

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.

38D2 Group

LCD Drive Control Circuit (Internal Dividing Resistor Usage Example 1)

1. Abstract

The following article introduces and shows an example of how to use the LCD Drive Control Circuit (Internal Dividing Resistor Usage Example 1) on the 38D2 Group device.

2. Introduction

The application explained in this document applies to the following MCU and parameter(s):

Applicable MCU: 38D2 Group

Frame frequency: 8 MHz

This sample program may include operations of unused bit functions for the convenience of the SFR bit layout. Set the values according to the operational conditions of the user system.

3. Contents

3.1 LCD Panel Display (Internal Dividing Resistor Usage: VL1, VL2 = Output)

Outline: The LCD drive control circuit is used for displaying the LCD panel.

Specifications:

- Segment output SEG0 to SEG19 and common COM0 to COM3 are used.
- Frame frequency = 61 Hz
- VL2 pin is used as P27, VL1 pin is used as P26
- Duty ratio = 4, Bias value = 1/3
- Waveform type B
- Internal dividing resistor is used.
- “M38d2” is displayed.

Figure 3.1 shows a Segment Allocation Example, Figure 3.2 shows the Circuit Example (When Using Internal Dividing Resistor), Figure 3.3 shows the LCD Display RAM Map, Figure 3.4 shows as LCD Display RAM Setting Example, Figure 3.5 and Figure 3.6 show the Relevant Register Settings, and Figure 3.7 shows the Control Procedure.

