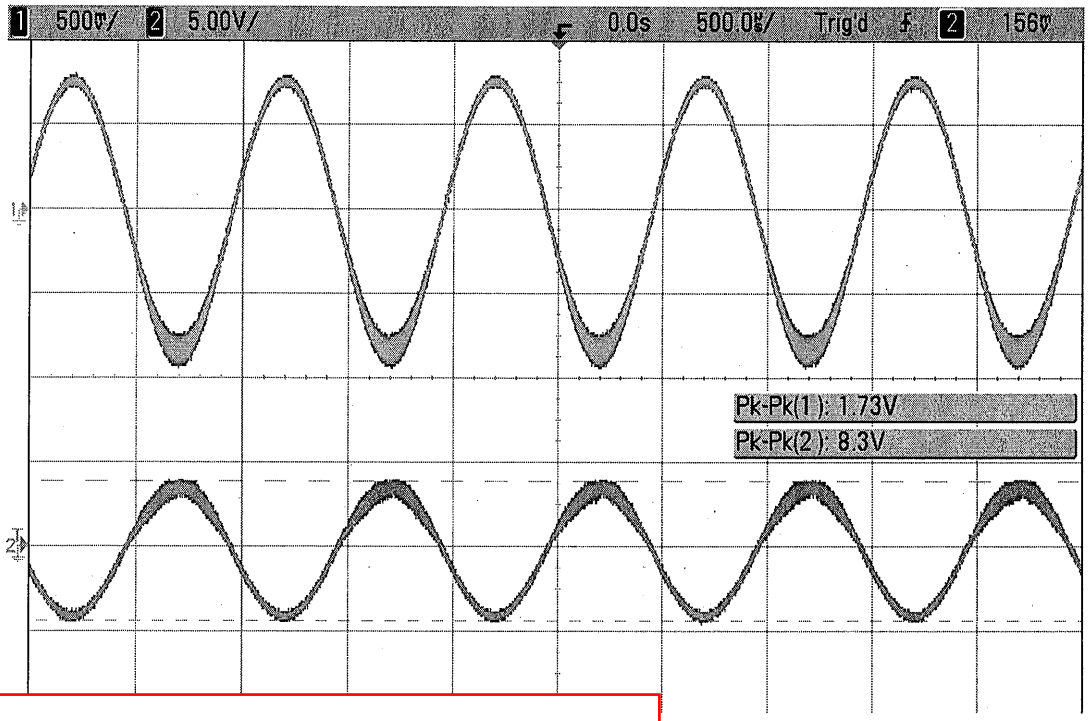
EE 254
Project 2
10/22/13

Project 2: Experiments with Standard Power Amplifier Circuits

The purpose of this project was to design three different classes of amplifiers: 'AB',' B', and 'A', and to build and test each of these three circuits.

In [redacted] p-Amp was chosen (Fi[redacted]en so to give some am[redacted]d. An amplification factor of 5 was also an easy number to calculate with. The voltage gain from the Op-Amp is shown in (Figure 2).



[redacted] 'AB' amplifier. In order to use this amplifier, a driver circuit was needed to connect to the power transistors (Figure 3), the output can be seen in Figure 4.

