

EE 3310L/5310L • Electronic Devices and Circuits Laboratory

Lab 4: BJT Voltages and Currents

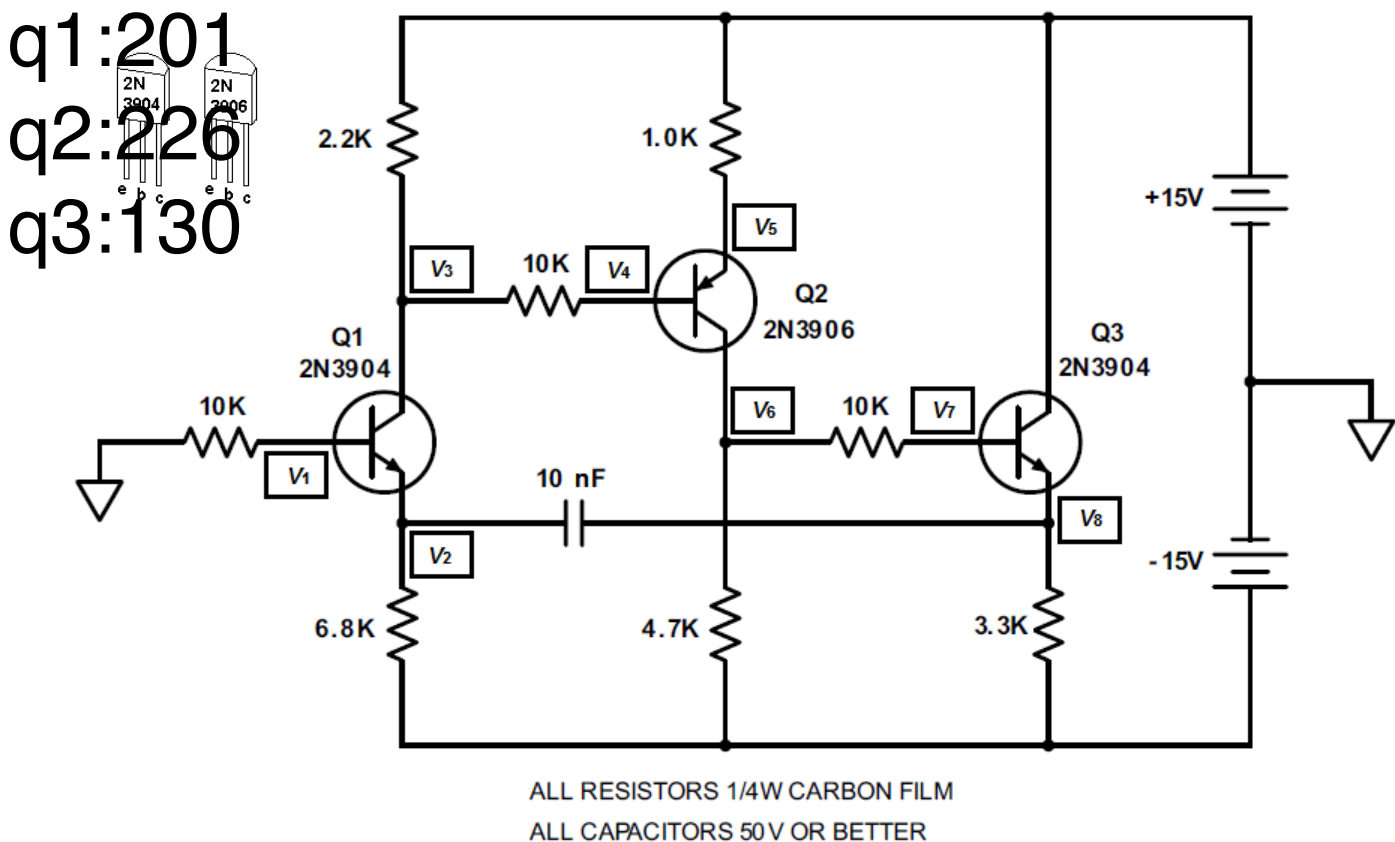
Purpose

The purpose of this lab is to construct a three-transistor circuit and measure its operating voltages and currents to verify that all transistors are in the active region and thus capable of small-signal linear amplification. Setting DC values to an operating point conducive to passing AC signals is called *biasing*, so these values are often termed bias voltages/currents. Note that the three transistors are connected together such that, for example, Q_1 's collector voltage determines Q_2 's base voltage. This type of connection is called *DC* or *direct coupling* and thus it is important to build the circuit very carefully and avoid wiring mistakes; one error can make every voltage in the circuit wrong.

Procedure

1) Select **two 2N3904 NPN** transistors and **one 2N3906 PNP** transistor. Use your **DMM to measure h_{FE} ($\equiv \beta$)** of each transistor. **If any transistor has an h_{FE} less than 30, check to make sure that the transistor is plugged in correctly and then discard it if the low value is verified.** Refer to the transistor pinout on the schematic.

2) Using the three preselected transistors (and keeping track of which one is which!), build the following circuit:



3) Measure and record node voltages V_1 through V_8 . Verify and demonstrate to the TA that the node voltages are close to those given in the following table before leaving lab.

V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8
-63 mV	-0.74 V	10.4 V	10.6 V	11.3 V	2.1 V	1.6 V	0.82 V
-108mV	-0.78V	10.46V	10.52V	11.32V	2.13V	1.91V	1.11V

Postlab

1) Use the measured node voltages and resistor values to determine the following voltages/currents:

Q_1 : V_{B1} , V_{C1} , V_{E1} , V_{BE1} , V_{CE1} , I_{B1} , I_{C1} , I_{E1}

Q_2 : V_{B2} , V_{C2} , V_{E2} , V_{BE2} , V_{CE2} , I_{B2} , I_{C2} , I_{E2}

Q_3 : V_{B3} , V_{C3} , V_{E3} , V_{BE3} , V_{CE3} , I_{B3} , I_{C3} , I_{E3}

For each value, write the equation with corresponding node voltages and resistances clearly!

2) Check that the measured voltages and currents verify operation in the active region for each transistor.

3) Use measured currents to calculate β for each transistor. Do the computed values match the h_{FE} values measured on the DMM?

4) Use Multisim to determine all simulated node voltages. Do they match the experimental values?

They were generally similar, except for voltages 6, 7 and 8 which were a fair bit lower than the experimental values.