

Introduction:

Generation of One shot pulse using Timer RB in Programmable one shot generation mode. To the timer output, an LED is connected and the pulse width is generated in terms of seconds, so that it is visible to the eyes.

Hardware:

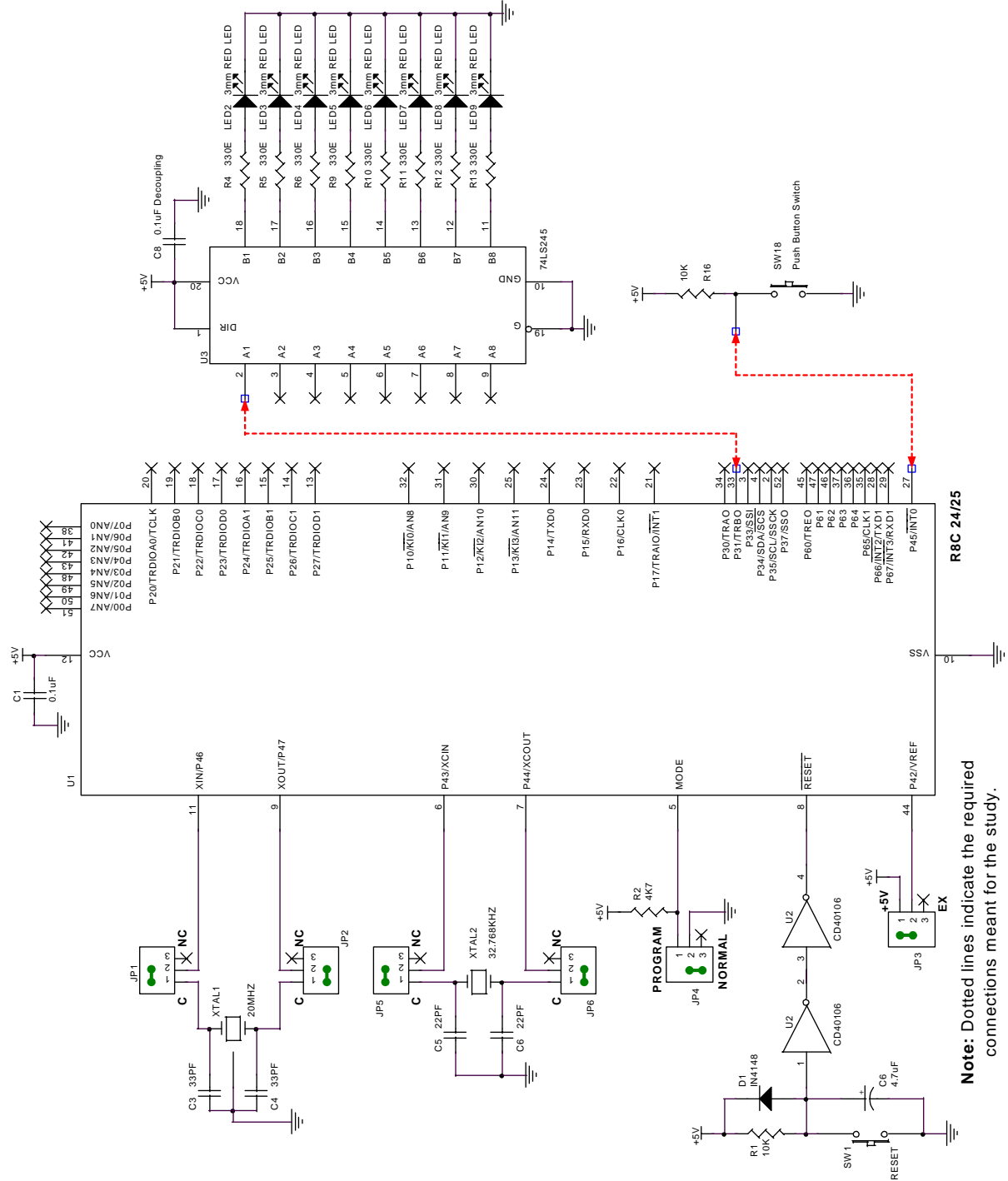
To generate a one shot pulse, the internal peripheral Timer RB of the R8C micon is used. R8C has a range of Timers, Timer RA, Timer RB and Timer C. Each timer has different modes of operations. Timer RB is used in Programmable one shot generation mode.

The Timer RB output pin P31 (TRB0) is connected to a point LED to view the mono shot pulse duration.

