ELEC 2210 LABORATORY REPORT COVER PAGE
Complete and attach this page to the front of your lab report.

Meeting # 7 Bipolar Junction Transistors
Title of Lab Experiment

Student Name: Gabriel Emerson
Name (Last, First, MI)

Student Email: gte0002
AU 7-character username

GTA: Paul Atilola
Name of your GTA

Section you are enrolled in: (Circle One): (1) 2 3 4 5 6 7 8

Date experiment performed (dd / mm / yy): 3/2/21

Date report submitted: (dd / mm / yy): 3/8/21

If you performed this experiment at a time other than your regularly scheduled section meeting:

Section # of the section you sat in on (Circle One): 1 2 3 4 5 6 7 8 Makeup

Name of the GTA who supervised your work: _____

I hereby certify that the contents of this report are true and complete to the best of my ability.
The lab work was performed by me exclusively, and this report was written by me exclusively.

GTE

Student signature

3/8/21

Date signed

Gabriel Emerson
ELEC 2210 – T 11:00
Experiment #7 Bipolar Junction Transistors
03/02/2021

Introduction:
The goal of this lab is to take the knowledge of bipolar junction transistors the student has gained from lectures and apply them to a physical circuit. A 2N3904 NPN BJT will be used to assemble said circuit. This lab will help students visualize concepts gained from the classroom and will further solidify the BJT's significance in current amplification.

Part 1: Forced I_B Output Characteristics
The 2N3904 NPN BJT was connected onto the NI ELVIS board, making sure the collector was inserted into DUT+, the emitter into DUT, and the base into BASE. Using the 3-wire current voltage analyzer, the forced base current output characterizers were measured. Then, using the data from this plot, another graph was generated that plotted β_F vs V_{CE}. The forward and saturation regions are shown in the figures below.

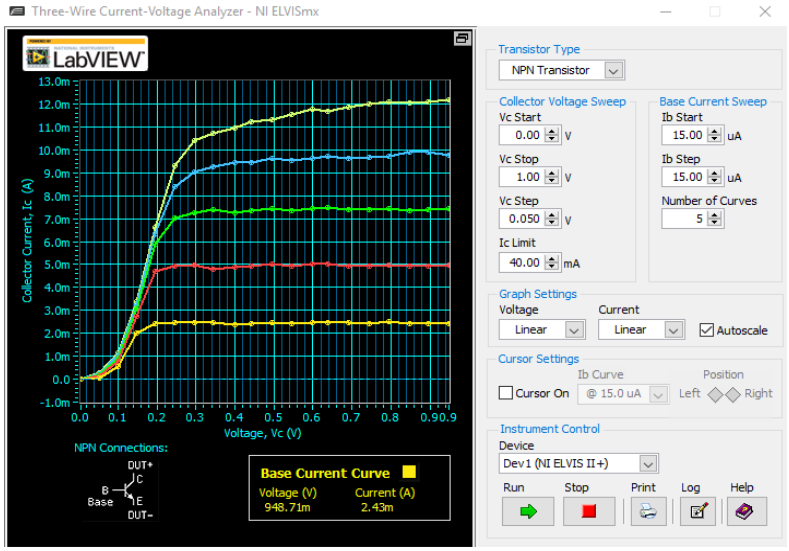

Figure 1: Forced I_B Characteristics

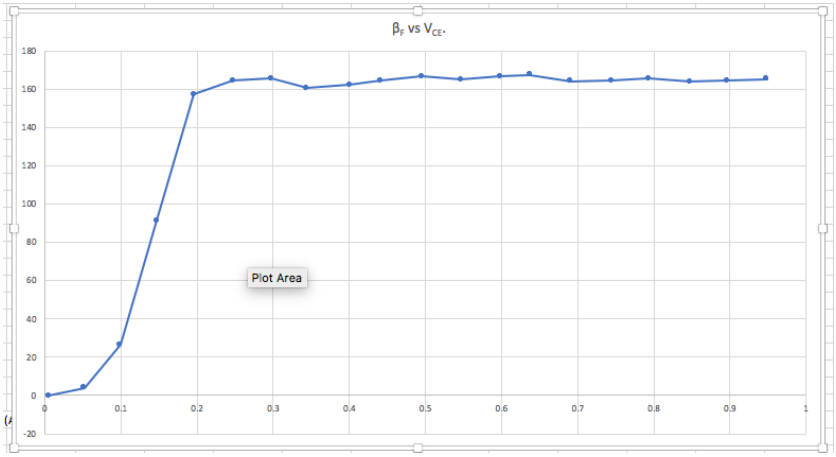

Figure 2: β_F vs V_{CE} Plot

Part 2: Forced V_{BE} Output Characteristics

Using a 2N3904 NPN transistor, we measured the forced V_{BE} output characteristics of the transistor. Due to the analog outputs having a very small current capacity, two non-inverting unity gain op-amps were used to achieve the measurements. The reaults can be seen below, along with the saturation and forward regions.

