ELECENG 2EI5 Lab 4

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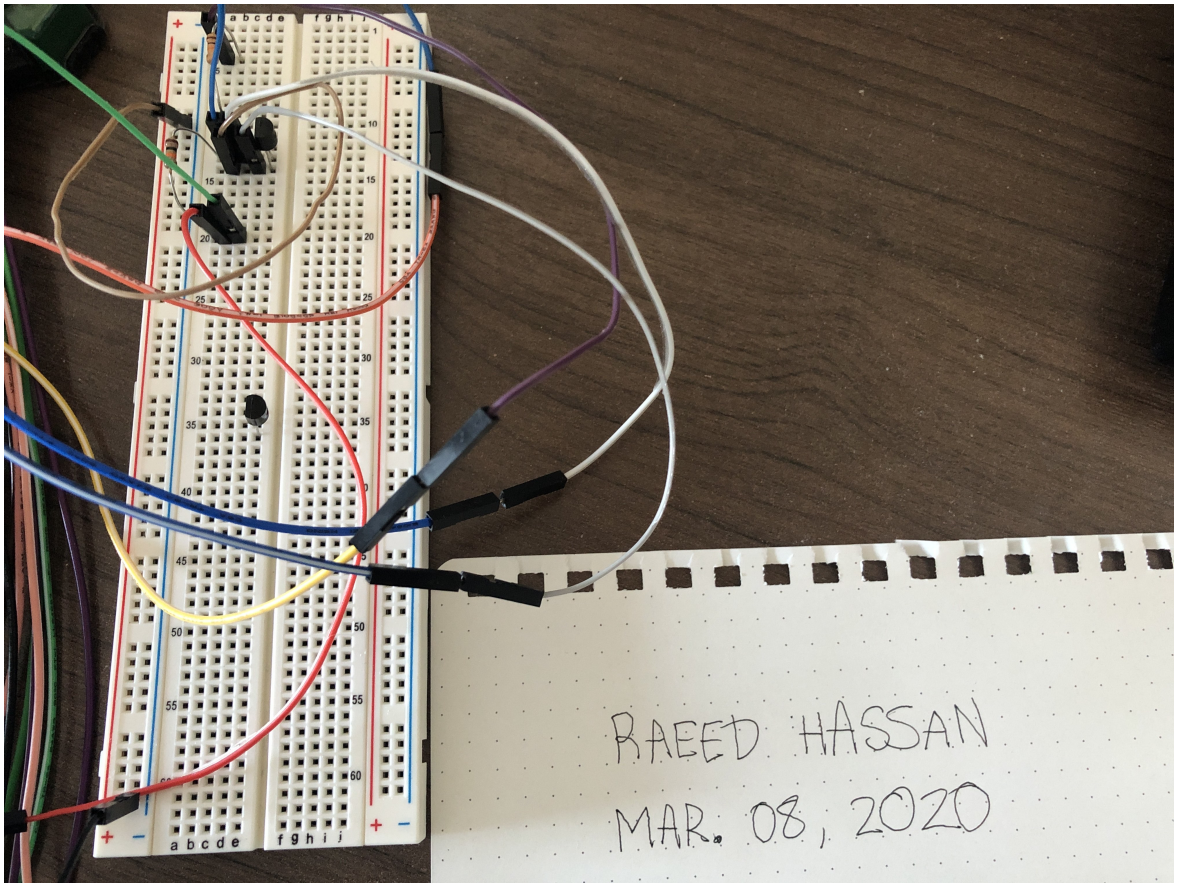
1. The photograph of the hardware setup.



2. Measurements

   (a) For the NPN, the circuit had a resistor connected to the wave generator at both the base and the collector. The emitter was connected to ground. To measure v_{CE} and v_{BE}, the negative terminal of the scope was connected to the emitter while the positive terminal was connected to the collector or the base. To measure i_C and i_B, the voltage drop across the resistor was measured and the current was displayed using a math channel that divided the voltage drop by the resistance of the resistors.

   For the PNP, the circuit had a resistor connected to the wave generator at both the base and the emitter. The base was connected to ground. To measure v_{EC} and v_{BC}, the negative terminal of the scope was connected to the collector while the positive terminal was connected to the emitter or the base. To measure i_E and i_B, the voltage drop across the resistor was measured and the current was displayed using a math channel that divided the voltage drop by the resistance of the resistors.

(b) Figure 1 shows part a for the NPN at three different values of i_B.

