Som Wakdikar sw38937
Kevin Tong kyt259
17710

# Lab 3 Report

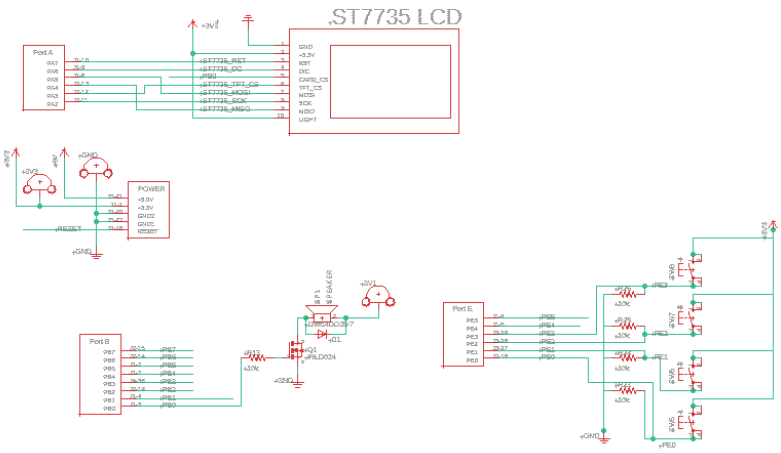
## OBJECTIVES

The objective is to design, build, and test an alarm clock. Through this process we will learn how to design and test modular software and how to perform switch/keypad input in the background.

## HARDWARE DESIGN

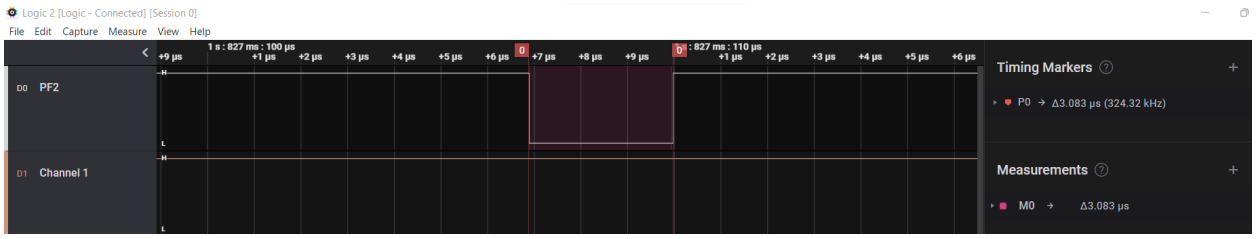
Uploaded on GitHub:
https://github.com/EE445L-FALL-2022/lab-3-som-wakdikar-kevin-tong-3/tree/main/hw

1a.




*Drawing of Electrical Circuit used to create the Alarm Clock*

1b.




*Measurement of how long it takes the LCD display to update*

## SOFTWARE DESIGN

Uploaded on Github: https://github.com/EE445L-FALL-2022/lab-3-som-wakdikar-kevin-tong-3

## MEASUREMENT DATA

2.

