R32C/100 Series

Timer A Operation in Event Counter Mode Using Free-running Count Operation

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Abstract

This document describes timer A operation in event counter mode using free-running count operation in the R32C/100 Series.

Products

MCUs: R32C/116 Group, R32C/117 Group, and R32C/118 Group

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Contents

1. Specifications

When using the event counter mode of timer A0, the timer counts an external signal applied to the TA0IN pin. When using the free-running count function, the reload register value is not reloaded even if the counter overflows or underflows.
Table 1.1 lists the Peripheral Function and Its Application. Figure 1.1 shows a Usage Example.

Table 1.1 Peripheral Function and Its Application

Peripheral Function	Application
Timer A (timer A0)	Counts an external signal applied to the TA0IN pin

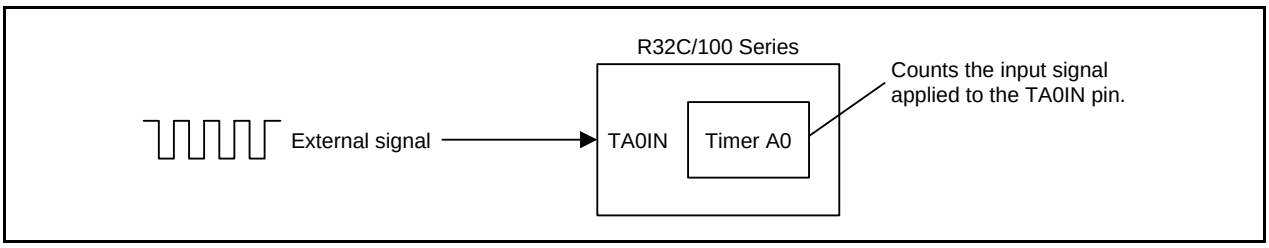

Figure 1.1 Usage Example

2. Operation Confirmation Conditions

The sample code accompanying this application note has been run and confirmed under the conditions below.

Table 2.1 Operation Confirmation Conditions

Item	Contents
MCU used	R5F64189DFD (R32C/118 Group)
Operating frequencies	Main clock: 16 MHz PLL clock: 100 MHz Base clock: 50 MHz CPU clock: 50 MHz Peripheral bus clock: 25 MHz Peripheral function clock source: 25 MHz
Operating voltage	5 V
Integrated development environment	Renesas Electronics Corporation High-performance Embedded Workshop Version 4.07
C compiler	Renesas Electronics Corporation R32C/100 Series C Compiler V.1.02 Release 01
	Compile options -D__STACKSIZE__=0X300 -D__ISTACKSIZE__=0X300 -DVECTOR_ADR=0x0FFFFFBDC -c -finfo -dir "$(CONFIGDIR)" (Default setting is used in the integrated development environment.)
Operating mode	Single-chip mode
Sample code version	Version 1.00
Board used	Renesas Starter Kit for R32C/118 (product name: R0K564189S000BE)

3. Reference Application Note

The application note associated with this application note is listed below. Refer to the following application note for additional information.

- R32C/100 Series Configuring PLL Mode (REJ05B1221-0100)

4. Hardware

4.1 Pin Used

Table 4.1 lists the Pin Used and Its Function.

Table 4.1 Pin Used and Its Function

Pin Name	I/O	Function
P7_1/TA0IN	Input	Timer A0 count source input

5. Software

5.1 Operation Overview

The timer counts an external signal applied to the TA0IN pin. If the counter underflows, a timer A0 interrupt is generated.

(1) Timer A0 initial settings
Settings to use timer A0 in event counter mode. In the sample code, select the timer A0 event/trigger as input to the TA0IN pin.

Settings for timer A0 are as follows:
- Count source: External signal applied to the TA0IN pin
- Count polarity: Count falling edges
- Count operation: Decrement
- Count operation type: Free-running

(2) Timer A0 count starts
When setting the timer A0 count start bit in the count start register to 1 (start counter), the timer starts counting an external signal applied to the TA0IN pin.

(3) When the timer A0 counter underflows
When the counter underflows, the timer A0 interrupt request flag becomes 1 (interrupt requested). The counter continues counting without reloading the value in the reload register.

Figure 5.1 shows the Timer A0 Operation in Event Counter Mode Using Free-running Count Operation.