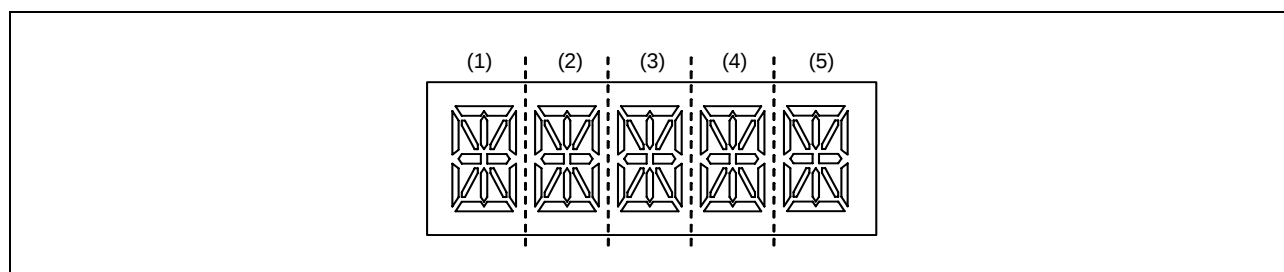


Figure 3.1 Segment Allocation Example

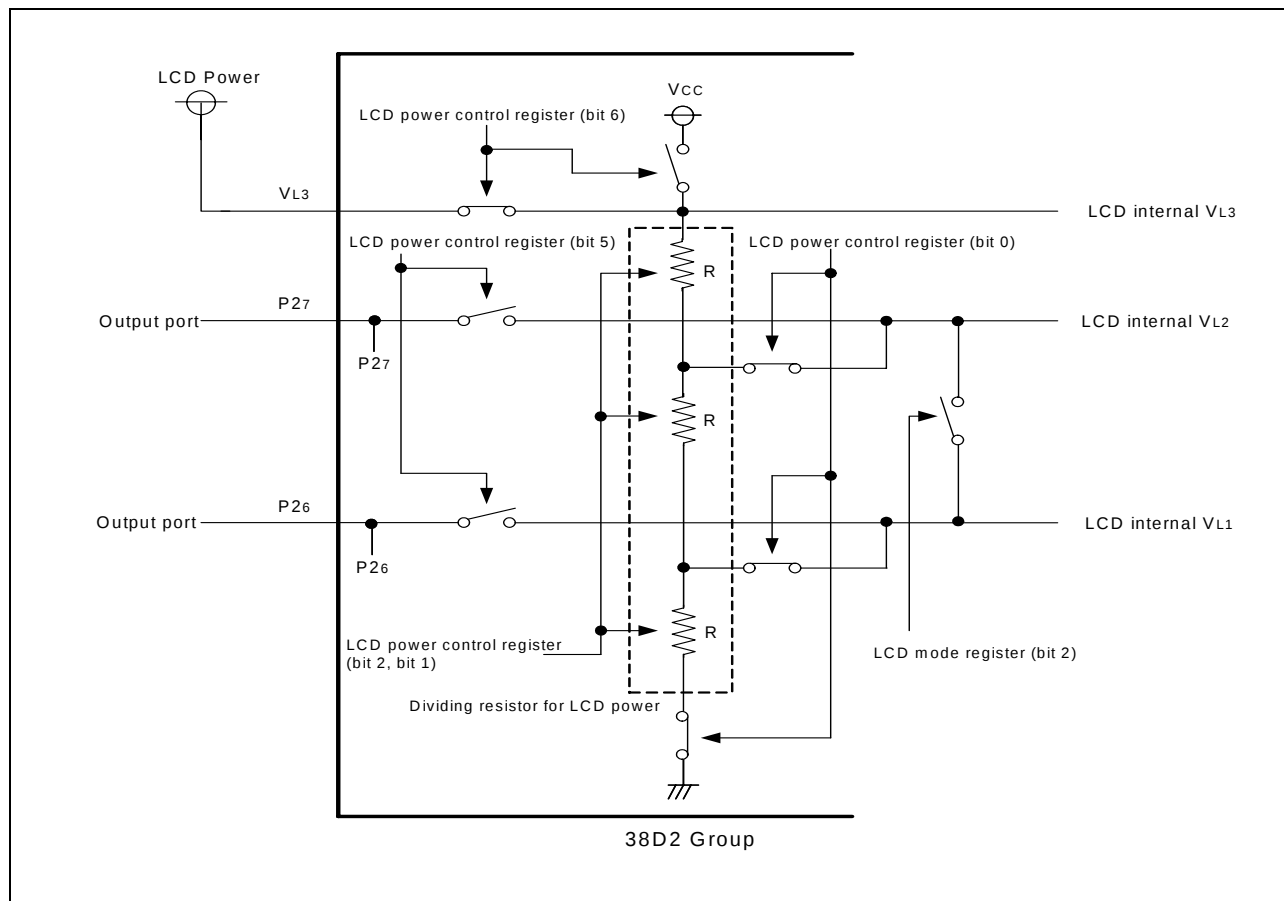


Figure 3.2 Circuit Example (When Using Internal Dividing Resistor)

address \ bit		7	6	5	4	3	2	1	0
		COM ₃	COM ₂	COM ₁	COM ₀	COM ₃	COM ₂	COM ₁	COM ₀
0040h	LRAM0	SEG ₁				SEG ₀			
0041h	LRAM1	SEG ₃				SEG ₂			
0042h	LRAM2	SEG ₅				SEG ₄			
0043h	LRAM3	SEG ₇				SEG ₆			
0044h	LRAM4	SEG ₉				SEG ₈			
0045h	LRAM5	SEG ₁₁				SEG ₁₀			
0046h	LRAM6	SEG ₁₃				SEG ₁₂			
0047h	LRAM7	SEG ₁₅				SEG ₁₄			
0048h	LRAM8	SEG ₁₇				SEG ₁₆			
0049h	LRAM9	SEG ₁₉				SEG ₁₈			
004Ah	LRAM10	SEG ₂₁				SEG ₂₀			
004Bh	LRAM11	SEG ₂₃				SEG ₂₂			

Figure 3.3 LCD Display RAM Map

address \ bit		7	6	5	4	3	2	1	0
		COM ₃	COM ₂	COM ₁	COM ₀	COM ₃	COM ₂	COM ₁	COM ₀
0040h	LRAM0	h	g	f	e	d	c	b	a
0041h	LRAM1	m	l		n	k	j		i
0042h	LRAM2	h	g	f	e	d	c	b	a
0043h	LRAM3	m	l		n	k	j		i
0044h	LRAM4	h	g	f	e	d	c	b	a
0045h	LRAM5	m	l		n	k	j		i
0046h	LRAM6	h	g	f	e	d	c	b	a
0047h	LRAM7	m	l		n	k	j		i
0048h	LRAM8	h	g	f	e	d	c	b	a
0049h	LRAM9	m	l		n	k	j		i
004Ah	LRAM10								
004Bh	LRAM11								

digit
→ (1)
→ (1)
→ (2)
→ (2)
→ (3)
→ (3)
→ (4)
→ (4)
→ (5)
→ (5)