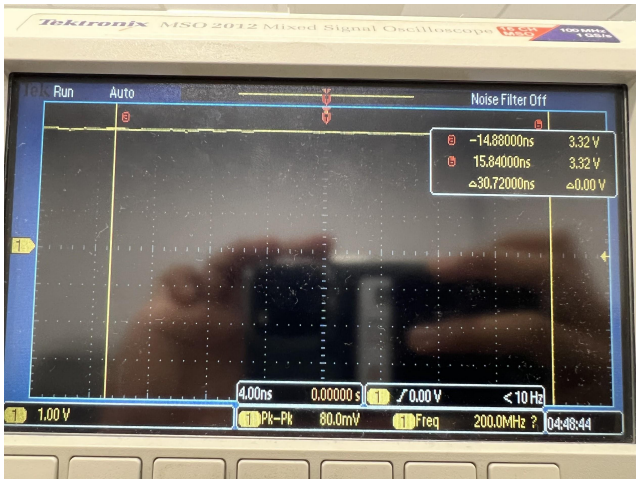



*Photo of oscilloscope showing the noise on the 3.3V without alarm.*

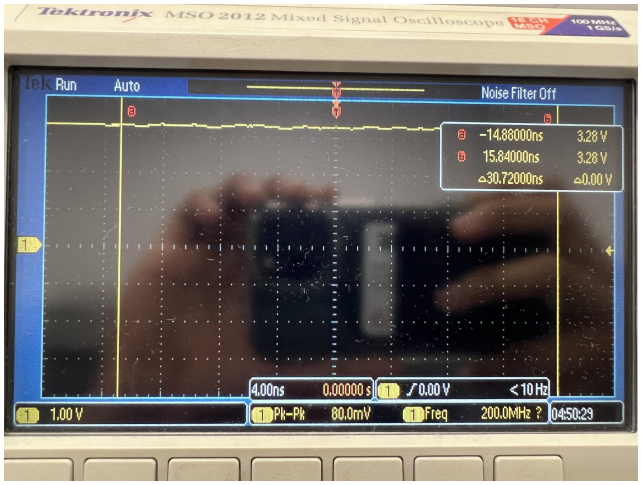



*Photo of oscilloscope showing noise on the 3.3V with alarm.*

3a.

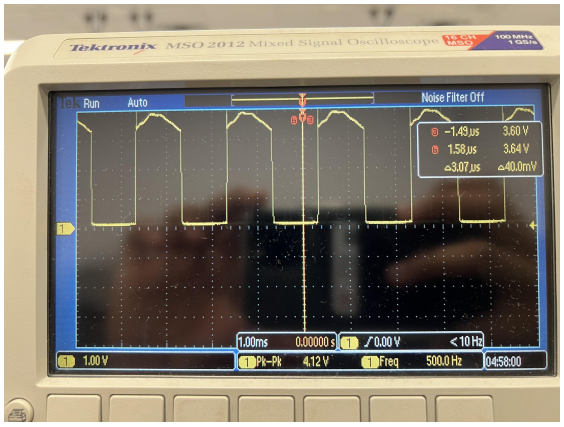



*Photo of oscilloscope measuring the drain pin of the MOSFET, showing that the voltage oscillates with a frequency of 500 Hz.*

<u>Current through speaker:</u>

V = I * R

I = V / R

According to the oscilloscope measurements:

V = 3.64V

According to the data sheets and circuit diagram:

R = resistance of alarm + resistance of resistor

R = 8 + 10 = 18 Ohms

I = 3.64V / 18 Ohms = 202 mA

I = 202 mA

4.