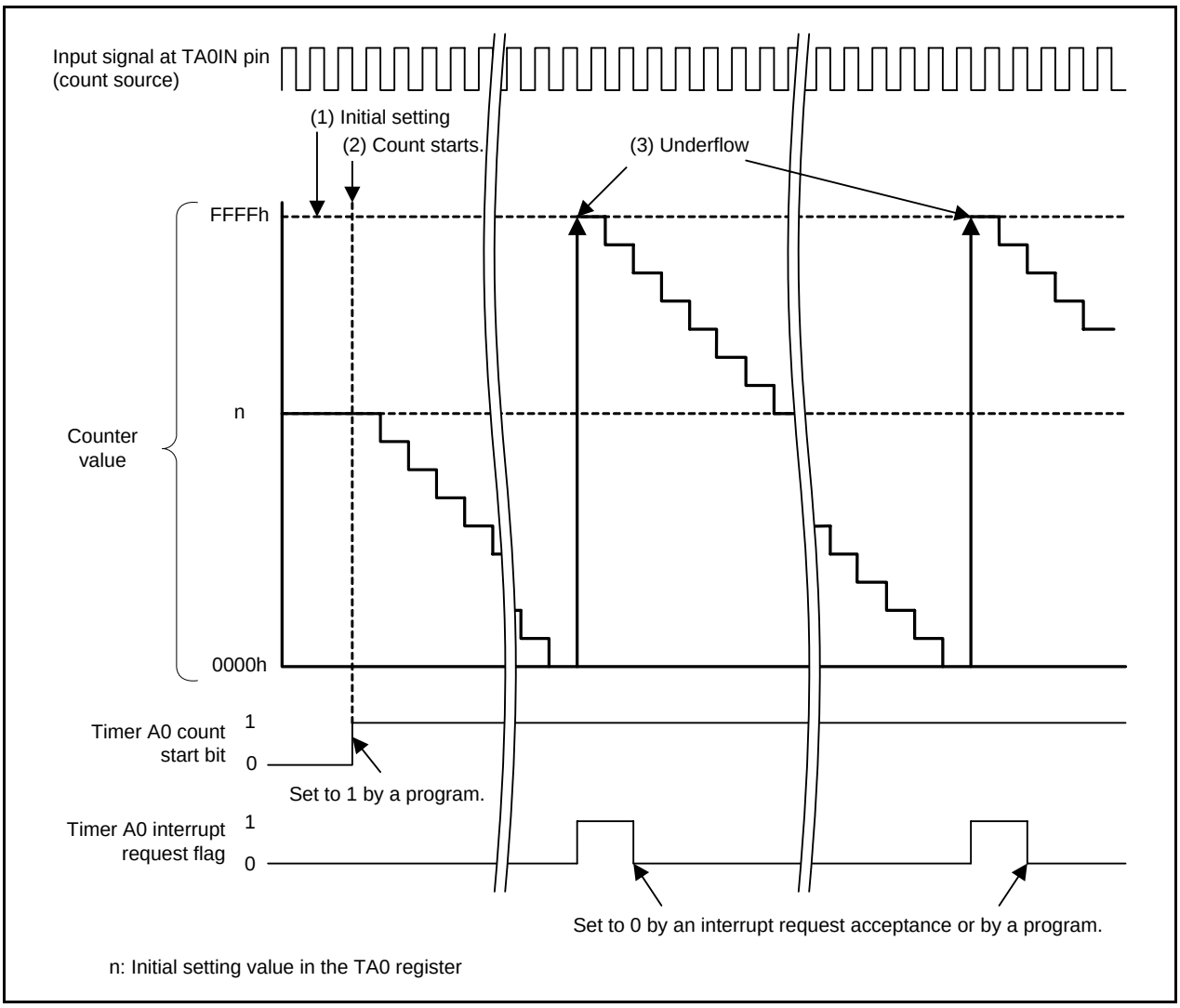

Figure 5.1 Timer A0 Operation in Event Counter Mode Using Free-running Count Operation

5.2 Invariable Table

Table 5.1 lists the Invariable Used in the Sample Code.

Table 5.1 Invariable Used in the Sample Code

Invariable Name	Setting Value	Contents
INIT_TA0_VALUE	0005h	Initial setting value in the timer A0 register

5.3 Flowchart

5.3.1 Main Processing

Figure 5.2 shows the Main Processing.

