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.

H8/38602R Group

Counting Seconds by Using Timer B1

Introduction

A second counter is implemented by using Timer B1. The second counter is placed in on-chip RAM in BCD representation, and the input clock source of Timer B1 is a subclock of 38.4 kHz.

Target Device

H8/38602R

Contents

1. Specifications

The auto-reload function of Timer B1 is used to count seconds with the input of a ϕw-derived clock. Using ϕw/256 as the input clock of timer counter B1 (TCB1), an interrupt is generated every second by the auto-reload function to increment the second counter in on-chip RAM. The second counter counts up from 00 to 59 seconds with the counter value represented in BCD code. Figure 1 shows a block diagram of counting seconds using Timer B1. This sample task uses a 38.4 kHz crystal oscillator to generate the subclock.

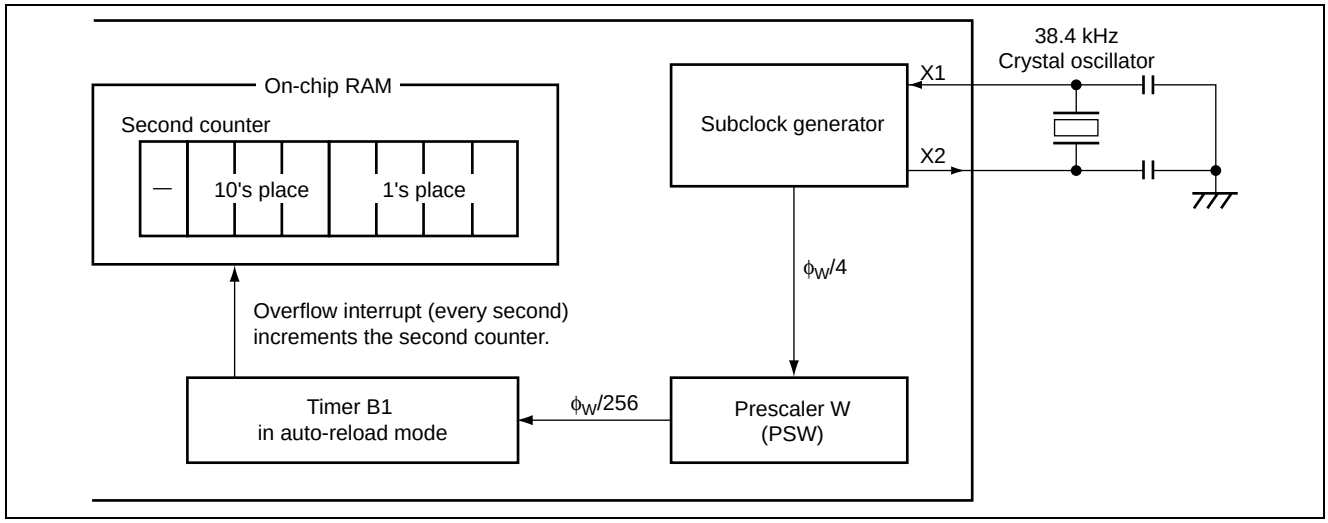


Figure 1 Counting Seconds Using Timer B1

2. Description of Functions

2.1 Functions

This sample task uses the auto-reload function of Timer B1 to generate an interrupt every second to increment the BCD second counter in on-chip RAM. The functions used by this sample task are described below.

2.1.1 Timer B1 Auto-Reload Function

The auto-reload function uses the subclock of ϕw/256 to cause timer counter B1 (TCB1) to overflow every second. Figure 2 shows a block diagram of the auto-reload function of Timer B1.

- Timer Mode Register B1 (TMB1)
  TMB1 selects whether Timer B1 operates in interval timer mode or auto-reload mode, starts/stops the counter, and selects the input clock of timer counter B1 (TCB1).

- Timer Counter B1 (TCB1)
  TCB1 is an 8-bit read-only up-counter, which is incremented by internal clock input. The clock input to this counter is selected by the TMB12 to TMB10 bits in TMB1. When TCB1 overflows (H'FF → H'00 or H'FF → setting value of TLB1), the IRRTB1 flag in Interrupt Flag Register 2 (IRR2) is set to 1. TCB1 is allocated to the same address as TLB1. The initial value of TCB1 is H'00.