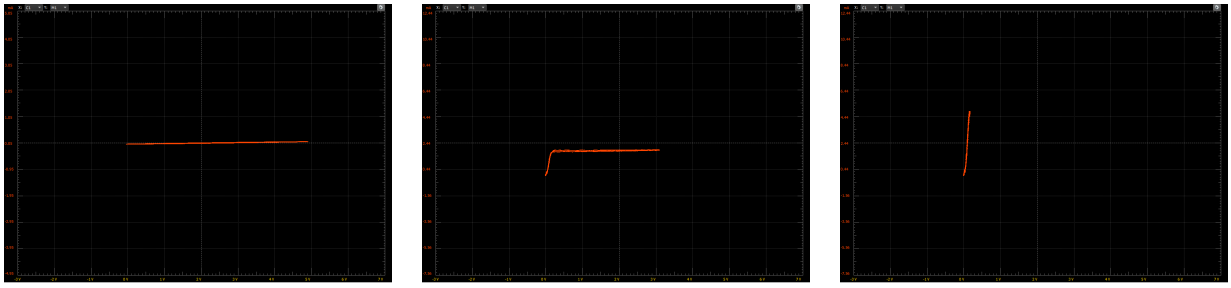
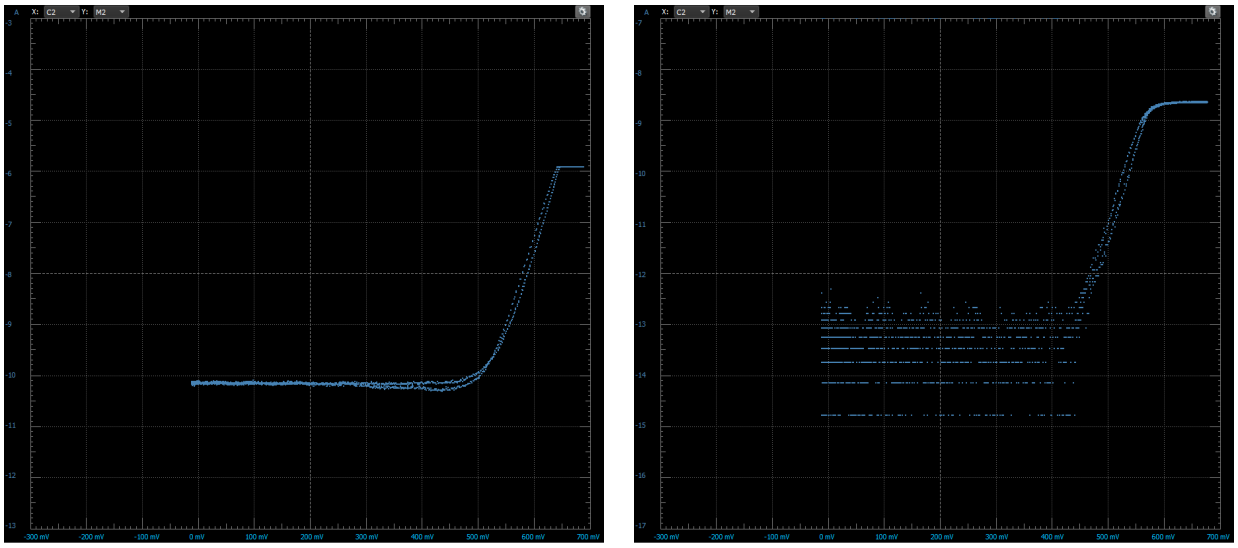


Figure 1: Part a for three different values of i_B

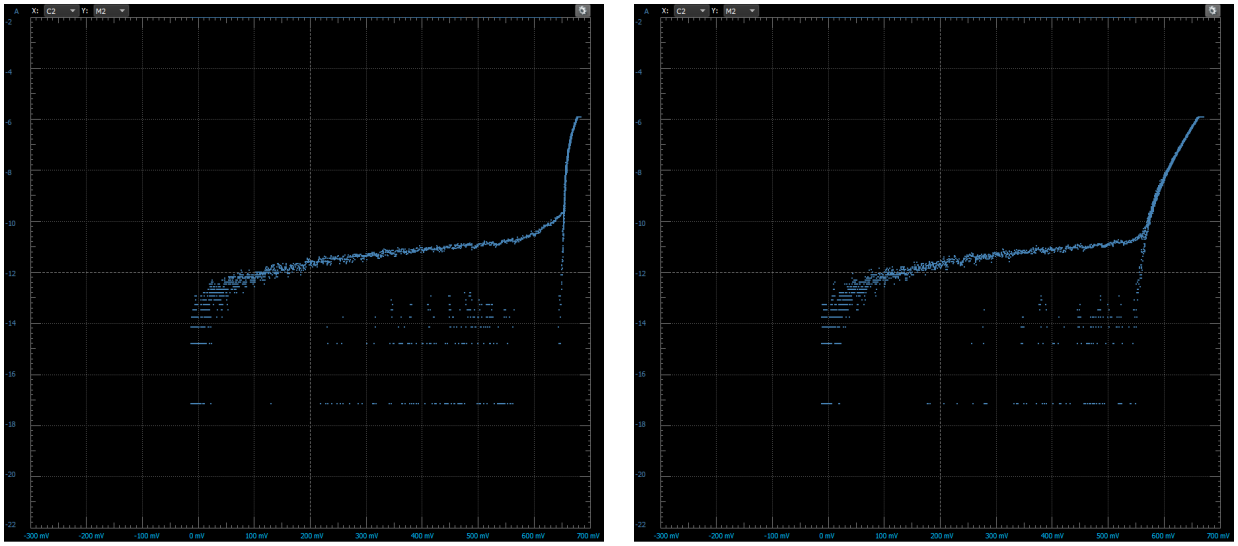
Figure 2 shows $\ln i_C$ as a function of v_{BE} for the NPN in parts b and c.