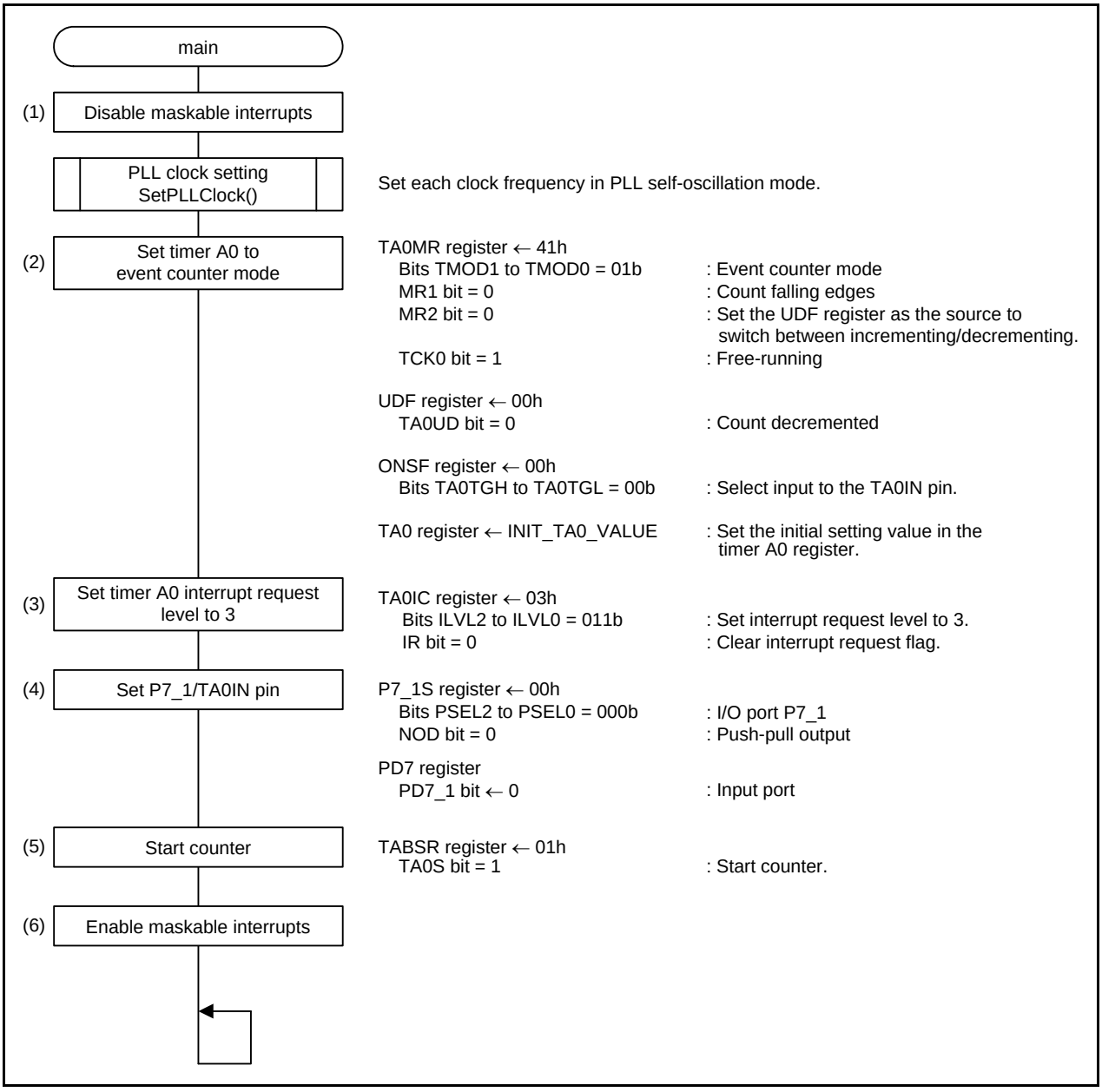

Figure 5.2 Main Processing

6. Application Example

6.1 Switching Between Incrementing and Decrementing During a Count Operation

Stop the count operation before setting the increment/decrement counting select register to switch between incrementing and decrementing.

(1) Stop counter
Set the timer Ai count start bit in the count start register to 0 (stop counter) (i = 0 to 4).
(2) Increment/decrement switching
While the count is stopped, switch the timer Ai increment/decrement counting select bit in the increment/decrement counting select register.
(3) Start counter
Set the timer Ai count start bit to 1 (start counter). After the counter starts, the count starts from the valid edge of the external signal.

Figure 6.1 shows an Operation Example of Switching Between Incrementing and Decrementing.