- Timer Load Register (TLB1)
  TLB1 is an 8-bit write-only register that sets the reload value of TCB1. Writing the reload value to TLB1 must be done while the TMB16 bit in TMB1 is 0. When a reload value is written to TLB1, the same value is set in TCB1 as well, and TCB1 starts counting up from that value. When TCB1 overflows during auto-reload operation, the TLB1 value is loaded into TCB1. Accordingly, the overflow period can be set in the range of 1 to 256 input clock cycles. TLB1 is allocated to the same address as TCB1. The initial value of TLB1 is H'00.

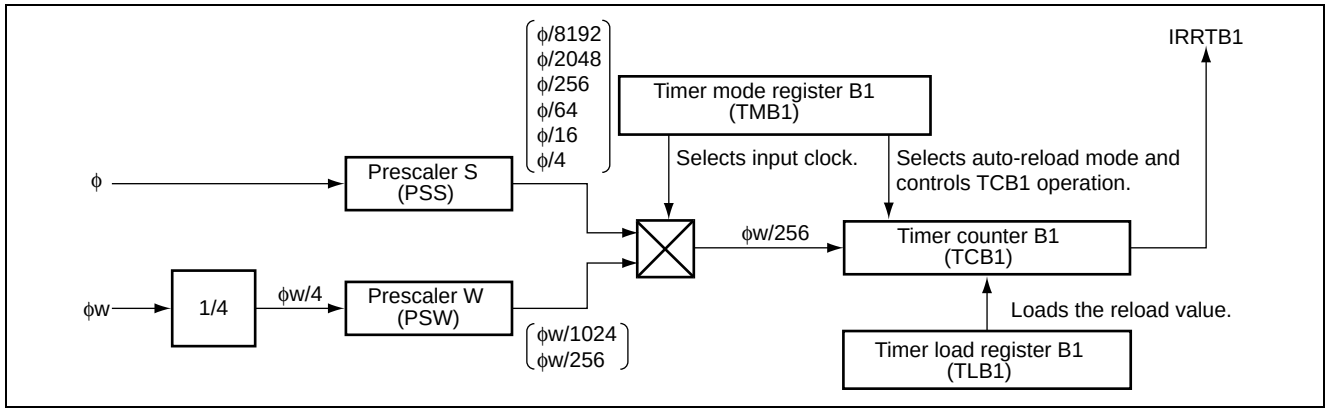


Figure 2 Block Diagram of Timer B1 Auto-Reload Function

2.1.2 Module Standby Function

By the module standby function, Timer B1 is placed in module standby mode after a reset. Module standby mode of Timer B1 can be cancelled by setting the TB1CKSTP bit in Clock Halt Register 1 (CKSTPR1) to 1.

- Clock Halt Register 1 (CKSTPR1)
  CKSTPR1 is used to place the on-chip peripheral modules in standby mode in module units.

2.1.3 Watchdog Timer Function

The H8/38602R includes a watchdog timer, which is active after a reset. The timer counter WD (TCWD) counts up, and the H8/38602R is internally reset if the TCWD overflows. This sample task does not use the watchdog timer function, and thus stops this timer.

- Timer Control/Status Register WD1 (TCSRWD1)
  TCSRWD1 controls writing to TCSRWD1 and TCWD. TCSRWD1 also controls the watchdog timer operation and indicates the operating status. TCSRWD1 must be rewritten by using the MOV instruction. The setting value cannot be changed by bit manipulation instructions.

2.1.4 Exception Handling Function

This sample task increments the second counter by the interrupt processing routine for the Timer B1 overflow interrupt, which is generated every second.

- Interrupt Enable Register 2 (IENR2)
  IENR2 is used to enable Timer B1 interrupt requests.
- Interrupt Flag Register 2 (IRR2)
  IRR2 includes the status flag of Timer B1 interrupt request.

