# **EEC 345 Microprocessor Electronics**

# **Lab 3: Toggling LED**

## **Objectives**

* Create a program that toggles the LED.
* Utilize loops.

## **Part 1: Enabling PORTB output**

By default, PORTB output will not be enabled. In order to enable it type the following code:

**LDAA #$FF**

**STAA DDRB**

Storing the value of $FF in DDRB enables PORTB.

## **Part 2: Displaying on the LED**

We will be able to display something on the screen by storing a value in PORTB. Try the following:

**BACK**

**LDAA #$FF**

**STAA PORTB**

**BRA BACK**

Q: What is displayed on the board?

The program puts the board in a loop that constantly flashes a red light at URX and caused DSP1-4 display the number 8.

## **Part 3: Make the LED blink**

By storing 0 in PORTB, the screen will become blank. To make the LED blink we need to alternate between #$FF and #$0 in PORTB. The following code achieves this:

**BACK**

**LDAA #$FF**

**STAA PORTB**

**LDAA #$0**

**STAA PORTB**

**BRA BACK**

Q: Does this code work properly? What is wrong with it? *Hint: Use F11 while debugging to step through your code slowly.*

*No. There is no delay so we aren’t able to see the LED blink. This happens too quickly.*

## **Part 4: Creating a Delay**

We can use loops to create a delay in between each instruction. (**<Loop>** is a placeholder)

**BACK**

**LDAA #$FF**

**STAA PORTB**

**<Loop>**

**LDAA #$0**

**STAA PORTB**

**<Loop>**

**BRA BACK**

Create a loop (or several loops) in place of **<loop>** above so that there is long enough delay for the blinking to be viewable to the human eye. *Hint: Can you make a loop inside of another loop?*

**Useful Commands:**

**BNE <label> – Branch to <label> if not equal to zero**

**DEC <label> - Decrement the value assigned to <label>**

**JSR <label> - Jump to <label> temporarily**

**RTS – Jump back to the location where JSR was used**

**R1 EQU $1001**

**R2 EQU $1002**

**R3 EQU $1003**

**LDAA #$FF**

**STAA DDRB**

**BACK**

**LDAA #$FF**

**STAA PORTB**

**JSR DELAY**

**LDAA #$00**

**JSR DELAY**

**BRA BACK**

**DELAY**

**LDAA #10**

**STAA R3**

**L3**

**LDAA #100**

**STAA R1**

**L1**

**LDAA #240**

**STAA R2**

**L2**

**DEC R2**

**BNE L2**

**DEC R1**

**BNE L1**

**DEC R2**

**BNE L3**

**RTS**

**We are nesting loops in order to create a larger time delay. One loop isn’t enough since we don’t have enough room in accumulator A for a large number.**