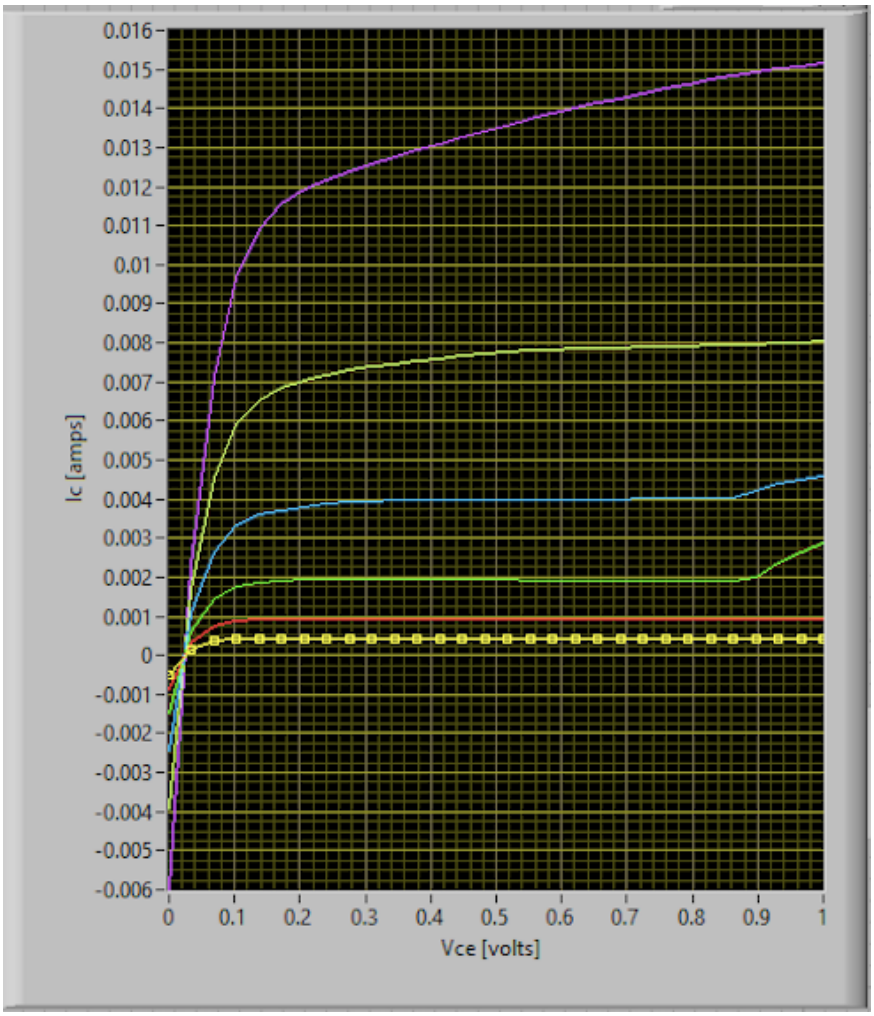

Figure 3

Part 3: NPN Transistor Switching Characteristics

Using a 2N3904 NPN BJT and a few resistors, we created a simple circuit. Then, using probes and the LabVIEW simulator, we generated voltage transfer curves for different locations in the circuit. AO0 was used as the programmable input voltage and was swept from from 0-5V in a 100 step increment. A screenshot was taken of each of the graphs and they can be seen below.

