

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.

H8/300H SLP Series

Pulse Output Using TPU Output Compare Function

Introduction

The output compare function of the 16-bit timer pulse unit (TPU) is used to output pulses with a 4-ms cycle and 50% duty cycle from an output compare output pin (TIOCA1).

Target Device

H8/38076R

Contents

1. Specifications	2
2. Functions Used.....	2
3. Principles of Operation	5
4. Description of Software	6
5. Flowcharts	9

1. Specifications

- The output compare function of the 16-bit timer pulse unit (TPU) is used to output pulses with a 4-ms cycle and 50% duty cycle from an output compare output pin (TIOCA1).
- An example of pulse output by means of the TPU output compare function is shown in figure 1.

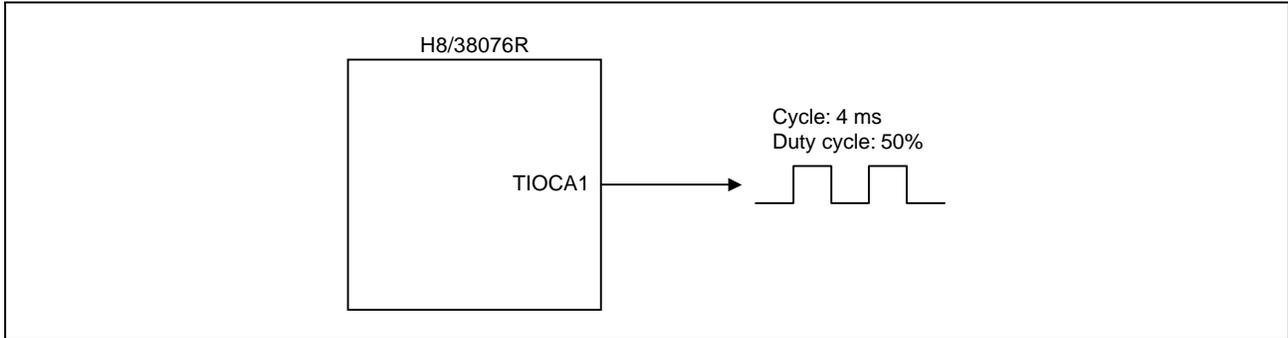


Figure 1 Example of Pulse Output Using TPU Output Compare Function

2. Functions Used

2.1 TPU Output Compare Function

In this sample task, the output compare function of the TPU is used to output pulses with a 4-ms cycle and 50% duty cycle from an output compare output pin (TIOCA1). A block diagram of the output compare function of the TPU is shown in figure 2. The block diagram of the output compare function of the TPU is explained below.

- Timer control register_1 (TCR_1)
Selects timer counter_1 (TCNT_1) counter clearing source, the input clock edge, and the clock source.
- Timer mode register_1 (TMDR_1)
Sets the operating mode of channel 1.
- Timer I/O control register_1 (TIOR_1)
Controls timer general register A_1 (TGRA_1).
- Timer counter_1 (TCNT_1)
A 16-bit readable/writable counter that counts using the rising edge of internal clock $\phi/4$
- Timer general register A_1 (TGRA_1)
A 16-bit readable/writable output compare register
- Timer start register (TSTR)
Controls operation/stopping of timer counter_1 (TCNT_1).
- An example of output compare output cycle calculation is shown below.
($\phi = 10$ MHz, TCNT_1 input clock = $\phi/4$, TGRA_1 = H'1387 = 4999)

$$\text{Pulse cycle} = \frac{\text{TGRA}_1 \text{ set value} + 1}{\text{TCNT}_1 \text{ input clock}} \times 2 = \frac{4999 + 1}{10 \text{ MHz} / 4} \times 2 = 4 \text{ ms}$$

