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.

78K0R/Kx3 Microcontroller

Sample Program

Operation Manual

(Interval Timer/Square Wave Output (Timer Array Unit), C Source)

This software is for reference only and NEC Electronics does not guarantee its operation.
Thoroughly evaluate this software on your set prior to use.

ZUD-CC-07-0072-E
January, 2008

1st Product Solution Group, Multipurpose Microcomputer Systems Division,
Microcomputer Operations Unit
NEC Electronics Corporation

- **The information in this document is current as of January, 2008. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC Electronics data sheets or data books, etc., for the most up-to-date specifications of NEC Electronics products. Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.**
- No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Electronics. NEC Electronics assumes no responsibility for any errors that may appear in this document.
- NEC 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 NEC Electronics products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Electronics or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of a customer's equipment shall be done under the full responsibility of the customer. NEC Electronics assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC Electronics endeavors to enhance the quality, reliability and safety of NEC Electronics products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC Electronics products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.
- NEC Electronics products are classified into the following three quality grades: "Standard", "Special" and "Specific".
  The "Specific" quality grade applies only to NEC Electronics products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of an NEC Electronics product depend on its quality grade, as indicated below. Customers must check the quality grade of each NEC Electronics product before using it in a particular application.
  "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.
  "Special": 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, life support systems and medical equipment for life support, etc.

The quality grade of NEC Electronics products is "Standard" unless otherwise expressly specified in NEC Electronics data sheets or data books, etc. If customers wish to use NEC Electronics products in applications not intended by NEC Electronics, they must contact an NEC Electronics sales representative in advance to determine NEC Electronics' willingness to support a given application.

(Note)
(1) "NEC Electronics" as used in this statement means NEC Electronics Corporation and also includes its majority-owned subsidiaries.
(2) "NEC Electronics products" means any product developed or manufactured by or for NEC Electronics (as defined above).

