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ECSE 331: Electronics

Laboratory Report No. 5

McGill University

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Design of a BJT Amplifier

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Abstract—The purpose of laboratory experiment is to design a BJT amplifier using the 2N2222A npn transistor that we studied in Lab 4 using the NI Elvis-II test instrument. In the laboratory, an amplifier with a gain of 50 V/V was built. Then in the second part, its gain at various temperatures were measured and compared. Experimental results shows that as the temperature of the transistors increases, the gain also increases.

Index Terms—BJT, transistors, Amplifier

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. The performance of the amplifier was tested under the required constrains of bandwidth and RMS level. The effect of temperature on the operation of the transistors was also tested and found.

II. EXPERIMENTS PROCEDURES AND RESULT

- A. BJT Amplifier Circuit Design
- B. BJT Amplifier Performance Testing
- C. Temperature Effects of BJT Amplifier

As seen in Fig. 1, the gain of the BJT amplifier at at room temperature (27 °C) is

$$\begin{aligned} G &= \frac{V_{out}}{V_{in}} \\ &= \frac{4.864 \text{ V}}{83.88 \text{ mV}} \\ &= 58.0 \text{ V/V} \end{aligned}$$

When the temperature is increased to 63 °C, as seen in Fig. 2, we have the gain

$$\begin{aligned} G &= \frac{V_{out}}{V_{in}} \\ &= \frac{3.690 \text{ V}}{100.66 \text{ mV}} \\ &= 36.9 \text{ V/V} \end{aligned}$$

Thus, it is observed that the gain of the BJT amplifier decreases as its temperature increases. Similarly, we conducted similar operations to observe its temperature characteristics when the circuit is brought down from room temperature. Similarly, as given in Fig. 3, we could calculate that the gain

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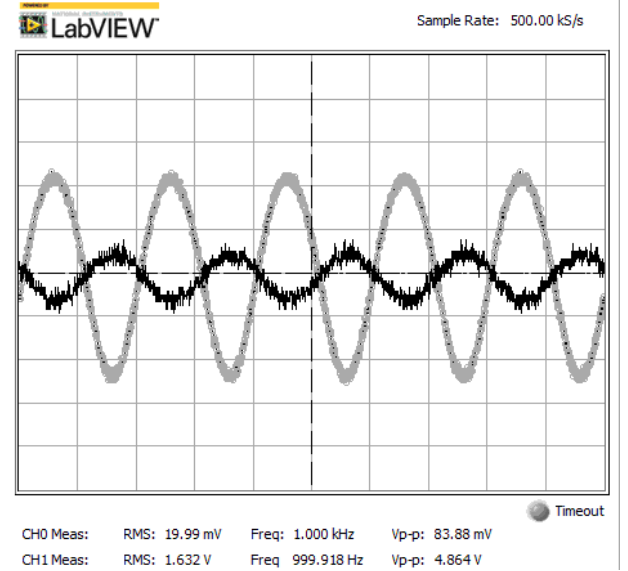


Fig. 1. V_{in} and V_{out} of the circuit at room temperature (27 °C).

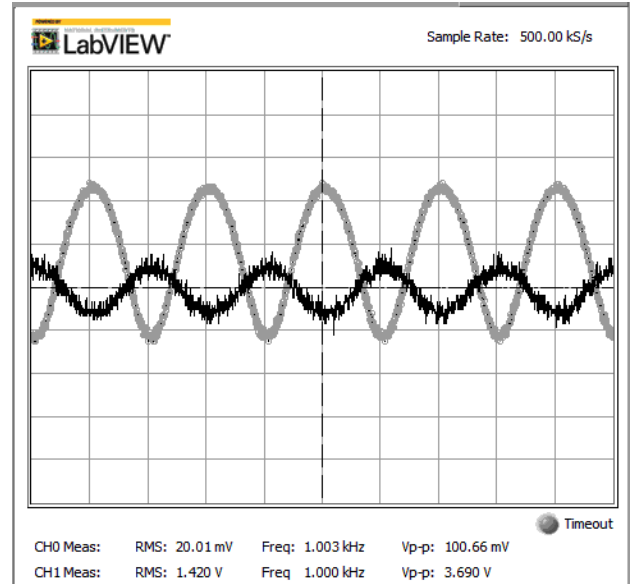


Fig. 2. V_{in} and V_{out} of the circuit at 63 °C.

of the amplifier at -10 °C is 55.64 V/V. It can be observed that the gain has a small decrease as the temperature is brought down, which is surprisingly not pertaining with the theory.

III. CONCLUSION

To conclude, this lab was very helpful for using a BJT transistor. We built an amplifier that produced a gain of around 55 V/V for a frequency range of over 100 kHz. The behavior

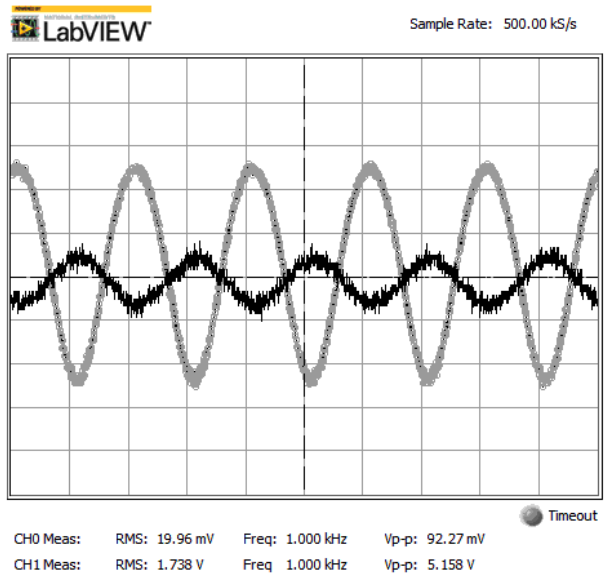


Fig. 3. BJT amplifier at -10°C .

of the amplifier was tested at various temperatures, the gain was found using the Bode plot at room temperature (27°C), -10°C and 63°C . 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 mobile charge carriers.