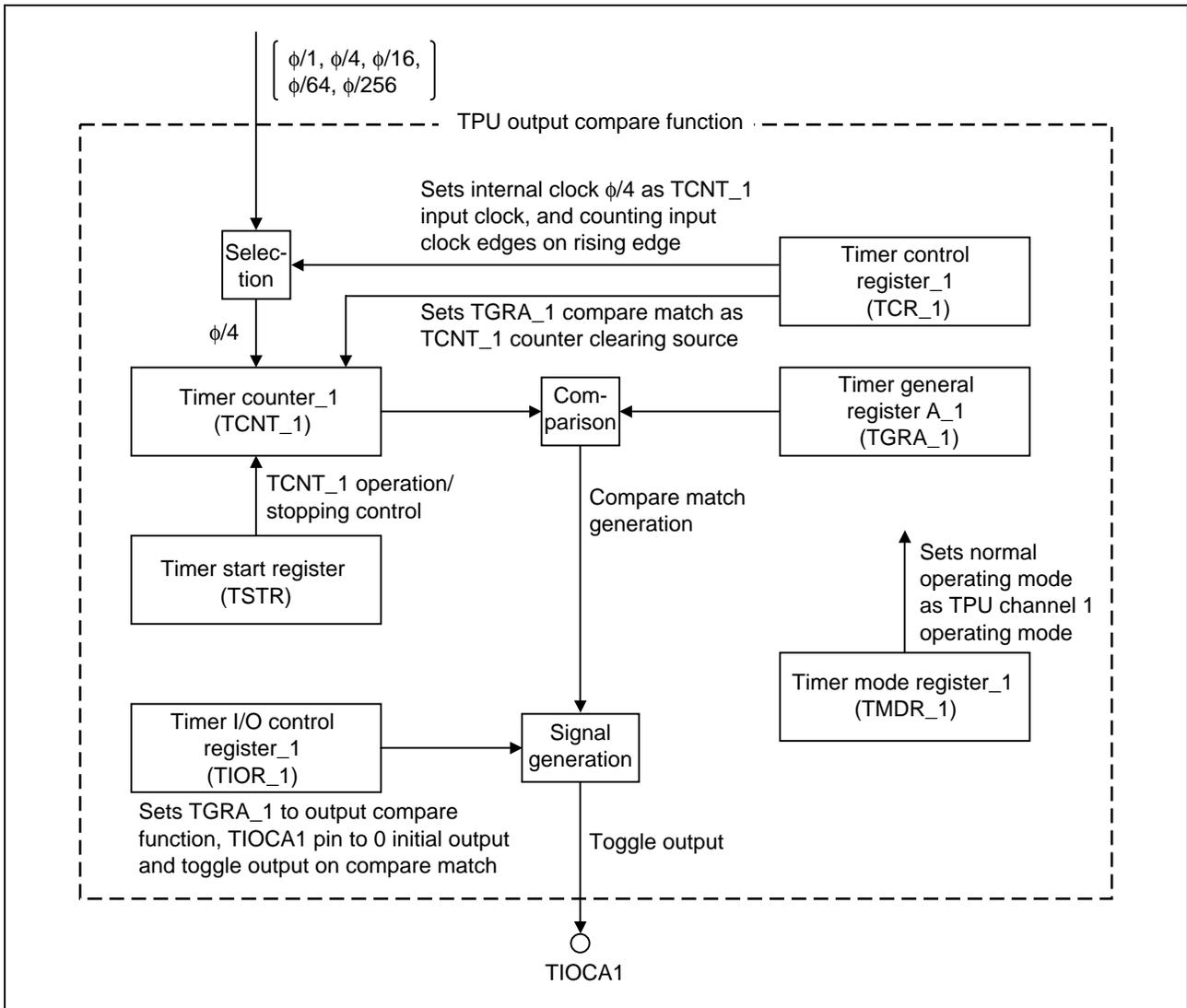


Figure 2 Block Diagram of TPU Output Compare Function

2.2 Assignment of Functions

Table 1 shows the assignment of functions in this sample task. Using functions assigned as shown in table 1, pulses are output by means of the output compare function of the TPU.

Table 1 Assignment of Functions

Elements	Description
TCR_1	Sets TGRA_1 compare match as TCNT_1 counter clearing source, rising edge as input clock edge, and internal clock $\phi/4$ as clock source
TMDR_1	Sets normal operating mode as TPU channel 1 operating mode
TIOR_1	Sets output compare register as TGRA_1 function, initial output 0 and toggle output on compare match for TIOCA1 pin function
TCNT_1	16-bit counter using internal clock $\phi/4$ as clock source
TGRA_1	16-bit output compare register, pulse cycle set to 4 ms
TSTR	Sets TCNT_1 count operation
TIOCA1	TGRA_1 output compare output pin

3. Principles of Operation

The principles of operation of this sample task are illustrated in figure 3. Using the hardware and software processing shown in figure 3, pulses are output by means of the TPU output compare function.

