Lab 2
Linear regulators

In this lab you will build a discrete-component regulator and configure an IC voltage regulator.

Pre-lab

1. Obtain the data sheets for the different components as necessary. `www.digikey.com` is often a good source.

2. Derive the expression for the ripple in step 2.

3. Answer the question in step 3.

4. Answer the questions in step 10 and 11.

5. Design the circuit in step 14.

Full-wave rectifier

1. Build a full-wave rectifier from four 1N4001 diodes followed by a $100\,\mu$F capacitor. Be sure to observe the correct polarity on the capacitor.

2. Connect the input to a $12\,$V transformer and measure the ripple for several different load resistances between $200\,\Omega$ and $1\,$kΩ, and compare with a theoretical calculation.

Discrete component regulator

3. Explain how the following regulator circuit functions. What is the output voltage, and what is the purpose of the $4.8\,$kΩ resistor?
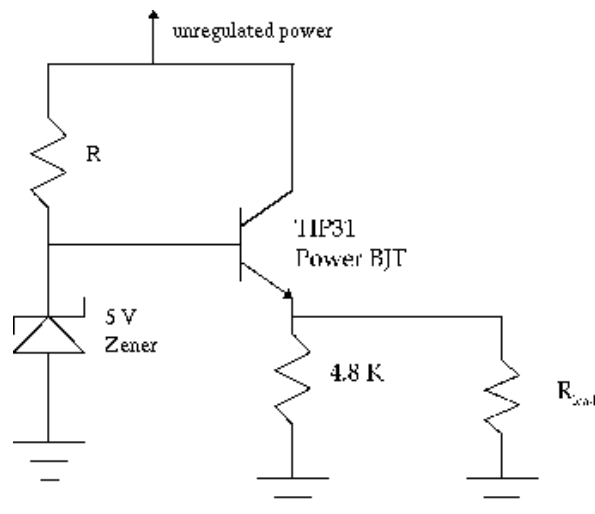
4. Build the circuit, choosing R such that $10\,\text{mA}$ current flows through the zener diode.

5. Measure the output DC voltage for zero current and compare with a theoretical prediction.

6. Measure the ripple at the rectifier, the zener, and the load for several different load resistance between $200\,\Omega$ and $1\,\text{k}\Omega$.

7. What fraction of the output ripple comes from the zener ripple?

8. What is the ripple rejection factor, the output ripple divided by the input ripple.

Current limiter

9. Add a current limiter to your circuit as shown here (leave the $4.8\,\text{k}\Omega$ resistor in place).
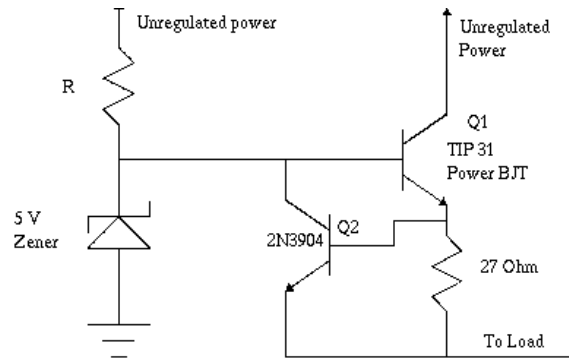
10. Explain how this circuit works.

11. What is the theoretical output current limit of this circuit?

12. Measure and plot the output voltage as a function of the output current by applying several different resistors corresponding to currents both below and above the current limit.

13. Short the output and compare the short circuit current with the theoretical current limit.

IC regulator

14. Use a LM317 to design and build a $5\,\text{V}$ regulator and attach it to the rectifier. Follow the recommendations in the data sheet.

15. Measure the ripple rejection factor for several different load currents and compare with information from the data sheet.

16. What is the short-circuit current?