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.

4559 Group

Carrier Output

1. Abstract

This document shows an example of how to set the carrier output of the 4559 group of Renesas microcomputers and an application example for using it.

2. Introduction

The application example explained in this document applies for use with the microcomputers and under the conditions described below.

- Microcomputer : 4559 group
- Oscillator frequency : 4 MHz as main clock f(XCIN), however
- System clock : Used in through mode (not frequency divided)

Please note that the sample program for the 4559 group may somewhere in it manipulate the bits of unused functions for reasons of bit arrangement in the control registers. The values of these bits in a user system should be set to suit the usage condition of the system.

3. Related Registers

3.1 Interrupt Control Register V1

Table 3.1 shows the bit configuration of Interrupt Control Register V1.

For write to the register V1, first set a value in the register A and then use the TV1A instruction.

Furthermore, the TAV1 instruction may be used to transfer the content of register V1 to the register A.

Table 3.1 Bit Configuration of Interrupt Control Register V1

Interrupt Control Register V1		When reset: 0000_2	When powered down: 0000_2	R/W TAV1/TV1A
$V1_3$	Timer 2 interrupt enable bit	0	Disables interrupt generation (SNZT2 instruction effective)	
		1	Enables interrupt generation (SNZT2 instruction has no effect)	
$V1_2$	Timer 1 interrupt enable bit	0	Disables interrupt generation (SNZT1 instruction effective)	
		1	Enables interrupt generation (SNZT1 instruction has no effect)	
$V1_1$	Unused	0	This bit has no functions assigned, but can be read/written.	
		1		
$V1_0$	External 0 interrupt enable bit	0	Disables interrupt generation (SNZ0 instruction effective)	
		1	Enables interrupt generation (SNZ0 instruction has no effect)	

Note 1: The letter R denotes "readable," and the letter W denotes "writable."

Note 2: : Unused bits during carrier output setting.

3.2 Interrupt Control Register I1

Table 3.2 shows the bit configuration of Interrupt Control Register I1.

For write to the register I1, first set a value in the register A and then use the TI1A instruction.

Furthermore, the TAI1 instruction may be used to transfer the content of register I1 to the register A.

Table 3.2 Bit Configuration of Interrupt Control Register I1

Interrupt Control Register I1		When reset: 0000_2	When powered down: State retained	R/W TAI1/TI1A
$I1_3$	INT pin input control bit Note 2	0	Disables input	
		1	Enables input	
$I1_2$	INT pin interrupt active waveform/ return level select bit Note 2	0	Falling waveform/low level (SNZI0 instruction recognizes low level on INT pin)	
		1	Rising waveform/high level (SNZI0 instruction recognizes high level on INT pin)	
$I1_1$	INT pin edge detection circuit control bit	0	Detects one edge	
		1	Detects both edges	
$I1_0$	INT pin timer 1 count start synchronizing circuit select bit	0	Deselects timer 1 count start synchronizing circuit	
		1	Selects timer 1 count start synchronizing circuit	

Note 1: The letter R denotes "readable," and the letter W denotes "writable."

Note 2: When the contents of these bits ($I1_2$ or $I1_3$) are changed, the external interrupt request flag (EXF0) may be set.

Note 3: : Unused bits during carrier output setting.

3.3 Timer Control Register W1

Table 3.3 shows the bit configuration of Timer Control Register W1.

For write to the register W1, first set a value in the register A and then use the TW1A instruction.

Furthermore, the TAW1 instruction may be used to transfer the content of register W1 to the register A.

Table 3.3 Bit Configuration of Timer Control Register W1

Timer Control Register W1		When reset: 0000_2		When powered down: State retained	R/W TAW1/TW1A
$W1_3$	Timer 1 count auto stop circuit select bit Note 2	0	Deselects timer 1 count auto stop circuit		
		1	Selects timer 1 count auto stop circuit		
$W1_2$	Timer 1 control bit	0	Stop (state retained)		
		1	Start		
$W1_1$	Timer 1 count source select bit Note 3	$W1_1$	$W1_0$	Count source	
		0	0	PWM signal (PWMOUT)	
		0	1	Prescaler output (ORCLK)	
$W1_0$		1	0	Timer 3 underflow signal (T3UDF)	
		1	1	CNTR input	

Note 1: The letter R denotes “readable,” and the letter W denotes “writable.”
Note 2: This function is usable only when the timer 1 count start synchronizing circuit is selected ($I1_0 = 1$).
Note 3: If CNTR input is selected for the timer 1 count source, port C output is disabled.

