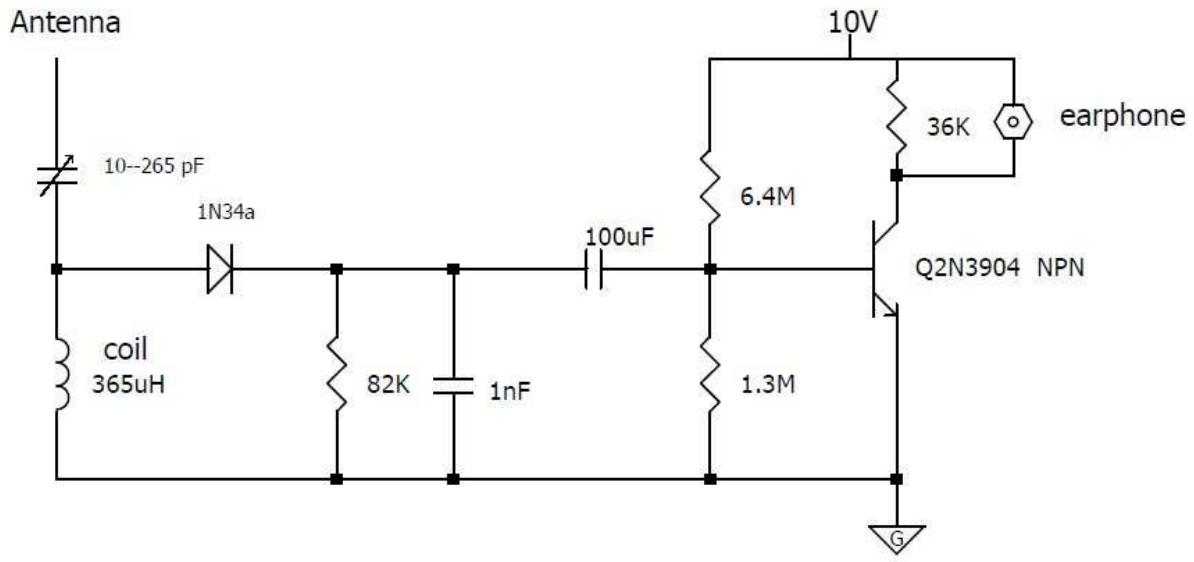
Physics 517/617 Experiment 4B
Transistors II

Basic Experiment - Physics 517/617

1) The following circuit is an AM radio. If you look closely you will also note that it's just an L-C circuit connected to a rectifying circuit amplified by the amplifier you designed and built in Experiment 4A. Note that the amplifier has been rebiased to increase h_{ie}. The coil, variable capacitor, and earphone are available in the far cabinet. The 1N34a is a special germanium diode with a low turn on voltage $\gamma \sim 0.2V$.



2) Our laboratory, being in the middle of the building, is in a very poor location for receiving AM signals. A master antenna has been set up by running a 90 ft wire along the outside of the building. Run a wire from the master antenna to your circuit.

The above guidelines are very rough and may need fine-tuning. Check to see if your transistor is biased properly. If there is no sound from your earphone even after biasing your transistor you might want to remove the L-C circuit and replace it with your function generator in order to debug the circuit.

With this radio you will be able to receive several radio stations. Below is a procedure, which will help you analyze which station you are receiving.

3) When studying filters we learned that the frequency domain is important for understanding how circuits work. Fast Fourier Transforms is a numerical method for solving coefficients of a Fourier transform. To see how this works use your frequency generator to feed a 500 KHz sine wave into your scope. Using the Matlab ScopeGui program obtain a FFT frequency spectrum of this sine wave. How to the peak frequency and amplitude displayed on the FFT compare with what you measure with your oscilloscope. If a square wave is used what is the observed FFT spectrum and what do you expect it to be?

4) Back to the radio. Obtain a FFT frequency spectrum of the raw antenna wire attached to the oscilloscope. You identify several local radio stations. Local radio station frequencies are available on the FCC webpage linked on our class webpage.

5) With your radio tuned to an AM station (listen for FCC call letters e.g. WOSU) obtain frequency spectrums directly before the 1N34A on the diagram above. Additionally obtain a frequency spectrum directly after the 1N34a. Lastly obtain a frequency spectrum of the voltage driving the earphone. Explain these frequency spectra in terms of the workings of a radio.

6) A frequency generator with an amplitude modulated wave is provided if you want to further study the workings of your radio. The carrier frequency is set to 1 MHz, while the modulation is a pure sine wave of frequency 100 Hz.

7) When you write up this lab include the following:

- A description of the radio in terms of basic building blocks (e.g. detector, amplifier, demodulator).
- A description of demodulation.

You should compare the FFT spectrums with what you expect based on the function of each portion of the radio circuit.

Horowitz and Hill, *Art of Electronics* is a useful reference book for this.

No additional work is required for Physics 617