

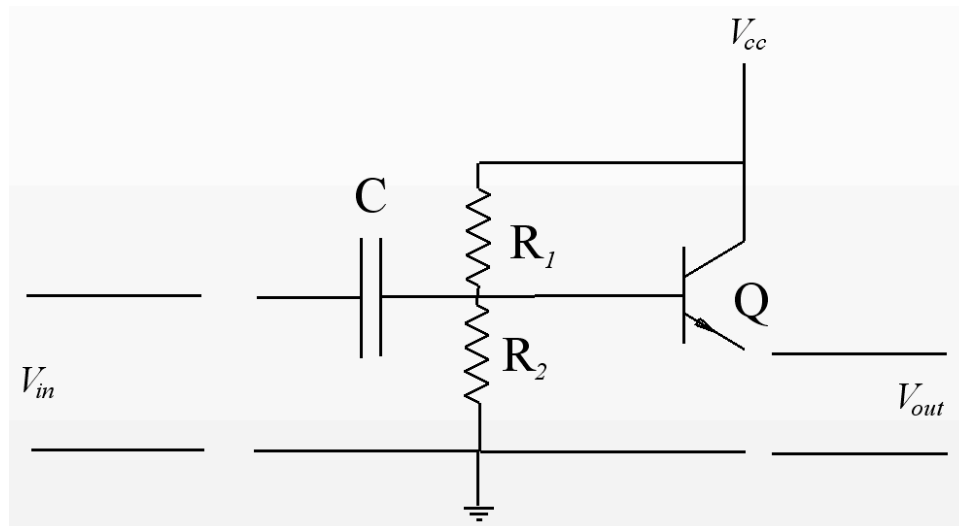
Physics 517/617 Experiment 4

Alternate Project 2

2) This project will study an emitter follower similar to that shown below (Fig. 4.57 of *Practical Electronics for Inventors*). Emitter followers allow low impedance loads to be driven by high impedance sources. Use a function generator with $600\ \Omega$ output impedance for this project. You will use this to drive a loudspeaker with nominal impedance of $8\ \Omega$. While it is disconnected from the circuit, set the function generator to produce a $1\ \text{V}$ peak-to-peak sine wave at $1\ \text{kHz}$. *Don't change the function generator settings in what follows.*

a) Hook the function generator directly to the speaker. Note the sound and measure the amplitude of the function generator output/speaker input. In your write up explain your observations.

b) Construct the emitter follower circuit below. Set $V_{cc} = 5\text{V}$. Note: ideally to minimize the load on the function generator, the current gain of the transistor, β multiplied by the impedance of the load (speaker) should be much larger than the output impedance of the drive (function generator). Also, ideally, to minimize the load on the function generator, the bias resistors should be much larger than its output impedance. On the other hand, to provide a reliable operating point, the bias resistors should be much *smaller* than β times the load impedance. For the transistor you are using β is about 100 and these conditions require some compromising. Take $R_1 = R_2 = 1\ \text{k}\Omega$. The value of the capacitor just needs to be large, $RC, \beta \cdot R_{load} \gg \frac{1}{2\pi f}$. Connect the function generator to the input and measure voltages at V_{in} , V_{out} , and the base of the transistor with and without the speaker connected to the output. Use your measurements to find the output impedance of the emitter follower circuit. Study as a function of frequency.



Extra credit:c) A “Darlington pair” is a neat trick to make a very high beta transistor. See page 453 of *Practical Electronics for Inventors*. Use a Darlington pair to make an improved drive for your speaker (*n.b.* you will want to change your bias network).