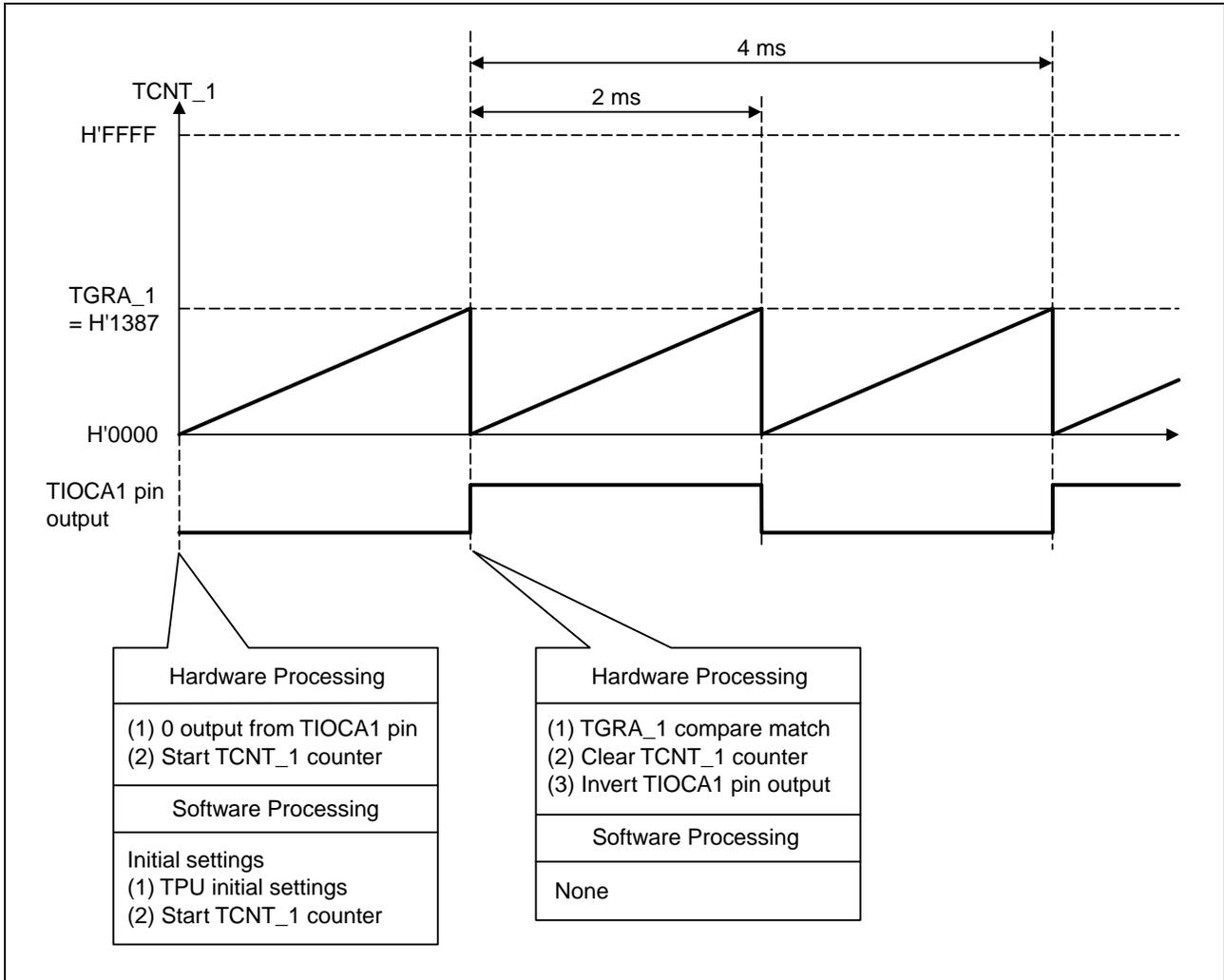


Figure 3 Principles of Operation

4. Description of Software

4.1 Modules

Table 2 shows the modules used in this sample task.