M8E 02. 11-1

CONTENTS

1. OVERVIEW....4

2. RESOURCES USED....5

3. SOFTWARE CONFIGURATION....6

4. FUNCTION EXPLANATIONS....7

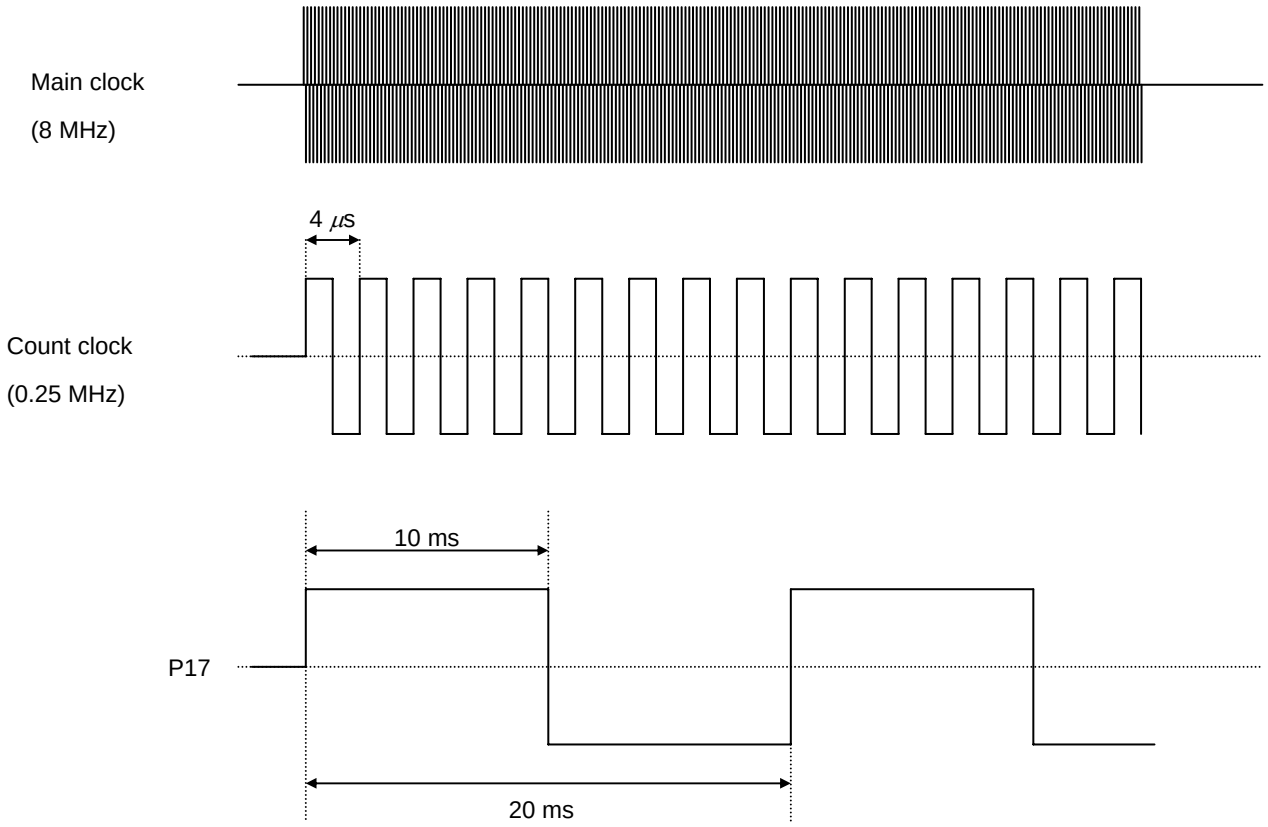
5. FLOWCHARTS....9

1. OVERVIEW

This manual explains sample program functions of the interval timer/square wave output for the 78K0R/Kx3.

In this sample program, an interrupt is generated at intervals of 10 ms (every 2,500 counts) by using a count clock whose frequency is $1/2^5$ of that of the main clock (8 MHz).

A toggle operation is performed by using output pin P17 to output a square wave with a cycle of 20 ms and a duty factor of 50% when the interrupt is generated.



2. RESOURCES USED

Resource	Description	Remark
Main clock specification	Internal high-speed oscillator used (8 MHz (TYP.))	Supplied to CPU and peripheral hardware
	High-speed system clock used (20 MHz)	Oscillated by initial processing
Subclock	XT1 (32.768 kHz)	Oscillated by initial processing
Related hardware	Peripheral enable register 0 (PER0)	Controls the input clock of the timer array unit.
	Timer clock select register 0 (TPS0)	Operation clock: CK01 ($1/2^5$), 0.25 MHz (4 μs)
	Timer mode register 02 (TMR02)	Operation clock: CK01, 8 MHz (0.125 μs)
	Timer data register 02 (TDR02)	Interval cycle: 10 ms (4 μs $\times$ 2500)
	Timer output mode register 0 (TOM0)	Channel 2 toggle operation mode
	Timer output level register 0 (TOL0)	Channel 2 positive logic output (active high)
	Timer output register 0 (TO0)	Channel 2 timer output value is “0”.
	Timer output enable register 0 (TOE0)	Channel 2 timer output enable (valid when square wave is output)
	Timer channel start register 0 (TS0)	
	Timer channel stop register 0 (TTO)	
	Port mode register (PM1)	
	Port register (P1)	
I/O	Output: TO02 (P17)	
Interrupt	Timer channel 2	
Others	Not used	

3. SOFTWARE CONFIGURATION

Files

File Name	Processing Outline
K0R_def.h	Definition file
K0R_init.c	Initialization processing
K0R_ext.h	External declaration
K0R_main.c	Main processing
K0R_sfr_set.c	Interval timer/square wave output

4. FUNCTION EXPLANATIONS

[File name]

K0R_main.c

Function

Function Name	Processing Outline	Argument	Return Value
main	Interval timer/square wave output main processing	None	None