3.4 Timer Control Register W2

Table 3.4 shows the bit configuration of Timer Control Register W2.

For write to the register W2, first set a value in the register A and then use the TW2A instruction.

Furthermore, the TAW2 instruction may be used to transfer the content of register W2 to the register A.

Table 3.4 Bit Configuration of Timer Control Register W2

Timer Control Register W2		When reset: 0000_2	When powered down: 0000_2	R/W TAW2/TW2A
$W2_3$	CNTR pin output control bit	0	Disables CNTR pin output	
		1	Enables CNTR pin output	
$W2_2$	PWM signal high period extend function control bit	0	Disables PWM signal high period extend function	
		1	Enables PWM signal high period extend function	
$W2_1$	Timer 2 control bit	0	Stop (state retained)	
		1	Start	
$W2_0$	Timer 2 count source select bit	0	X_{IN} input	
		1	Prescaler output (ORCLK) divided by 2	

Note 1: The letter R denotes “readable,” and the letter W denotes “writable.”

3.5 Timer Control Register W4

Table 3.5 shows the bit configuration of Timer Control Register W4.

For write to the register W4, first set a value in the register A and then use the TW4A instruction.

Furthermore, the TAW4 instruction may be used to transfer the content of register W4 to the register A.

Table 3.5 Bit Configuration of Timer Control Register W4

Timer Control Register W4		When reset: 0000_2		When powered down: State retained	R/W TAW4/TW4A
$W4_3$	Timer LC control bit	0	Stop (state retained)		
		1	Start		
$W4_2$	Timer LC count source select bit	0	Bit 4 of timer 3 ($T3_4$)		
		1	System clock (STCK)		
$W4_1$	CNTR pin output auto control circuit select bit	0	Deselects CNTR pin output auto control circuit		
		1	Selects CNTR pin output auto control circuit		
$W4_0$	CNTR pin input count edge select bit	0	Falling edge		
		1	Rising edge		

Note 1: The letter R denotes “readable,” and the letter W denotes “writable.”

Note 2: : Unused bits during carrier output setting.

4. Timer Application Example

4.1 Carrier Output

Point : • Timer 2 is used to generate a PWM signal (remote control carrier).
• Timer 1 is used to control whether or not to output a PWM signal from the CNTR pin.
• Each time timer 1 underflows after reaching the terminal count, PWM output from the CNTR pin is switched on and off.
• Timer 1 uses the PWM signal as its count source. The interval time for which PWM output from the CNTR pin is turned on or off can be changed by altering the set value of timer 1.
• Even when no PWM signals are output from the CNTR pin, the chip is generating a PWM signal internally in it.

Specification : PWM signal: Approx. 33.3 kHz, 1/2 duty cycle
CNTR output: Basic duration T = 0.55 ms; Output on for 8T, output off for 4T, and output on for T

Figure 4.1 shows automatic control of CNTR output. Figure 4.2 shows an example of carrier output setting (example 1). Figure 4.3 shows an example of carrier output setting (example 2).

