Bipolar Junction Transistors

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Purpose: To get some experience with bipolar junction transistors (BJT's), specifically the 2N3904 general purpose NPN transistor to use small currents to control larger currents, and create a constant current source.

Procedure:

1) Build the circuit as shown in Fig. (2) and measure the current into the lamp, I_c, and then measure and compare it with the current into the base of the transistor, I_b. Measure the V_{ce} in both the on and off states.

2) Create a graph of I_c vs I_b.

3)Build the constant current source shown in Fig. (1). Measure the collector current as a function of the variable load resistance, and explain what is happening. Estimate beta for your transistor.

Data:

1) After building the circuit in Fig.(2), the base current and collector current were measured, along with the V_{ce} whilst on and off.

I_c = 0.136 A

I_b = 4.167mA

V_{ce} on = 1.25V

V_{ce}=10V

Current through the collector to emitter is controlled by the base current supply.

2)Graphs are represented by Fig. (3) and (4), and were created in LabVIEW as shown in Fig. (5) and (6).

3) The circuit from Fig. (1) was built and data was recorded for a series of different resistance values. Since there is a constant current on the base pin of the transistor, the collector current remains constant. Variable resistance is negligible as long as there is sufficient voltage at the source (within the collector pin connection). Data is represented by Fig. (7), and here an estimated value for beta.

- $\beta = \frac{I_c}{I_b}$, $\beta = 183.57$

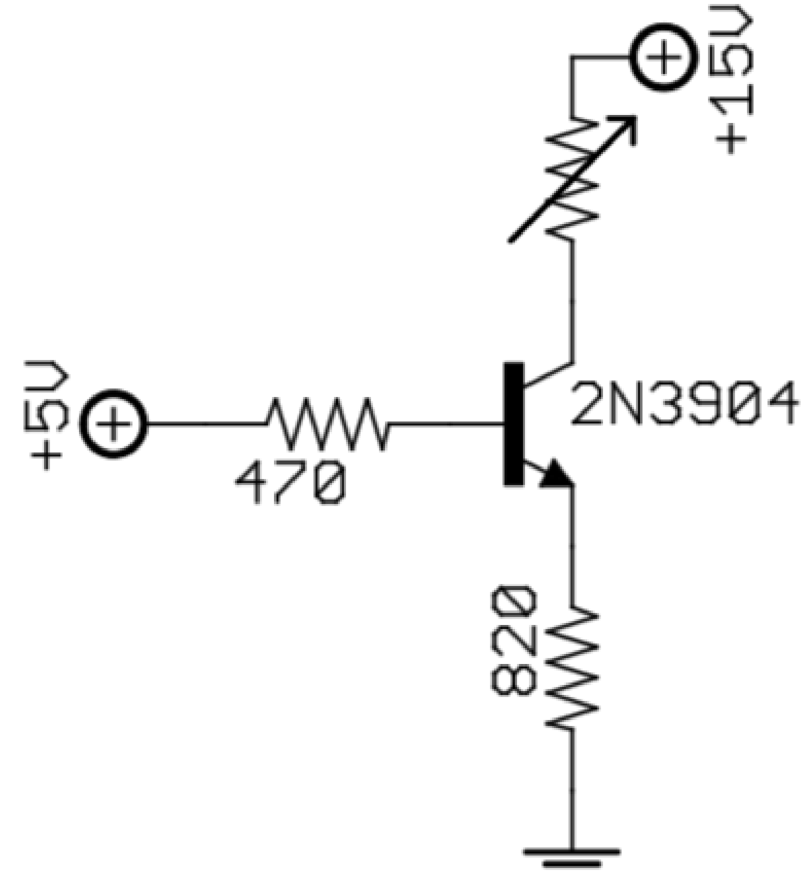

Figure 1: Constant Current Source.

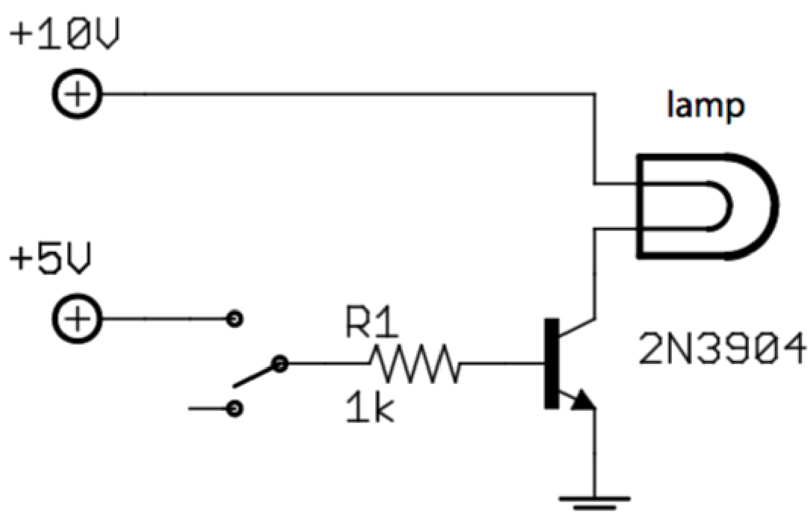

Figure 2: BJT Switch.