Function explanations

Function name	main
Processing	Interval timer/square wave output main processing
Argument	–
Return value	–
Description	Executes initialization processing and then starts interval timer/square wave output. After timer channel 2 interrupt request flag is set to ON, clears it.
Remark	–

[File name]

K0R_sfr_set.c

Functions

Function Name	Processing Outline	Argument	Return Value
STM_IINI	Initializes interval timer/square wave output.	None	None
STM_ISTT	Starts interval timer/square wave output operation.	None	None
STM_ISTP	Stops interval timer/square wave output operation.	None	None

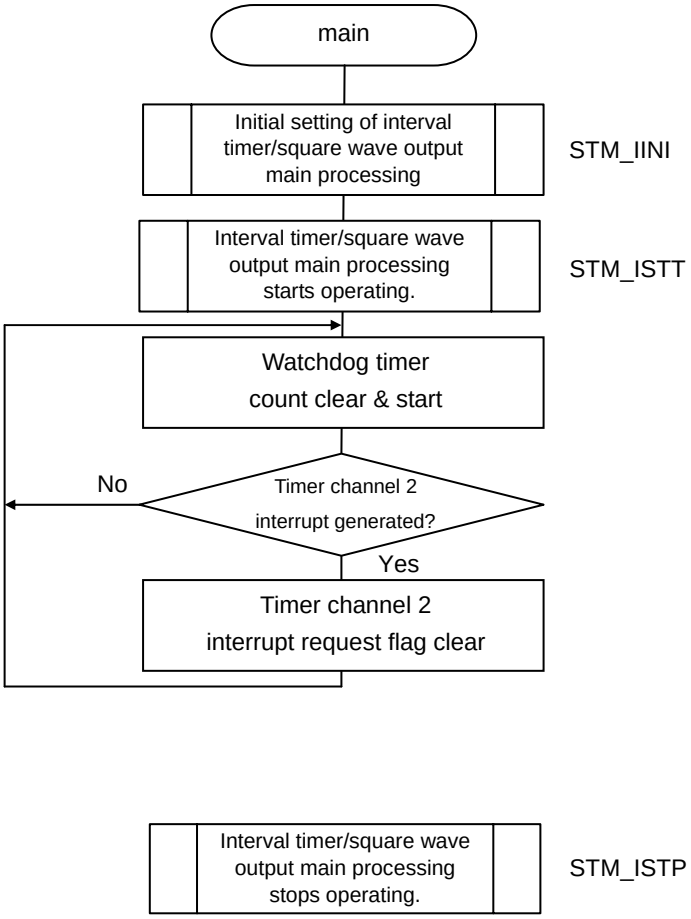
Function explanations

Function name	STM_IINI
Processing	Initializes interval timer/square wave output.
Argument	–
Return value	–
Description	Initializes the timer array unit. • Supplies a timer array unit input clock. • Sets the clock frequency of CK01 to 4 μs. Initializes timer channel 2. • Uses operation clock CK01 and sets the interval timer mode. • Sets the generation cycle to 10 ms. • Enables output.
Remark	–

Function name	STM_ISTT
Processing	Starts interval timer/square wave output operation.
Argument	–
Return value	–
Description	Starts timer channel 2 operation. • Enables output. • Starts operation. • Clears interrupt request flag. • Enables interrupts.
Remark	–

