Creating a 32-Bit Timer From a 16-Bit Timer Chain

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MSP Applications

ABSTRACT

In some applications, there is a need for a 32-bit timer on devices that include only 16-bit timers, such as the MSP430™ microcontrollers. A 32-bit timer can be achieved by chaining two separate timers on the MSP430 MCU so the output of one timer drives the clock of a second. This method of creating a 32-bit timer was chosen to reduce CPU overhead and to get the lowest power savings. This document explains the chaining process and gives two code examples that implement the feature.

The example files described in this document can be downloaded from http://www.ti.com/lit/zip/slaa726.

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1 Timer Chaining With MSP430 Timers

By utilizing the unique features of the MSP430 Timer_A or Timer_B module, a 32-bit timer can be created with any MSP430 MCU that has two timers on board. This can be accomplished by chaining the output of one timer (lower 16-bits of 32-bit timer) to the input clock of another (upper 16-bits of 32-bit timer). This requires an external connection between the output of a chosen timer's CCR and the input clock to the second timer. Figure 1 shows this chaining using two Timer_A modules, but any combination of Timer_A or Timer_B can be used.

Upper 16-Bit Count   Lower 16-Bit Count

TA1CCR2   TA0CCR1
TA0CCR1 Output
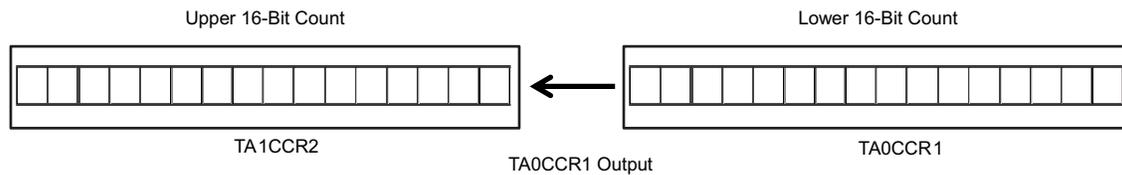
Figure 1. Example of Timer Chaining Using TA0 and TA1

> **NOTE:** This example uses TA0CCR1 and TA1CCR2, but any CCR can be used with the exception of CCR0 of a timer.

The CCR of the lower 16-bit timer must be set in such a way that a pulse is sent out to the clock of the upper 16-bit timer every time the lower timer overflows. This is done by setting the lower timer CCR to continuous mode with OUTMOD = 7 settings. CRR0 is set to the maximum count (0xFFFF) and the chosen CCR is set to 0x0000 (see Figure 2).

TxCCR0
0xFFFF

TxCCR1
0x0000
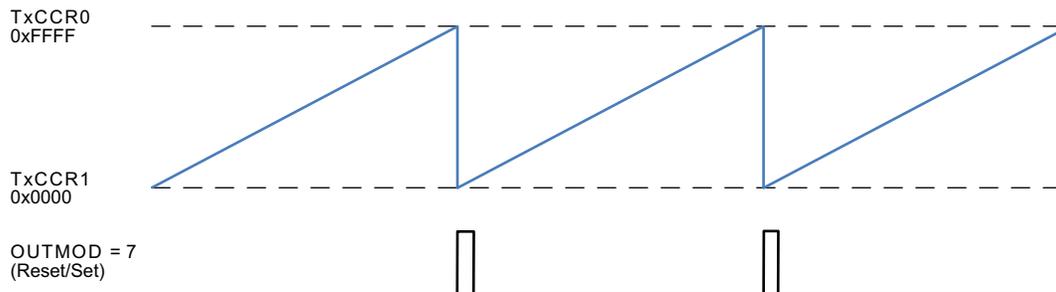
OUTMOD = 7
(Reset/Set)

Figure 2. CCR Settings and Generated Output

2 Example Code

From this point the chained timer can be used as a single 32-bit timer. This chaining method leaves the bulk of Timer_A or Timer_B functionality for the user to use in their application, and thus extends Timer_A and Timer_B functionality to 32-bits. This is the extent of functionality provided within the example software included with this document. Depending on the application, some additional software overhead may be needed to combine the two 16-bit values for application use. Care must be taken to stop both timers by changing the timer mode to "Stop" before reading these values. For more information, see the timer section of the applicable device user guide.

Example code provided was originally developed on the MSP430FR5969 LaunchPad™ development kit, but any MSP430 MCU with two timers, with one timer having an external input clock available, can be used. A C code example and a DriverLib example are included in http://www.ti.com/lit/zip/slaa726.

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