in which the user program places
                                        a 8-bit binary number.
         . ALIGN

WORK2    . RES. W     1      ---------  Reserve a data memory area in which the user program places
           .                             a corresponding 2-byte ASCII code.
           .
           .
           MOV. B     @WORK1, R0L  -------  Place the 8-bit binary number set by the user program
                                            in R0L.
         | JSR        @COBYTE    |  -------  Call the software COBYTE as a subroutine.

         MOV. W  R1,  @WORK2       -------  Place the 2-byte ASCII code set in the output argument
                                            in the data memory area of the user program.
```

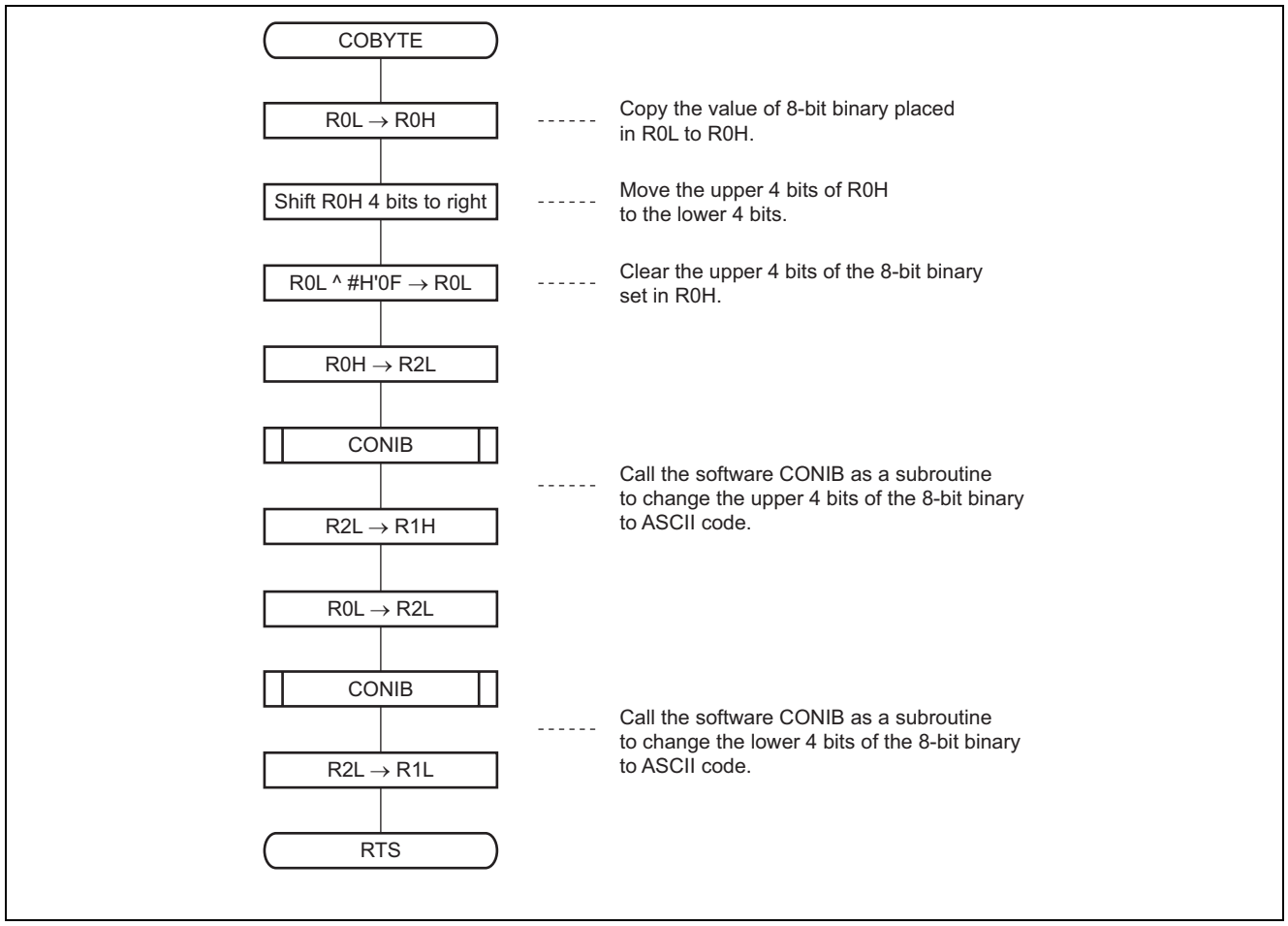
4.5 Operation

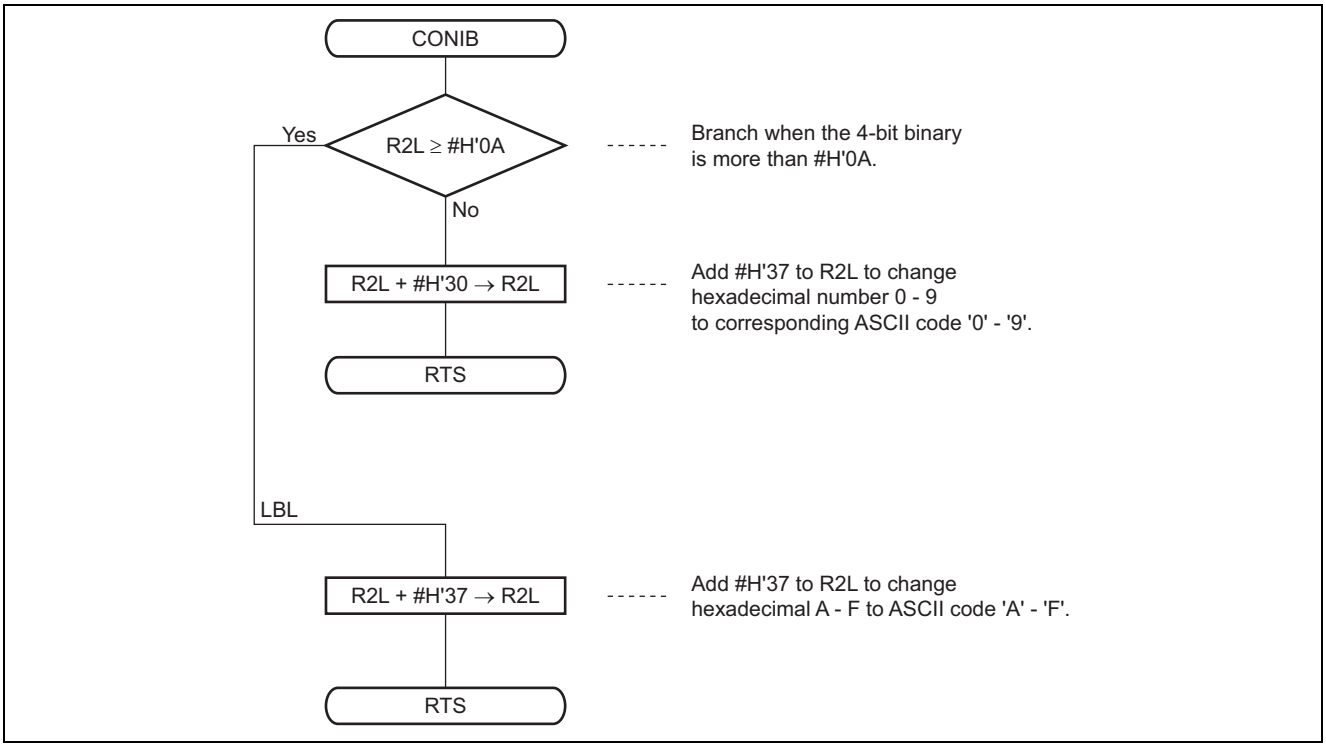
1. The 8-bit binary number is separated into two bit groups, the upper 4 bits and the lower 4 bits.