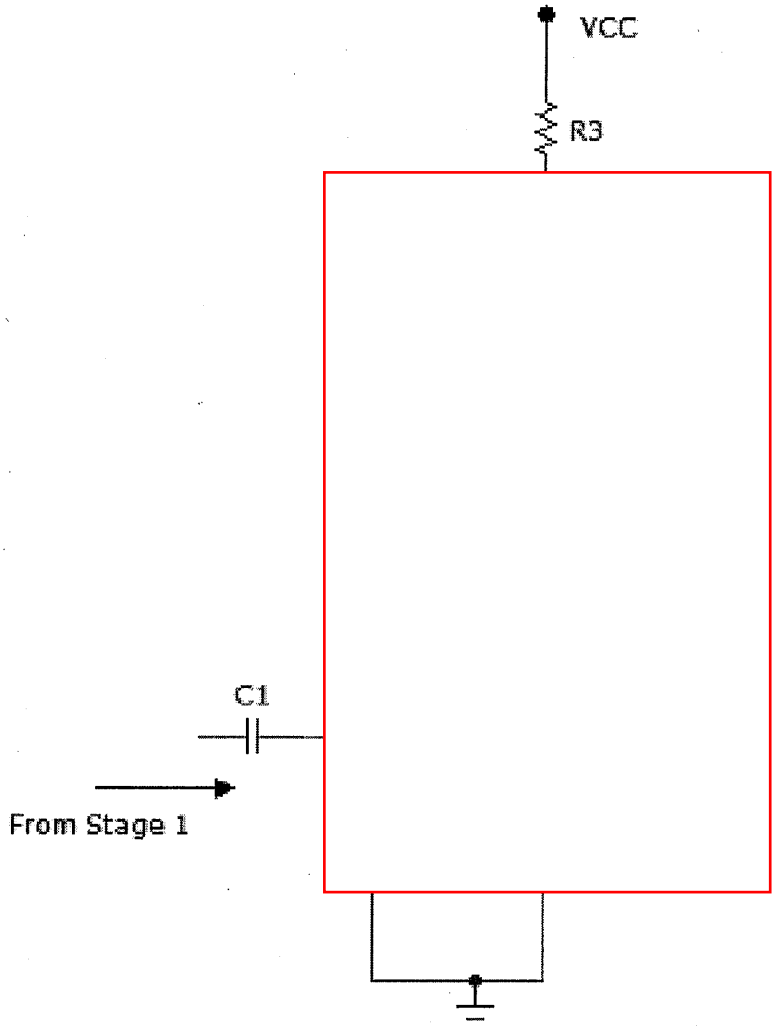


Figure 3: Driver circuit for class 'AB' Amplifier

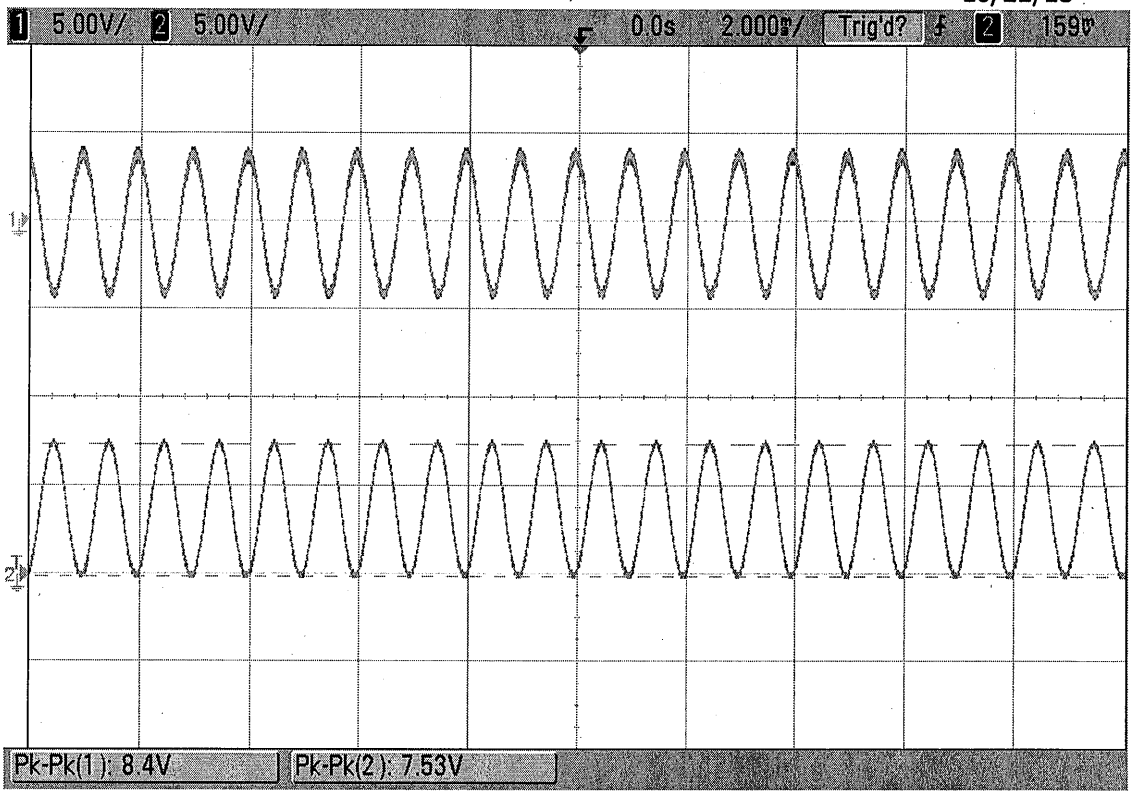


Figure 4: Output of Driver Circuit

This was connected to the Class 'AB' Amplifier circuit (Figure 5). The amplifier (Figure 6) did not produce the output that was expected; the output is actually less than the measured input, even though it should be at least 5 times as large. A 20Ω, power resistor was used as the load resistor for this circuit, as there is a significant amount of power flowing through these power transistors. One problem that showed up when this circuit was being tested was that the npn transistor was a thermal runaway. This means that the current was increasing, causing a temperature increase, which in turn caused the current to increase, and this cycle kept repeating. To fix this problem, two 200Ω resistors were placed