

**Faculty of Engineering and Technology**

**Electrical And Computer Engineering Department**

**Computer Design Lab**

**ENCS4110**

**Assembly Addressing Modes Lab Report**

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# Abstract:

In this experiment, we will discuss TM4C123 Timer interrupt programming on ARM Cortex M4 microcontrollers. First, we will see applications of timer interrupt, the general-purpose timer module TimerA module will be configured, and initialized to generate a 1s periodic interrupt. All this by using **Keil uVision5.**

# Contents

[Abstract: 2](#_Toc104752901)

[Contents 3](#_Toc104752902)

[Theory: 4](#_Toc104752903)

[Procedure: 4](#_Toc104752904)

[ TM4C123 Timer Interrupt Example Code: 4](#_Toc104752905)

[ In-Lab Task: 5](#_Toc104752906)

[1. Modify the code above to make the GREEN LED blinks every 500ms. 5](#_Toc104752907)

[2. Modify the code above to make the RED LED blinks every 4s. 6](#_Toc104752908)

[Conclusion: 7](#_Toc104752909)

# Theory:

What are the General Purpose Timers Interrupt?

Timer interrupts allow you to perform a task at very specifically timed intervals regardless of what else is going on in your code[[1]](#footnote-1). In our experiment, Programmable general-purpose timer modules (GPTM) of TM4C123 microcontroller can be used to count external events as a counter or as a timer. For example, we want to measure an analog signal with the ADC of TM4C123 microcontroller after every one second. By using GPTM, we can easily achieve this functionality[[2]](#footnote-2).

# Procedure:

## TM4C123 Timer Interrupt Example Code:

This is a timer interrupt example code of TM4C123 Tiva C Launchpad generates a delay of one second using Timer1A interrupt handler routine.

.c Code:

#include "TM4C123.h" // Device header file for Tiva Series Microcontroller

#define Blue (1<RCGCGPIO |= 0x20; // turn on bus clock for

GPIOF GPIOF->DIR |= Blue; // set blue pin as a digital output pin

GPIOF->DEN |= Blue; // Enable PF2 pin as a digital pin

Time1A\_1sec\_delay();

while(1) { // do nothing wait for the interrupt to occur } }

/\* Timer1 subtimer A interrupt service routine \*/

TIMER1A\_Handler() {

if(TIMER1->MIS & 0x1)

GPIOF->DATA ^= Blue; /\* toggle Blue LED\*/

TIMER1->ICR = 0x1; /\* Timer1A timeout flag bit clears\*/

}

void Time1A\_1sec\_delay(void) {

SYSCTL->RCGCTIMER |= (1<CTL = 0; /\* disable timer1 output \*/

TIMER1->CFG = 0x4; /\*select 16-bit configuration option \*/

TIMER1->TAMR = 0x02; /\*select periodic down counter mode of timer1 \*/

TIMER1->TAPR = 250-1; /\* TimerA prescaler value \*/

TIMER1->TAILR = 64000-1 ; /\* TimerA counter starting count down value \*/

TIMER1->ICR = 0x1; /\* TimerA timeout flag bit clears\*/

TIMER1->IMR |=(1<<0);

TIMER1->CTL |= 0x01; /\* Enable TimerA module \*/

NVIC->ISER[0] |= (1<<21);

## In-Lab Task:

### Modify the code above to make the GREEN LED blinks every 500ms.

The code:

#include "TM4C123.h" // Device header file for Tiva Series //Microcontroller

#define Green (1<<3) // PF3 pin of TM4C123 Tiva Launchpad, Green LED

void Time1A\_1sec\_delay(void);

int main(void) { /\*Initialize PF3 as a digital output pin \*/

SYSCTL->RCGCGPIO |= 0x20; // turn on bus clock for GPIOF

GPIOF->DEN |= Green;

GPIOF->DIR |= Green; // set Green pin as a digital output pin

Time1A\_1sec\_delay();

while(1) { // do nothing wait for the interrupt to occur }

} /\* Timer1 subtimer A interrupt service routine \*/

TIMER1A\_Handler() {

if(TIMER1->MIS & 0x1)

GPIOF->DATA ^= Green; /\* toggle Green LED\*/

TIMER1->ICR = 0x1; /\* Timer1A timeout flag bit clears\*/

}

void Time1A\_1sec\_delay(void) {

SYSCTL->RCGCTIMER |= (1<<1); /\*enable clock Timer1 subtimer A in run mode \*/

TIMER1->CTL = 0; /\* disable timer1 output \*/

TIMER1->CFG = 0x4; /\*select 16-bit configuration option \*/

TIMER1->TAMR = 0x02; /\*select periodic down counter mode of timer1 \*/

TIMER1->TAPR = 125-1; /\* TimerA prescaler value \*/

TIMER1->TAILR = 128000-1 ; /\* TimerA counter starting count down value \*/

TIMER1->ICR = 0x1; /\* TimerA timeout flag bit clears\*/

TIMER1->IMR |=(1<<0); /\*enables TimerA time-out interrupt mask \*/

TIMER1->CTL |= 0x01; /\* Enable TimerA module \*/

NVIC->ISER[0] |= (1<<21); /\*enable IRQ21 \*/

}

### Modify the code above to make the RED LED blinks every 4s.

The code:

#include "TM4C123.h" // Device header file for Tiva Series Microcontroller

#define Red (1<<1) // PF3 pin of TM4C123 Tiva Launchpad, Red LED

void Time1A\_1sec\_delay(void);

int main(void) {

/\*Initialize PF3 as a digital output pin \*/

SYSCTL->RCGCGPIO |= 0x20; // turn on bus clock for GPIOF

GPIOF->DEN |= Red;

GPIOF->DIR |= Red; // set red pin as a digital output pin

Time1A\_1sec\_delay();

while(1) { // do nothing wait for the interrupt to occur }

}

/\* Timer1 subtimer A interrupt service routine \*/ TIMER1A\_Handler() {

if(TIMER1->MIS & 0x1)

GPIOF->DATA ^= Red; /\* toggle Red LED\*/

TIMER1->ICR = 0x1; /\* Timer1A timeout flag bit clears\*/

}

void Time1A\_1sec\_delay(void) {

SYSCTL->RCGCTIMER |= (1<<1); /\*enable clock Timer1 subtimer A in run mode \*/

TIMER1->CTL = 0; /\* disable timer1 output \*/

TIMER1->CFG = 0; /\*select 16-bit configuration option \*/

TIMER1->TAMR = 0x02; /\*select periodic down counter mode of timer1 \*/

TIMER1->TAILR = 64000000-1 ; /\* TimerA counter starting count down value \*/

TIMER1->ICR = 0x1; /\* TimerA timeout flag bit clears\*/

TIMER1->IMR |=(1<<0); /\*enables TimerA time-out interrupt mask \*/

TIMER1->CTL |= 0x01; /\* Enable TimerA module \*/

NVIC->ISER[0] |= (1<<21); /\*enable IRQ21 \*/

}

# Conclusion:

In conclusion, we learnt about TM4C123 Timer interrupt programming on ARM Cortex M4 microcontrollers. First, we dealt with applications of timer interrupt in many exercises and examples.

1. https://www.instructables.com/Arduino-Timer-Interrupts/#:~:text=Timer%20interrupts%20allow%20you%20to,Compare%20Match%20or%20CTC%20Mode. [↑](#footnote-ref-1)
2. Manual lab [↑](#footnote-ref-2)