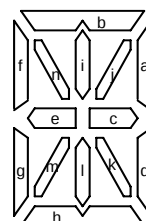


Figure 3.4 LCD Display RAM Setting Example

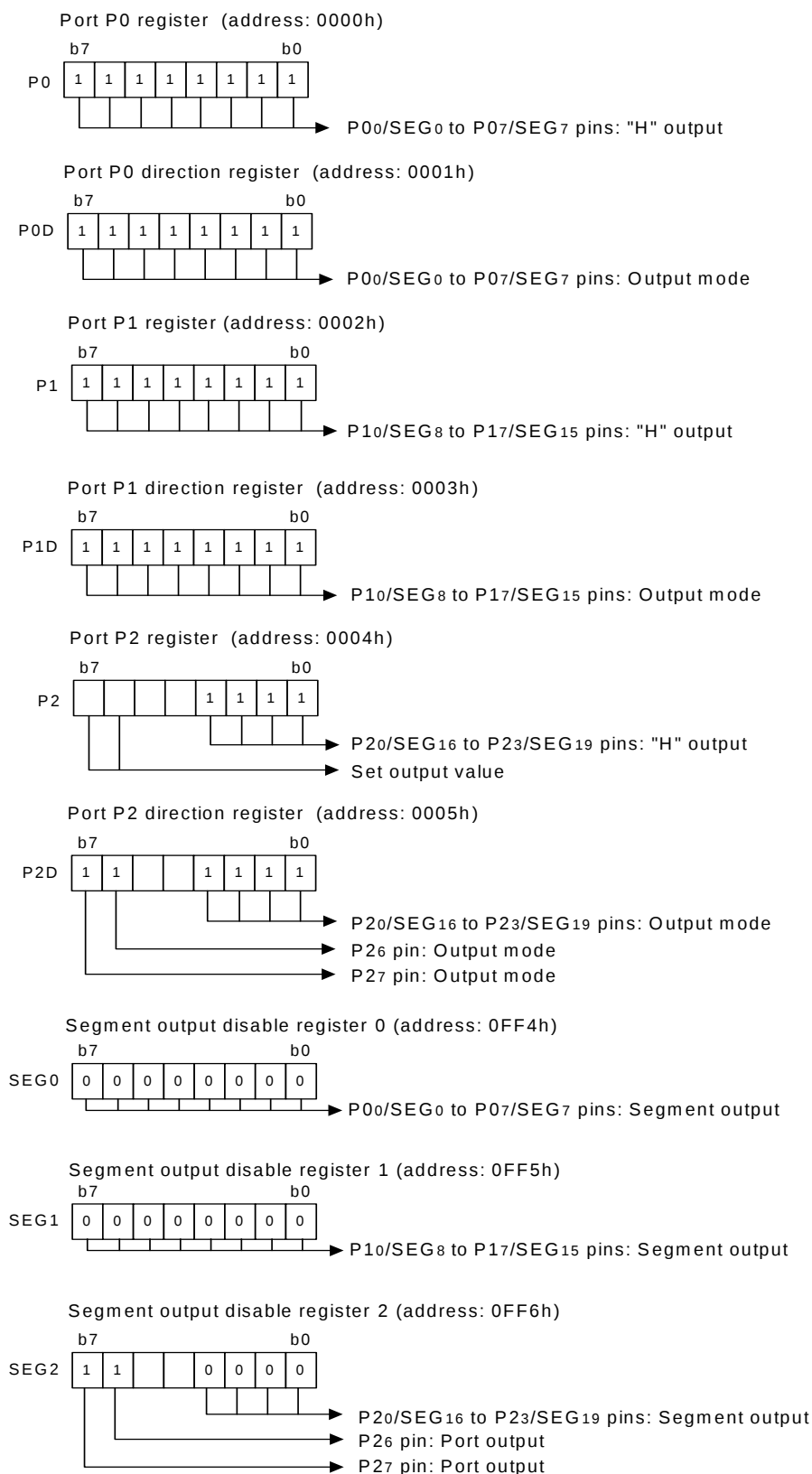
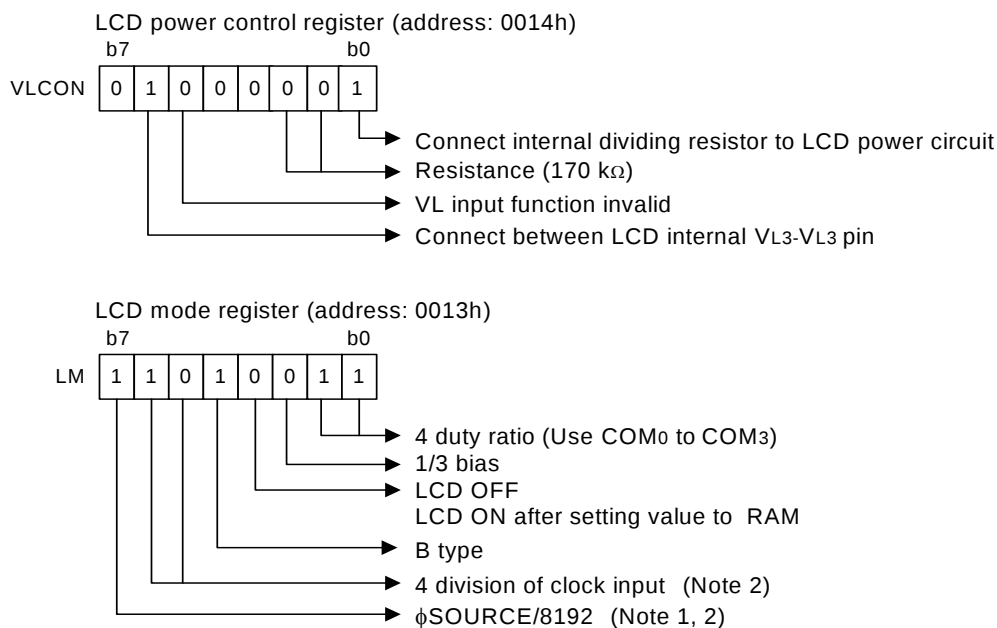