on the emitters of each transistor and connected to create feedback. Adding the stability emitter resistors seemed to solve the problem. The shape of the output was also better after increasing the V+ and V-. After taking measurements for icn=0.18, icp=0.16, and Vcc=12.2V , the efficiency of the amplifier was calculated to be 0.28354%, which is not that high (Calculations 1-3). After looking back through datasheets, it was noted that the turn on voltage for the power transistors (Vbe/Veb) was 1.8V. Since only about 0.3V was measured, it is possible that biasing the transistors differently than the current way might have allowed the transistors to work as a power amplifier better.

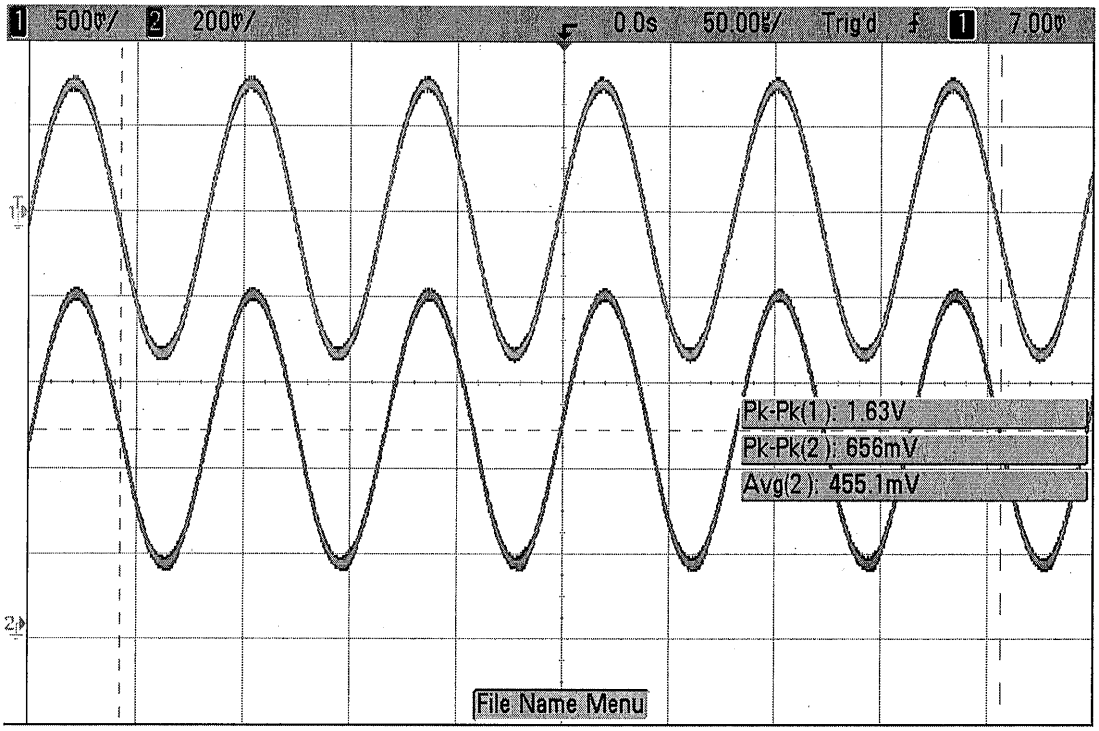


Figure 6: Output of class 'AB' Amplifier

The next class of amplifier built was the Class 'B' amplifier (Figure 7). Once again, the op-amp was used

