



Module 13

Activity: Timers



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Question 1

There is a 32-bit timer on the MSP432. If this timer is clocked at 12 MHz, what is the slowest period at which you could create a periodic interrupt?

Question 2

Read the MSP432 data sheet on the 32-bit timer. Write software that uses this timer to execute a periodic task, Task(), once a second.

Question 3

Use the Timer A2 example without changing the Timer A2 initialization, from the lecture slides, to run Task1 once a second, Task2 twice a second, and Task3 three times a second. To reduce latency, set it up so no two tasks run during the same ISR. Assume SMCLK is 12 MHz.

Question 4

Write software to generate four PWM cycles with period 1ms, but have independent duty cycles.

Question 5

List all the MSP432 pins that could be used to generate PWM outputs.

Question 6

Read the MSP432 data sheet for the **Timer_A** module. Describe the behavior of this software system, assuming the main program calls **TimerA0_Init** and then enables interrupts.

```
#define N1 1000
#define N2 1500
#define N3 2000
void TimerA0_Init(void) {
    TA0CTL &= ~0x0030;    // 0) halt Timer A0
    TA0CTL = 0x0240;    // 1) SMCLK, divide by 2
    TAOEX0 = 0x0005;    // divide by 6
    TA0CCTL1 = 0x0010;  // 2) compare mode, arm CCIFG
    TA0CCTL2 = 0x0010;  // compare mode, arm CCIFG
    TA0CCTL3 = 0x0010;  // compare mode, arm CCIFG
    TA0CCR1 = N1/2;     // 3) time of first interrupt
    TA0CCR2 = N2/2;     //
    TA0CCR3 = N3/2;     //
    NVIC_IPR2 = (NVIC_IPR2&0xFFFF00FF)|0x00004000;
    NVIC_ISER0 = 0x00000200; // 5) enable interrupt 9
    TA0CTL |= 0x0024;    // 6) reset and start
}

void TA0_N_IRQHandler(void) {
    if(TA0CCTL1&0x0001){
        TA0CCTL1 &= ~0x0001; // acknowledge interrupt 1
        TA0CCR1 = TA0CCR1+N1; // set up for next time
        Task1(); // execute user task
    }
    if(TA0CCTL2&0x0001){
        TA0CCTL2 &= ~0x0001; // acknowledge interrupt 2
        TA0CCR2 = TA0CCR2+N2; // set up for next time
        Task2(); // execute user task
    }
    if(TA0CCTL3&0x0001){
        TA0CCTL3 &= ~0x0001; // acknowledge interrupt 3
        TA0CCR3 = TA0CCR3+N3; // set up for next time
        Task3(); // execute user task
    }
}
```

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
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