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.

R8C/L3AA Group

Timer RA (Timer Mode)

1. Abstract

This document describes the setting method and an application example of the R8C/L3AA Group's timer RA timer mode.

2. Introduction

The application example described in this document applies to the following MCU:

- MCU : R8C/L3AA Group
- XIN clock frequency : 20 MHz

The sample program in this application note can be used with other R8C Family MCUs which have the same special function registers (SFRs) as the above group. Check the manual for any modifications to functions. Careful evaluation is recommended before using the sample program described in this application note.

3. Application Example

3.1 Program Outline

Count source f8 is counted in the prescaler register (TRAPRE) and timer RA register (TRA). The timer RA interrupt is generated every 1 ms and interrupts are counted to 10.

Settings

- TRAPRE = 249 TRA = 9
- The XIN clock (20 MHz) is selected as the system clock.

Calculation formula of settings

$$1\ \text{ms} = (1 \div f8) \times (\text{TRAPRE} + 1) \times (\text{TRA} + 1)$$
$$= \{1 \div (20\ \text{MHz} \div 8)\} \times 250 \times 10$$
$$= (4 \times 10^{-7})\ \text{s} \times 2500$$

Figure 3.1 shows a Block Diagram.

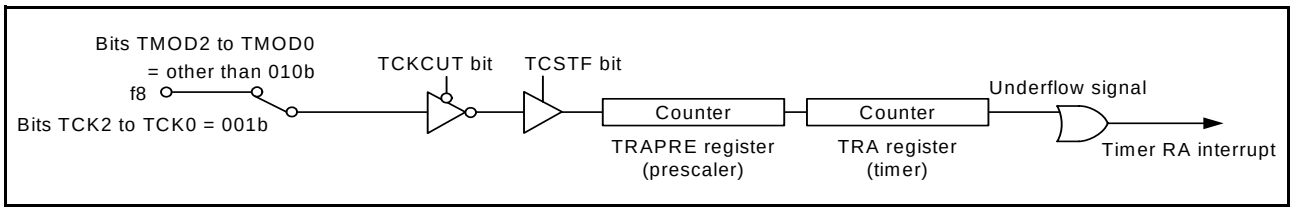


Figure 3.1 Block Diagram

3.2 Memory

Table 3.1 Memory

Memory	Size	Remarks
ROM	129 bytes	In the rej05b1289_src.c module
RAM	2 bytes	In the rej05b1289_src.c module
Maximum user stack	10 bytes	
Maximum interrupt stack	18 bytes	

Memory size varies depending on the C compiler version and compile options.
The above applies to the following conditions:
• C compiler: M16C/60, 30, 20, 10, and Tiny, and R8C/Tiny Series Compiler V.5.44 Release 00
• Compile option: -c -finfo -dir “$(CONFIGDIR)” -R8CE

4. Software Outline

This section shows the setting procedures and values to set the example described in section **3. Application Example**. Refer to the latest **R8C/L3AA Group Hardware Manual** for details on individual registers.

The × in the register's Setting Value represents bits not used in this application, blank spaces represent bits that do not change, and the hyphen represents reserved bits or bits that have nothing assigned.