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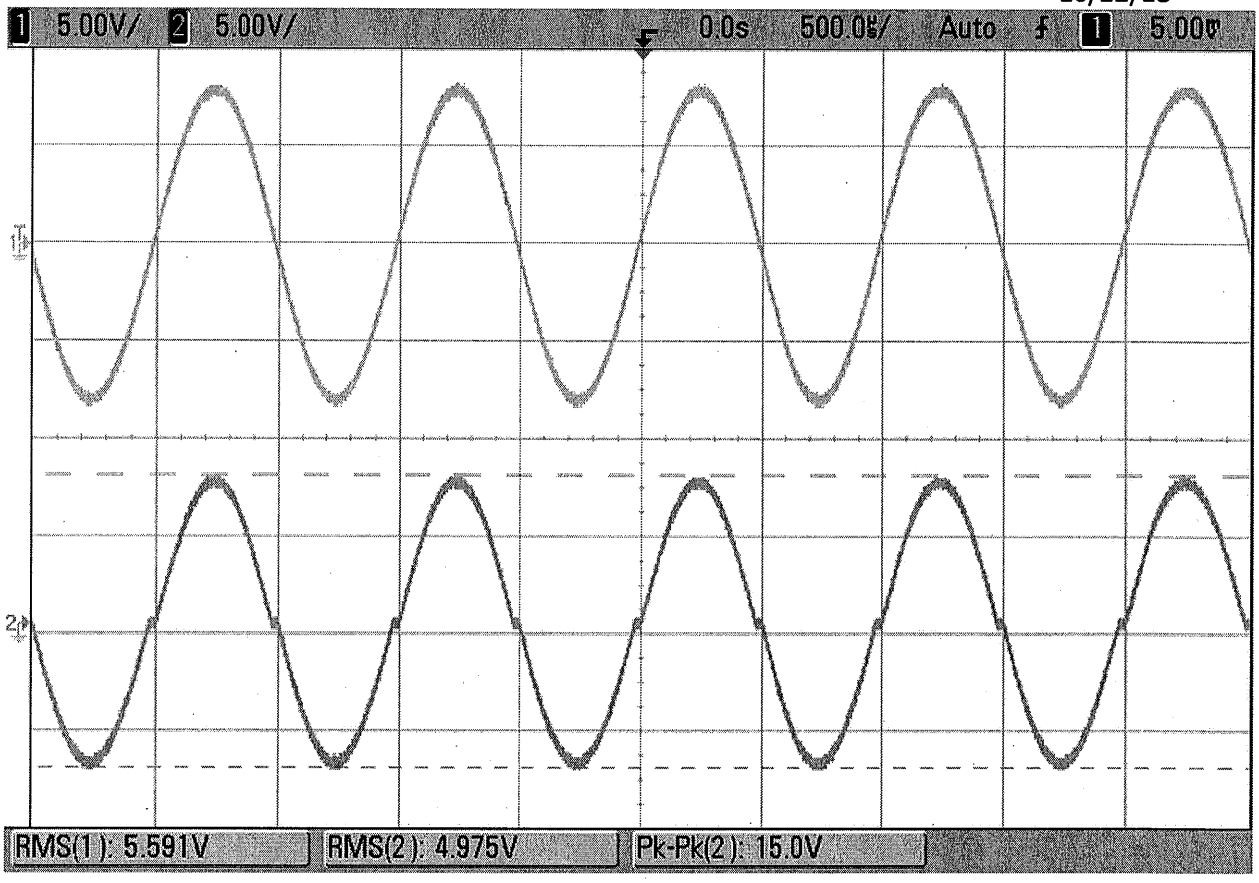


Figure 8: output of class 'B' amplifier.

