Bipolar Junction Transistor

Forrest Bullard[1]

[1]California State University, Chico

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Purpose

To gain experience in working with bipolar junction transistors (BJT's). We'll be using the 2N3904 an NPN transistor to control large current with small current. Also we will make a constant current source.

Procedure

Build the BJT switch shown below in figure 1. Compare current through the lamp I_c current through the base I_b. Then measure V_{ce} in the on and off states. Make a more careful analysis using lab view. Do these values make sense, explain what is going on. Build the constant-current source shown in figure 2. Measure collector current I_c as a function of the variable load resistance. Explain how this works. Estimate β for the transistor.

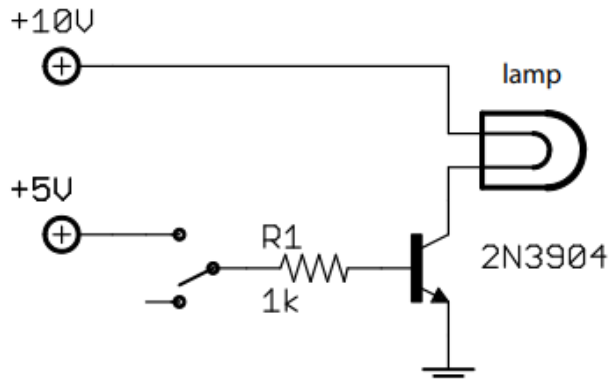

Figure 1: First BJT circuit for analysis

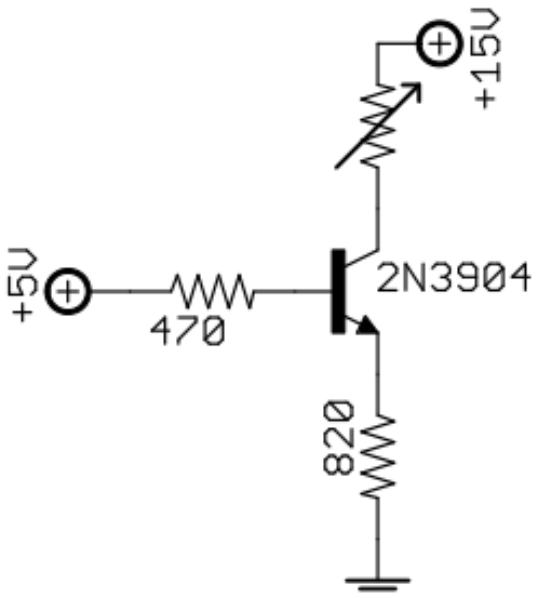

Figure 2: Second BJT circuit for analysis

Data

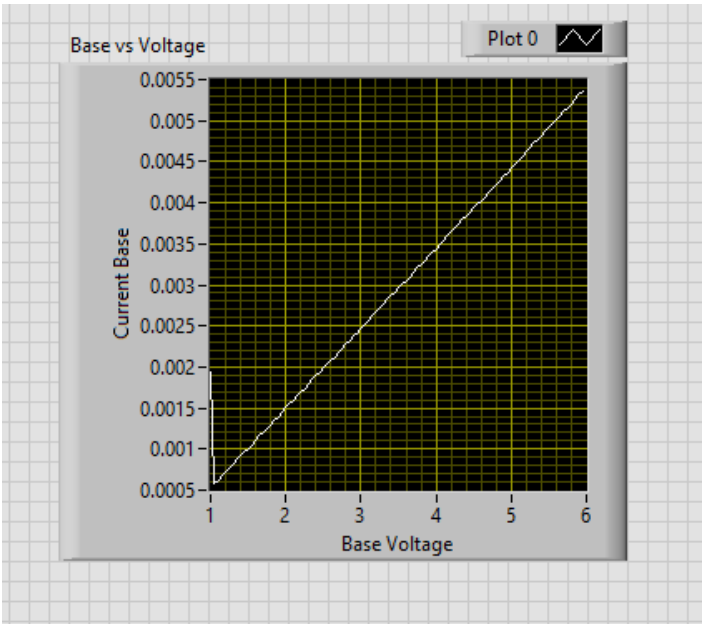

Figure 3: V_b vs I_b

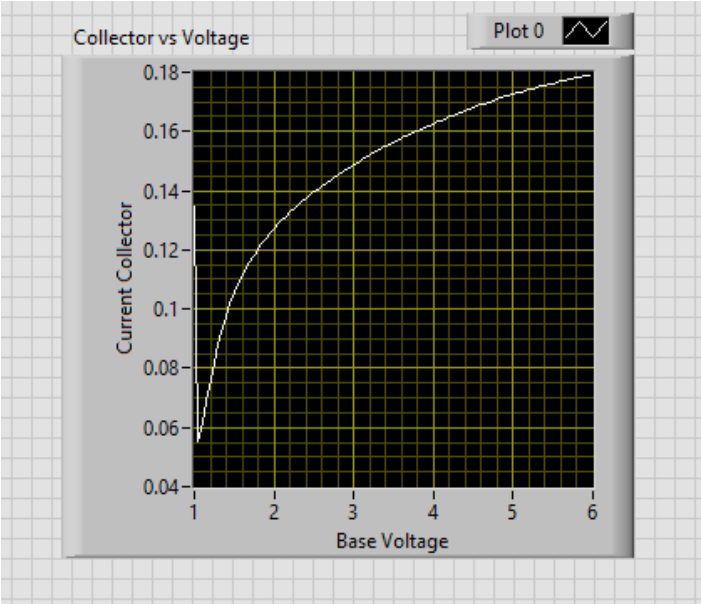

Figure 4: V_b vs I_c

Current Base(mA)	Current Collector(mA)	Resistance
0.03	5.14	100
0.03	5.14	200
0.03	5.14	300
0.03	5.14	400
0.03	5.14	1000

Table 1: Constant Current Source

Results

Bulb

The voltage from the collector to the emitter in the BJT's off state is the full value of the voltage put on the collector as the BJT will act as a short in this case, as well when current is applied to the base the BJT will have minimal voltage across it as it acts as an open. It can be seen from the graphs of I_c and I_b that as current is applied to the base of the BJT the current coming from the collector is much larger and will grow to some max value.

Constant Current Source

Since there is a constant current on the base pin of the transistor the collector current remains constant and variable resistance will be negligible as long as there is sufficient voltage at the source. When evaluating β the following equation was used

- $\beta = \frac{I_c}{I_b}$

which resolved as.

- $\beta = 183.6$