Background

The objective of this lab is to analyze the BJT. This will be achieved by first determining the I-V characteristic curve for the BJT. The voltage transfer characteristics were then found by building a BJT amplifier circuit. This lab also analyzed the characteristics of a common-emitter amplifier and an emitter follower circuit. Lastly, this lab analyzed the combined effect of the common-emitter amplifier and emitter follower.

Procedure

The Bipolar Junction Transistor (BJT) is a type of transistor similar to the MOSFET due to its ability to serve as a switch, an amplifier, and a dependent current source. BJTs are also defined by various modes of operation – in this lab, and in most use cases, we will utilize the forward active mode of operation, which allows the BJT to act as a current source with the following current:

$$i_C = ßi_B \qquad (1)$$

where ß is an amplifying factor.

This lab explores the characteristics of a BJT and an amplifier circuit that can be constructed using one. To determine the I-V characteristics of a BJT, an amplifier circuit was set up to measure the current through the collector branch's resistor and V_{CE}, the voltage between the collector and emitter.

Next, we proceed to determine the voltage transfer curve. Due to the linearity in the current, when the voltage transfer curve is in its active region, the slope of the voltage transfer curve will be constant and will equal the gain. By using the small-signal model of a BJT, the gain of the BJT amplifier circuit can be represented by the following equation:

$$G = -\frac{ßR_C}{R_B} \qquad (2)$$

where the negative denotes that this circuit is an inverting amplifier. We can infer that by changing the base or collector resistances, we can alter the gain from the common-emitter amplifier circuit.

We analyze the common-emitter amplifier by measuring the voltage across the collector's resistor and determining the current. After analyzing the behavior of the common-emitter amplifier, we can construct an emitter follower circuit in a similar fashion by instead applying a resistance at the emitter of the BJT to measure voltage instead of at the collector. Similarly, we can measure the emitter voltage and use the resistance to determine the current.

We can lastly piece the two BJT circuits we have analyzed together by connecting the output of the common-emitter amplifier to the input of the emitter follower. This will allow us to simultaneously observe the effects of the amplifier and follower circuits.

Figures 1 and 2 below show the circuits used to construct a common-emitter amplifier and an emitter follower, respectively.

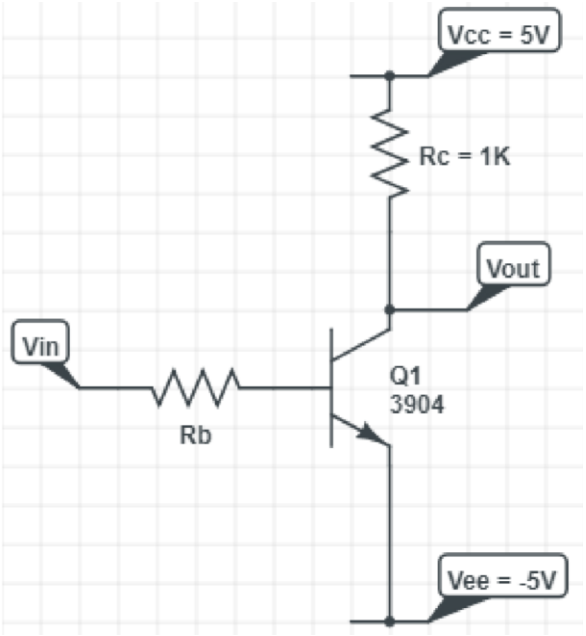

Figure 1: Schematic for Common-Emitter Amplifier

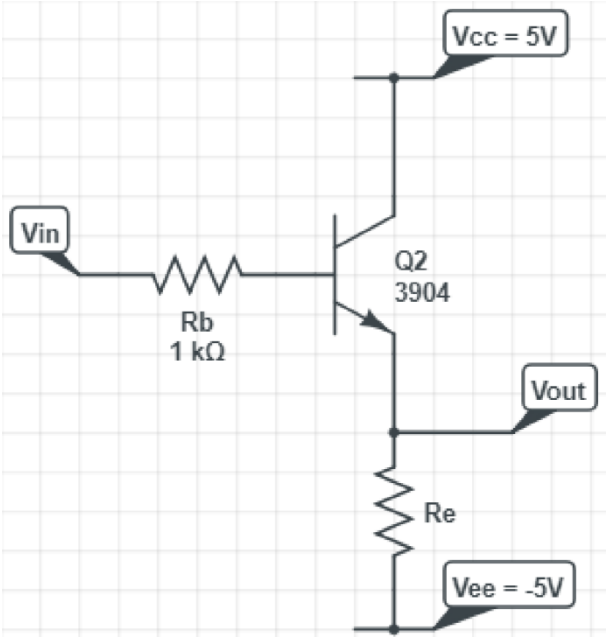

Figure 2: Schematic for Emitter Follower