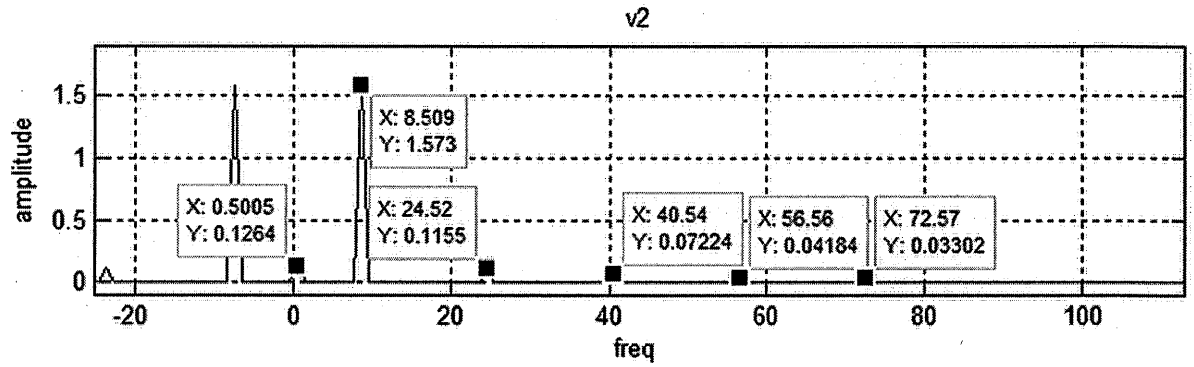


Figure 9: THD measurements for Class 'B' Amplifier and code

The last type of amplifier that was designed was the Class 'A' amplifier (Figure 9). In order to do this,