2.2 Example of Calculating Reload Value for Timer B1

The reload value that is set in TLB1 of Timer B1 is calculated in the following way:

TCB1 Overflow Period = TCB1 Input Clock Period × (256 – TLB1 setting value) … (1)

In this sample task, the TCB overflow period is 1 second and the TCB1 input clock is ϕw/256. From the formula (1), we can obtain:

1 = (1 / (38400 / 256)) × (256 – TLB1 setting value)
256 – TLB1 setting value = 38400 / 256
TLB setting value = 256 –150 = 106

Accordingly, 106 (H'6A) is written to TLB1 in this sample task.

2.3 Function Assignment

Table 1 shows the assignment of functions used in this sample task. The second counter is implemented using Timer B1 by assigning the functions as shown in table 1.

Table 1 Functions Assignment

Function	Description
TMB1	Selects the auto-reload mode, controls the counter operation, and selects the clock input to the TCB1.
TCB1	8-bit up-counter with the input clock of ϕw/4
TLB1	Sets the reload value for TCB1.
CKSTPR1	Cancels module standby mode of Timer B1.
TCSRWD1	Stops the watchdog timer.
IENR2	Enables Timer B1 interrupt requests.
IRR2	Indicates the status of Timer B1 interrupt request.

3. Description of Operation

This sample task uses the auto-reload function of Timer B1 with the input of a subclock to increment the BCD second counter in on-chip RAM by generating an interrupt every second. Figure 3 illustrates the operation of counting seconds using Timer B1.