To trigger the monoshot generation, a push button switch is connected to the INT0 input. When the input is triggered through the switch, the timer RB generates the mono shot pulse on the TRB0 pin.

Demo 14 - Timer - One Shot Waveform Generation Mode Study

Circuit:



Note: Dotted lines indicate the required connections meant for the study.

Connections:

LED -> P31 (TRB0)

Push Button Switch -> P45 (INT0)

Functional Description:

Here, the two timers Timer RA and Timer RB are cascaded. Timer RB is used in one shot wave form generation mode and timer RA in timer mode. The clock for timer RB is coming from the underflow signal of Timer RA.

Both the Timers operate in the down counter mode. Timer RA counts the internal clock and the clock frequency of $f_{osc}/8$ is selected.

Timer RB is operated in one shot generation mode to generate a one shot pulse. The clock for timer RB is obtained from the underflow signal of the Timer RA.

Timer RA is operated in timer mode. The clock is divided by the Timer RA and generates a low frequency clock of 38Hz (approx.). Both the prescaler and the primary registers are loaded with 255. This low frequency signal coming out of timer RA becomes clock input to Timer RB.

The division ratio is obtained as

$$\begin{aligned} & (F_{osc} / 8) \\ = & \frac{\text{-----}}{(n+1) (m+1)} \\ & n - \text{Prescaler value} \\ & m - \text{Primary register} \\ & (20000000 / 8) \\ = & \frac{\text{-----}}{(256)* (256)} \\ = & 38 \text{ Hz (approx.)} \end{aligned}$$

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Timer RB again divides this clock using its prescaler register to 1 Hz. The prescaler is loaded with 37. Hence the clock is divided by 38 to generate a 1 Hz. Set a count of 1 to Timer RB primary register TZPR to get a time delay of 1 second. This will be the one shot pulse duration.

One Shot Pulse Duration is

$$\begin{aligned} & \frac{(n+1) (m+1)}{\text{Timer RA underflow}} \\ & n - \text{Prescaler value} \\ & m - \text{Primary register} \\ & \frac{(38) * (1)}{38} \\ & = 1 \text{ Second (approx.)} \end{aligned}$$

The INT0 pin acts a trigger input pin for one shot pulse generation. When a trigger is given using the push button switch, the timer RB outputs a high level in its TRB0 pin for the predefined time (as initialized in timer RB) and then changes to low level. Here the one shot pulse time is set as 1 second.

Registers used:

TRAPRE	-	8-bit Prescaler RA Register
TRA	-	8-bit Timer RA Primary Register
TRAMR	-	Timer RA Mode Register
TRACR	-	8-bit Timer RA Control Register
TRBMR	-	Timer RB Mode Register
TRBCR	-	8-bit Timer RB Control Register
TRBPRES	-	8-bit Prescaler RB Register
TRBPR	-	8-bit Timer RB Primary Register
TRBIOC	-	8-bit Timer RB I/O Control Register

Timer RA Mode Register - TRAMR

		Symbol TRAMR	Address 0102h	After Reset 00h
Bit Symbol	Bit Name	Function	RW	
TMOD0 ⁽¹⁾	Timer RA Operation Mode Select Bit	b2 b1 b0 0 0 0 : Timer mode	RW	
TMOD1 ⁽¹⁾			RW	
TMOD2 ⁽¹⁾			RW	
— (b3)	Nothing is assigned. When write, set to "0". When read, its content is "0".		—	
TCK0 ⁽²⁾	Timer RA Count Source Select Bit	b6 b5 b4 0 0 0 : f1 0 0 1 : f8 0 1 0 : f000 0 1 1 : f2 1 0 0 : fC32 1 0 1 : } 1 1 0 : } Do not set 1 1 1 : }	RW	
TCK1 ⁽²⁾			RW	
TCK2 ⁽²⁾			RW	
TCKCUT ⁽²⁾			Timer RA Count Source Cutoff Bit	0 : Provides count source 1 : Outs off count source

- NOTES :
1. Select operation mode while the count stops.
 2. Do not switch or cut off a count source during a count operation.
Stop the timer count before switching or cutting off a count source.

Load TRAMR register with H'01 to set timer RA in timer mode and clock is selected as Fosc/8.

