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.

M16C/64 Group

Operation of Timer A (timer mode, pulse output function)

1. Abstract

In timer mode, choose functions from those listed in Table 1. Operations of the circled items are described below.

2. Introduction

This application note is applied to the M16C/64 group microcomputers.

This program can be operated under the condition of M16C family products with the same SFR (Special Function Register) as M16C/64 Group products. Because some functions may be modified of the M16C family products, see the user's manual. When using the functions shown in this application note, evaluate them carefully for an operation.

3. Chosen functions

Table 1. Chosen functions

Item	Set-up	
Count source	O	Internal count source (f1TIMAB/f2TIMAB/f8TIMAB/f32TIMAB/f64TIMAB/foco-s/fc32)
Pulse output function		No pulse output
	O	Pulses output
Gate function	O	No gate function
		Performs count only for the period in which the TAiIN pin is at “L” level
		Performs count only for the period in which the TAiIN pin is at “H” level
Output polar control	O	Output waveform “H” active
		Output waveform “L” active (output reversed)

Note: i=0~4

4. Operation

(1) Setting the count start flag to “1” causes the counter to perform a down count on the count source.

(2) If an underflow occurs, the content of the reload register is reloaded to the counter, and the count continues. At this time, the timer Ai interrupt request bit goes to “1”. Also, the output polarity of the TAiOUT pin reverses.

(3) Setting the count start flag to “0” causes the counter to stop and to hold its value. Also, the output polarity of the TAiOUT pin outputs an “L” level.

Figure 1 shows the operation timing.

