ECSE 331: Electronics
Laboratory Report

Laboratory Experiment#6

Design of a BJT Amplifier

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Submitted:

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Abstract— The purpose of laboratory experiment number six, was to build an amplifier using a BJT transistor, various resistors and capacitors. In the first part of this laboratory, an amplifier having a gain of 50V/V was built. Then in the second part, its gain at various temperatures were measured using the Bode plot function of the Elvis Instrument. Experimental results showed that as the temperature of the transistors increased, the gain also increased. So as the temperature increased the current conducted increased. In the introduction, the results will be discussed further.

I. Introduction

The goal of this laboratory was to build, test, and explore the behavior of the BJT amplifier using the NI Elvis-II test instrument. More specifically, the gain of the amplifier was measured at room temperature, at 6 degrees and at 40 degrees. The effect of temperature on the operation of the transistors was tested and found. In the main body of this lab report the results for each of the circuits analyzed will be presented in a clear and concise manner.

II. Main Body

We conducted several experiments with the BJT amplifier that was built from scratch: The gain of the circuit was measured at various temperatures.

A. BJT Amplifier: Building the amplifier circuit and measuring temperature effect on gain

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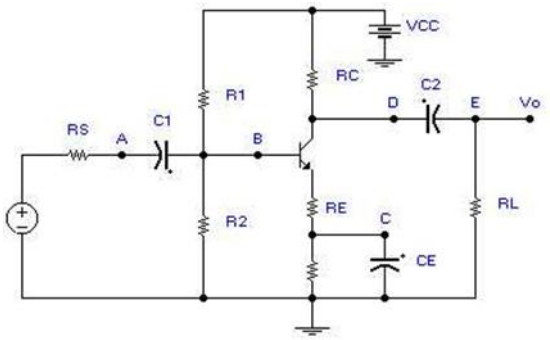

Fig1. Circuit diagram for the BJT amplifier circuit

I. Design of the amplifier:

The BJT amplifier of figure one was designed using the knowledge learned in class and figures and data from the textbook. We knew that G= (Rc//R_L)/Re.

We knew R_L=10Kohm, Re=40 Ohm (12.5 ohm due to internal resistance, so a resistor of around 27Ohm was used).

Since we wanted a gain of 50V/V, the value of Rc would be 2.5K ohm (found by algebraic manipulation). Using the 1/3, 2/3 ratio, we decided to chose R1=67KOhm and R2= 33KOhm. Also the capacitors used had a value of 47uF.

With the above values, the BJT amplifier did accomplish its task and generated a gain of around 45V/V, up to a frequency of 100KHz.

To change the gain factor, the Resistors Rc and Re can be changed!

II The circuit diagram in figure 1 was constructed to generate a gain of around 50V/V or in other words of around 33-35dB.

Building the circuit in figure 1, with the same values for resistors and capacitors, the circuit generated a gain of around 33dB at room temperature, 23 degrees. Figure 2 shows the bode plot for the magnitude of the gain at 23 degrees. The gain 33dB is around 45V/V, which is acceptable according to the 10% variation.

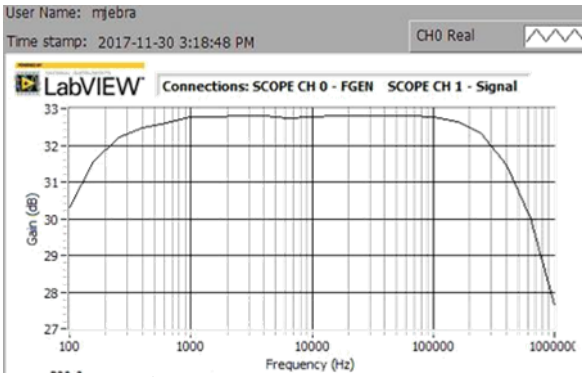

Fig2. Bode plot for the circuit at 23 degrees Celsius

III. When the temperature of the BJT was brought down to 6 degrees, surprisingly the gain increased slightly to around 33.3dB, which is around 46V/V gain. According to theory, the gain should have gone up.

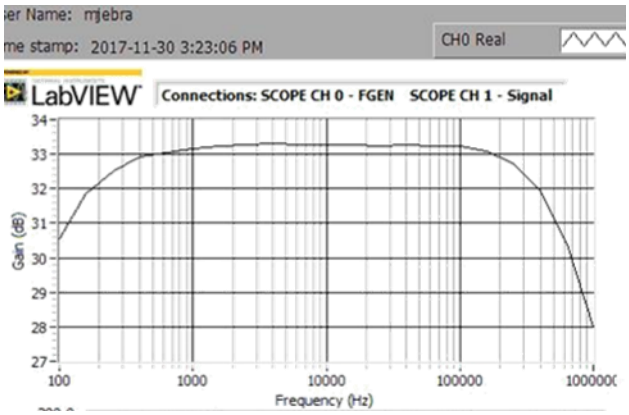

Fig3. Bode plot for the circuit at 6 degrees Celsius

IV. In the last experiment on the circuit, the temperature of the BJT was increased to 40 degrees Celsius and the gain of the amplifier measured using the Bode plot function of the Elvis Instrument. The gain was measured to be 32.7dB or around 44V/V very close to the gain that was sought. Figure 4 shows the bode plot at 40 degrees.

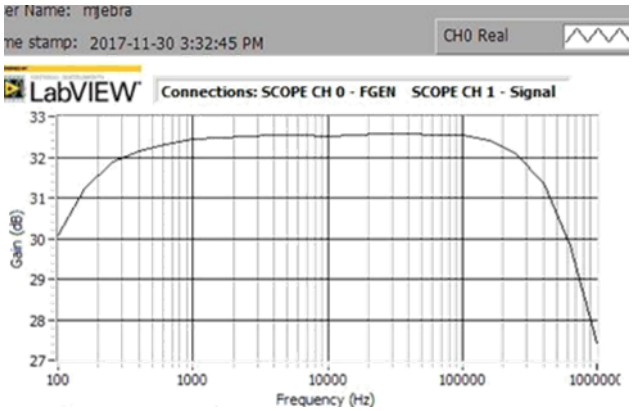

Fig4. Bode plot for the circuit at 40 degrees Celsius

V. As can be seen in the figures 2,3 and 4, the gain of the BJT amplifier stays constant with a value of around 33dB over a very wide frequency range. The gain falls of only starting at a frequency of about 100 000 Hz or 100KHz. Thus, the 3dB bandwidth is superior than the minimum value of 10KHz that was required.

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CONCLUSION

To conclude, this lab was very helpful and eye opening because using a BJT transisitor, resisitors, capacitors and a power supply, we built an amplifier that produced a gain of arounf 45V/V for a frequency range of over 100KHz.

The behavior of the amplifier was tested at various temepratures, the gain was found using the Bode plot at room temperature, at 6 degrees and finally at 40 degrees. The differences in the gain were very small, but overall satisfying. Our gain increased slightly as we decreased the temperature of the BJT. This could have been due to the fact that, at lower temperature, there are less minority charge carriers.

In this lab, the experiments overall confirmed what was learned in class, BJT transisitors, resisitors, capacitos and power supplies are all we need to build amplifiers.