Objectives: DC analysis of bipolar junction transistor is the principal purpose of this experiment. We will investigate two BJT biasing networks: the fixed-bias and the voltage-divider bias configuration.

Materials:

Breadboard
DMM (Digital multi-meter)
DC Power Supply
Function Generator
Oscilloscope
BC 237 (bjt)
Resistor(s)

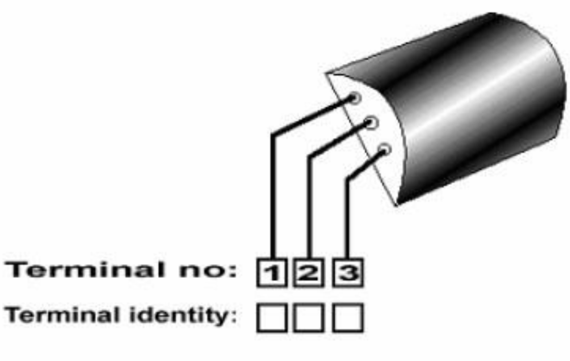
Background:

Bipolar transistors are made of either silicon (Si) or germanium (Ge). Their structure consists of two layers of n-type material separated by a layer of p-type material *(NPN)*, or two layers of p-type material separated by a layer of n-type material *(PNP)*. In either case, the center layer forms the base of the transistor, while the external layers form the collector and the emitter of the transistor. It is this structure that determines the polarities of any voltages applied and the direction of the electron or conventional current flow. With regard to the latter, the arrow at the emitter terminal of the transistor symbol for either type of transistor points in the direction of conventional current flow.

One part of this experiment will demonstrate how you can determine the type of transistor and its material, and identify its three terminals.

The relationship between the voltages and the currents associated with a bipolar junction transistor under various operating conditions determine its performance. These relationships are collectively known as the characteristics of the transistors. As such, they are published by the manufacturer of a given transistor in a specification sheet. It is one of the objectives of this laboratory experiment to experimentally measure these characteristics and to compare them to their published values.

Procedure:



1. Set the selector of the multimeter to the 10kΩ range. Connect multimeter probes as indicated in the table, and fill the readings.

Meter Leads Connected to BJT		**Resistance Reading**
Positive(Red)	***Negative(Black)***	
1	2	
2	1	
1	3	
3	1	
2	3	
3	2	

The meter readings between two of the terminals will read O.L. or a higher resistance regardless of the polarity of the meter leads connected. Neither of these two terminals will be the base.Based on this record the number of the base terminal.

BASE =……………………………

For *npn* type, connect the positive lead to the base terminal and the negative lead alternately to either of the other of the two terminals. The lower of the two readings obtained indicates that the base and collector are connected; thus other terminal is the emitter.

COLLECTOR =………………

EMITTER =……………………

2. Construct the fixed-bias circuit below, record measured resistor values and measure the voltages V_{BE} and V_{RC}

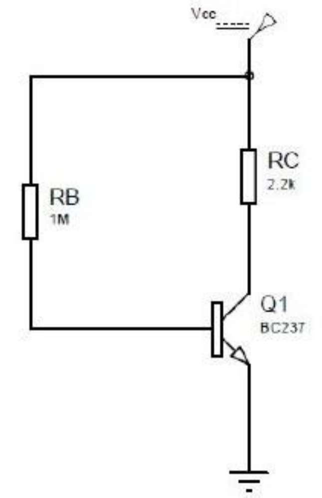
V_{CC} = 10 (V)

V_{BE} =…………………………………

V_{RC} =…………………………………

R_B = …………………………………

R_C = …………………………………



3. Using the measured resistor values calculate the resulting base current using the equation

$$I_B = \frac{V_{Rb}}{R_B} = \frac{V_{CC} - V_{BE}}{R_B} mA$$

And the collector current using the equation

$$I_C = \frac{V_{Rc}}{R_C} mA$$

Now, you can calculate the value of β and record it below. This value of β will be used for the BC 237 transistor throughout this experiment.

$$\beta = \frac{I_C}{I_B} = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

3. Using the β determined above, calculate the currents I_B and I_C for the same network with measured resistor values, supply voltage reading, and above measured value for V_{BE}. That is, determine the theoretical values of I_B and I_C using the network parameters and value of β.

I_B(calculated)=……………………

I_C(calculated)=……………………

How do the calculated levels of I_B and I_C compare to those determined from measured voltage levels in (2)?

4. Using the results (3) calculate the levels of V_B, V_C, V_E and V_{CE}.

V_B (calculated) = ……………………

V_C (calculated) = ……………………

V_E (calculated) = ……………………

V_{CE} (calculated) = ……………………

5. Energize the network and measure V_B, V_C, V_E and V_{CE}.

V_B(measured) = ……………………

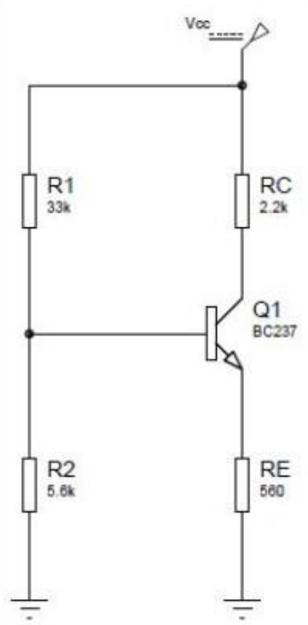
V_C(measureed) = ……………………

V_E (measured) = ……………………

V_{CE} (measured) = ……………………

6. How do the measured values compare to the calculated values? Explain on your report.

7. Construct the network below and record measured values of each resistor.



Using the beta determined before, calculate the theoretical levels of V_B,V_E, I_E, I_C, V_C,V_{CE} and I_B for the new circuit. Fill results table on next page.

	V_B	V_E	V_C	V_{CE}	I_E	I_C	$I_B(\mu A)$
Calculated at step (7)							
Measured at step (8)							

8. Run the network and measure V_B, V_E, V_C, and V_{CE}. Record their values in table. Also, measure the voltages V_{R1} and V_{R2}. Calculate the currents I_E and I_C and the currents I_1 and I_2 (using $I_1=V_{R1}/R_1$ and $I_2=V_{R2}/R_2$) from the voltage readings and measured resistor values. Insert the calculated current levels for I_E, I_C, and I_B in table.

9. Compare calculated and measured values of table. Explain on your report.