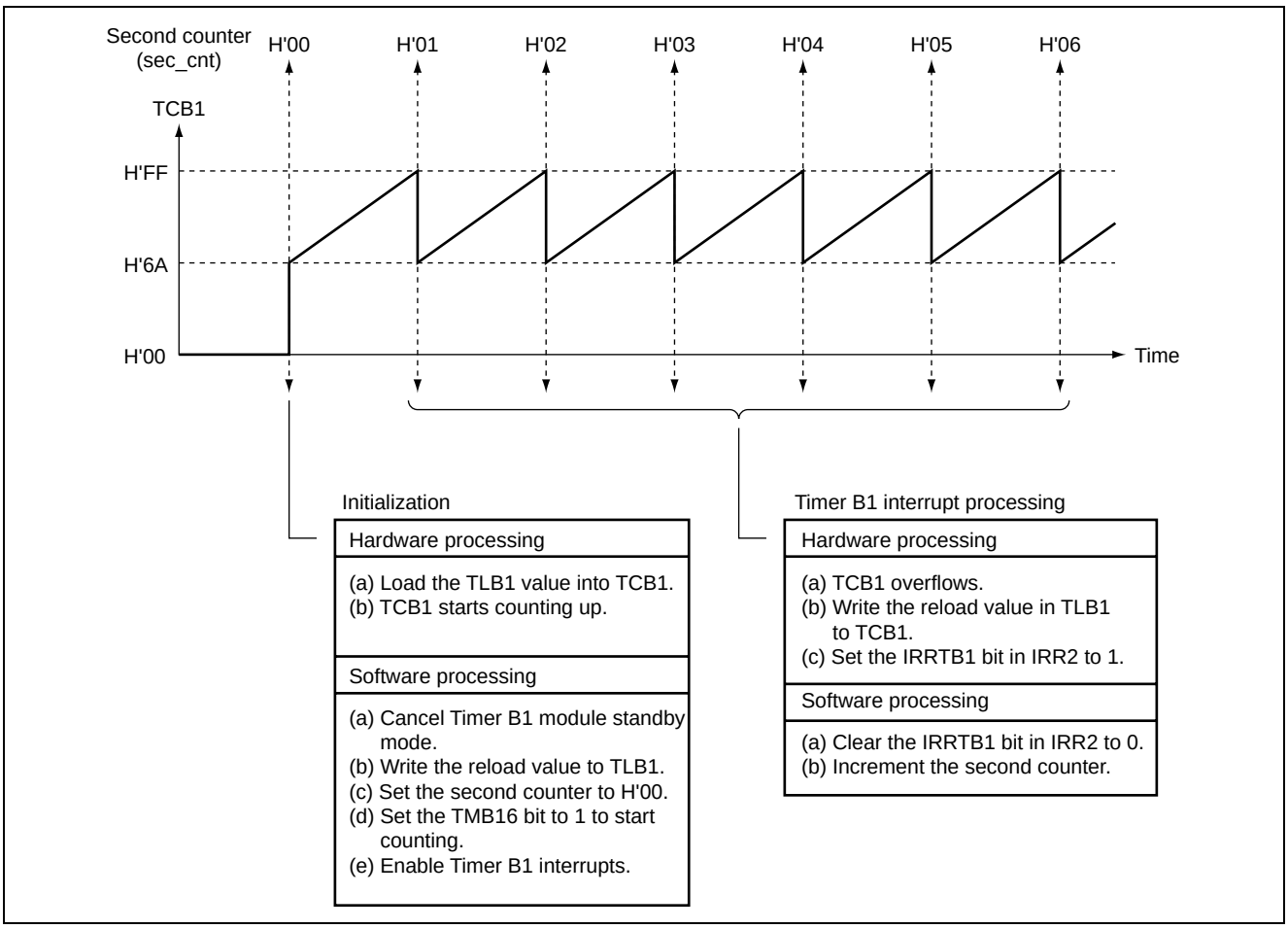


Figure 3 Operation Timing

4. Description of Software

4.1 Modules

Table 2 lists the modules used in this sample task.

Table 2 Description of Modules

Function Name	Description
main	Stops the watchdog timer, cancels Timer B1 module standby mode, initializes Timer B1 and RAM area to be used, and controls Timer B1 counting operation and interrupts.
int_tmb1	Timer B1 interrupt processing
cnt_up	Increments the second counter in on-chip RAM (sec_cnt).

4.2 Arguments

This sample task does not use any arguments.

4.3 Internal Registers Used

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

- Timer Mode Register B1 (TMB1) Address: H'F0D0

Bit	Bit Name	Setting	R/W	Function
7	TMB17	1	R/W	Auto-reload Function Select 0: Interval timer function selected. 1: Auto-reload function selected.
6	TMB16	1	R/W	Counter Operation/Stop Select 0: Counter stops. 1: Counter operates.
2	TMB12	1	R/W	Counter Clock Select
1	TMB11	1	R/W	000: internal clock ϕ/8129
0	TMB10	1	R/W	001: internal clock ϕ/2048 010: internal clock ϕ/256 011: internal clock ϕ/64 100: internal clock ϕ/16 101: internal clock ϕ/4 110: internal clock ϕw/1024 111: internal clock ϕw/256

- Timer Counter B1 (TCB1) Address: H'F0D1

Bit	Bit Name	Setting	R/W	Function
7	TCB17	0	R	TCB1 is an 8-bit read-only up-counter, which is incremented by internal clock input. The clock input to this counter is selected by bits TMB12 to TMB10 in TMB1. When TCB1 overflows (H'FF → H'00 or H'FF → setting value of TLB1), the IRRTB1 flag in Interrupt Flag Register 2 (IRR2) is set to 1. TCB1 is allocated to the same address as TLB1. The initial value of TCB1 is H'00.
6	TCB16	0	R	
5	TCB15	0	R	
4	TCB14	0	R	
3	TCB13	0	R	
2	TCB12	0	R	
1	TCB11	0	R	
0	TCB10	0	R	

- Timer Load Register B1 (TLB1) Address: H'F0D1

Bit	Bit Name	Setting	R/W	Function
7	TLB17	0	W	TLB1 is an 8-bit write-only register that sets the reload value of TCB1. Writing the reload value to TLB1 must be done while the TMB16 bit in TMB1 is 0. When a reload value is written to TLB1, the same value is set in TCB1 as well, and TCB1 starts counting up from that value. When TCB1 overflows during auto-reload operation, the TLB1 value is loaded into TCB1. Accordingly, the overflow period can be set in the range of 1 to 256 input clock cycles. TLB1 is allocated to the same address as TCB1. The initial value of TLB1 is H'00. TLB1 setting value = H'6A (106)
6	TLB16	1	W	
5	TLB15	1	W	
4	TLB14	0	W	
3	TLB13	1	W	
2	TLB12	0	W	
1	TLB11	1	W	
0	TLB10	0	W	

- Clock Halt Register 1 (CKSTPR1) Address: H'FFFA

Bit	Bit Name	Setting	R/W	Function
2	TB1CKSTP	1	R/W	Timer B1 Module Standby 0: Timer B1 is placed in module standby state. 1: Timer B1 module standby state is canceled

