1. Abstract

This document describes the setting procedure and operation example for timer A in timer mode using the pulse output function.

2. Introduction

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

MCU: R32C/111 Group

This program can be used with other R32C/100 Series MCUs which have the same special function registers (SFRs) as the R32C/111 Group. Check the user’s manual for any additions or modifications to functions. Careful evaluation is recommended before using this application note.
3. Overview

In timer mode, the timer counts an internally generated count source. The timer decrements until it underflows. Subsequently, the timer then generates an interrupt request.

This document also describes setting the peripheral clock source to 25 MHz, how to generate a timer interrupt request of timer A with a 1 ms period using the peripheral count source f8, and how to output a 1 kHz rectangular wave generated at TAiOUT pin from a port (i = 0 to 4).

Table 3.1 lists the Maximum Period of Timer A Interrupt Request Per Count Source.

Timer A Interrupt Request Period = (timer register value + 1) × Timer Count Source Period

<table>
<thead>
<tr>
<th>Count Source</th>
<th>Count Source Period</th>
<th>Maximum Period of Timer A Interrupt Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>f1</td>
<td>40 ns</td>
<td>2.621 ms</td>
</tr>
<tr>
<td>f8</td>
<td>320 ns</td>
<td>20.972 ms</td>
</tr>
<tr>
<td>f2n (n = 15)</td>
<td>1200 ns (1)</td>
<td>78.64 ms (1)</td>
</tr>
<tr>
<td>fC32</td>
<td>Approx. 0.977 ms</td>
<td>64 s</td>
</tr>
</tbody>
</table>

Xin (main clock) = 16 MHz, PLL clock = 100 MHz, f1 = 25 MHz, fC = 32.768 kHz

Note:
1. Value when selecting the peripheral count source as the f2n clock source.

When outputting the timer Ai pulse from the TAiOUT pin, set the corresponding direction bit of the pin to 1 (output) and TAiOUT output to function registers PSEL2 to PSEL0.

Table 3.2 lists the Port Assigned to TAiOUT Pin and Related Output Register.

<table>
<thead>
<tr>
<th>Timer Pin</th>
<th>Port</th>
<th>Port Direction Register</th>
<th>Function Select Register</th>
<th>Setting Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA0OUT</td>
<td>P3_0</td>
<td>PD3_0</td>
<td>P3_0S</td>
<td>01h</td>
</tr>
<tr>
<td></td>
<td>P7_0 (1)</td>
<td>PD7_0</td>
<td>P7_0S</td>
<td>01h</td>
</tr>
<tr>
<td>TA1OUT</td>
<td>P3_2</td>
<td>PD3_2</td>
<td>P3_2S</td>
<td>01h</td>
</tr>
<tr>
<td></td>
<td>P7_2</td>
<td>PD7_2</td>
<td>P7_2S</td>
<td>01h</td>
</tr>
<tr>
<td>TA2OUT</td>
<td>P3_4</td>
<td>PD3_4</td>
<td>P3_4S</td>
<td>01h</td>
</tr>
<tr>
<td></td>
<td>P7_4</td>
<td>PD7_4</td>
<td>P7_4S</td>
<td>01h</td>
</tr>
<tr>
<td>TA3OUT</td>
<td>P3_1</td>
<td>PD3_1</td>
<td>P3_1S</td>
<td>01h</td>
</tr>
<tr>
<td></td>
<td>P7_6</td>
<td>PD7_6</td>
<td>P7_6S</td>
<td>01h</td>
</tr>
<tr>
<td>TA4OUT</td>
<td>P3_6</td>
<td>PD3_6</td>
<td>P3_6S</td>
<td>01h</td>
</tr>
<tr>
<td></td>
<td>P8_0</td>
<td>PD8_0</td>
<td>P8_0S</td>
<td>01h</td>
</tr>
</tbody>
</table>

Note:
1. This port is N-channel open drain output.
3.1 Timer Mode Operation

The following describes timer mode operation of timer A.