(a) $v_{CE} = 4V$ (b) $v_{CE} = 0.2V$

Figure 2: $\ln i_C$ as a function of v_{BE}

Figure 3 shows $\ln i_B$ as a function of v_{BE} for the NPN in parts b and c.



(a) $v_{CE} = 4V$ (b) $v_{CE} = 0.2V$

Figure 3: $\ln i_B$ as a function of v_{BE}

Figure 4 shows part a for the PNP at three different values of i_B.

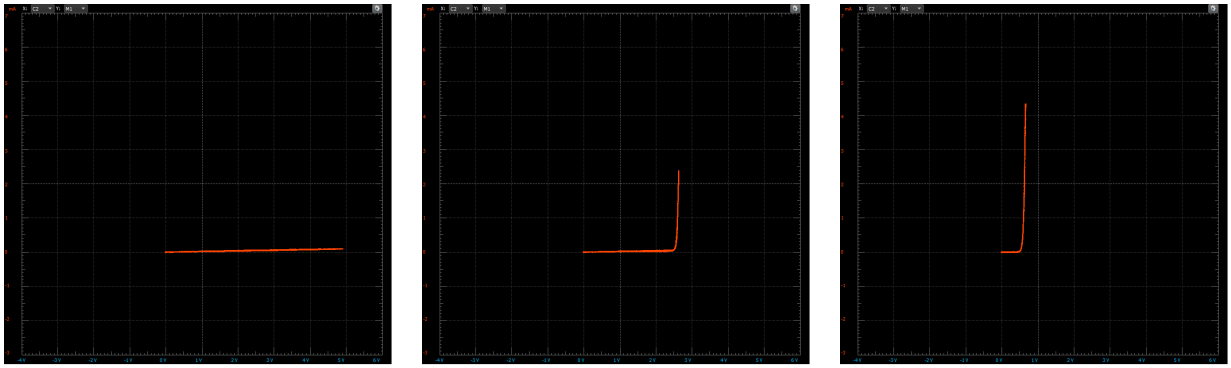
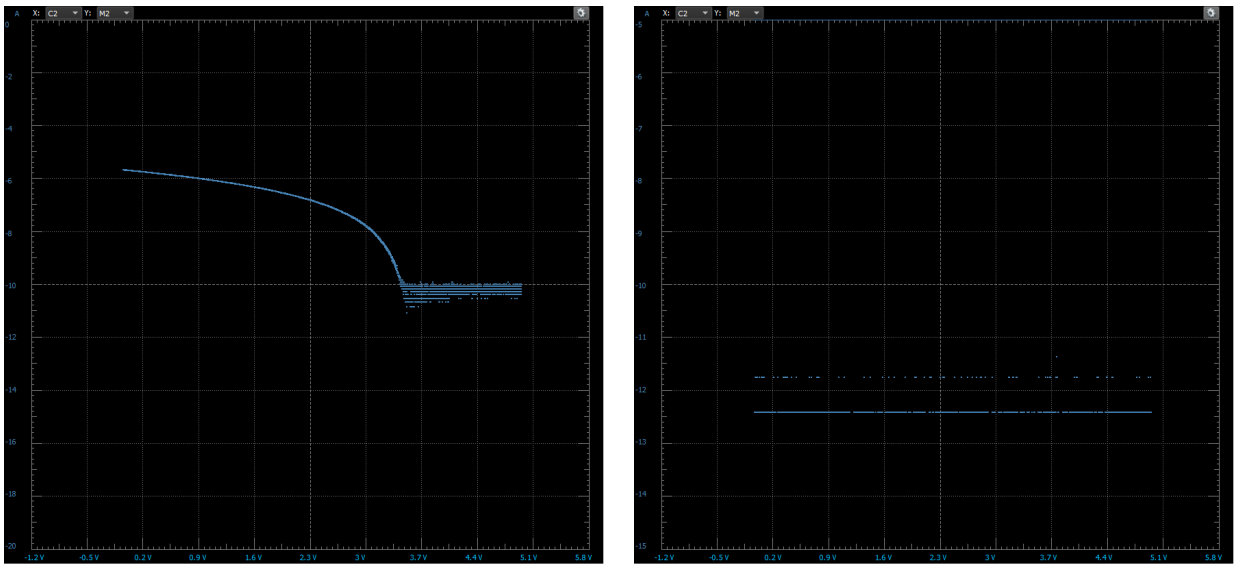