Table 2 Modules

Function Name	Description
main	TPU initial settings, TCNT_1 count operation start, interrupt enabling

4.2 Arguments

No arguments are used in this sample task.

4.3 Internal Registers Used

The internal registers used in this sample task are shown below.

- TSTR Timer start register Address: H'F030

Bit	Bit Name	Set Value	R/W	Description
1	CST1	1	R/W	Counter start 1 Selects TCNT_1 operation or stopping. CST1 = 1: TCNT_1 performs count operation

- TCR_1 Timer control register_1 Address: H'F040

Bit	Bit Name	Set Value	R/W	Description
6	CCLR1	0	R/W	Counter clear 1, 0
5	CCLR0	1	R/W	Select the TCNT_1 counter clearing source. CCLR1 = 0, CCLR0 = 1: TCNT_1 cleared by TGRA_1 compare match
4	CKEG1	0	R/W	Clock edge 1, 0
3	CKEG0	0	R/W	Select the TCNT_1 input clock edge. CKEG1 = 0, CKEG0 = 0: Counts at the rising edge
2	TPSC2	0	R/W	Timer prescaler 2, 1, 0
1	TPSC1	0	R/W	Select the TCNT_1 clock source.
0	TPSC0	1	R/W	TPSC2 = 0, TPSC1 = 0, TPSC0 = 1: Counts on internal clock $\phi/4$

- TMDR_1 Timer mode register_1 Address: H'F041

Bit	Bit Name	Set Value	R/W	Description
1	MD1	0	R/W	Mode 1, 0
0	MD0	0	R/W	Select the TPU_1 operating mode. MD1 = 0, MD0 = 0: TPU_1 set to normal operation mode

- TIOR_1 Timer I/O control register_1 Address: H'F042

Bit	Bit Name	Set Value	R/W	Description
3	IOA3	0	R/W	I/O control A3 to A0
2	IOA2	0	R/W	Select the function of TGRA_1.
1	IOA1	1	R/W	IOA3 = 0, IOA2 = 0, IOA1 = 1, IOA0 = 1: TGRA_1 function is output compare register, TIOCA1 pin function is toggle output on compare match with initial output = 0
0	IOA0	1	R/W	

- TCNT_1 Timer counter_1 Address: H'F046

Bit	Bit Name	Set Value	R/W	Description
15	Bit 15	0	R/W	Timer counter_1
14	Bit 14	0	R/W	16-bit readable/writable counter. TCNT_1 is initialized to H'0000 at a reset. TCNT_1 cannot be accessed in 8-bit units, and must always be accessed in 16-bit units.
13	Bit 13	0	R/W	
12	Bit 12	0	R/W	
11	Bit 11	0	R/W	
10	Bit 10	0	R/W	
9	Bit 9	0	R/W	
8	Bit 8	0	R/W	
7	Bit 7	0	R/W	
6	Bit 6	0	R/W	
5	Bit 5	0	R/W	
4	Bit 4	0	R/W	
3	Bit 3	0	R/W	
2	Bit 2	0	R/W	
1	Bit 1	0	R/W	
0	Bit 0	0	R/W	

- TGRA_1 Timer general register A_1 Address: H'F048

Bit	Bit Name	Set Value	R/W	Description
15	Bit 15	0	R/W	Timer general register A_1
14	Bit 14	0	R/W	A 16-bit readable/writable register, functioning as either output compare or input capture register. TGRA_1 is initialized to H'FFFF at a reset. TGRA_1 cannot be accessed in 8-bit units, and must always be accessed in 16-bit units. Note: Set value: H'1387
13	Bit 13	0	R/W	
12	Bit 12	1	R/W	
11	Bit 11	0	R/W	
10	Bit 10	0	R/W	
9	Bit 9	1	R/W	
8	Bit 8	1	R/W	
7	Bit 7	1	R/W	
6	Bit 6	0	R/W	
5	Bit 5	0	R/W	
4	Bit 4	0	R/W	
3	Bit 3	0	R/W	
2	Bit 2	1	R/W	
1	Bit 1	1	R/W	
0	Bit 0	1	R/W	