Timer RA Control Register - TRACR

		Symbol TRACR	Address 0100h	After Reset 00h
Bit Symbol	Bit Name	Function	RW	
TSTART ⁽¹⁾	Timer RA Count Start Bit	0 : Count stops 1 : Count starts	RW	
TCSTF ⁽¹⁾	Timer RA Count Status Flag	0 : Count stops 1 : During count	RO	
TSTOP ⁽²⁾	Timer RA Count Forcible Stop Bit	When this bit is set to "1", the count is forcibly stopped. When read, its content is "0".	RW	
— (b3)	Nothing is assigned. When write, set to "0". When read, its content is "0".		—	
TEDGF	Active Edge Judgment Flag	Set to "0" in timer mode	RW	
TUNDF	Timer RA Underflow Flag	Set to "0" in timer mode	RW	
— (b7-b6)	Nothing is assigned. When write, set to "0". When read, its content is "0".		—	

Set TSTART bit to 1 level to start the timer RA.

Timer RB Mode Register - TRBMR

Bit	Symbol	Address	After Reset	
b7	×	010Bh	00h	
b6	×			
b5	×			
b4	1			
b3	×			
b2	1			
b1	0			
b0	0			
Bit Symbol	Bit Name	Function	RW	
TMOD0 ⁽¹⁾	Timer RB Operating Mode Select Bit	b1:b0 1 0 : Programmable one-shot generation mode	RW	
TMOD1 ⁽¹⁾			RW	
— (b2)	Nothing is assigned. When write, set to "0". When read, its content is "0".		—	
TWRC ⁽³⁾	Timer RB Write Control Bit	Set to "1" in programmable one-shot generation mode	RW	
TCK0 ⁽²⁾	Timer RB Count Source Select Bit	b5:b4 0 0 : f1 0 1 : f8 1 0 : Timer RA underflow 1 1 : f2	RW	
TCK1 ⁽²⁾			RW	
— (b6)	Nothing is assigned. When write, set to "0". When read, its content is "0".		—	
TCKCUT ⁽²⁾	Timer RB Count Source Cutoff Bit	0 : Provides count source 1 : Cuts off count source	RW	

NOTES :

1. Select operation mode while the count stops.
2. Do not switch or cut off a count source during a count operation.
Stop the timer count before switching or cutting off a count source.
3. When the TCSTF bit in the TRBCR register is set to "1" (counting), the count value is written to the reload register only. When the TCSTF bit is set to "0" (Stops counting), the count value is written to both the reload register and counter.

Using Timer RB mode register, programmable one shot mode is set.

Set TMOD0 to 0 and TXMOD1 bit to 1 choose one shot mode.

Set TZWC to 1.

Set TCK0 to 0 and TCK1 to 1 to select underflow of timer RA as clock to Timer RB.

Timer RB I/OControl Register - TRBIOC

Symbol	Address	After Reset	
TRBIOC	010Ah	00h	
Bit Symbol	Bit Name	Function	RW
TOPL	Timer RB Output Level Select Bit	0 : Outputs one-shot pulse "H" Outputs "L" when the timer is stopped 1 : Outputs one-shot pulse "L" Outputs "H" when the timer is stopped	RW
TOCNT	Timer RB Output Switch Bit	Set to "0" in programmable one-shot generation mode	RW
INOSTG ⁽¹⁾	One-Shot Trigger Control Bit	0 : INT0 pin one-shot trigger disabled 1 : INT0 pin one-shot trigger enabled	RW
INOSEG ⁽²⁾	One-Shot Trigger Polarity Select Bit	0 : Falling edge trigger 1 : Rising edge trigger	RW
— (b7-b4)	Nothing is assigned. When write, set to "0". When read, its content is "0".		—

NOTES :

1. Set the INOSTG bit to "1" after the INOSEG bit and the INTOEN bit in the INTEN register are set. When setting the INOSTG bit to "1" (INT0 pin one-shot trigger enabled), set the INTOF0 to INTOF1 bits in the INTOF register.
2. The INOSTG bit is enabled only when the INTOPL bit in the INTEN register is set to "0" (one edge).

The Timer RB outputs a high level for one shot pulse and the corresponding trigger is enabled for INT0 pin by the following settings.

Set TOPL to 0 level, set INOSTG to 1 level.

Timer RB Control Register - TRBIOC

Symbol	Address	After Reset	
TRBIOC	0108h	00h	
Bit Symbol	Bit Name	Function	RW
TSTART ⁽¹⁾	Timer RB Count Start Bit	0 : Count stops 1 : Count starts	RW
TCSTF ⁽¹⁾	Timer RB Count Status Flag	0 : Count stops 1 : During count	RO
TSTOP ⁽²⁾	Timer RB Count Forcible Stop Bit	When this bit is set to "1", the count is forcibly stopped. When read, its content is "0".	RW
— (b7-b3)	Nothing is assigned. When write, set to "0". When read, its content is "0".		—

Set TSTART bit to 1 level to start the timer RB.