Figure 4: Part a for three different values of i_B

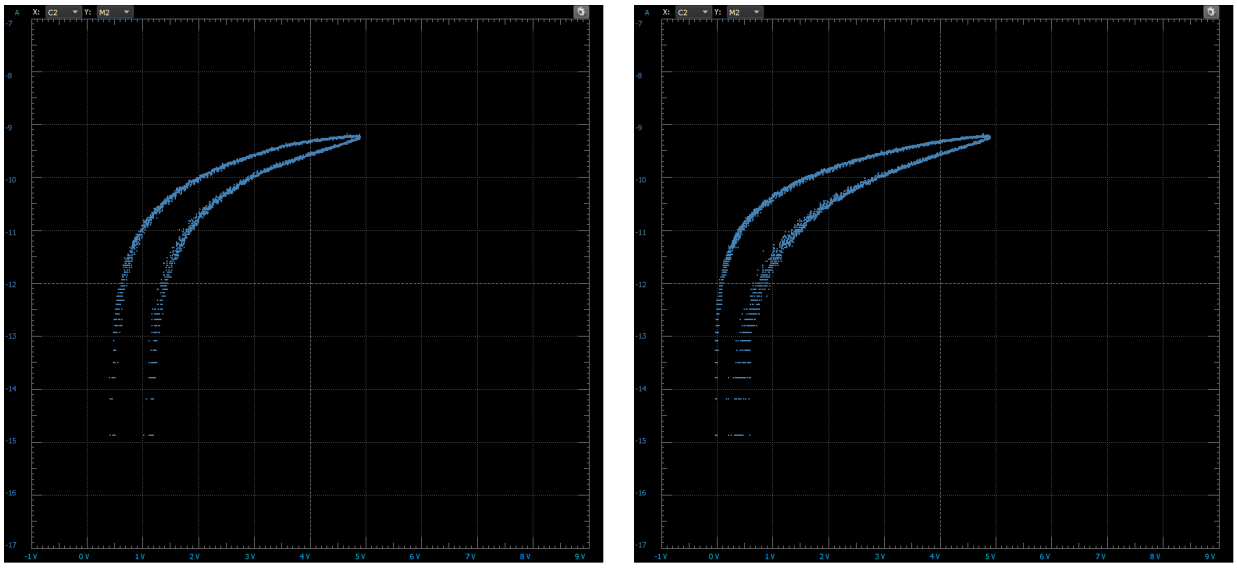
Figure 5 shows $\ln i_E$ as a function of v_{BC} for the PNP in parts b and c.



(a) $v_{EC} = 4V$ (b) $v_{EC} = 0.2V$

Figure 5: $\ln i_E$ as a function of v_{BC}

Figure 6 shows $\ln i_B$ as a function of v_{BC} for the PNP in parts b and c.



(a) $v_{EC} = 4V$ (b) $v_{EC} = 0.2V$

Figure 6: $\ln i_B$ as a function of v_{BC}

To determine the value of β for the NPN, you divide the linear region value of i_C found in figure 1 by the value of i_B. To determine the value of β for the PNP, you take the slope of i_E found in figure 4. To determine the value of $V_{BE(ON)}$ for the NPN, and the value of $V_{BC(ON)}$ for the PNP, you observe the non-zero regions in figures 2 and 5. To determine the value of $V_{CE(sat)}$ for the NPN, and the value of $V_{EC(sat)}$ for the PNP, you observe the the zero regions found in figure 1 and 4.

3. The marking section of the lab instructions state that no simulations are required for the report.

4. The shapes of the plots were as expected with little to no discrepancies. Some of the plots did appear to be splitting into different values, however this is because the value of v_B is being changed in those plots, causing the the value of i_B to also change. This causes the graph to shift up and down depending on the value of i_B.

5. For parts b and c, where the value of v_{CE} and v_{EC} had to be set to a certain value, this was not possible using the setup we had. As there had to be a voltage drop across the resistor, the value of v_C or v_E would not be exactly the value that we had for the voltage as the source for the resistor. This likely does not affect performance of the BJTs very much, as except slightly shifting the different modes of operation.