

Lab 6: Introduction to Transistors

(Estimated time: 15 minutes)

1. Set the output of the function generator to a 1 Hz square wave with a voltage which varies between 0 V and 3 V. Try to use this output to power a light bulb. Measure the output voltage when loaded by the light bulb. Is it consistent with what you would expect for a source with a 50 Ω impedance?

(Estimated time: 1 hour max)

2. Measure the current gain of a 2N3904 transistor using the constant current source circuit from design exercise 6-1. If you measure the collector current through the collector/load resistor for a variety of base currents (i.e. change the base resistor or the voltage applied to it), then you should be able to extract a value for β .

(Estimated time: 1 hour max)

3. (same set-up as exercise 3) With the component values you calculated for design exercise 6-1, verify that the circuit is indeed a constant current source by trying different collector/load resistors and measuring the collector current. Verify that the constant current source goes into saturation when you expect it to.

(Estimated time: 20 minutes)

4. Now use your transistor as a switch by connecting the collector through the bulb to a 6 V power supply (see design exercise 6-2). Measure the voltage across the light bulb and compare with your quantitative and qualitative results from lab exercise 2.

(Estimated time: 45 minutes)

5. Construct an *emitter-follower amplifier* using the 2N3904 (*npn*) transistor whose gain you've previously measured. The circuit should be based on your calculations for design exercise 6-3 (adjusted for the real value of β if necessary).
 - a. Adjust the function generator to output an AC signal at 1 kHz with an amplitude of 1 V and a DC bias of 3 V.
 - b. Measure the input impedance of your speaker, and measure the relevant voltages across it when it is attached directly to the function generator.
 - c. Use the speaker as the load resistor in your emitter-follower circuit, and adjust the collector supply voltage so as to keep the transistor power dissipation below 0.5 W.
 - d. Power up your emitter-follower circuit and measure the relevant voltages across the speaker and at the transistor base. Is the speaker louder?
 - e. Does the output signal sent to the speaker show any signs of distortion? How low can you lower the collector voltage before performance is significantly affected?

NOTE: Hang on to your transistor for next week.