Software Description:

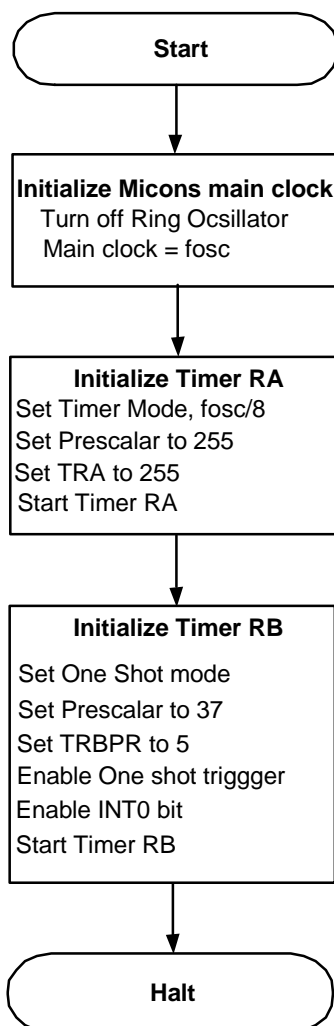
Initialize timer RA. Start the timer RA. Timer RA will generate clock for the Timer RB. Initialize Timer RB to operate in the one shot waveform generation mode with external trigger INT0 pin.

When the trigger is received, the Timer RB will generate a high pulse through the TRB0 for 1 seconds. After 1 second the TRB0 line is lowered. Connect a LED to the TRB0 line, to view the one shot pulse width.

The functions in the file “**Demo14.C**” and short descriptions are listed below:

<i>Functions</i>	<i>Description</i>
main	Main routine displays a message on LCD and does the initializations of Timers RA and RB
MCUInitialize	Initializes Micon
InitializeTimerRARB	Initializes Timers RA and RB

Program Flow:



Execute Demo:

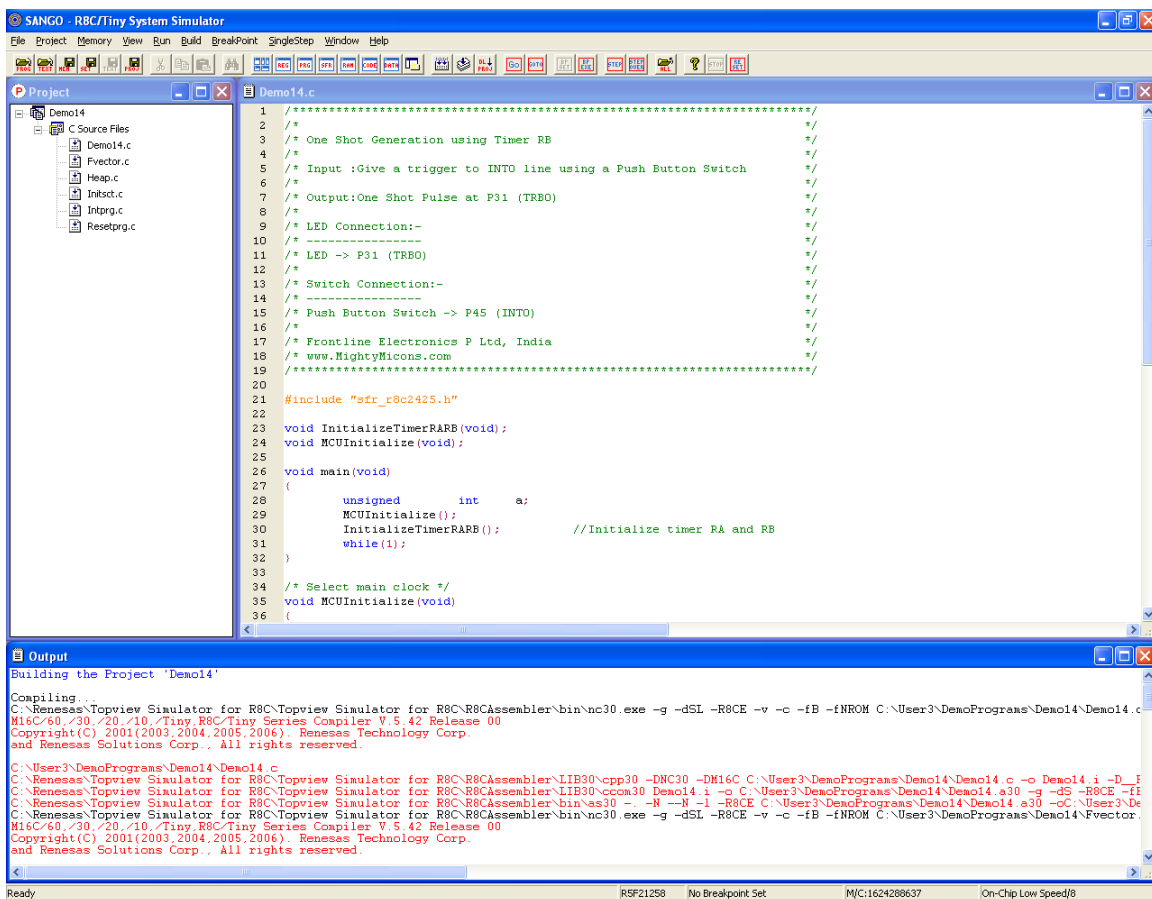
When a trigger pulse is given through INT0 line, the timer RB generates a one shot pulse in its output pin TRB0 for a period of 1 Second (approx.). LED connected to TRB0 will be switched on for that time and will be switched off again.