- Timer Control Register/Status Register WD1 (TCSRWD1) Address: H'FFB1

Bit	Bit Name	Setting	R/W	Function
7	B6WI	1	R/W	Bit 6 Write Disable Writing to the TCWE bit is only enabled when 0 is written to the B6WI bit. This bit is always read as 1.
6	TCWE	0	R/W	Timer Counter WD Write Enable Writing to the timer counter WD (TCWD) is enabled when the TCWE bit is set to 1. When writing to this bit, 0 must be written to the B6WI bit.
5	B4WI	1	R/W	Bit 4 Write Disable Writing to the TCSRWE bit is only enabled when 0 is written to the B4MI bit. The B4WI bit is always read as 1.
4	TCSRWE	0	R/W	Timer Control/Status Register WD1 Write Enable Writing to the WDON and WRST bits are enabled when the TCSRWE bit is set to 1. When writing to this bit, 0 must be written to the B4WI bit.
3	B2WI	1	R/W	Bit 2 Write Disable Writing to the WDON is only enabled when 0 is written to the B2WI bit. This bit is always read as 1.
2	WDON	0	R/W	Watchdog Timer On The TDWD starts counting up when the WDON bit is set to 1 and stops counting when the WDON bit is cleared to 0. [Setting condition] • If 0 is written to the B2WI bit and 1 to the WDON bit while the TCSRWE bit is 1. • Reset [Clearing condition] • If 0 is written to the B2WI and WDON bits while the TCSRWE bit is 1.
1	B0WI	1	R/W	Bit 0 Write Disable Writing to the WRST bit is only enabled when 0 is written to the B0WI bit. This bit is always read as 1.
0	WRST	0	R/W	Watchdog Timer Reset [Setting condition] • When the TCWD overflows and an internal reset signal is generated. [Clearing condition] • Reset by the $\overline{\text{RES}}$ pin • If 0 is written to both the BOWI and WRST bits while the TCSRWE bit is 1.

- Interrupt Enable Register 2 (IENR2) Address: H'FFF4

Bit	Bit Name	Setting	R/W	Function
2	IENTB1	1	R/W	Timer B1 Interrupt Request Enable Setting this bit to 1 enables Timer B1 interrupt requests.

- Interrupt Flag Register 2 (IPR2) Address: H'FFF7

Bit	Bit Name	Setting	R/W	Function
2	IRRTB1	0	R/W	Timer B1 Interrupt Request Flag [Setting condition] • When Timer B1 overflows [Clearing condition] • When 0 is written to this bit

4.4 RAM Usage

Table 3 describes the RAM usage in this sample task.