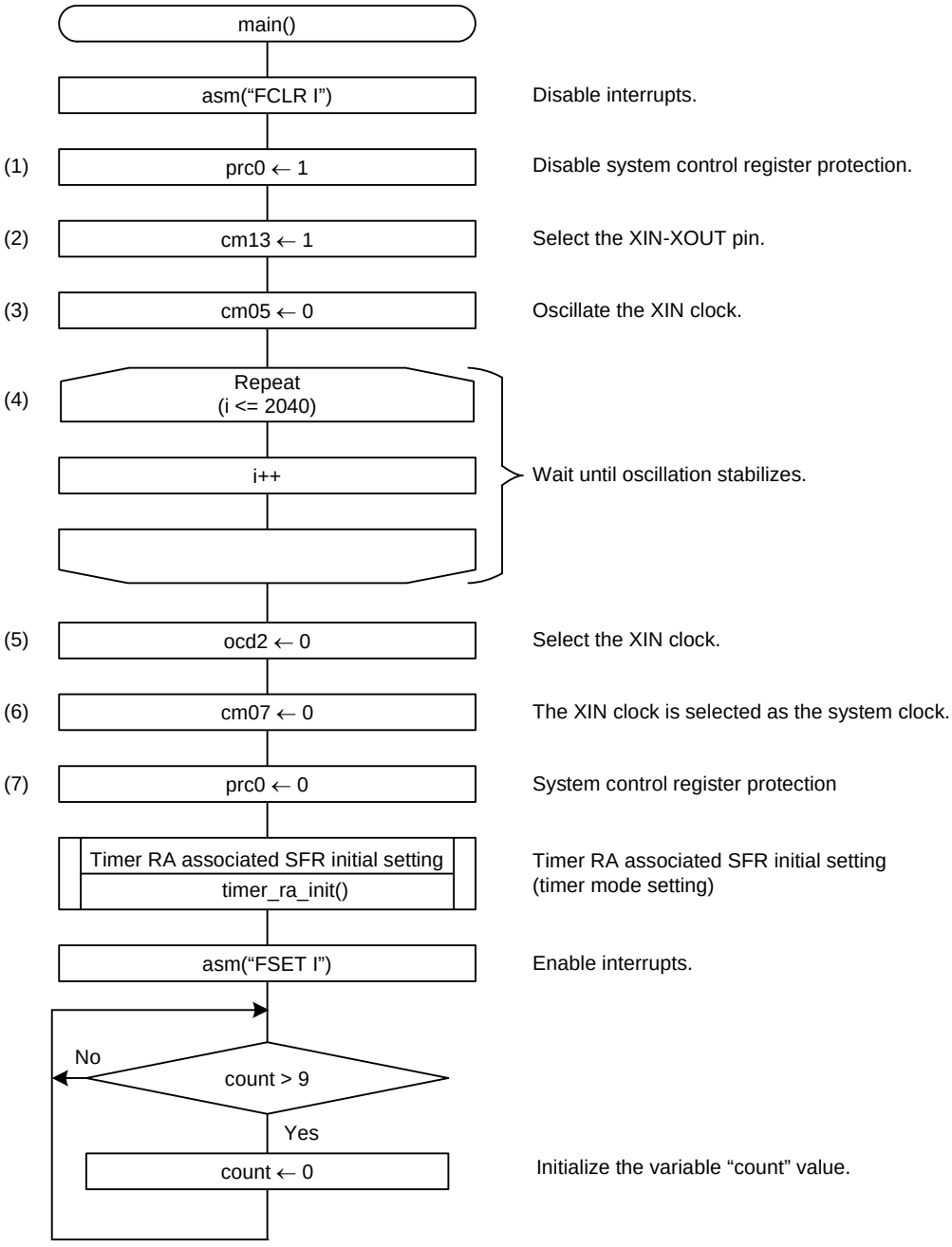
4.1 Function Tables

Declaration	void timer_ra_init(void)		
Outline	Timer RA associated SFR initial setting		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	None		—
Returned value	Type	Value	Meaning
	None	—	—
Function	Timer RA associated SFR registers are initialized.		

Declaration	void timer_ra_interrupt(void)		
Outline	Timer RA interrupt handling		
Argument	Argument name		Meaning
	None		—
Variable (global)	Variable name		Contents
	Count		Count number of timer RA interrupts generated.
Returned value	Type	Value	Meaning
	None	—	—
Function	An interrupt process in a 1 ms period which is generated by the TRA register underflow. The variable count increments by one.		

4.2 Main Function

- Flowchart



• Register Settings

(1) Enable writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3.

Protect Register (PRCR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting Value	—	—	—	—	×	—	×	1

Bit	Symbol	Bit Name	Function	R/W
b0	PRC0	Protect bit 0	Enables writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3. 1: Write enabled	R/W

(2) Select the XIN-XOUT pin.

System Clock Control Register 1 (CM1)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	×	×	—	×	1	×	×	×

Bit	Symbol	Bit Name	Function	R/W
b3	CM13	Port/XIN-XOUT switch bit	1: XIN-XOUT pin	R/W

(3) Oscillate the XIN clock.

System Clock Control Register 0 (CM0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value			0	×	×	×	×	—

Bit	Symbol	Bit Name	Function	R/W
b5	CM05	XIN clock (XIN-XOUT) stop bit	0: XIN clock oscillates	R/W

(4) Wait until oscillation stabilizes.

(5) Select the XIN clock.

Oscillation Stop Detection Register (OCD)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	—	—	—	—	×	0	×	×

Bit	Symbol	Bit Name	Function	R/W
b2	OCD2	On-chip oscillator clock select bit	0: XIN clock selected	R/W

(6) Select the XIN clock as the system clock.

