EGR326 F'09

Assignment #2

Due Date: **Monday, September 21, 11:00 AM**

Analytical Exercises

1. Lecture Notes Chapter 2 Exercise #3 (page 94).
2. Lecture Notes Chapter 2 Exercise #9 (page 94).

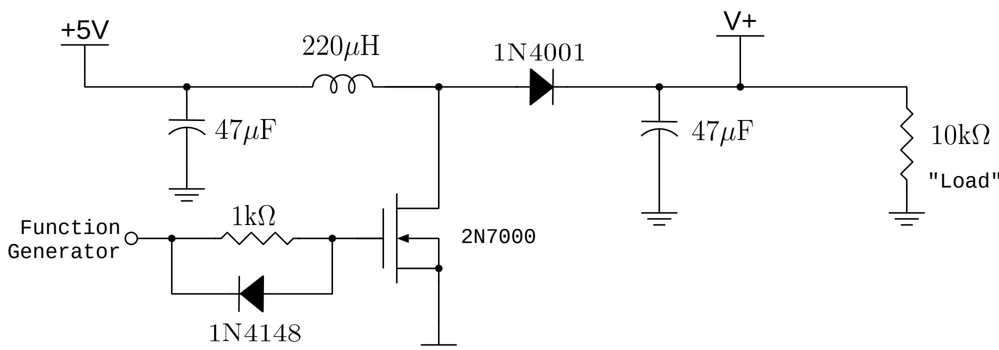
Laboratory Exercises

1. This exercise is similar to Lecture Notes Chapter 2 Laboratory Exercise #7 (page 99).

   Use the following procedure.

   - Use the bench power supply current limited to 150mA[1]. To set this current limit, set the output voltage to 2V and turn the current limit knob fully counterclockwise (minimum current). Short the power supply outputs together then turn the power supply on. Set the power supply's readout switch to amps. Now turn the current limit knob clockwise until the current display reads 0.15A. Remove the short from the power supply outputs – the supply is now current-limited to 150mA.
   - Set your function generator for square-wave pulses at a frequency of 40 kHz, 5% duty cycle, varying from 0V to 10V. Make sure to **use an oscilloscope to verify** that the function generator output does not go below 0V or above 10V before hooking it up to any circuit.
   - Build the circuit below. 220μH iron-core inductors are provided in the laboratory. Any 1N400x diode will do instead of a 1N4001 (e.g., 1N4002, 1N4004).

     Take note that the 47μF electrolytic capacitors are polarized and must be inserted the right way. A white stripe with a - sign in it along the side of the capacitor indicates the NEGATIVE terminal.



   - Use an oscilloscope to probe the V+ output and turn the +5V supply on, then turn the function generator on. Adjust the function generator's duty cycle until the V+ output has an average value of about +10V. Do not exceed 25% duty cycle.
   - Use the second channel on the oscilloscope to probe the V+ output in AC-coupled mode. Set the volts-per-division setting on the second channel to 50mV/div and measure the amplitude of the ripple on the V+ output. You should have channel 1 measuring average voltage (DC coupled) and channel 2 measuring ripple amplitude (AC coupled).

[1]This step is necessary to limit inductor and transistor current in case you mistakenly allow the transistor to be ON continuously.

- Vary the duty cycle and note how this changes the V+ output voltage. Record and report your results in a graph (results are average voltage AND amount of ± ripple around this voltage for each duty cycle). Do not exceed 25% duty cycle.
- Return to the duty cycle that maintains a nominal +10V output and set the frequency to a variety of values, going to at least a factor of 2 in both directions (i.e., 20kHz to 80kHz). Record and report your results in a graph (results are average voltage AND amount of ± ripple around this voltage for each frequency).
- Return to a frequency of 40kHz and duty cycle for nominal +10V output. Connect the electronic load in parallel with the 10kΩ load resistor and vary the load current in order to explore this circuit's load regulation characteristics. Record and report your results in a graph (results are average voltage AND amount of ± ripple around this voltage for each value of load *current*).

  NOTE: Think about why we simply shouldn't *replace* the 10kΩ resistor with the electronic load. With nowhere to go, the current flow will accumulate charge on the capacitor increasing its voltage indefinitely (at least in theory), possibly exceeding its voltage rating. The 10kΩ resistor ensures that the inductor current always has somewhere to go.

  When your electronic load starts drawing "too much current", your power supply will go into current limit mode. Consider this a "failure" of your boost converter and make sure you note at what load current level this "failure" occurred (this would represent the maximum current output of your boost converter).

2. Explain whether or not you think this circuit is usable without some kind of feedback to monitor the output voltage and adjust the frequency/duty cycle accordingly to maintain a steady output voltage. Justify your comments.