Demo 14 - Timer - One Shot Waveform Generation Mode Study

Use Topview Simulator to Verify the Design.

Open the project Demo14 in the R8C/Tiny System Simulator using **Open Project** option from **Project** menu. The project window opens up along with the Demo14.c file. Use **Build** option from **Build** menu to compile the project. An output window captures the compiler output.

Use **Project -> Download Project** from main menu to download the .mot file into the simulator's memory for simulation.

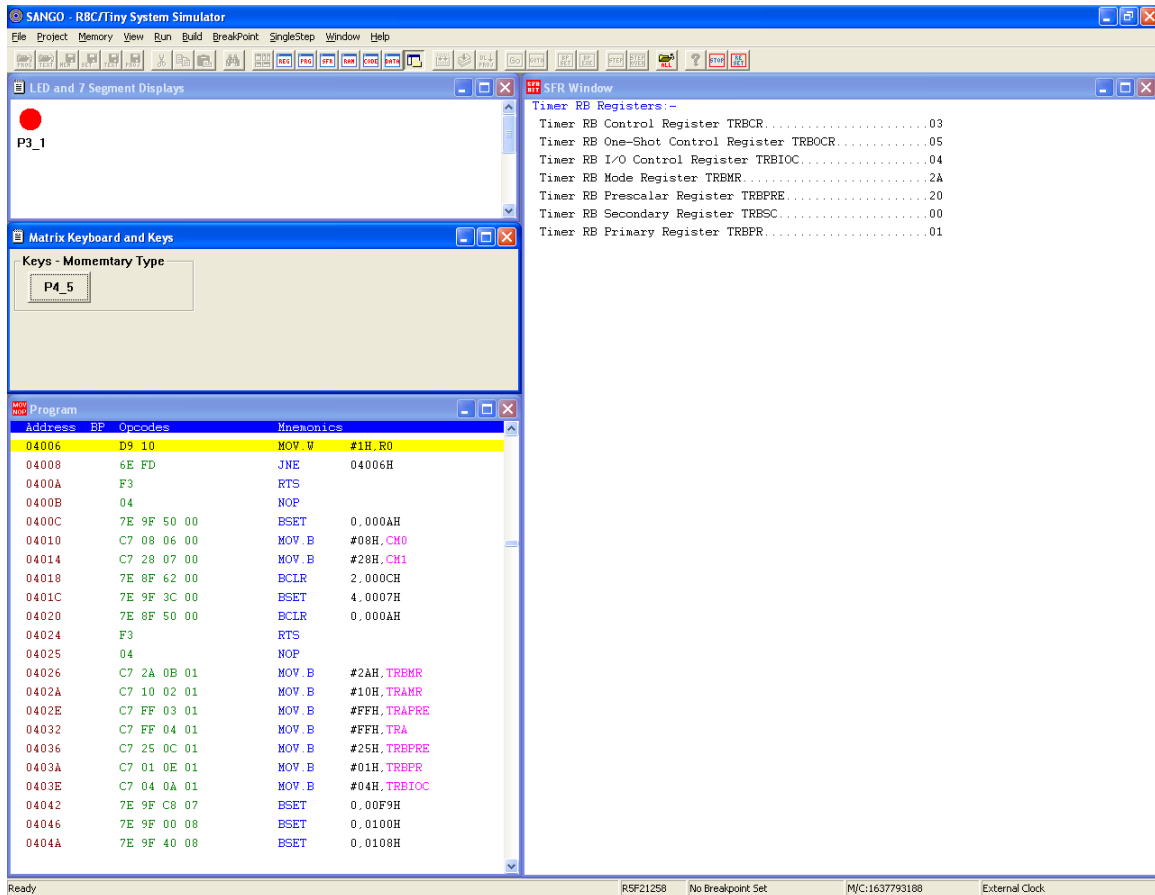


```
1 /*****  
2 /*  
3 /* One Shot Generation using Timer RB  
4 /*  
5 /* Input :Give a trigger to INTO line using a Push Button Switch  
6 /*  
7 /* Output:One Shot Pulse at P31 (TRBO)  
8 /*  
9 /* LED Connection:-  
10 /* -----  
11 /* LED -> P31 (TRBO)  
12 /*  
13 /* Switch Connection:-  
14 /* -----  
15 /* Push Button Switch -> P45 (INTO)  
16 /*  
17 /* Frontline Electronics P Ltd, India  
18 /* www.MightyMicons.com  
19 *****/  
20  
21 #include "sfr_r8c2425.h"  
22  
23 void InitializeTimerRARB(void);  
24 void HCUInitialize(void);  
25  
26 void main(void)  
27 (  
28     unsigned int a;  
29     MCUInitialize();  
30     InitializeTimerRARB(); //Initialize timer RA and RB  
31     while(1);  
32 )  
33  
34 /* Select main clock */  
35 void HCUInitialize(void)  
36 (  
37
```

```
Building the Project 'Demo14'  
Compiling...  
C:\Renesas\Topview Simulator for R8C\Topview Simulator for R8C\R8CAssembler\bin\nc30.exe -g -dSL -R8CE -v -c -fB -fNROM C:\User3\DemoPrograms\Demo14\Demo14.c  
M16C/60/30/20/10/Tiny.R8C/Tiny Series Compiler V.5.42 Release 00  
Copyright(C) 2001(2003,2004,2005,2006). Renesas Technology Corp.  
and Renesas Solutions Corp., All rights reserved.  
C:\User3\DemoPrograms\Demo14\Demo14.c  