System Clock Control Register 0 (CM0)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	0			×	×	×	×	—

Bit	Symbol	Bit Name	Function	R/W
b7	CM07	System clock select bit	0: XIN clock or on-chip oscillator clock	R/W

(7) Disable writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3.

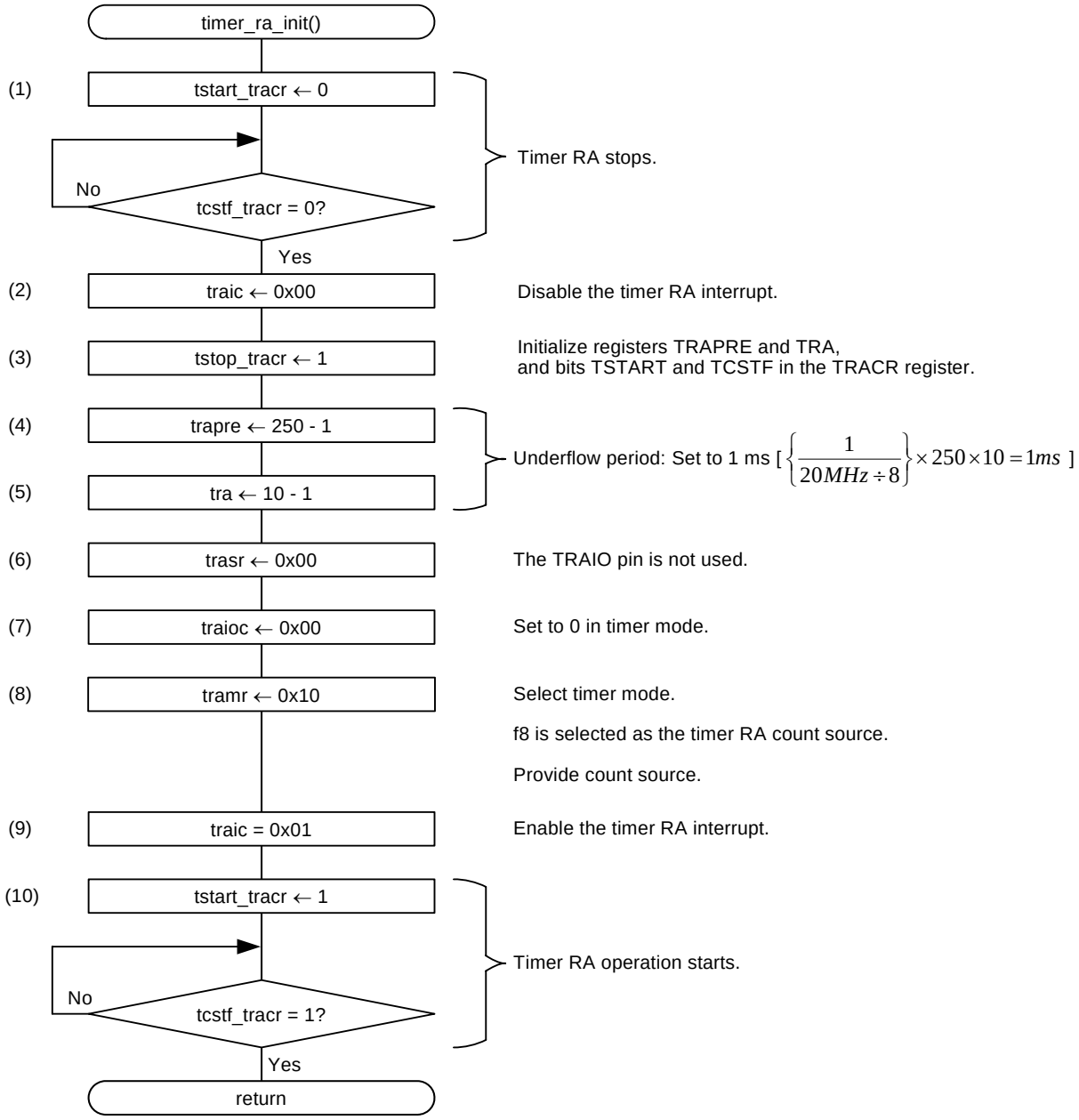
Protect Register (PRCR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	—	—	—	—	×	—	×	0

Bit	Symbol	Bit Name	Function	R/W
b0	PRC0	Protect bit 0	Enables writing to registers CM0, CM1, CM3, OCD, FRA0, FRA1, FRA2, and FRA3. 0: Write disabled	R/W

4.3 Timer RA Associated SFR Initial Setting

- Flowchart



• Register Settings

(1) Stop the timer RA count.