2. A compare instruction (CMP.B) is used to determine whether the data (the upper 4 bits + the lower 4 bits) is in the H'00 to H'09 range ([▭] in table 1) or in the H'0A to H'0F range ([▭] in table 1). H'30 is added to the data when it falls in the H'00 to H'09 range and H'37 to the data when it falls in the H'0A to H'0F range to convert to a corresponding ASCII code.

Table 1 ASCII Code Table

LSD \ MSD		0 000	1 001	2 010	3 011	4 100	5 101	6 110	7 111
0	0000	NUL	DLE	SP	0	@	P	`	p
1	0001	SOH	DC1	!	1	A	Q	a	q
2	0010	STX	DC2	"	2	B	R	b	r
3	0011	ETX	DC3	#	3	C	S	c	s
4	0100	EOT	DC4	$	4	D	T	d	t
5	0101	ENG	NAK	%	5	E	U	e	u
6	0110	ACK	SYN	&	6	F	V	f	v
7	0111	BEL	ETB	'	7	G	W	g	w
8	1000	BS	CAN	(	8	H	X	h	x
9	1001	HT	EM	)	9	I	Y	i	y
A	1010	LF	SUB	*	:	J	Z	j	z
B	1011	VT	ESC	+	;	K	[	k	{
C	1100	FF	FS	,	<	L	\	l	|
D	1101	CR	GS	-	=	M	]	m	}
E	1110	SO	RS	.	>	N	↑	n	~
F	1111	SI	VS	/	?	O	←	o	DEL

5. Flowchart


COBYTE
R0L → R0H
Copy the value of 8-bit binary placed in R0L to R0H.