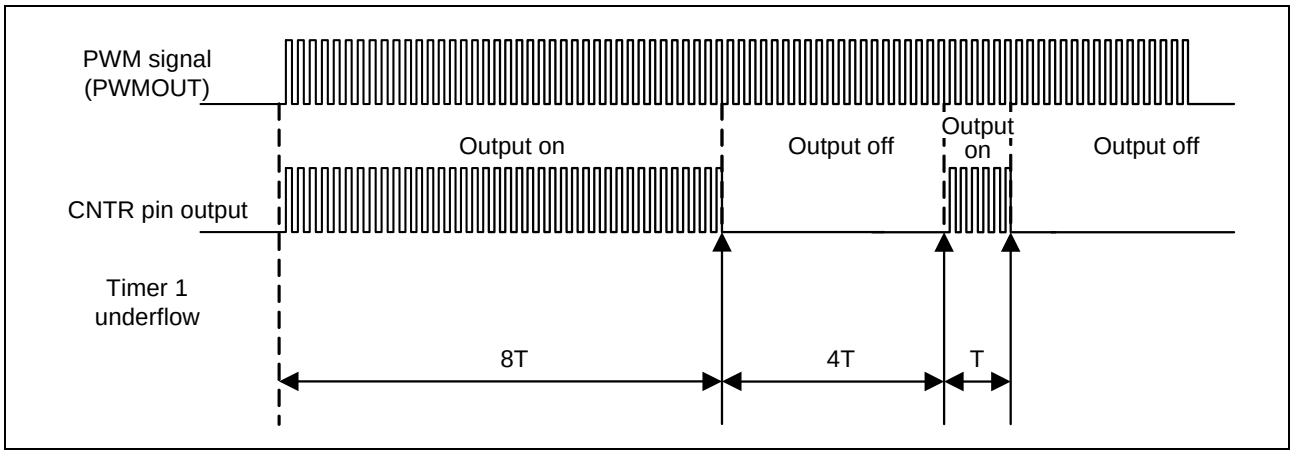

Figure 4.1 Automatic Control of CNTR Output

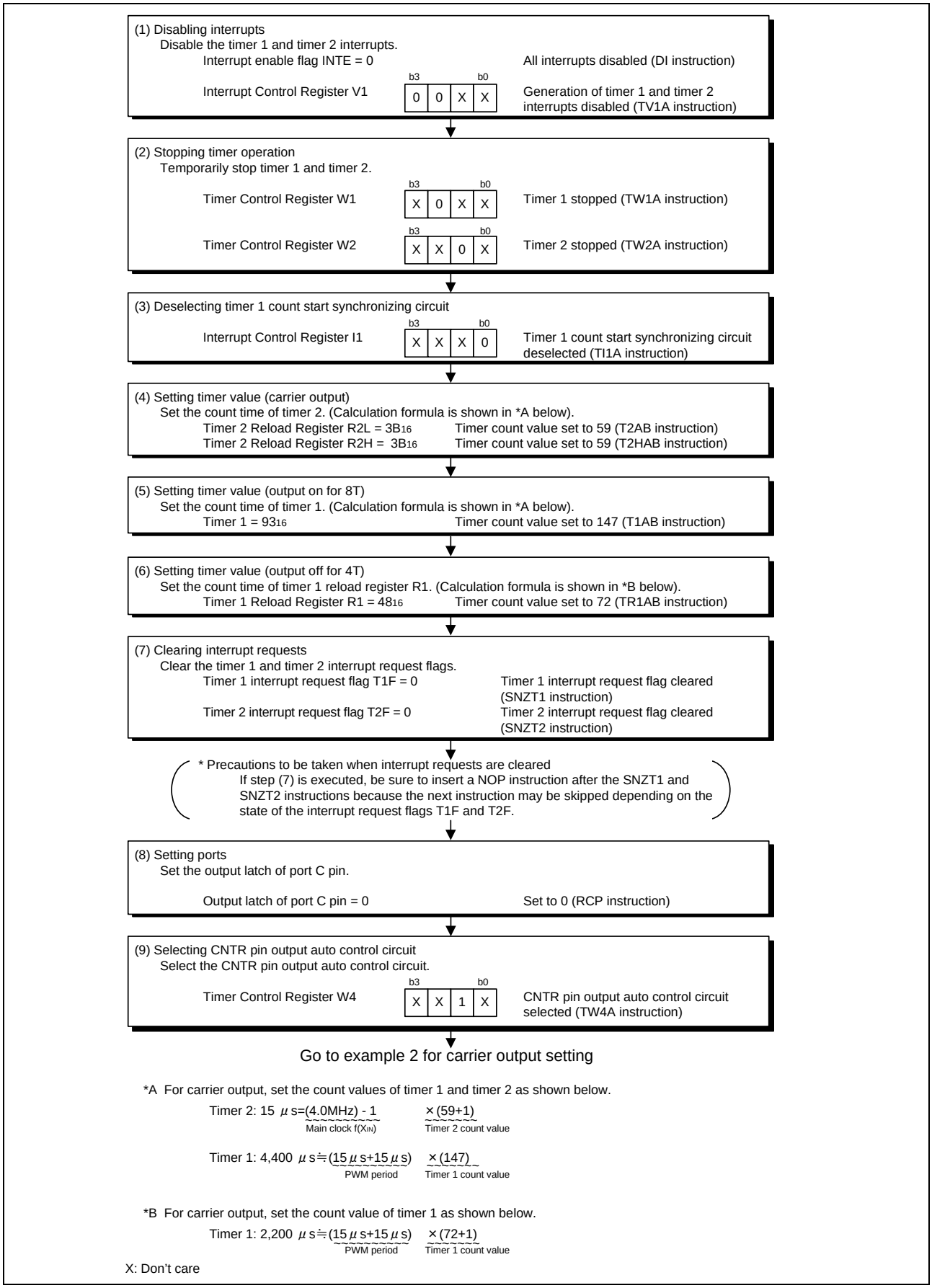

Figure 4.2 Example 1 for Carrier Output Setting

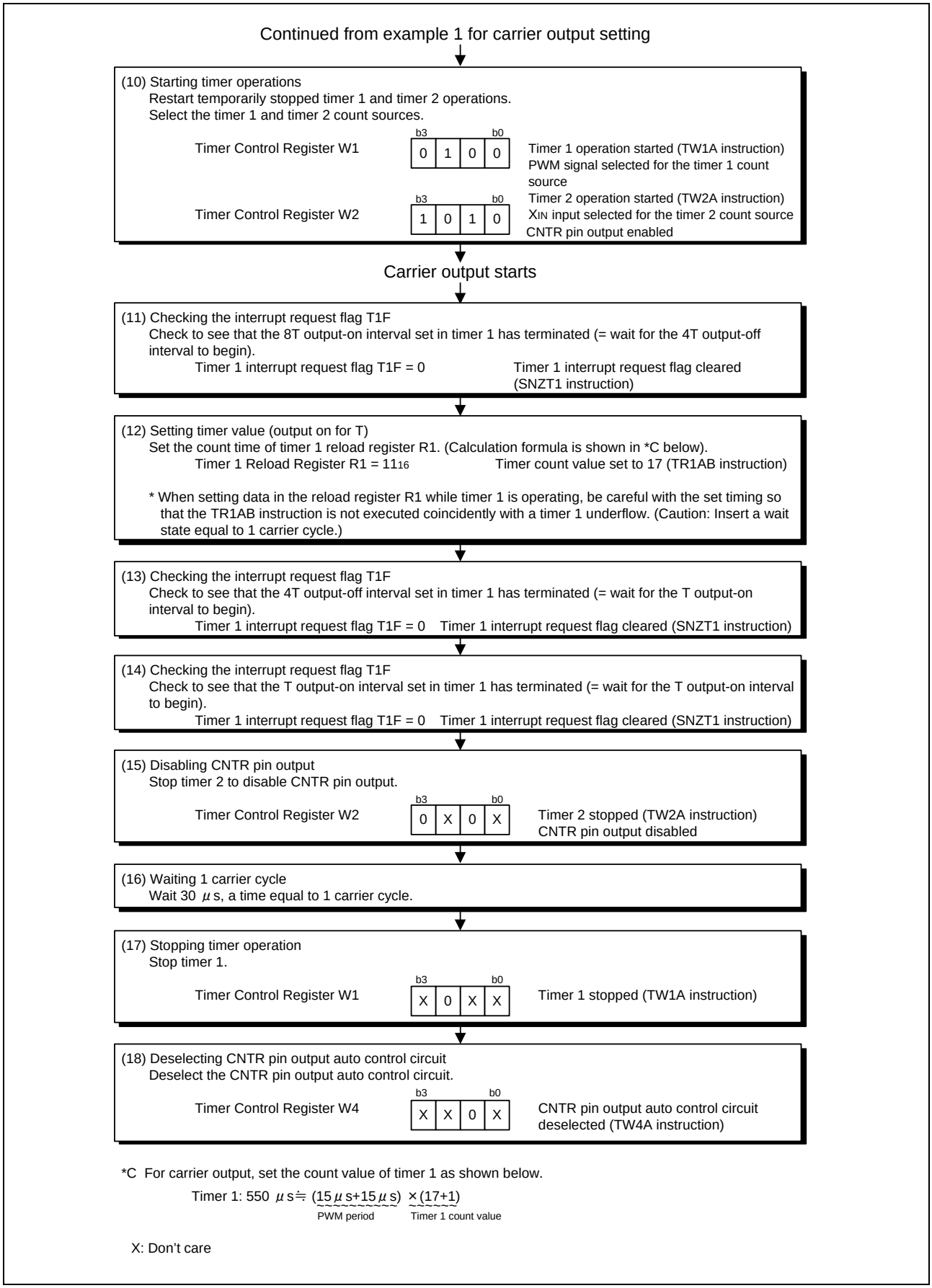

Figure 4.3 Example 2 for Carrier Output Setting

5. Sample Programs

Sample programs are available from the Renesas Technology Web site. To download one, click the screen menu "Application Note" on the left side of 4559 group Web page.

6. Reference Documents

Data sheet
4559 Group Data Sheet

The latest version is available from the Renesas Technology Web site.

7. Renesas Web Site and Where to Contact

Renesas Technology Web site:
http://japan.renesas.com/

Where to contact:
http://japan.renesas.com/inquiry
csc@renesas.com

Revision history	4559 Group Carrier Output Application Note

Rev.	Date	Description	
		Page	Points
1.00	2006.11.01	–	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.