Timer RA Control Register (TRACR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	—	—	×	×	—		×	0

Bit	Symbol	Bit Name	Function	R/W
b0	TSTART	Timer RA count start bit	0: Count stops	R/W

(2) Disable the timer RA interrupt.

Interrupt Control Register (TRAIC)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	—	—	—	—	0	0	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	ILVL0	Interrupt priority level select bit	b2 b1 b0 0 0 0: Level 0 (interrupt disabled)	R/W
b1	ILVL1			R/W
b2	ILVL2			R/W
b3	IR	Interrupt request bit	0: No interrupt requested	R/W

(3) Initialize registers TRAPRE and TRA, and bits TSTART and TCSTF in the TRACR register.

Timer RA Control Register (TRACR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	—	—	×	×	—	1	×	

Bit	Symbol	Bit Name	Function	R/W
b2	TSTOP	Timer RA count forcible stop bit	1: The count is forcibly stopped. When read, the content is 0.	R/W

(4) Set the timer RA prescaler register to F9h.

Timer RA Prescaler Register (TRAPRE)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	1	1	1	1	1	0	0	1

Bit	Function	Setting Range	R/W
b7 to b0	Counts an internal count source.	00h to FFh	R/W

(5) Set the timer RA register to 09h.

Timer RA Register (TRA)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	0	0	0	0	1	0	0	1

Bit	Function	Setting Range	R/W
b7 to b0	Counts the TRAPRE register underflows.	00h to FFh	R/W

(6) Set the timer RA pin select register.

Timer RA Pin Select Register (TRASR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	—	—	—	—	—	—	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	TRAIOSEL0	TRAIO pin select bit	b1 b0 0 0: TRAIO pin not used	R/W
b1	TRAIOSEL1			R/W

(7) Set the timer RA I/O control register.

Timer RA I/O Control Register (TRAIOC) in Timer Mode

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	×	×	0	0	×	0	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	TEDGSEL	TRAIO polarity switch bit	0: Set to 0 in timer mode.	R/W
b1	TOPCR	TRAIO output control bit		R/W
b2	TOENA	TRAO output enable bit		R/W
b4	TIPF0	TRAIO input filter select bit	0: Set to 0 in timer mode.	R/W
b5	TIPF1			R/W

(8) Set the timer RA mode register.

Timer RA Mode Register (TRAMR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	0	0	0	1	—	0	0	0

Bit	Symbol	Bit Name	Function	R/W
b0	TMOD0	Timer RA operating mode select bit	b2 b1 b0 0 0 0: Timer mode	R/W
b1	TMOD1			R/W
b2	TMOD2			R/W
b4	TCK0	Timer RA count source select bit	b6 b5 b4 0 0 1: f8	R/W
b5	TCK1			R/W
b6	TCK2			R/W
b7	TCKCUT	Timer RA count source cutoff bit	0: Count source provided	R/W

(9) Enable the timer RA interrupt.

Interrupt Control Register (TRAIC)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	—	—	—	—	0	0	0	1

Bit	Symbol	Bit Name	Function	R/W
b0	ILVL0	Interrupt priority level select bit	b2 b1 b0 0 0 1: Level 1	R/W
b1	ILVL1			R/W
b2	ILVL2			R/W
b3	IR	Interrupt request bit	0: No interrupt requested	R/W

(10) Start the timer RA count.

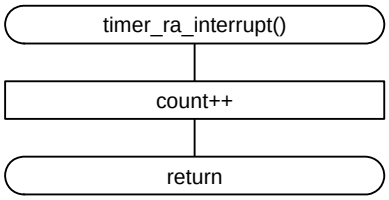
Timer RA Control Register (TRACR)

Bit	b7	b6	b5	b4	b3	b2	b1	b0
Setting value	—	—	×	×	—		×	1

Bit	Symbol	Bit Name	Function	R/W
b0	TSTART	Timer RA count start bit	1: Count starts	R/W

4.4 Timer RA Interrupt

• Flowchart



5. Sample Program

A sample program can be downloaded from the Renesas Technology website.
To download, click “Application Notes” in the left-hand side menu of the R8C Family page.

6. Reference Documents

Hardware Manual
R8C/L3AA Group Hardware Manual Rev.0.30
The latest version can be downloaded from the Renesas Technology website.

Technical Update/Technical News
The latest information can be downloaded 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	R8C/L3AA Group Timer RA (Timer Mode)

Rev.	Date	Description	
		Page	Summary
1.00	Mar 01, 2010	–	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.