ECEN 204 Lab 4

Bipolar Junction Transistors

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1 Bipolar Junction Transistor (BJT) Measurements

Path Tested	Resistance	Diode Voltage
Base → Collector	481kΩ	0.703V
Collector → Base	∞	Na
Base → Emitter	488kΩ	0.698V
Emitter → Base	∞	Na

From these measurements, it can be deduced that a BJT has a similar internal construction to 2 diodes placed in opposite directions as shown in figure 1. Using this model, it would be expected to measure voltage drops of around 0.7V in the forward bias direction's of both diodes (Base → Collector & Base → Emitter), and for there to be a measurable resistance across the diode. However when placing the diodes in reverse bias (Collector → Base & Emitter → Base), the resistance should be near infinite. Both of these expected trends can be observed in the above table of measurements:

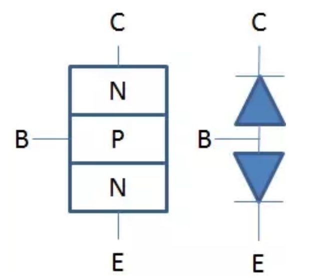

Figure 1: BJT Diode Model

2 Current Limiting Resistors

In our constructed circuit, there were 2 current limiting resistors, one placed between V_{BB} and the base, and the other between V_{CC} and the collector. The purpose of these resistors are to limit the maximum current than can flow from both the base to the emitter, and the collector to the emitter. This is done in order to stop the BJT from exceeding its maximum ratings.

Using $4.7k\Omega$ resistor attached to the base, and a $1k\Omega$ resistor attached to the collector, and assuming an ideal transistor, we can calculate the maximum I_B and I_C.

$$I_B = \frac{V_{BB}}{R} = \frac{5}{4.7k} = 1.06mA$$

$$I_C = \frac{V_{cc}}{R} = \frac{10}{1k} = 10mA$$

3 Current Gain

The current gain of the BJT is defined by the input collector current I_C vs the input base current I_B. This was measured both using a transistor tester, and by measuring the I_C and I_B with different current limiting resistors.

The outputs are as follows:

Using transistor tester: $\beta = 440$
Using lab measurements: $\beta = 391$

It can also be noted form figure 2 that as the base current limiting resistor increases in size, the gain of the transistor increases,meaning that for the highest gain value, a large resistor must be used.

Figure 2: Transistor gain vs Base limiting transistor

4 Base current vs Collector current

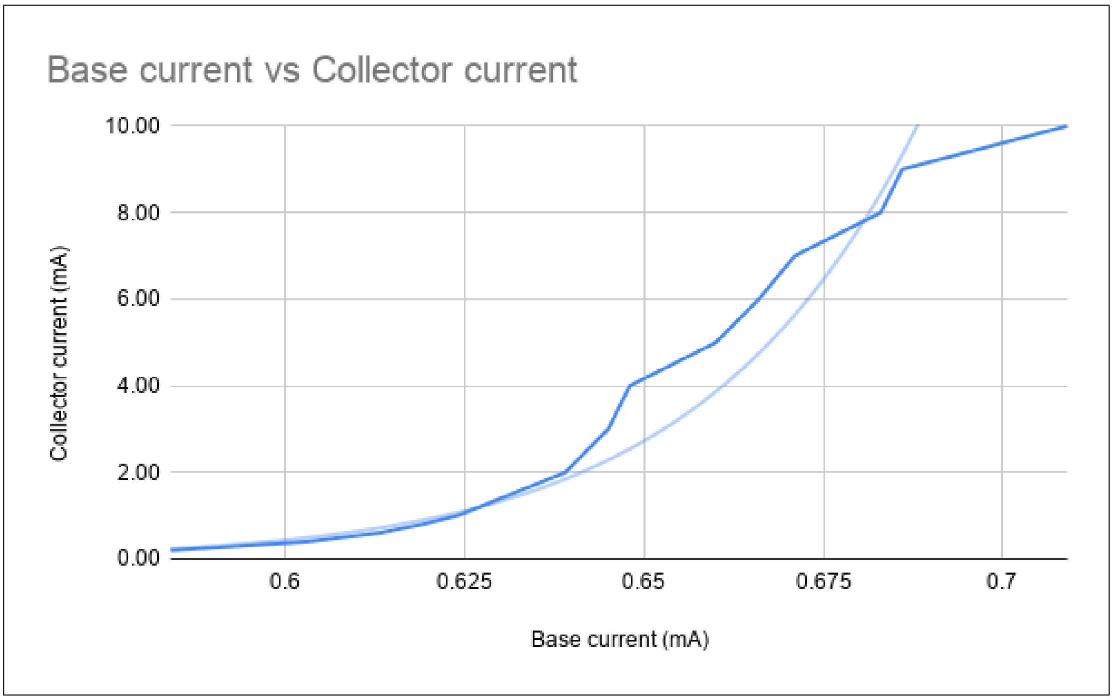

Figure 3: Base current vs Collector current

It can be observed in figure 3 that as the base current (I_B) increases, the collector current (I_C) will increase at an exponential rate. this means that with a relatively low base current, a large collector current can be allowed to flow. This is the basis of the amplification properties of transistors.