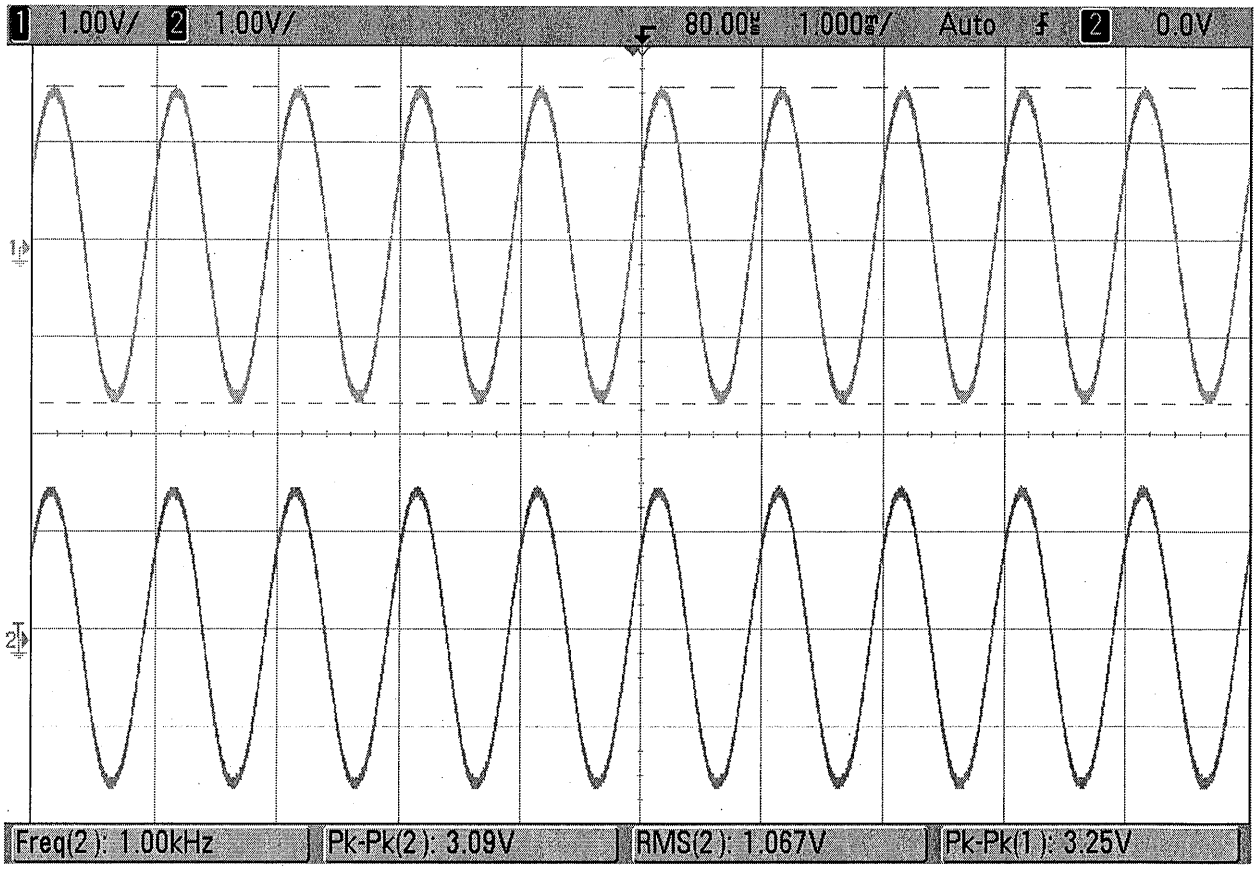


Figure 11: output of Class 'A' amplifier