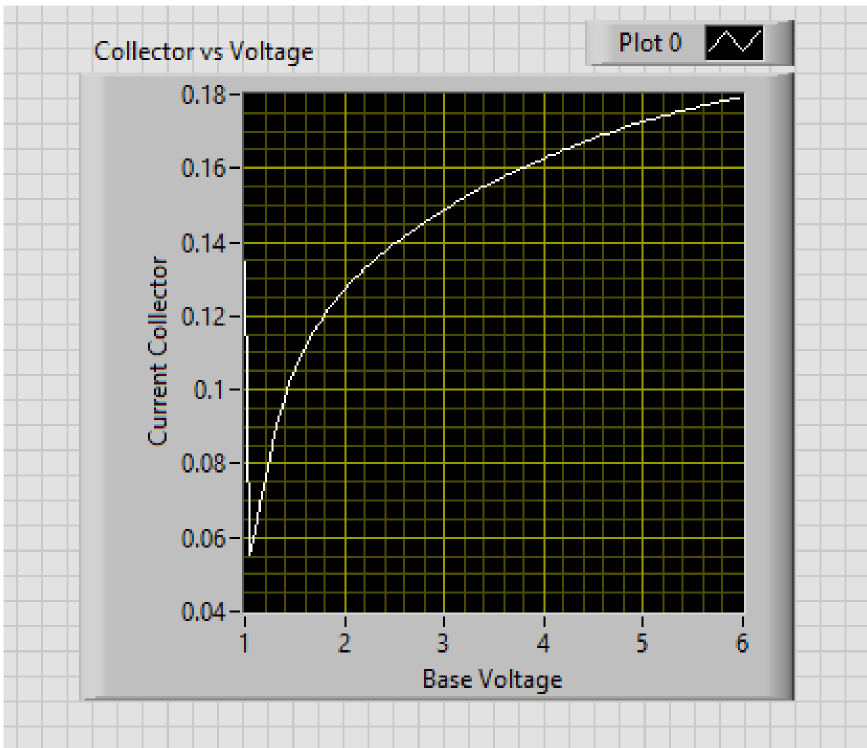

Figure 3: Collector Current vs. Base Voltage.

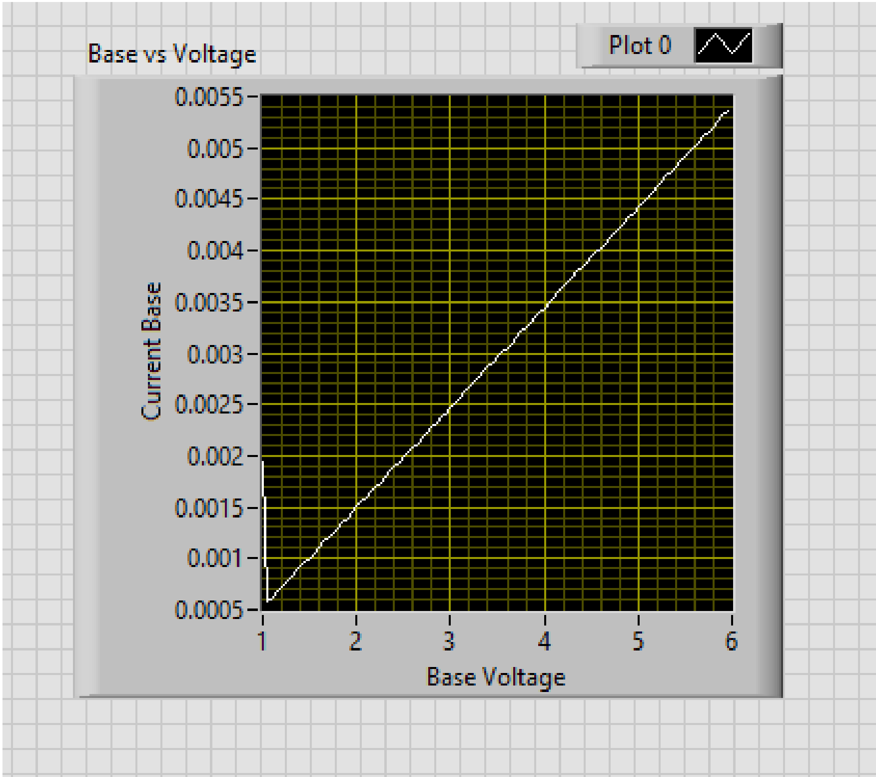

Figure 4: Base Current vs. Base Voltage.