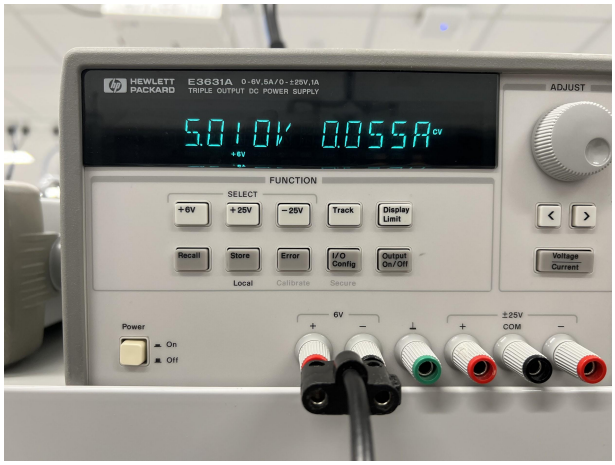



*Photo of DC power supply when the TM4C123 is drawing current from it.*

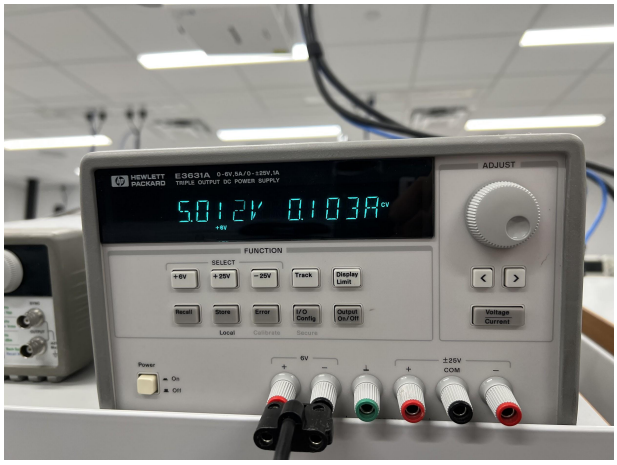



*Photo of DC Power supply when TM4C123 and LCD Display are drawing current from it.*

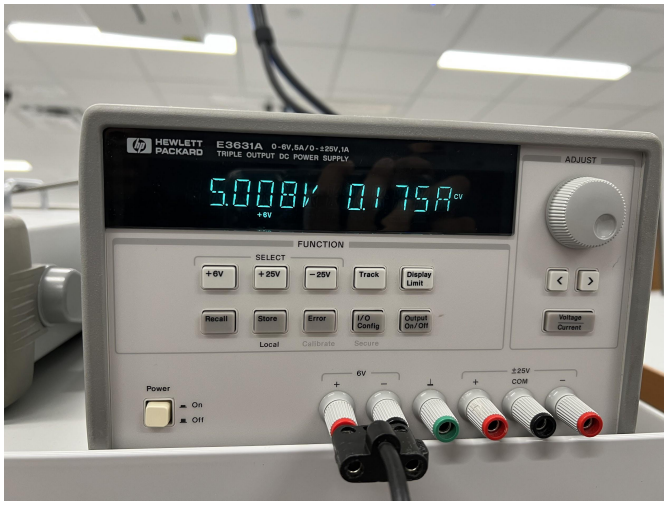



*Photo of DC Power supply when TM4C123, LCD Display, and alarm are drawing current from it.*

According to the measurements of the DC Power supply, the TM4C123 uses a current of 55 mA, the LCD Display uses a current of 48 mA, and the alarm uses a current of 72 mA. In total, the entire system uses around 175 mA.

The power of the system is calculated with the formula P = I * V. According to the 3rd photo, the entire system has a 5.008V voltage and a current of 0.175A. Using the formula, the power used by the entire system is 0.8764 Watts.

**ANALYSIS AND DISCUSSION**

1. Give two ways to remove a critical section.

One way to remove a critical section includes disabling/enabling interrupts before and after the lines of code of the critical section. The other way to remove this critical section is by using bit-specific addressing in which only the accessed pin is changed and not the whole port. This avoids critical sections when multiple functions access the same port.

2. What would be the disadvantage of updating the LCD in the background ISR?

The disadvantage of updating an LCD in the background ISR is jitter. This causes jitter because transferring data to the LCD is slow in comparison to the TM4C clock.

3. Did you redraw the entire clock for each output? If so, how could you have redesigned the LCD update to run much faster, and create a lot less flicker? If not, how did you decide which parts to redraw?

We did not redraw the entire clock for each second or each time the while loop updates. This causes flickering on the LCD screen. Global flags can be set to only update the display in the main function. We decided what parts to redraw based on what changes. For example, the hands of the clock will change every second because of the second hand. Another example includes changing to the menu display, which requires another flag to update graphics.

4. Assuming the system were battery powered, list three ways you could have saved power.

One way to conserve power is to update the display only when necessary and when something changes on the display, as mentioned above. Another way to conserve power is to add a resistor in series with the speaker to limit current flow into the speaker. The final way is to completely turn off the LCD display when it is not being used.