1. While the timer counter is stopped, the value written to the timer Ai register is written to both the reload register and the counter \(i = 0 \) to \(4\).
2. After setting the TAiS bit in the TABSR register to 1 (count started), the counter decrements the count source.
3. When the counter underflows, the value from the reload register is reloaded, and the count continues. At the same time, the IR bit in the TAiIC register becomes 1 (interrupt requested), and the TAiOUT pin is inverted.
4. After setting the TAiS bit to 0 (count stopped), the counter holds the count value and stops. At this time, the TAiOUT pin outputs a low signal.
5. The IR bit in the TAiIC register becomes 0 by accepting an interrupt request, or setting it to 0 by a program.

Figure 3.1 shows the operation timing, Figure 3.2 shows the Flowchart of main Process, and Figure 3.3 shows the Process Flowchart of Initial Timer A0 Setting.
Timer A Operation in Timer Mode Using the Pulse Output

Figure 3.2 Flowchart of main Process

Figure 3.3 Process Flowchart of Initial Timer A0 Setting

Note:
1. For SetPLLClock function setting, refer to the user’s manual.

Note:
1. This procedure is for setting port P3_0 to TA0OUT output.
3.2 Settings

This section shows the setting procedures and values to set the example shown in section 3.1 “Timer Mode Operation”. Refer to the user’s manual for details on individual registers.

Set the timer A0 mode register.

<table>
<thead>
<tr>
<th>b7</th>
<th>b6</th>
<th>b5</th>
<th>b4</th>
<th>b3</th>
<th>b2</th>
<th>b1</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Timer A0 Mode Register (TA0MR)

- **TMOD1 and TMOD0**: Operating Mode Select Bit
  - 00b: Timer mode

- **MR2 and MR1**: Gate Function Select Bit
  - 00b: No gate function

- **MR3**: Set to 0 in timer mode.

- **TCK1 and TCK0**: Count Source Select Bit
  - 01b: f8

Set the timer A0 register.

<table>
<thead>
<tr>
<th>b15</th>
<th>b14</th>
<th>b13</th>
<th>b12</th>
<th>b11</th>
<th>b10</th>
<th>b9</th>
<th>b8</th>
<th>b7</th>
<th>b6</th>
<th>b5</th>
<th>b4</th>
<th>b3</th>
<th>b2</th>
<th>b1</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>3124</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Timer A0 Register (TA0)

- **Timer Mode**: 3124: Divides the count source by 3125

A 16-bit read/write access to this register should be performed.

Set the port P3 direction register.

<table>
<thead>
<tr>
<th>b7</th>
<th>b6</th>
<th>b5</th>
<th>b4</th>
<th>b3</th>
<th>b2</th>
<th>b1</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Port P3 Direction Register (PD3)

- **PD3_0**: Port P3_0 Direction Bit
  - 1: Output port

When setting port P3_0 to TA0OUT output, set the port P3_0 direction bit to 1.
Set the function select register.

Set the count start register.

When setting port P3_0 to pulse output using timer A0 timer mode, set the port P3_0 output function select bit in the port P3_0 function select register to 001b (TA0OUT output).
4. **Sample Program**

A sample program can be downloaded from the Renesas Electronics website.

5. **Reference Documents**

User’s Manual
R32C/111 Group User’s Manual Rev.1.10
The latest version can be downloaded from the Renesas Electronics website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Electronics website.

C compiler manual
R32C/100 Series C Compiler Package V.1.02 C Compiler User’s Manual Rev.2.00
The latest version can be downloaded from the Renesas Electronics website.

**Website and Support**

Renesas Electronics website
http://www.renesas.com/

Inquiries
http://www.renesas.com/inquiry
# REVISION HISTORY

**R32C/100 Series**  
**Timer A Operation in Timer Mode Using the Pulse Output Function**

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>June 4,</td>
<td>First Edition issued</td>
</tr>
<tr>
<td></td>
<td>2010</td>
<td></td>
</tr>
</tbody>
</table>

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The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins
   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.
   - The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on
   The state of the product is undefined at the moment when power is supplied.
   - The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
     In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
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3. Prohibition of Access to Reserved Addresses
   Access to reserved addresses is prohibited.
   - The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals
   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.
   - When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

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   Before changing from one product to another, i.e. to one with a different part number, confirm that the change will not lead to problems.
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