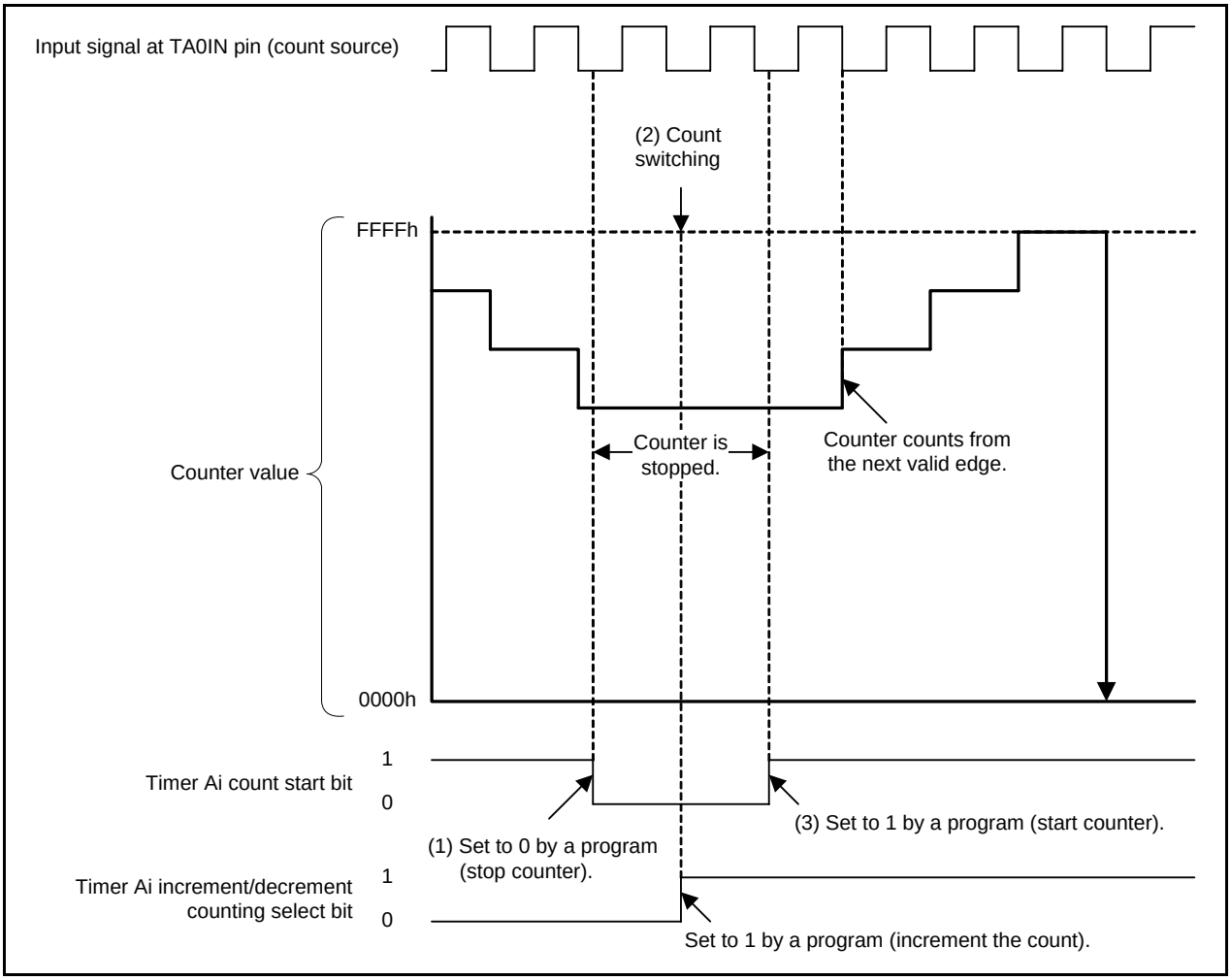

Figure 6.1 Operation Example of Switching Between Incrementing and Decrementing

7. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

8. Reference Documents

R32C/116 Group User's Manual: Hardware Rev.1.10
R32C/117 Group User's Manual: Hardware Rev.1.10
R32C/118 Group User's Manual: Hardware Rev.1.10
The latest versions 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.

9. Website and Support

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Revision History	R32C/100 Series Timer A Operation in Event Counter Mode Using Free-running Count Operation

Rev.	Date	Description	
		Page	Summary
1.00	Jan. 14, 2011	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

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.

   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

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.

5. Differences between Products

   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.

   — The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.

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