

Laboratory 11: Bipolar Junction Transistors and Amplifiers

Concept

Explore basic BJT behavior and analyze simple amplifier concepts.

Helpful hints and warnings

Read the transistor specification sheets. Avoid an excessive collector current (DC or AC) in a transistor. Always apply a signal to the base using a current-limiting resistor. Do not forward bias the base-collector junction. Touch, or have your lab partner touch, the transistors and resistors to determine if excessive power is dissipated in a component of the circuit.

Experimental Instructions

Transistor Specifications

The Instructor will lead a discussion of the following:

1. Packages and pin-outs.
2. Specifications for common pnp transistors.
3. Specifications for common npn transistors.
4. Protecting transistors.

1 Build a Useful Instrument: The Difference Amplifier

Background:

For this and future laboratory endeavors, an instrument to measure the potential across any element of a circuit is necessary. An oscilloscope cannot accomplish this task, as the signal is always measured with respect to earth ground. The resistors must be chosen to present a sufficiently high input resistance.

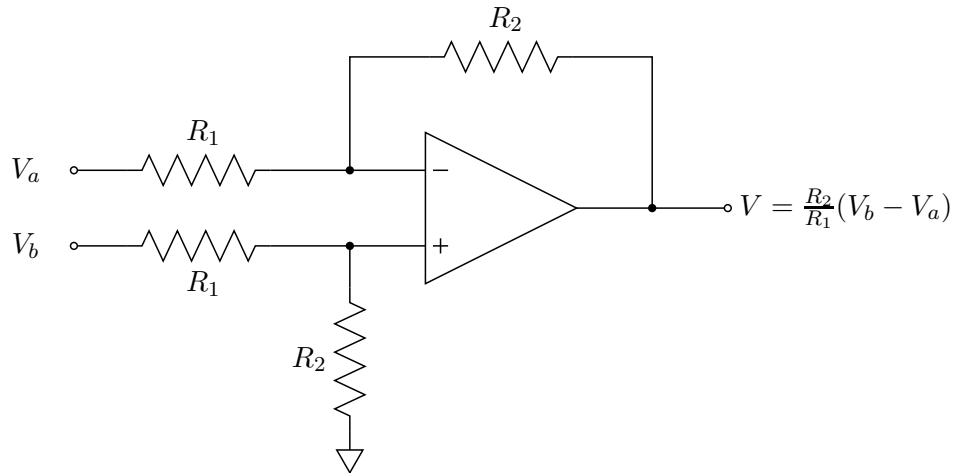


Figure 1: The difference amplifier.

Derive the expression for the output signal using this helpful diagram. The op amp to be used will have very low I_B , but it is wise to include it in the analysis. Be sure to include V_{io} , the input offset potential, in your derivation. What is the input resistance of the difference amplifier?

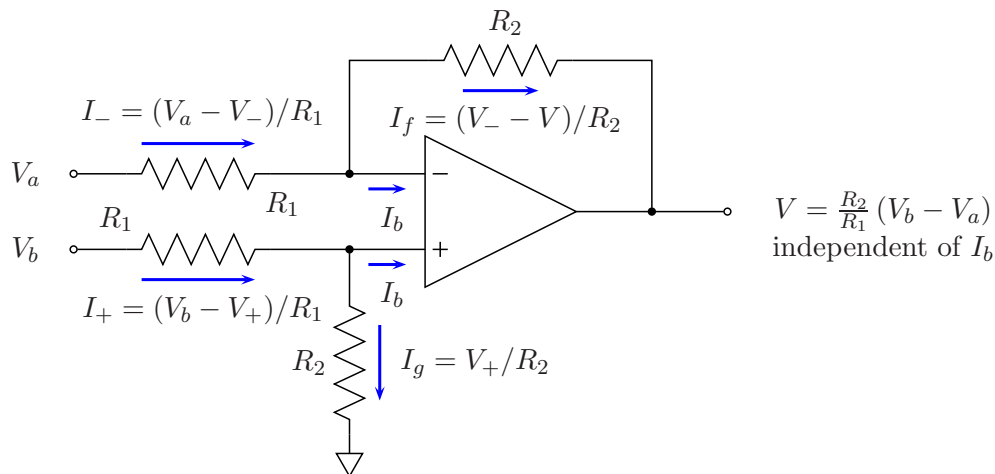


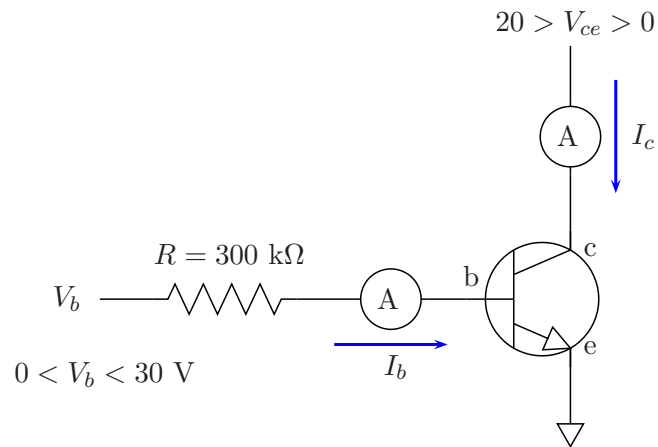
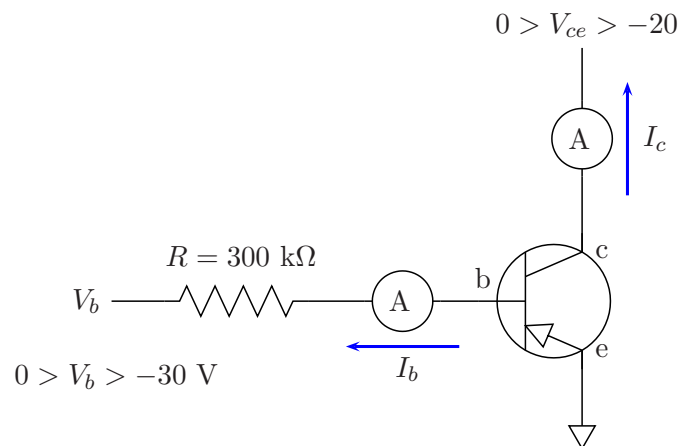
Figure 2: The difference amplifier with currents to help in the analysis.

Instructions:

1. Build a difference amplifier at the end of a breadboard so that it can be used for multiple experiments using an AD711, TL071C or LF356. The gain should be 1 or 2, and the resistors must be matched as precisely as possible. The resistors should be 300 K Ω or greater.
2. Measure the gain as a function of frequency using the scan program.

2 Measure Current Gain

1. Measure $\beta = I_c/I_b$ for an npn and a pnp using the circuits presented below.
2. Measure the experimental gain V_{out}/V_{in} as a function of frequency.

Figure 3: Measuring β for an npn transistor.Figure 4: Measuring β for an pnp transistor.