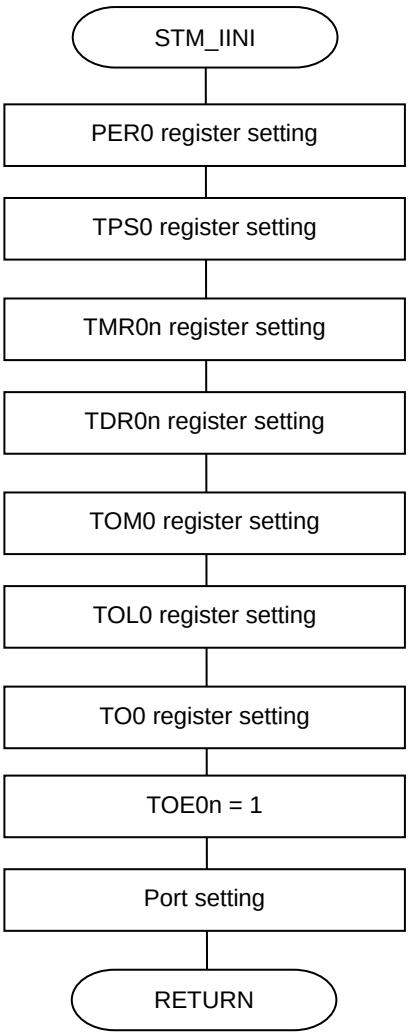
Function name	STM_ISTP
Processing	Stops interval timer/square wave output operation.
Argument	–
Return value	–
Description	Stops timer channel 2 operation. • Stops operation. • Disables output.
Remark	–

5. FLOWCHARTS



Remark n = 0 to 7 can be set.

n = 2 for this sample program.



Supplies a timer array unit input clock.

Determines the clock frequency (CK01 used).
Sets the clock cycle of CK01 to 4 μs.

Determines the operation mode of the channel.
Uses operation clock CK01 for timer channel n.

Sets the interval (cycle) value.
Sets the generation cycle of timer channel n to 10 ms.

Sets the timer output mode register.

Sets the timer output level register.

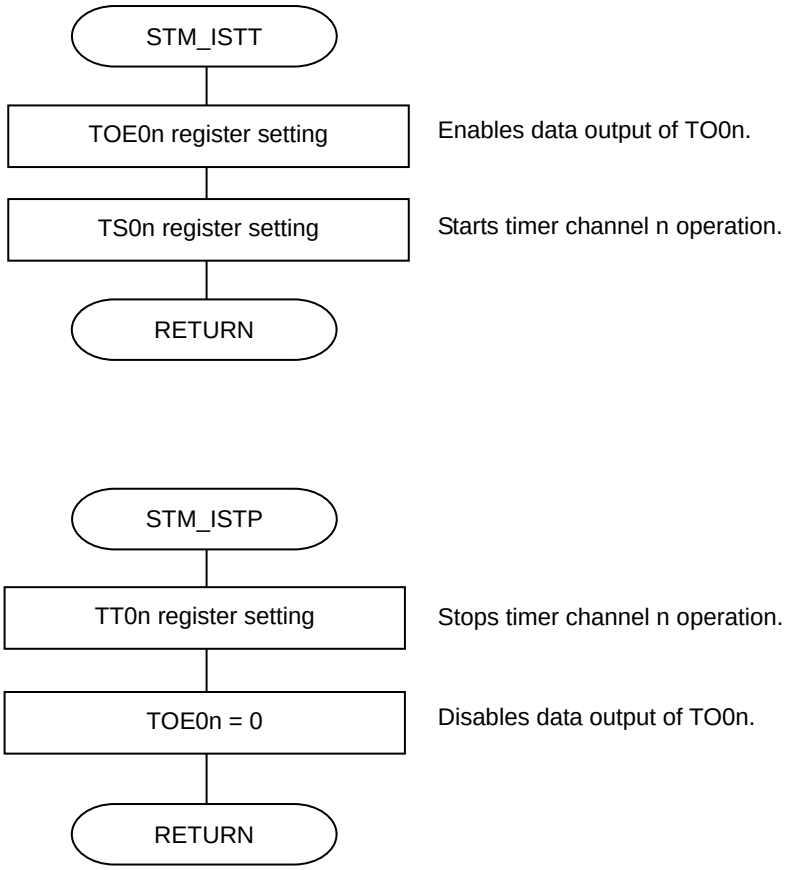
Sets the timer output register.

Enables data output of TO0n.

Validates data output of the target channel by setting the port register and port mode register.

Remark n = 0 to 7 can be set.

n = 2 for this sample program.



Remark n = 0 to 7 can be set.

n = 2 for this sample program.