# TI-RSLK MAX

Texas Instruments Robotics System Learning Kit

Texas Instruments

# 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
  TA0EX0 = 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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