CS 241 Lab 12
(DC-DC Converter)

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1 Answers to Questions

- **Assignment 0:** *Hit Code → Serial Monitor → Plot icon (bottom right). Push the button, and notice the voltage spike. Is it possible for the real circuit voltage to exceed the 5V supply voltage, or is this a simulation artifact?*
- We observed the rise and fall across the plot, but it is not possible to exceed the 5V supply voltage (not a simulation artifact, either).
- *Switch the meter to current mode ("A" setting, for amps). Hold the button, and watch the current reading. Tap the button repeatedly, and watch the current reading. About how much current do you get when doing each one? Why?*
- 500 mA for constantly holding; 635 mA with tapping.
- *Switch the meter back to voltage ("V" setting, for volts). Tap the button lightly, leaving it off most of the time. What happens to the voltage? Tap the button hard, leaving it pressed most of the time. What happens now? What's the relationship between the button "duty cycle" (percent on time) and the output voltage?*

- Tapping the button lightly (slight rise and fall), whereas tapping it hard leads to a higher maximum voltage.
- As the button duty cycle increases, we notice the Serial Monitor plot changes with more variance. A longer percent on time corresponds to a more rapid increase in the output voltage. On the other hand, leaving the button off most of the time yields a smoother sinusoidal shape.
- **Assignment 1:** *Set pinMode OUTPUT and manually digitalWrite values to the FET gate pin. Which value makes the FET conduct? Which makes it not conduct? Is this normal for a P-channel FET?*
- Setting pinMode (OUTPUT) and digitalWrite (LOW) to pin 3 make the system conduct. To make the FET not conduct set the digitalWrite to HIGH – relating to a switch from the ground of 0V to 5V.
- *Write code to adaptively set the FET gate pin with a digitalWrite every time through loop(), to try to maintain an output voltage of 3.7VDC, which is the charge voltage for a 1S LiFePo battery cell.*
- See attached code snippet below.
- *Vary the load resistance by manually changing the bottom right load resistor's value. How low a resistance can you feed before your voltage consistently drops below 3.7V?*
- With variable load resistance, we cannot go below 950 Ω.
- *What happens with a load resistance of 22000 ohm? Why? Would changing the capacitor values affect this, and how?*
- With a load resistance of 22000 Ω, we see a spike to 4.88 volts. Removing the delay ultimately pushes the voltage up above our maximum without delay.
- Changing the capacitor values does not impact the load resistance.

2 Appendix

2.1 Source Code

```
// Benjamin Stream & Solomon Himelbloom
// Assignment 1

const int RELAY_PIN = 3;
bool FET_GATE_VALUE = 1;

void setup() {
  Serial.begin(9600);
  pinMode(RELAY_PIN,OUTPUT);
}

void loop() {
    int rawVoltage=analogRead(A0);
    float V=rawVoltage*(5.0/1023);
    Serial.println(V);
    digitalWrite(RELAY_PIN,FET_GATE_VALUE);
    FET_GATE_VALUE = !FET_GATE_VALUE;
    delay(8);
}
```