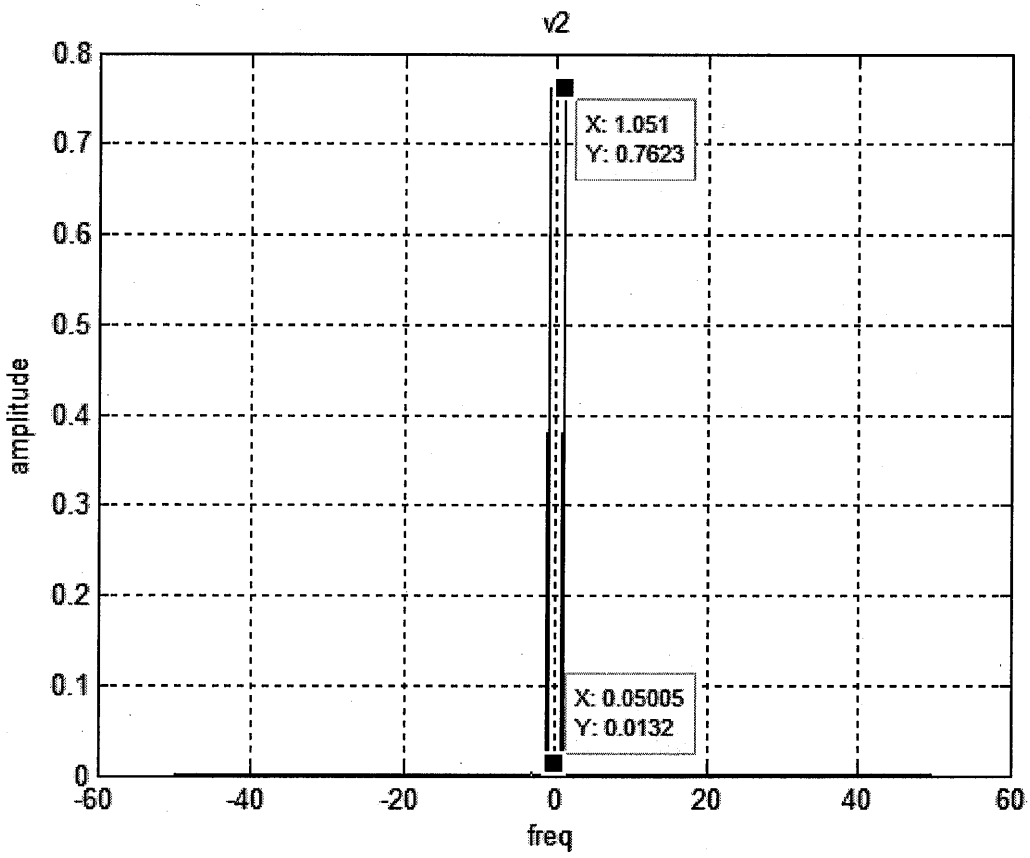
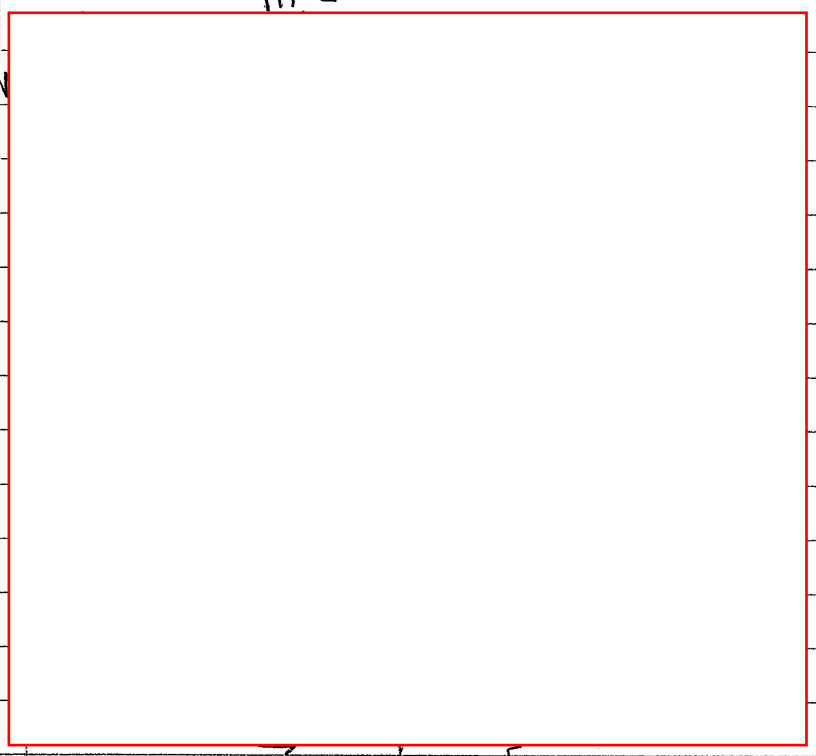


