Lab #5: Two-Part Amplifier Design

EE3124: Electronics II

Peter Lam & Calvin Ong

Date of Experiment: May 5, 2017

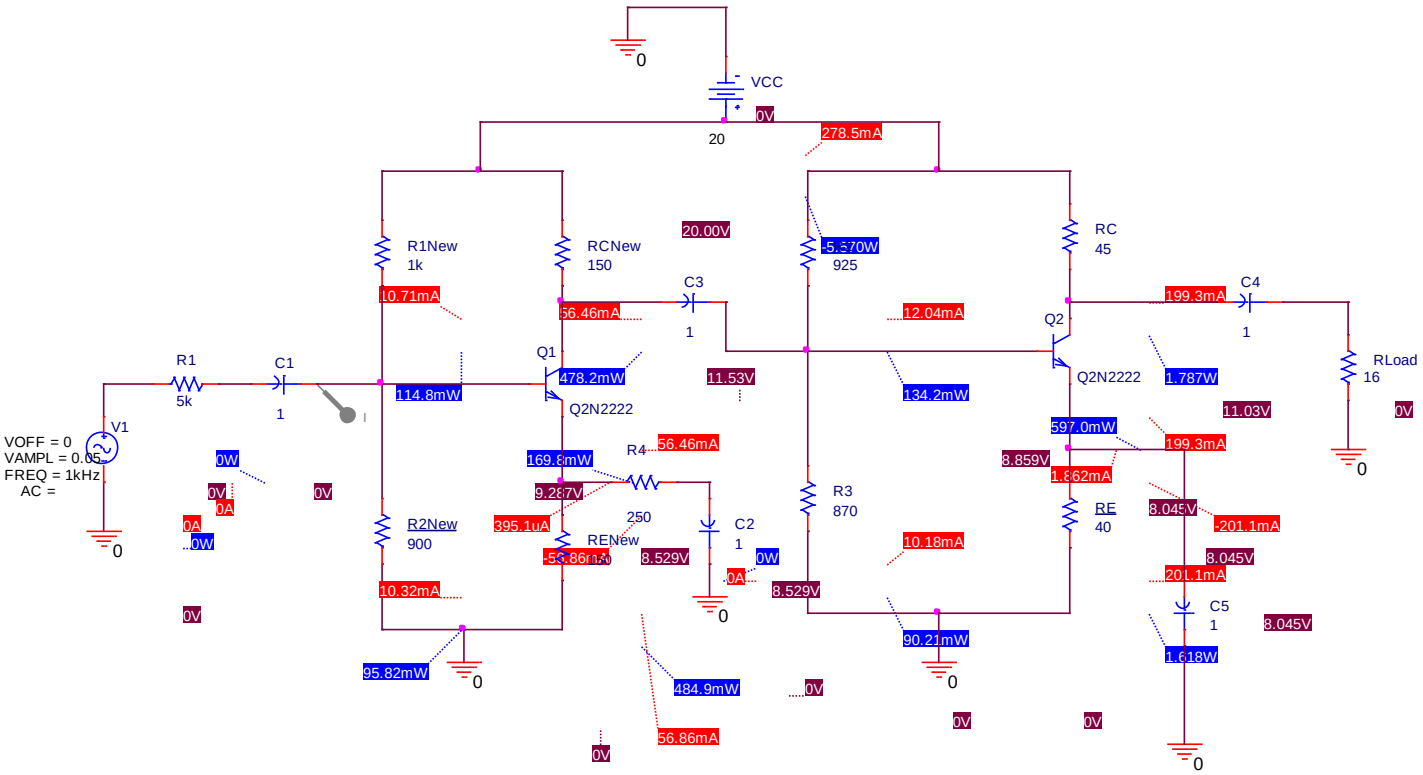
Due Date: May 12, 2017

Introduction

The purpose of this experiment was to test the two stage BJT amplifier we designed for Project 2 and compare the experimental values with the PSpice simulation values and hand calculated values. We designed the experiment according to Calvin's two-stage amplifier and used standard resistors for the circuit.