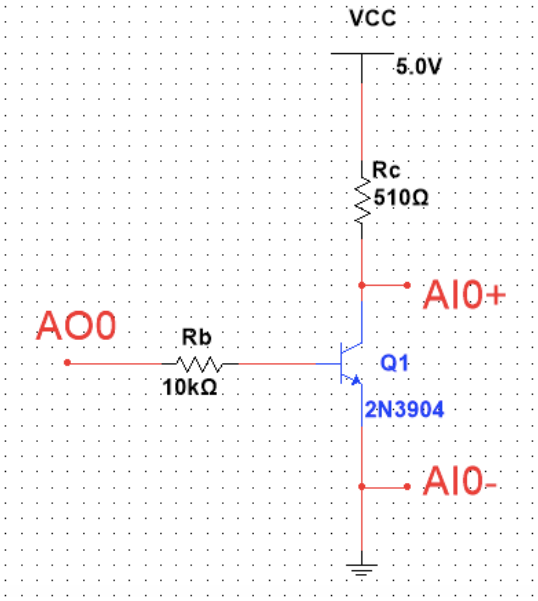

Figure 4: Circuit Schematic

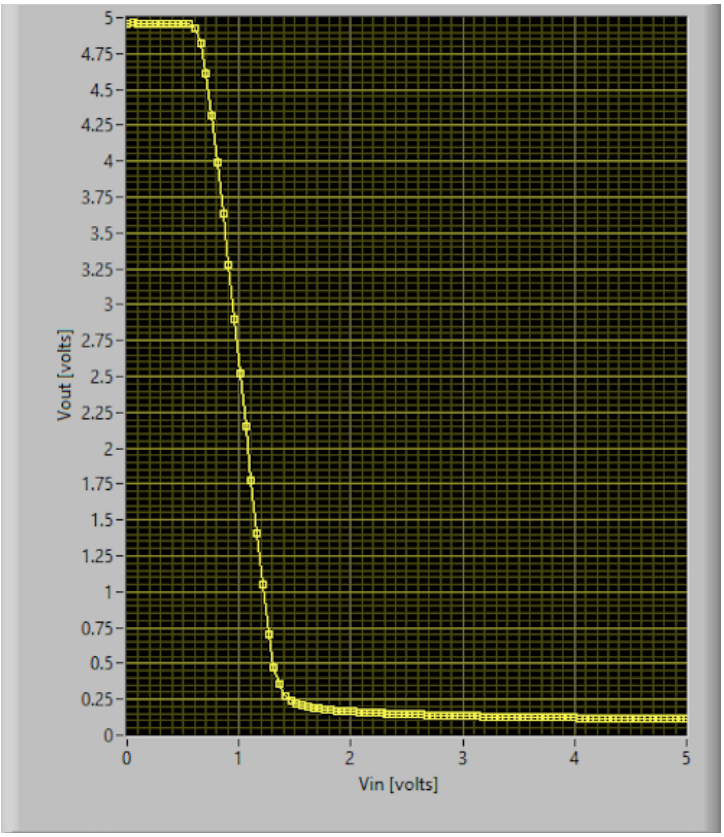

Figure 5: V_{CE} vs V_{in}

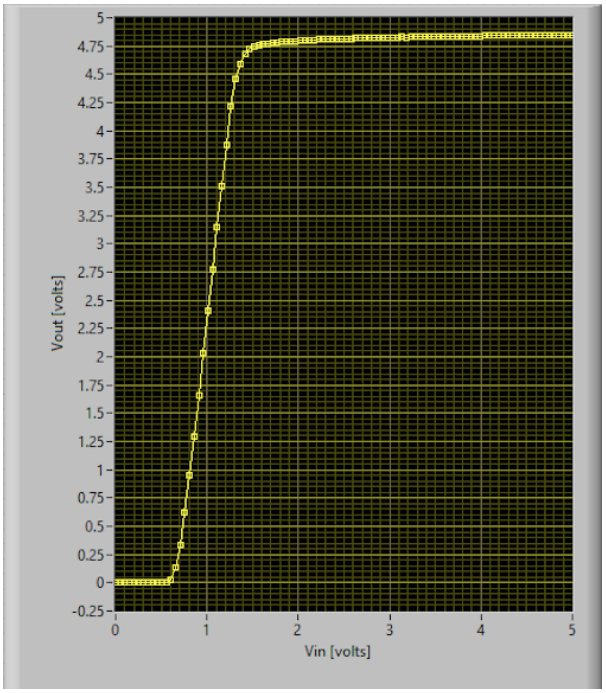

Figure 6: $V_{C\text{-}Load\text{-}Resistor}$ vs V_{in}

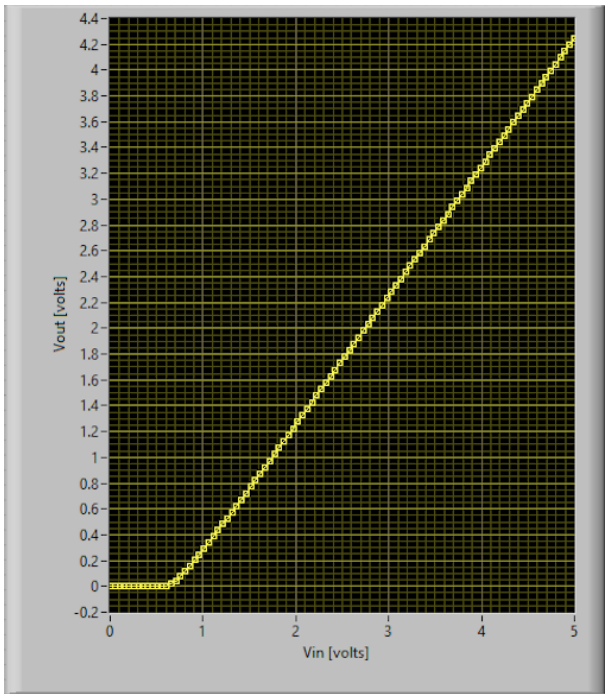

Figure 7:$V_{B\text{-}Resistor}$ vs V_{in}

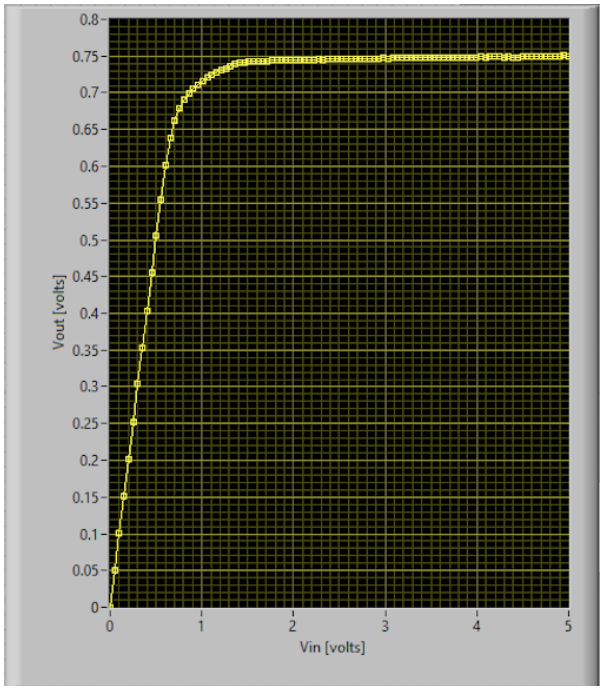

Figure 8: V_{BE} vs V_{in}

The output voltage seems to drop appreciably around ~0.6-0.65V in Figure 5. This value is close to the turn on voltage of 0.7V for a Si PN junction. This follows sound logic as the base-emitter junction is essentially a PN junction. The cut-off mode of operation begins at 0 and lasts until ~0.6-0.65V. Saturation mode occurs during the interval of ~0.65- ~1.5V. Forward mode occurs from ~1.5V onward.

Using data from the plots above, a graph can be generated that plots I_C and I_B against V_{in}. From the graph, as V_{in} increases, Beta decreases. This can be determined using the I_C/I_B values as V_{in} increases.

Part 4: Transistor as a Switch

Using the lab manual schematic, a circuit was built with the 2N3904 NPN BJT, some resistors, and an LED. With the multimeter and digital writer, measurements were taken for several variables when the LED was on and when the LED was off. This data implies that the transistor was in saturation mode when the LED was on. Furthermore, it also showed that the transistor was in cutoff mode when the LED was off.

LED	V_{CE}	V_{BE}	V_{BC}	I_B	I_C