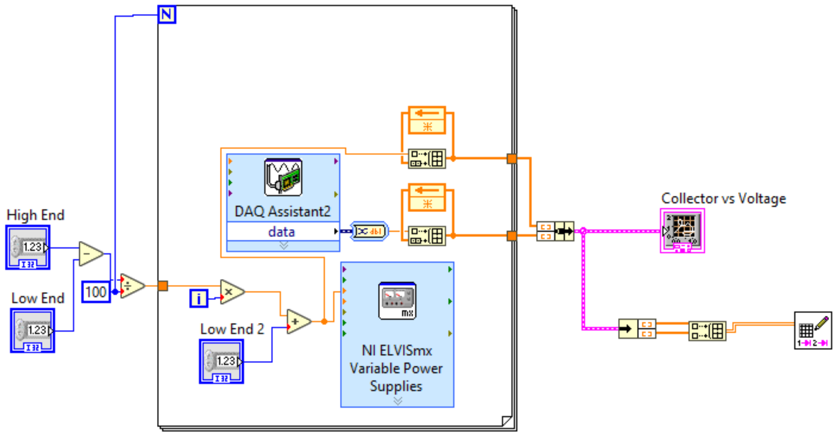

Figure 5: LabVIEW Grid.

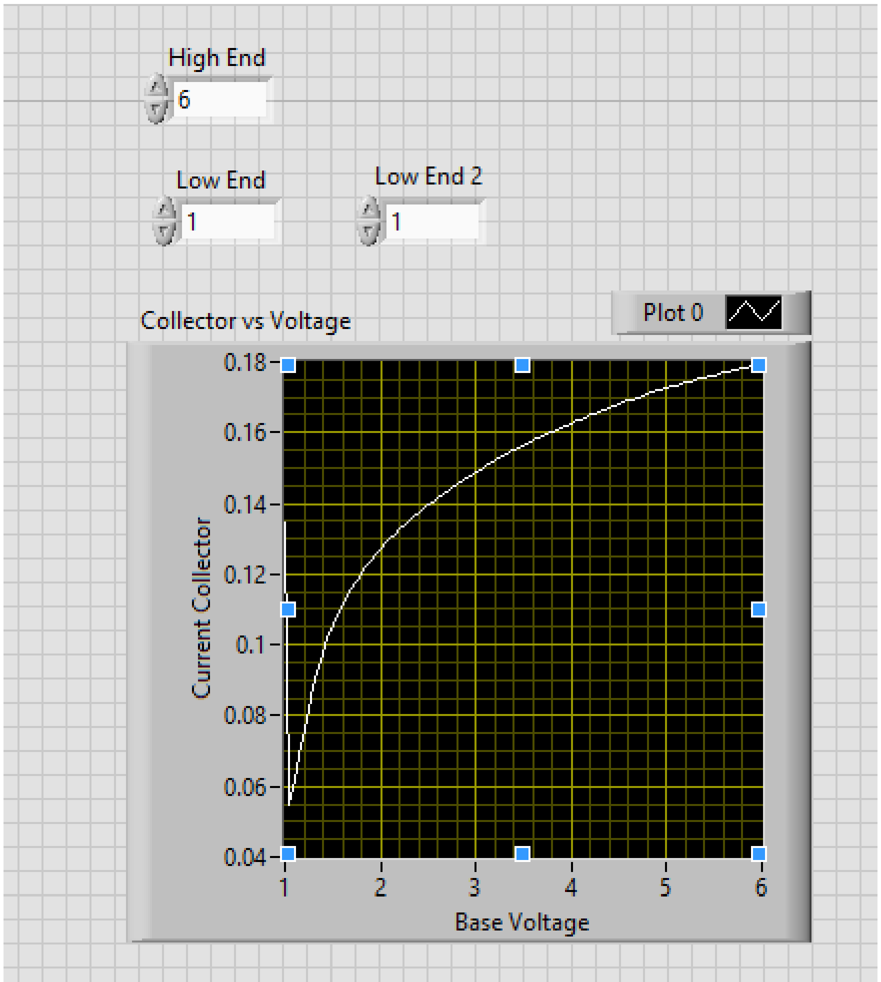

Figure 6: LabVIEW Front Panel.

I_b(mA)	I_C(mA)	Ohms
0.28	5.14	100
0.28	5.14	200
0.28	5.14	300
0.28	5.14	400
0.28	5.14	1000

Figure 7: Data for Part 3