Experimental Results

The figure below shows the schematic that was used throughout the lab:



From this circuit, I_{CQ}, V_{BEQ}, and V_{CEQ} were measured from the DC operating point for both the Project 1 and Project 2 circuits. I_{CQ} was found by taking the voltage of the resistor flowing over the collector resistor and dividing by the corresponding resistor value. The peak-to-peak swing was tested by inputting a 1 kHz sinusoidal signal to the amplifier and adjusting the function generator until it clipped. The experimental value was found to be 150mVpp. The amplitude was changed to 1-2Vpp. The peak to peak voltage for the input and output signal was measured on the oscilloscope. The peak-to-peak value was then divided by the corresponding resistor value.

$$I_{Load} = \frac{V_{Load\ Pk-to-Pk}}{16\Omega} = \frac{33.9mV}{16\Omega} = 2.12mA\ ;\ I_{Source} = \frac{V_{Source\ Pk-to-Pk}}{5000\Omega} = \frac{33.3mV}{5000\Omega} = 6.66\mu A$$

The gain was calculated as follows:

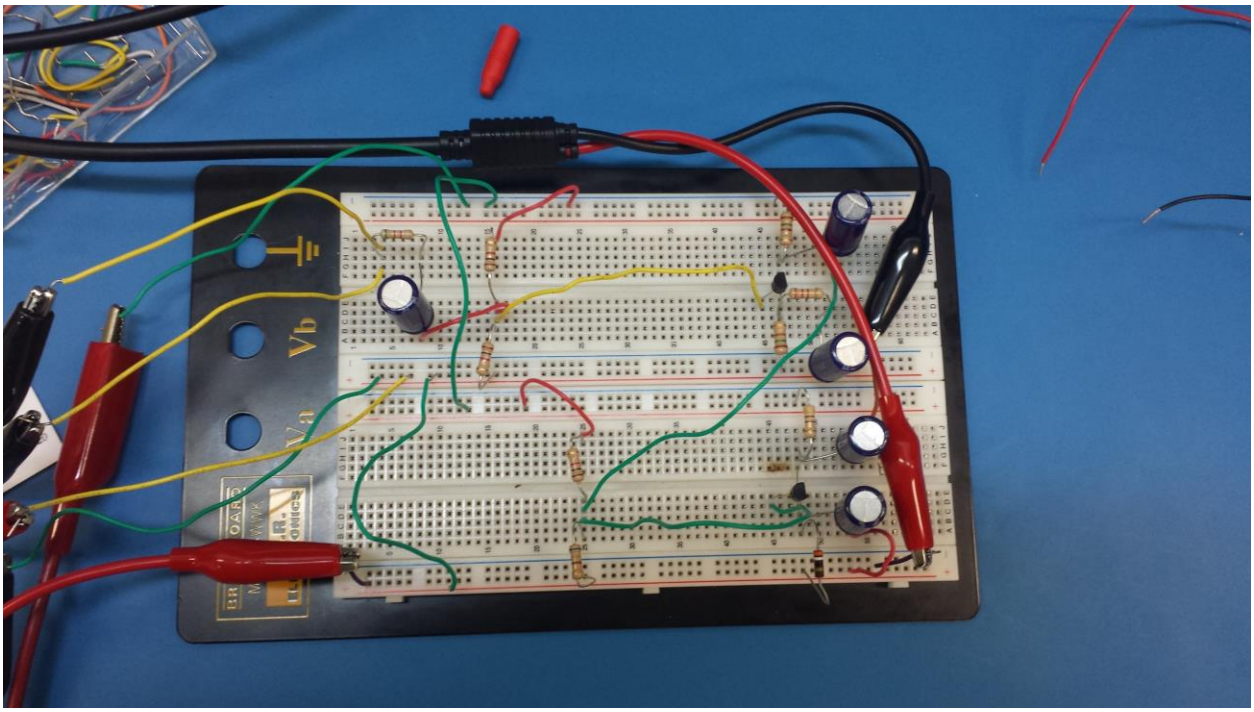
$$A_i = \frac{I_{Load}}{I_{Source}} \frac{2.12mA}{6.66\mu A} = 318.318$$