ON	0.107	0.706	0.648	0.00042	0.009174
OFF	3.66	0	-3.6	0	0
FAN	V_{CE}	V_{BE}	V_{BC}	I_B	I_C
ON	0.107	0.83	0.704	0.003997	0.087306
OFF	4.64	0	-4.64	0	0

Conclusion:

This lab allowed me to have a better understanding of the BJTs that we have discussed in class. I had an issue with a faulty transistor, but other than that the lab went well and I had no issues. Part 3 had

the biggest impact on me. I really appreciated being able to see the voltage characteristics at each point in the circuit. I wish I would have grasped this concept sooner. I also think that this lab allowed me to further my intuition skills when determining if the BJT is in forward or saturation mode.

ELEC 2210 Lab Checklist

Student Name Gabriel Emerson

Meeting Date & Time T 11:00 GTA Name Paul Atilola

Section # 001 Station #_____

Meeting # & Title 7 BJT Transistors

Student Instructions: Fill in the items to be checked off by the GTA. When you are ready for checking off, notify the GTA. Include this sheet in your lab report.

GTA Instructions: Initial the student activities as requested in the experiment. Include comments as appropriate.

Part 1 Forced I_B output characteristics GTA Initials P.O.A.

Comments (GTA / Student):

Part 2 Forced V_{BE} output characteristics GTA Initials P.O.A.

Comments (GTA / Student):

Part 3 NPN Transistor Switching GTA Initials P.O.A.

Comments (GTA / Student):

Part 4 Transistor as Switch GTA Initials P.O.A.

Comments (GTA / Student):

Cleanup Inspection GTA Initials P.O.A.