Table 3 Description of RAM

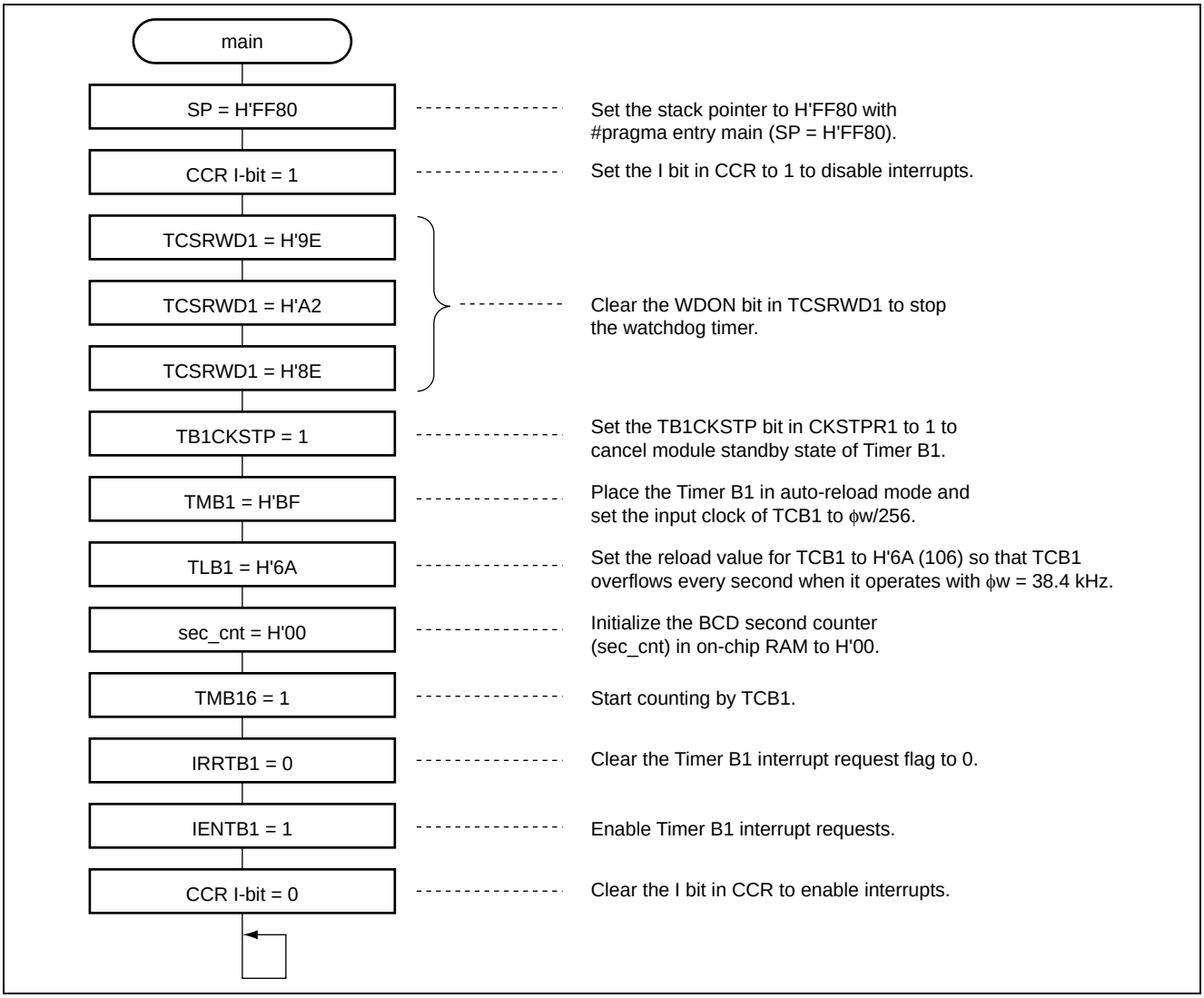
Label Name	Function	Data Length	Used In
sec_cnt	Second counter in BCD code	1 byte	main, cnt_up

- Second Counter (sec_cnt) Address: H'FB80

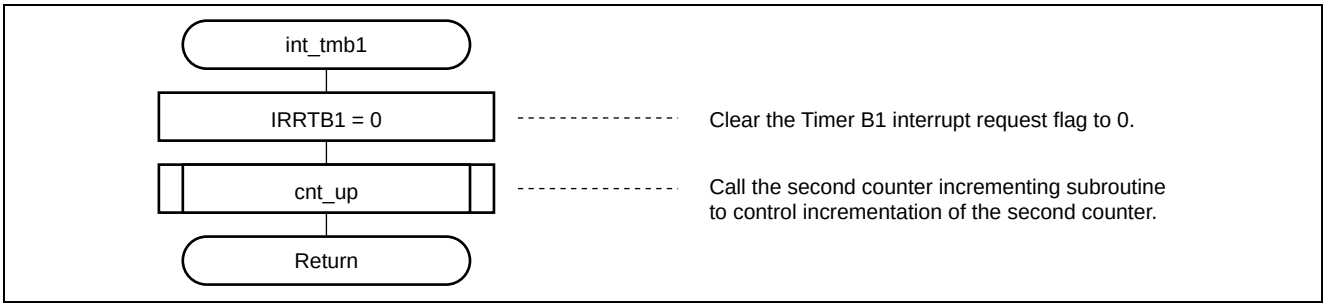
Bit	Bit Name	Initial Value	Function
7	—	0	Not used
6	sec12	0	10's place of the second counter
5	sec11	0	Incremented from 0 to 5 in the counting of 60 seconds.
4	sec10	0	
3	sec03	0	1's place of the second counter
2	sec02	0	Incremented from 0 to 9. When a carry is generated, the 10's place
1	sec01	0	is incremented by 1.
0	sec00	0	

