

# ECE 304 Hands-on Lab #1

The differential amplifier is an important circuit configuration used to amplify the difference between two signals. This is the input circuit of an operational amplifier, and thus underlies much of modern analog electronics. Figure 1 shows an example of a simple differential amplifier using BJTs. The symmetry of this circuit can reject unwanted interference such as temperature effects and common-mode noise.

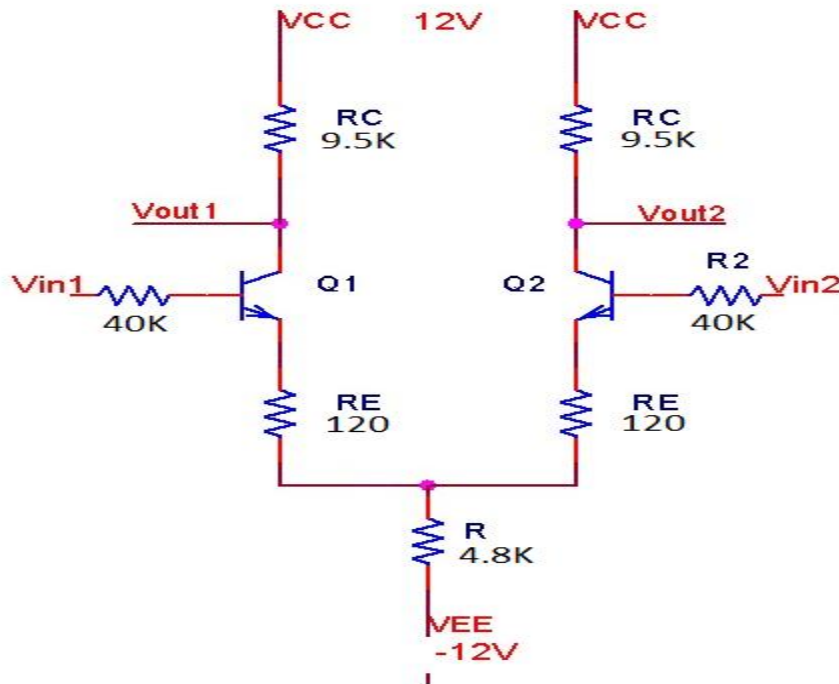


Figure 1. A simple BJT differential amplifier. AC sources are meant to be directly connected to the points marked Vin1 and Vin2.

## PRELAB

Using the circuit of Figure 1, perform hand calculations to estimate the DC operating point of the amplifier and the differential-mode gain. Assume the transistors are equivalent 2N2222s and have a thermal voltage  $V_t$  of 25.9 mV.

1. Determine the DC operating point.
2. Determine the differential-mode gain using the following signals for inputs:
  - o Vin1 = amplitude of 150 mV and frequency of 5 kHz
  - o Vin2 = ground.

## **LABORATORY EXPERIMENTS**

**In the lab, build a differential amplifier using two 2N2222's. Measure the  $I_b$  and  $I_c$  to obtain beta for each transistor. Then replace one transistor with a different one. Measure the beta values again. For both circuits, take the measurements described above (operating point and differential-mode gain). Compare the circuit results to each other and to the pre-lab results. Which circuit performs better? What is the relationship to beta?**

**Be sure that all relevant spec sheets are included in your lab notebook.**