Figure 3.5 Relevant Register Settings (1)



Notes: 1. LCDCK is a clock for timing controller. ϕ SOURCE = XIN input in frequency/2, 4, 8 mode, on-chip oscillator divided by 4 in on-chip oscillator mode, and oscillation frequency of sub-clock in low-speed mode
2. Frame frequency = f(LCDCK)/duty ratio
f(LCDCK) = Count source for LCDCK/frequency divider division ratio for LCD
Frame frequency when f(XIN) = 8 is as follows.

$$\text{Frame frequency} = \{(8 \times 10^6/8192)/4/4\} \approx 61.035\text{Hz}$$

Direction register	Segment output disable register	
	0	1
0	Input port NO pull-up	Input port Pull-up
1	Segment output	Port output

Initial state

Figure 3.6 Relevant Register Settings (2)

P0	(0000h)	←	11111111b	• X: Not used in this application. Set to 0 or 1 according to use.
P0D	(0001h)	←	11111111b	• Port P0 ₀ /SEG ₀ to P0 ₇ /SEG ₇ pins: "H" output
P1	(0002h)	←	11111111b	• Port P1 ₀ /SEG ₈ to P1 ₇ /SEG ₁₅ pins: "H" output
P1D	(0003h)	←	11111111b	• Port P2 ₀ /SEG ₁₆ to P2 ₃ /SEG ₁₉ pins: "H" output
P2	(0004h)	←	XXXX1111b	• SEG ₀ to SEG ₁₉ pins: Segment output
P2D	(0005h)	←	11XX1111b	• Set LCD mode register
SEG0	(0FF4h)	←	00000000b	• Set value to RAM for LCD display (Set LCD ON bit to 1, OFF bit to 0)
SEG1	(0FF5h)	←	00000000b	
SEG2	(0FF6h)	←	11XX0000b	
VLCON	(0014h)	←	01000001b	
LM	(0013h)	←	11010011b	• LCD ON
LRAM0	(0040h)	←	01101001b	
LRAM1	(0041h)	←	00010100b	
LRAM2	(0042h)	←	10011111b	
LRAM3	(0043h)	←	00000000b	
LRAM4	(0044h)	←	11111111b	
LRAM5	(0045h)	←	00000000b	
LRAM6	(0046h)	←	11011101b	
LRAM7	(0047h)	←	00000000b	
LRAM8	(0048h)	←	11010111b	
LRAM9	(0049h)	←	00000000b	
LM	(0013h),bit 3	←	1	

Figure 3.7 Control Procedure

4. Sample Programming Code

Download a sample program from the Renesas Technology website.
To download, click “Application Notes” in the left side menu on the page of the 38D2 Group.

5. Reference Document

Datasheet
38D2 Group Datasheet
Download the latest version from the Renesas Technology website.

Technical News/Technical Update
Download the latest information from the Renesas Technology website.

Website and Support

Renesas Technology website
<http://www.renesas.com>

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

REVISION HISTORY	38D2 Group LCD Drive Control Circuit (Internal Dividing Resistor Usage Example 1)
------------------	---

Rev.	Date	Description	
		Page	Summary
1.00	Feb 9, 2007	–	First Edition issued

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 non-flammable 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.