4.4 Constants Used

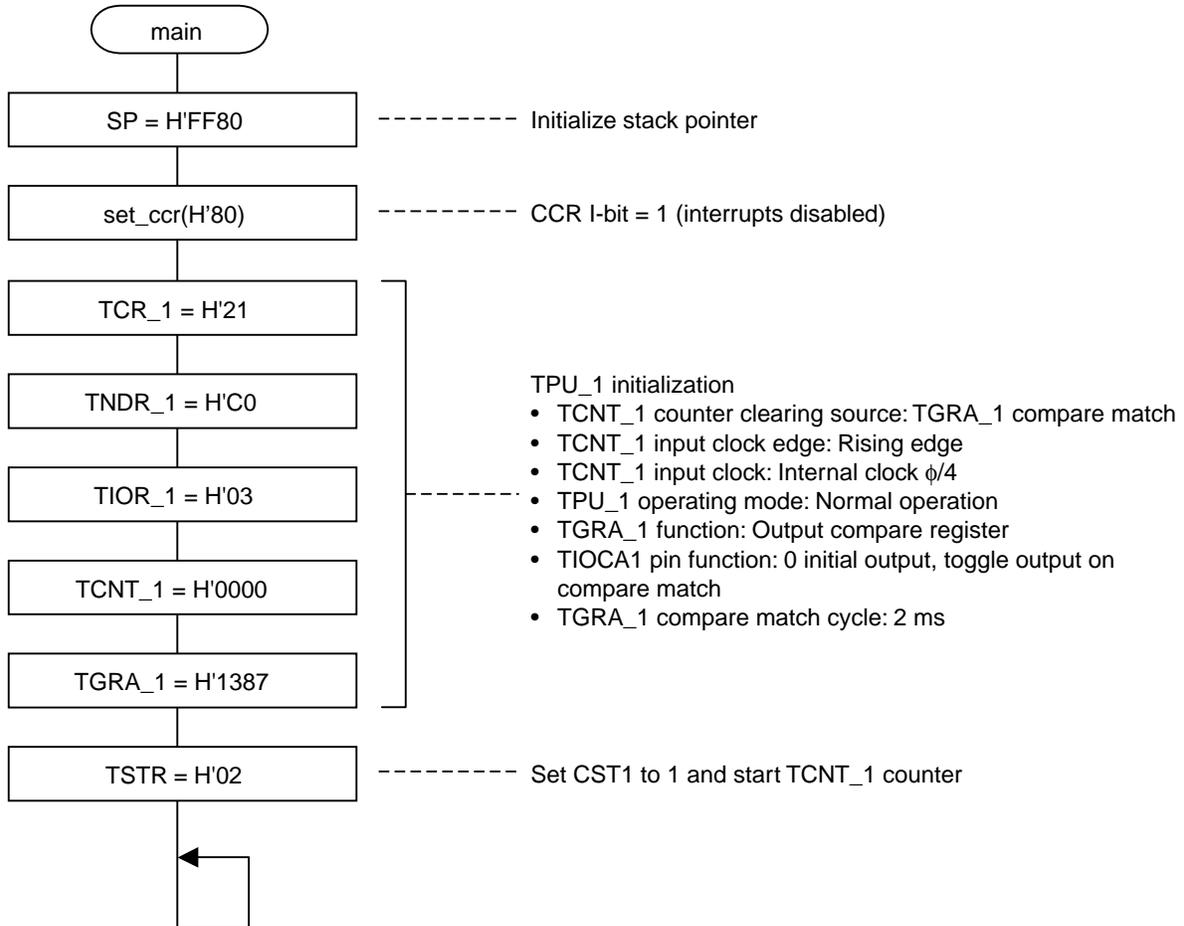
No constants are used in this sample task.

4.5 RAM Usage

No RAM is used in this sample task.

5. Flowcharts

5.1 main



- Link Address Specifications

Section Name	Address
CV1	H'0000
P	H'0100

Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Sep.16.04	—	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 nonflammable 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.