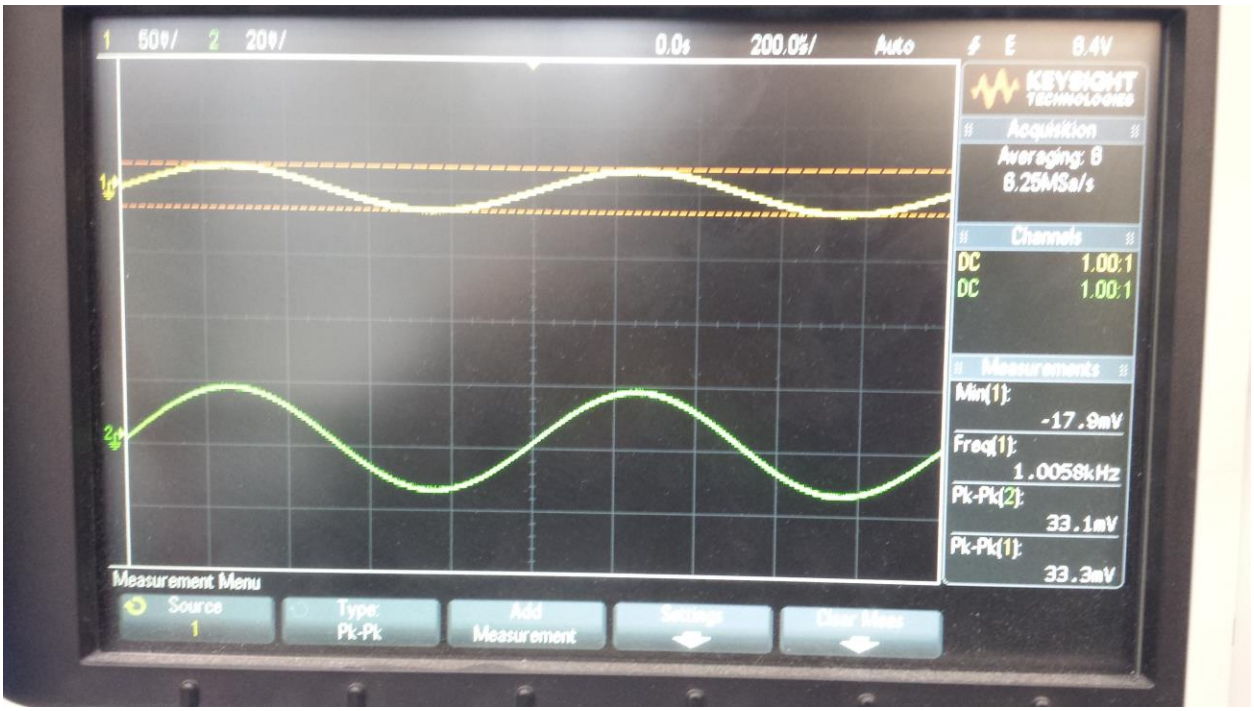
The total gain of the circuit is 318.318 which was more than the requirement for Project 2. The simulated value is 226.246. The load resistor was then replaced with a speaker to test if the circuit design could play sound. We were successful in getting the speaker to play sound and by adjusting the frequency input to around 6.5Khz, the sound would change.

For the first part of the lab we observed the DC values of the power and driver stages of the amplifier. The measured values are shown in the tables below:

Power Stage	
	Measured Values
ICQ	60.5 mA
VCEQ	1.88 V
VBEQ	0.71 V

Driver Stage	
	Measured
ICQ	140 mA
VCEQ	6.02 V
VBEQ	0.66 V





Conclusion:

In conclusion, the experiment was a success. We were able to meet all the requirements for the design of the project and the simulated and experimental values also matched the calculated values. There were minor differences in experimental and calculated values but this may be due to human error. Also when running simulations in PSpice the values for everything are perfect, but in reality the values for all the circuit components and measured values cannot be perfectly the same value for everything. In the Driver Stage, the resistor values used were slightly different from the simulated values. The collector and emitter resistor (RC and RE) were especially sensitive to changes, so the gain was affected significantly by these changes. While the beta was not known, it was a contributor to the changes as expected. In the simulation, changes in beta resulted in different gain values, with beta as 300 being closest to the experimental gain. The transistor in the driver stage was saturated, but the measured 0.66V value may have been due to human error or signal interference from other nearby circuit elements.