**Lab Experiment 1: Playing musical tones through a buzzer**

**Introduction:**

This lab introduces students to the EduBase-V2 Trainer board and the Tiva EK-TM4C123GXL Launchpad. I

**Procedure:**

For this lab we will be using the on-board speaker on the EduBase-V2. The board has a speaker at the PortC4. This is the one that we will be using for playing musical tones. 50 MHz clock will be used for this lab.

PortC4 is the name of the Pin that is on the EduBase-V2 board. The Pin # is 7 of J19. J19 is the on-board jumper. This information can be found in the “EduBase V2 Trainer User’s Guide for TI ARM Launchpad Version 1.1.”

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The guide can be downloaded from this link: <http://www.microdigitaled.com/EduPad/EduBaseV2_TI_Arm_MSP432Tiva_user_guide_ver1.13.pdf>

There is more information in the guide regarding different ports and interfaces on the board.

The TM4C123GH6PM Microcontroller has six GPIO ports i.e., PORTA, PORTB, PORTC, and PORTD. Each port has a different number of pins. Since, the speaker is connected to the PORT C, therefore we will need to enable and configure the PORTC. You can find more information about the different GPIO ports on the TIVA,

Therefore, the first step in this lab is to configure the GPIO PORT C. You can find more information about different GPIO ports on the micro controller by reading through the data sheet which can be downloaded from the following link:

<https://www.ti.com/lit/ds/spms376e/spms376e.pdf?ts=1670842727881&ref_url=https%253A%252F%252Fwww.google.com%252F>

**Step 1: Clock configuration**

The first step in GPIO configuration is to enable the clock for the peripheral that we want to use. A register known as RCGCGPIO (Clock gating GPIO register) is responsible for enabling the clock. This register provides your software, the ability to enable and disable the GPIO modules. You will need to write a particular bit field for the required GPIO port in the RCGCGPIO.

RCGCGPIO register is mapped to the address 0x400FE608. All these memory address mappings are provided in the datasheet of TM4C123GH6PM microcontroller. The bit 0 to bit 5 of RCGC\_GPIO\_R register are used to enable the port A to port F on the peripherals respectively. By default, all the clock on all GPIO ports is disabled in order to save power. Note: Even if you want to use a few pins from the GPIO port, you **must** enable the clock for that particular GPIO port.

Note, we are setting BIT 2 to 1, since we are using PORT C. The equivalent hexadecimal value is 0x04.

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**Step 2: Bus selection:**

The next step is to select the bus configuration. Every GPIO port can be accessed either using APB bus (Advanced peripheral bus) or AHP bus (Advanced performance bus). The bus selection is done by selecting the appropriate base address. This base address can be found in Page 663 of the data sheet.

As you can see, in this table, every port has two different base address: one for the APB bus and the other one for the AHP bus. For this lab we will be selecting the APB bus for accessing the Port C.

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**Step 3: GPIO registers**

Every GPIO port comes with a set of registers that are using for performing different configuration steps

The next step is to configure the GPIODIR direction control register. This register decides whether we want to configure our pin as a “digital” output or “digital” input. Setting a bit in the GPIODIR register configures the corresponding pin to be an output, while clearing a bit configures the corresponding pin to be an input. All bits are cleared by a reset, meaning all GPIO pins are inputs by default. More information about direction register can be found on page 663 of the data sheet.

Note, we are using pin 4 of the GPIO port C, which means we will need to set that particular pin as a digital output. You will need to first find the address range of the Port C from the data sheet