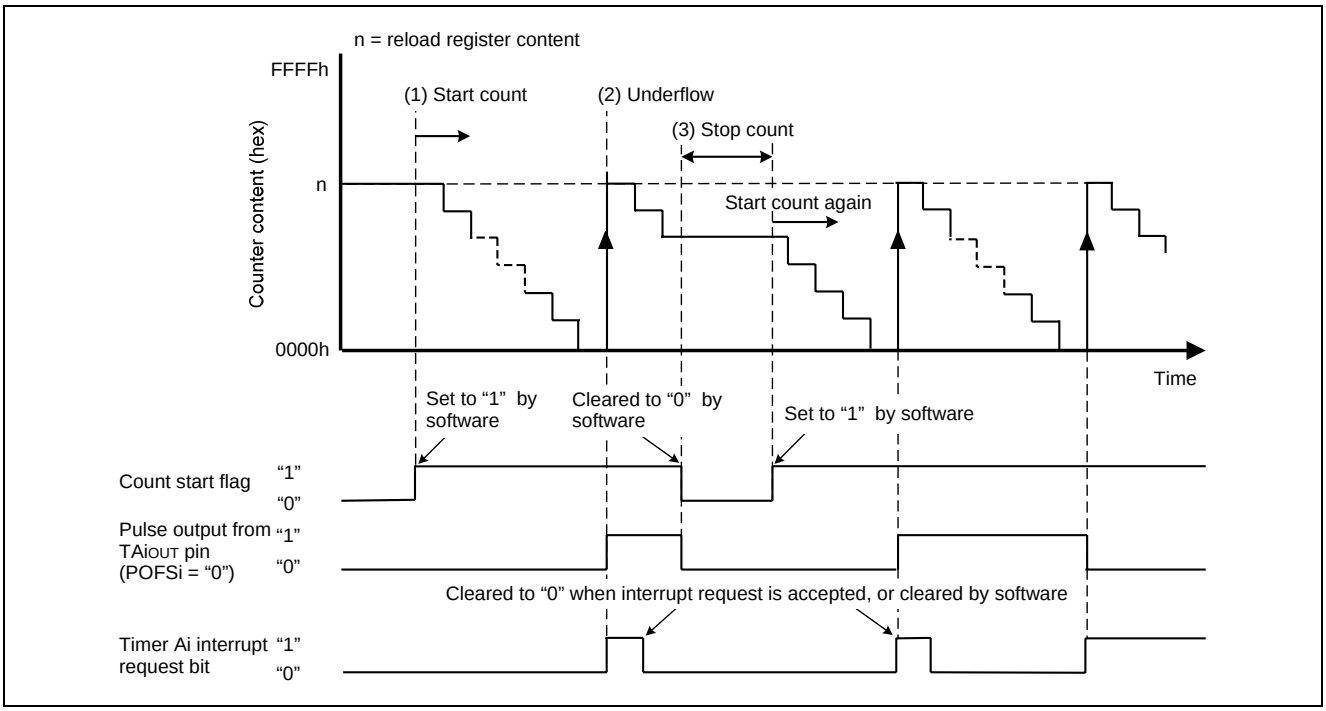


Figure 1. Operation timing of timer mode, pulse output function

5. Set-up procedure

Table 2 shows Timer A count source, Figure 2 shows block diagram of Timer A count source in timer mode.

Table 2. Count Source Selection of Timer A

TACSj register (Note 1)				TAiMR register		Count source	Count source period
TCS3/ TCS7	TCS2/ TCS6	TCS1/ TCS5	TCS0/ TCS4	TCK1	TCK0		f(PLL):24MHz f(XCIN):32.768kHz
0	-	-	-	0	0	f1TIMAB/f2TIMAB (Note 2)	41.7ns or 83.3ns
0	-	-	-	0	1	f8TIMAB	333.3ns
0	-	-	-	1	0	f32TIMAB	1333.3ns
0	-	-	-	1	1	fc32	976.56µs
1	0	0	0	-	-	f1TIMAB/f2TIMAB (Note 2)	41.7ns or 83.3ns
1	0	0	1	-	-	f8TIMAB	333.3ns
1	0	1	0	-	-	f32TIMAB	1333.3ns
1	0	1	1	-	-	f64TIMAB	2666.7ns
1	1	0	1	-	-	foco-s	About 8µs
1	1	1	0	-	-	fc32	976.56µs

Note 1: TCS3~TCS0 bits of TACS0 register correspond to Timer A0 count source selection, TCS7~TCS4 bits of TACS0 register correspond to Timer A1 count source selection, TCS3~TCS0 bits of TACS1 register correspond to Timer A2 count source selection, TCS7~TCS4 bits of TACS1 register correspond to Timer A3 count source selection, and TCS3~TCS0 bits of TACS2 register correspond to Timer A4 count source selection.
Note 2: When the PCLK0 bit in the PCLKR register is "1", the selected clock source is f1TIMAB. When the PCLK0 bit is "0", the selected clock source is f2TIMAB.