5. Flowchart

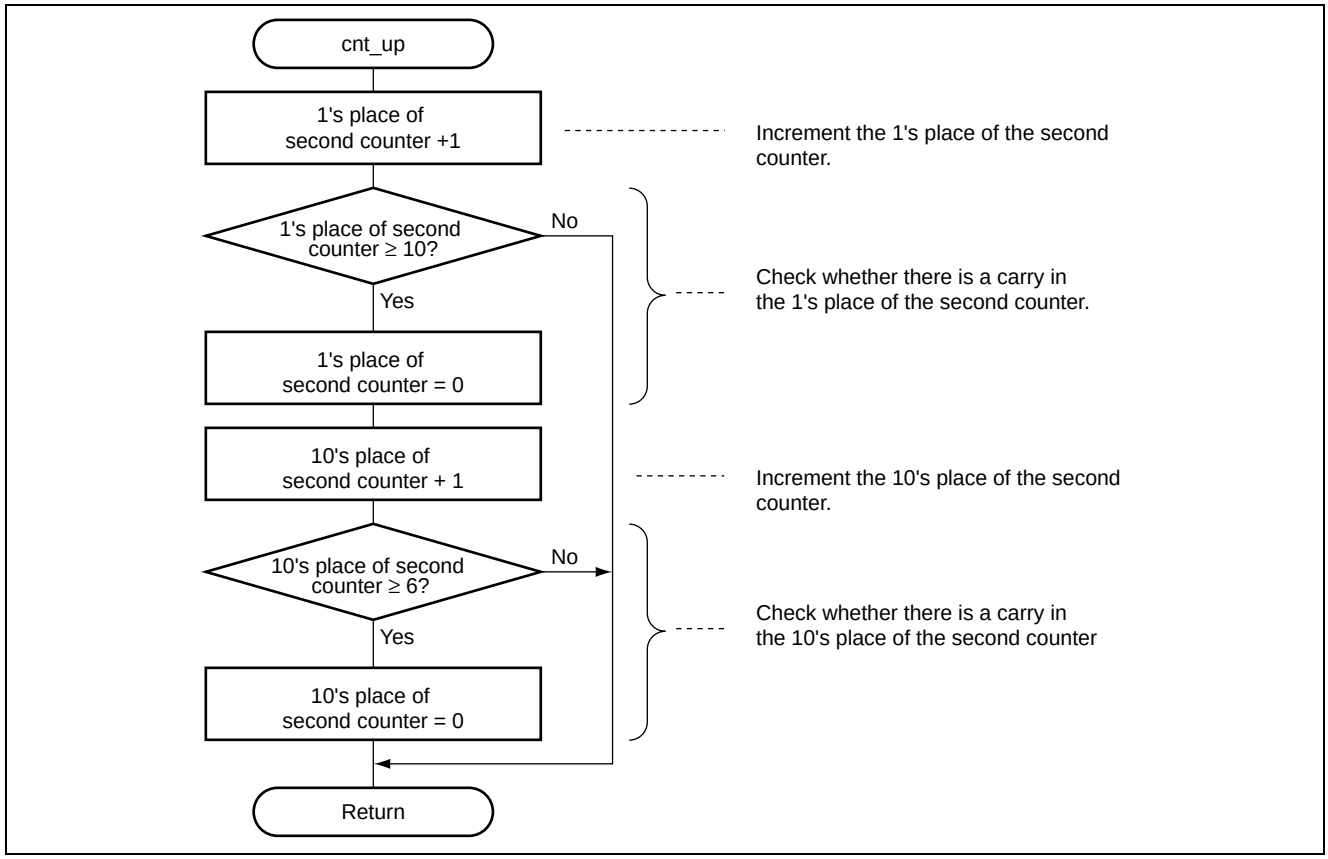
5.1 main



5.2 int_tmb1



5.3 cnt_up



5.4 Link Address Specifications

Section Name	Address
CVECT	H'0000
P	H'0100
B	H'FB80

Revision Record

		Description	
Rev.	Date	Page	Summary
1.00	Mar.18.05	—	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.