

Course Name: EMBEDDED SYSTEMS I / III

Course Number and Section: 14:332:493:03

Year: Spring 2021

Lab Report #: Lab 0

Lab Instructor: Philip Southard

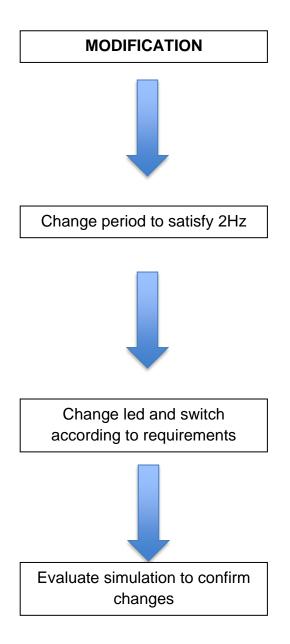
Student Name and RUID: Matthew Hanna; RUID:178001207

Date Submitted: 2/4/2021

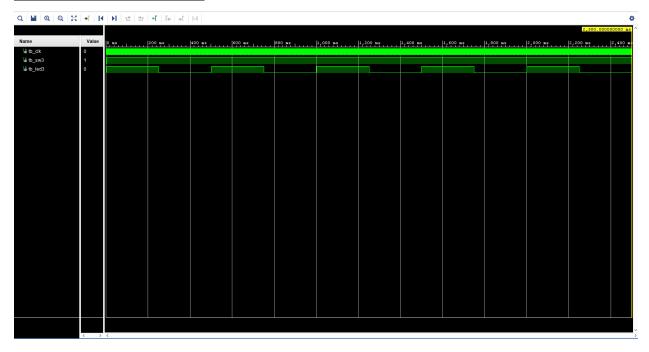
GitHub Link: https://github.com/matthanna99/Blinker-Lab-0

<u>Purpose/Objective:</u> The objective of this lab was to introduce counters and constraints through a simple medium which was the "blinker." In the modification portion of the lab, we were tasked with changing the blinking rate to 2Hz instead of 1Hz.

Theory of Operation:

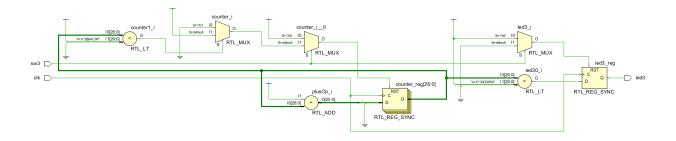


Simulation Waveforms:



Vivado Schematics:

a) Vivado Elaboration Schematic



In the constraint file, the desired ports were changed to satisfy the conditions stated in the modification portion of the lab. Instead of switch 0 and led 0, the desired pins were changed to switch 3 and led 3.

Answers to Additional Questions and Extra Credit:

Setup and Analysis Questions

- 1. Since the frequency is 1 Hz, the period is 1 second. If we used a duration in nanoseconds, we would not have noticed a change from low to high and vice versa.
- 2. The counter was 0 before the switch went high. After the switch went high, the counter would increment until it reached 62500000. The light would turn off when it hit that number and would stay off until the counter reached 124999999. This process would repeat until the end of the simulation period.
- 3. The count value was set to 124999999 because the clocks frequency is 125 MHz and we desired a 1Hz frequency. The counter begins at 0 and goes to 124999999 which is 125000000 values. The light is on for half of the period so that is half of 125000000, or 62500000.
- 4. The simulation does behave as expected because the frequency is 1HZ and the led remains high for half of the period.

Modification

- 1. The new counter value is 62499999. We need the light to blink at twice the frequency. Moreover, we have to divide the period by two. To get the led to stay on for half of the period, we divided 62500000 by 2 which is 31250000.
- 2. The desired led and switch were changed to switch 3 and led 3. I changed the parameters in the vhd, constraint, and test bench files.
- 3. The target switch and led changed from switch0 and led0 to switch 3 and led 3.

Conclusion:

The purpose of this lab was to understand the use of counters and constraints by manipulating a blinker. By simulating before the modifications, I was able to understand how the code works and the next part became a matter of changing the period to fulfill the requirements. When simulating with the modifications, I observed that the new period was 500ms and the blinker would remain on for 250ms. After generating the bitstream, I confirmed that led3 on the board was targeted and blinking at the proper rate.

<u>Follow Up:</u> I completely understood the function of the counter and the purpose of the clock. I did not understand what 26 downto 0 meant until the demo session, where I learned that it describes the number of total bits the counter can use.