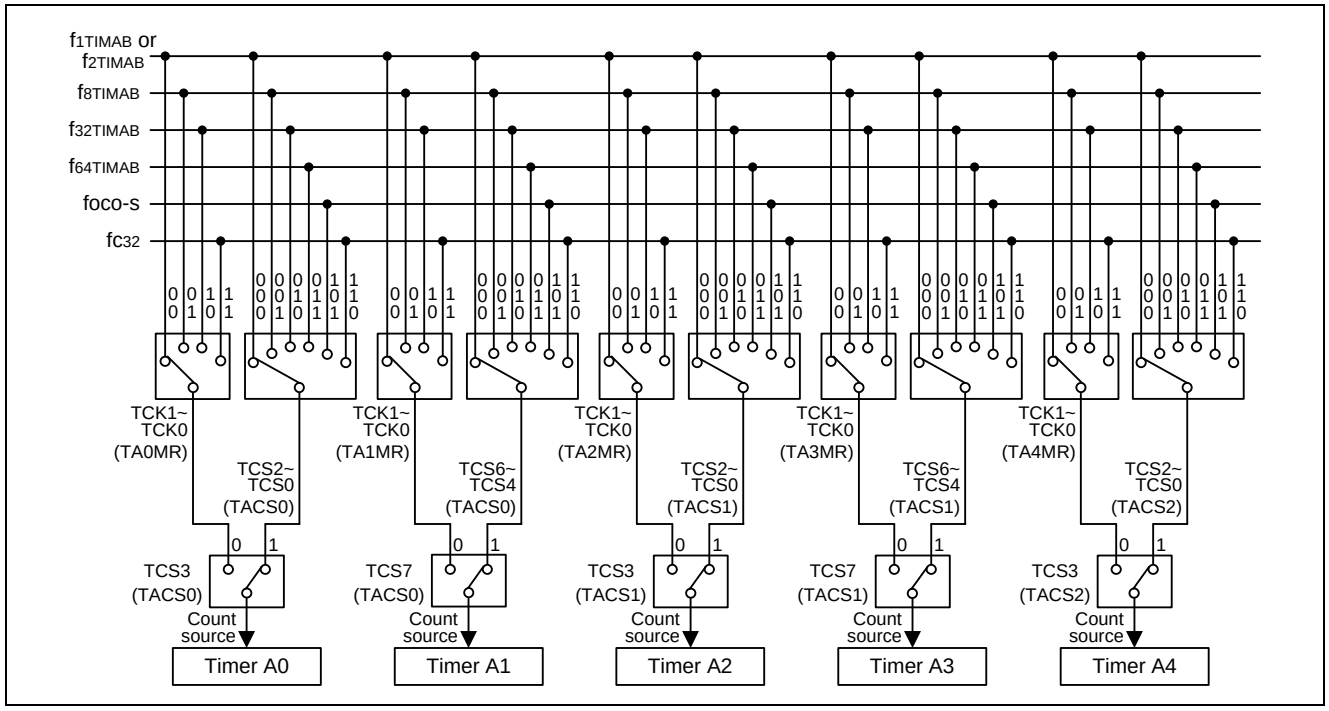
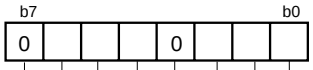


Figure 2. Count source of Timer A

Selecting timer count source

TACS0 register can select Timer A0 and Timer A1 count source, TACS1 can select Timer A2 and Timer A3 count source, and TACS2 can select Timer A4 count suorce.



Timer A count source select register 0 [Address 01D0h] TACS0
Timer A count source select register 1 [Address 01D1h] TACS1

TAi count source select bit (Note1)

b2 b1 b0
0 0 0 : f_{1TIMAB} or f_{2TIMAB} (Note2)
0 0 1 : f_{8TIMAB}
0 1 0 : $f_{32TIMAB}$
0 1 1 : $f_{64TIMSB}$
1 0 0 : Do not set
1 0 1 : foco-s
1 1 0 : f_{C32}
1 1 1 : Do not set

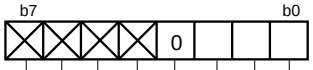
TAi count source option specified bit (Note1)
0 : TCK0, TCK1 enabled, TCS0 to TCS2 disabled

TAj count source select bit (Note1)

b2 b1 b0
0 0 0 : f_{1TIMAB} or f_{2TIMAB} (Note2)
0 0 1 : f_{8TIMAB}
0 1 0 : $f_{32TIMAB}$
0 1 1 : $f_{64TIMSB}$
1 0 0 : Do not set
1 0 1 : foco-s
1 1 0 : f_{C32}
1 1 1 : Do not set

TAj count source option specified bit (Note1)
0 : TCK0, TCK1 enabled, TCS4 to TCS6 disabled

TACS0 register: i = 0, j = 1, TACS1 register: i = 2, j = 3
Note 1: About the count source period, please refer to Table 2.
Note 2: When the PCLK0 bit in the PCLKR register is “1”, the selected clock source is f_{1TIMAB}. When the PCLK0 bit is “0”, the selected clock source is f_{2TIMAB}.



Timer A count source select register 2 [Address 01D2h] TACS2

TA4 count source select bit (Note1)

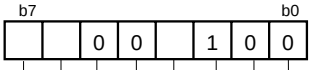
b2 b1 b0
0 0 0 : f_{1TIMAB} or f_{2TIMAB} (Note2)
0 0 1 : f_{8TIMAB}
0 1 0 : $f_{32TIMAB}$
0 1 1 : $f_{64TIMSB}$
1 0 0 : Do not set
1 0 1 : foco-s
1 1 0 : f_{C32}
1 1 1 : Do not set

TA4 count source option specified bit (Note1)
0 : TCK0, TCK1 enabled, TCS0 to TCS2 disabled

No register bits. If necessary, set to 0. Read as undefined value.