C:\Renesas\Topview Simulator for R8C\Topview Simulator for R8C\R8CAssembler\LIB30\cpp30 -DNC30 -DM16C C:\User3\DemoPrograms\Demo14\Demo14.c -o Demo14.i -D_F  
C:\Renesas\Topview Simulator for R8C\Topview Simulator for R8C\R8CAssembler\LIB30\ccom30 Demo14.i -o C:\User3\DemoPrograms\Demo14\Demo14.a30 -g -dS -R8CE -H  
C:\Renesas\Topview Simulator for R8C\Topview Simulator for R8C\R8CAssembler\bin\nc30 -b -H -i -R8CE C:\User3\DemoPrograms\Demo14\Demo14.a30 -oC:\User3\De  
C:\Renesas\Topview Simulator for R8C\Topview Simulator for R8C\R8CAssembler\bin\nc30.exe -g -dSL -R8CE -v -c -fB -fNROM C:\User3\DemoPrograms\Demo14\Fvector.  
M16C/60/30/20/10/Tiny.R8C/Tiny Series Compiler V.5.42 Release 00  
Copyright(C) 2001(2003,2004,2005,2006). Renesas Technology Corp.  
and Renesas Solutions Corp., All rights reserved.
```

Connect point LED to the port line P31 using LED module setting and connect one push button switch to the port line P45 to give the trigger signal to timer RD using keyboard module setting. Open the LED and keyboard window and arrange them as shown for better visibility.

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Download the program using **Download Project** command in **Project** menu.

Run the program using **Go** command in **Run** menu.

Now the LED connected to the port line P31 will be in off state and timer RB is waiting for trigger signal from P45. Give the trigger signal to port line P45 by pressing the push button switch connected to P45 in keyboard window. The LED will now be switched on to indicate that the output of the mono shot of timer RB is 1 level. After 10 to 15 seconds the LED will be switched off according to the PC speed and other things. Because in Topview Simulator we can't simulate the timing signals as per actual as in the real hardware.