Figure 12: THD measurements for Class 'A' amplifier

Conclusion:

After doing this experiment, the class B amplifer actually got the best effieciency, which is suprising. This might make sense because when looking at the setup, it is very simple and there are not extra components that can distort the output. In my case, two 100µF capacitors were used to stabilize the output from the op-amp stage, but that did not seem to harm the efficiency. I excpected that the class 'AB' would generate the best efficiency because it gets rid of the distortion in both the class 'A' and class 'B' amplifiers, it is conducting more than half of the time. This project was a good tool for understanding the different setups for each class of power amplifier, as well as how to do efficiency calculations and THD.

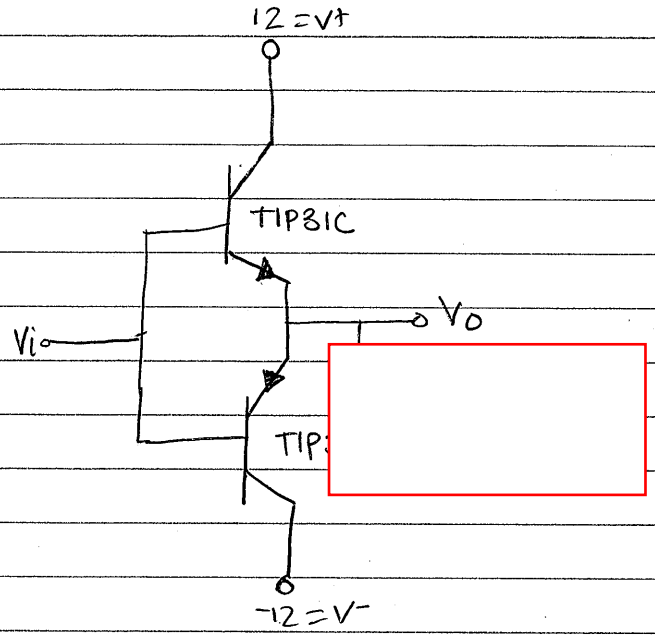


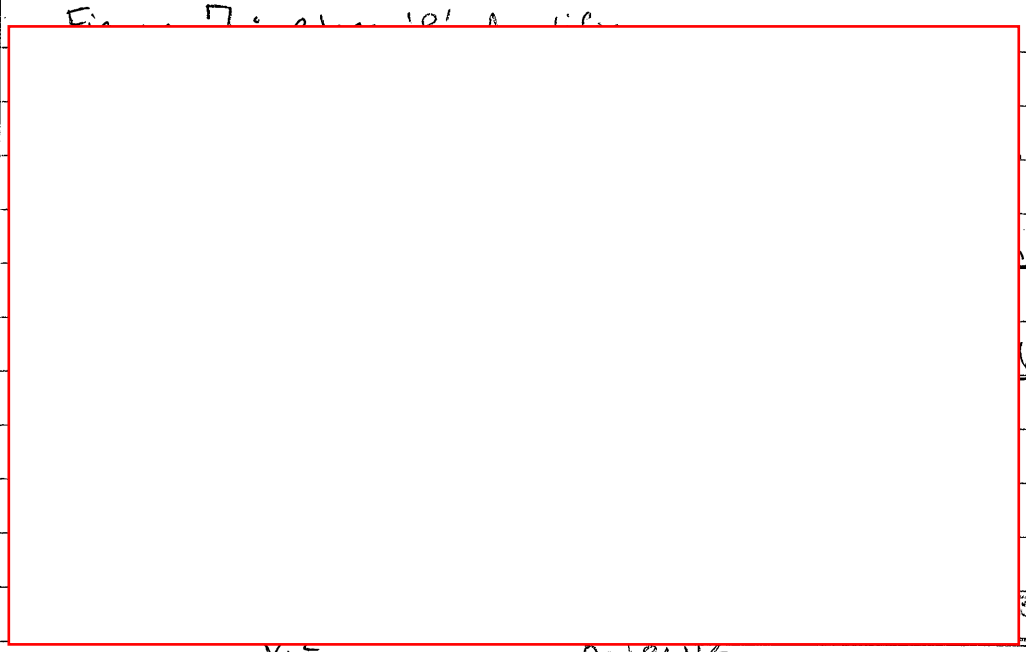
Circuit

Calculation 1

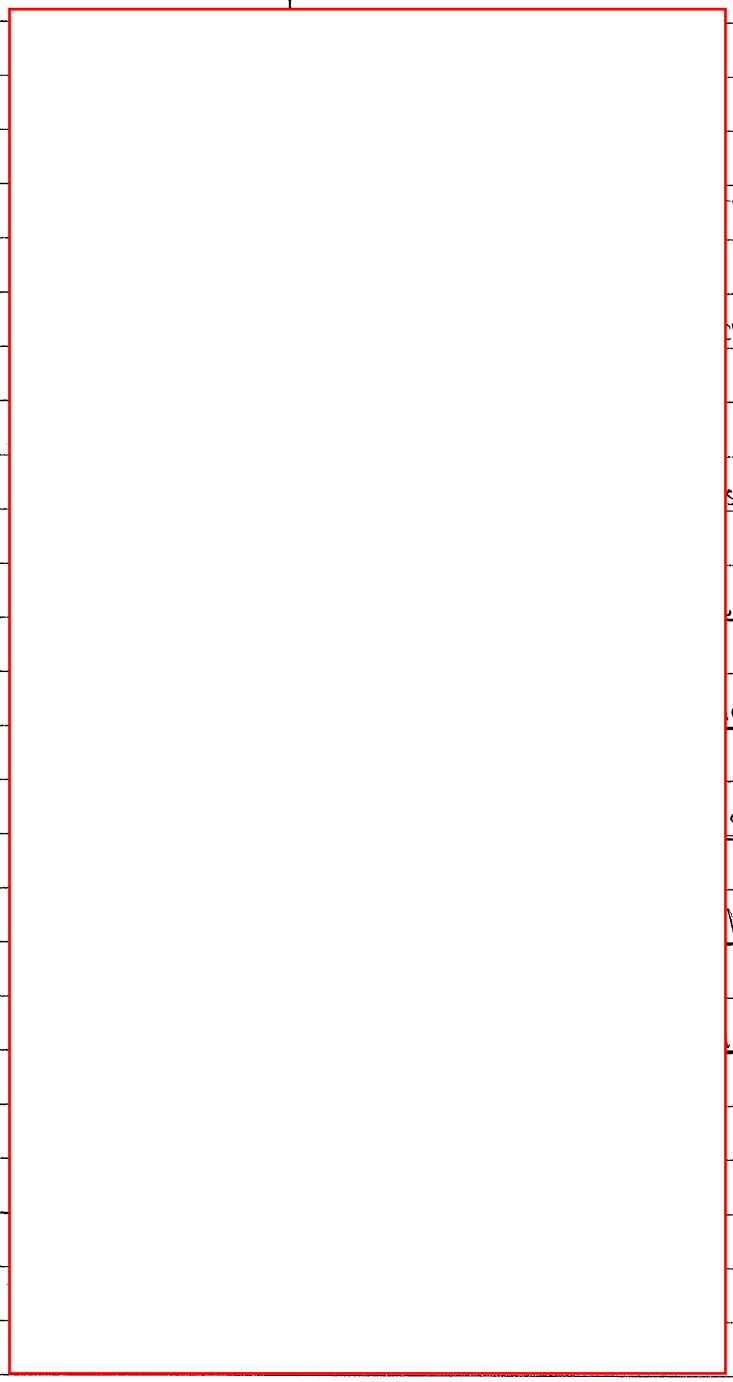
---- Calculation 2

% --- Calculation 3





= 149.2 ... Calculation 12



A

5W resistor

hose 8W

ss 'A' Amplifier

alculation 7

culation 8

culation 9

lculation 10

culation 11

Calculation 13