Note 1: About the count source period, please refer to Table 2.
Note 2: When the PCLK0 bit in the PCLKR register is “1”, the selected clock source is f_{1TIMAB}. When the PCLK0 bit is “0”, the selected clock source is f_{2TIMAB}.

Selecting timer mode and functions



Timer Ai mode register (i=0 to 4) [Address 0336h to 033Ah]
TAiMR (i=0 to 4)

Selection of timer mode

Pulse output function select bit
1 : Pulse is output (Note1) (TAiOUT pin is a pulse output pin)

Gate function select bit

b4 b3
0 0 :
0 1 : } Gate function not available (TAiIN pin is a normal port pin)

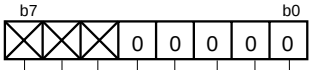
0 (Must always be "0" in timer mode)

Count source select bit (Note2)

b7 b6
0 0 : f1TIMAB or f2TIMAB (Note3)
0 1 : f8TIMAB
1 0 : f32TIMAB
1 1 : fc32

Note 1: The settings of the corresponding port register and port direction register are invalid.
Note 2: Valid when the TCS3 bit or TCS7 bit in registers TACS0 to TACS2 is set to 0 (TCK0, TCK1 enabled). About the count source period, please refer to Table 2.
Note 3: When the PCLK0 bit in the PCLKR register is "1", the selected clock source is f1TIMAB. When the PCLK0 bit is "0", the selected clock source is f2TIMAB.

Selecting waveform output function



Timer A waveform output function select register [Address 01D5h]
TAPOFS

TA0OUT output polar control bit
0 : Output waveform "H" active

TA1OUT output polar control bit
0 : Output waveform "H" active

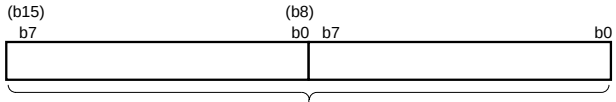
TA2OUT output polar control bit
0 : Output waveform "H" active

TA3OUT output polar control bit
0 : Output waveform "H" active

TA4OUT output polar control bit
0 : Output waveform "H" active

No register bits. If necessary, set to 0. Read as undefined value

Setting counter value



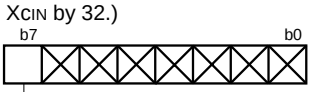
Timer A0 register [Address 0327h, 0326h] TA0
Timer A1 register [Address 0329h, 0328h] TA1
Timer A2 register [Address 032Bh, 032Ah] TA2
Timer A3 register [Address 032Dh, 032Ch] TA3
Timer A4 register [Address 032Fh, 032Eh] TA4

Can be set to 0000h to FFFFh

:

Setting clock prescaler reset flag

(This function is effective when fc_{32} is selected as the count source. Reset the prescaler for generating fc_{32} by dividing the X_{CIN} by 32.)

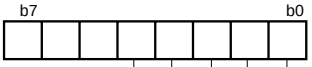


Count prescaler reset flag [Address 0015h]
CPSRF

Clock prescaler reset flag
0 : No effect
1 : Prescale is reset (When read, the value is "0")

:

Setting count start flag



Count start flag [Address 0320h]
TABSR

Timer A0 count start flag
Timer A1 count start flag
Timer A2 count start flag
Timer A3 count start flag
Timer A4 count start flag

:

Start count

6. Reference

Hardware manual

M16C/64 Group Hardware Manual

(Use the most recent version of the document on the Renesas Technology Web site.)

Technical news/Technical update

(Use the most recent version of the document on the Renesas Technology Web site.)

Web-site and contact for support

Renesas Technology Web site

http://www.renesas.com/

Inquiries

http://www.renesas.com/inquiry

csc@renesas.com

Revision

Rev.	Issue date	Revised	
		Page	Point
1.00	2008.06	-	First edition issued

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.