Shift R0H 4 bits to right
Move the upper 4 bits of R0H to the lower 4 bits.
R0L ^ #H'0F → R0L
Clear the upper 4 bits of the 8-bit binary set in R0H.
R0H → R2L
CONIB
Call the software CONIB as a subroutine to change the upper 4 bits of the 8-bit binary to ASCII code.
R2L → R1H
R0L → R2L
CONIB
Call the software CONIB as a subroutine to change the lower 4 bits of the 8-bit binary to ASCII code.
R2L → R1L
RTS


CONIB
Yes
R2L ≥ #H'0A
No
Branch when the 4-bit binary is more than #H'0A.
R2L + #H'30 → R2L
Add #H'37 to R2L to change hexadecimal number 0 - 9 to corresponding ASCII code '0' - '9'.
RTS
LBL
R2L + #H'37 → R2L
Add #H'37 to R2L to change hexadecimal A - F to ASCII code 'A' - 'F'.
RTS

6. Program List

```
*** H8/300 ASSEMBLER VER 1.0B ** 08/18/92 09:49:53
PROGRAM NAME =
 1                              ;*****************************************************************
 2                              ;*
 3                              ;*      00 - NAME            :CHANGE 1 BYTE HEXADECIMAL
 4                              ;*                            TO 2 BYTE ASCII CODE (COBYTE)
 5                              ;*
 6                              ;*****************************************************************
 7                              ;*
 8                              ;*      ENTRY                :R0L (1 BYTE HEXADECIMAL)
 9                              ;*
10                              ;*      RETURN               :R1 (2 BYTE ASCII CODE)
11                              ;*
12                              ;*****************************************************************
13                              ;
14  COBYTE_c C    0000                      .SECTION             COBYTE_code,CODE,ALIGN=2
15                                          .EXPORT              COBYTE
16                              ;
17  COBYTE_c C          00000000  COBYTE .EQU $                 ;Entry Point
18  COBYTE_c C    0000  0C80                MOV.B    R0L,R0H
19                              ;
20  COBYTE_c C    0002  1100                SHLR     R0H
21  COBYTE_c C    0004  1100                SHLR     R0H
22  COBYTE_c C    0006  1100                SHLR     R0H
23  COBYTE_c C    0008  1100                SHLR     R0H         ;Select upper 4 bit hexadecimal(R0H)
24                              ;
25  COBYTE_c C    000A  E80F                AND.B    #H'0F,R0L   ;Select lower 4 bit hexadecimal(R0L)
26                              ;
27  COBYTE_c C    000C  0C0A                MOV.B    R0H,R2L
28  COBYTE_c C    000E  550A                BSR      CONIB       ;Branch subroutine CONIB
29  COBYTE_c C    0010  0CA1                MOV.B    R2L,R1H     ;Set 1st ASCII code to R1H
30                              ;
31  COBYTE_c C    0012  0C8A                MOV.B    R0L,R2L
32  COBYTE_c C    0014  5504                BSR      CONIB       ;Branch subroutine CONIB
33  COBYTE_c C    0016  0CA9                MOV.B    R2L,R1L     ;Set 2nd ASCII code to R1L
34                              ;
35  COBYTE_c C    0018  5470                RTS
36                              ;---------------------------------------------------------------
37  COBYTE_c C    001A            CONIB                         ;Change R2L to ASCII code
38  COBYTE_c C    001A  AA0A                CMP.B    #H'0A,R2L
39  COBYTE_c C    001C  4404                BCC LBL              ;Branch if R2L ASCII "A"-"F"
40  COBYTE_c C    001E  8A30                ADD.B    #H'30,R2L   ;Reshape R2L ASCII "0"- "9"
41  COBYTE_c C    0020  5470                RTS
42  COBYTE_c C    0022            LBL
43  COBYTE_c C    0022  8A37                ADD.B    #H'37,R2L
44  COBYTE_c C    0024  5470                RTS
45                              ;
46                                          .END
*****TOTAL ERRORS 0
*****TOTAL WARNINGS 0
```

Website and Support

Renesas Technology Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/inquiry
csc@renesas.com

Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Sep.18.03	—	First edition issued
2.00	Nov.30.06	All pages	Content correction

Notes regarding these materials

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, 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 products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (http://www.renesas.com)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guaranties regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
   (1) artificial life support devices or systems
   (2) surgical implantations
   (3) healthcare intervention (e.g., excision, administration of medication, etc.)
   (4) any other purposes that pose a direct threat to human life

   Renesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas 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 applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.