BJT Characteristics and Biasing

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Lab No. 6

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I. Introduction

The purpose of this part of the lab is to investigate the characteristics of a circuit using superposition principle with both dependent and independent voltage sources.

II. Background Information

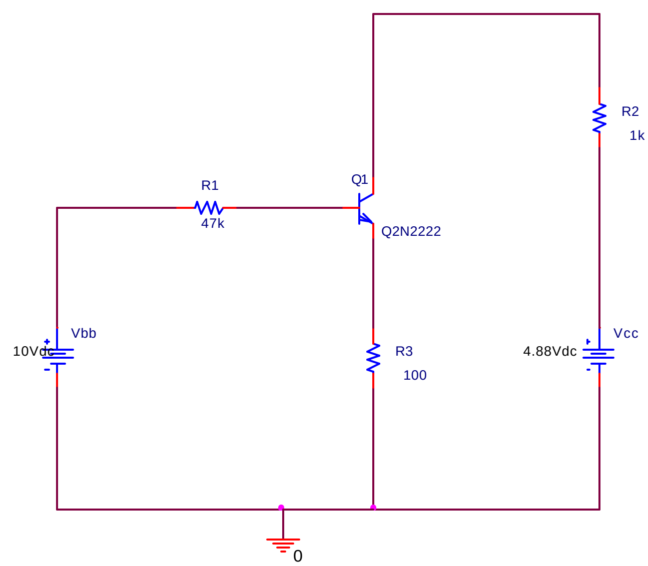
A transistor is a three terminal solid state electronic device capable of amplification and switching.Two different transistor designs predominate today: bipolar and metal-oxide semiconductor field effect (MOSFET). They are made as discrete small-signal and power devices and are integrated into digital and analog or linear silicon integrated circuits. Bipolar transistors have dominated where high speed switching has been stressed. For example, they have been used in the central processing units (CPUs) of most computers.

III. Materials Used

The following materials were used in this part of the lab: two resistors of 1 kΩ and one 4.7 kΩ resistor, DC voltage sources of 12 V, multimeters, banana to alligator wires, resistor substitution box, and the bread board on the Heathkit Trainer.

IV. Procedure

1. Set up the following circuit:

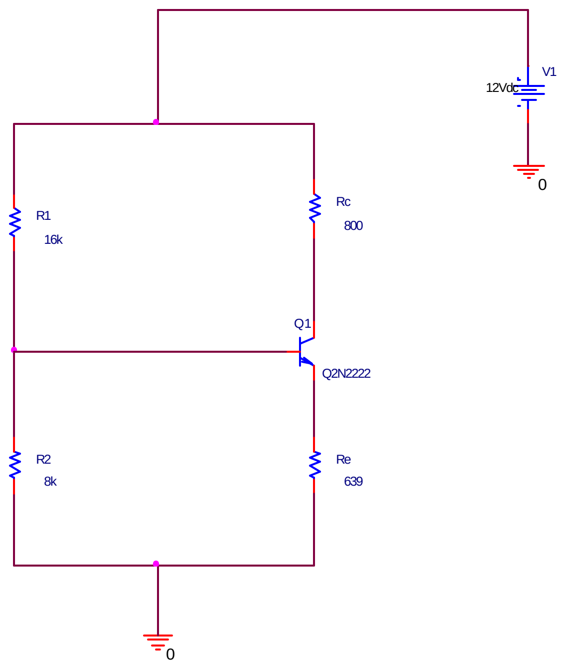


2. Connect the positive outlet of the voltage source V_{cc} to the circuit as indicated above.
3. Connect the negative outlet of the voltage source V_{cc} to the ground as indicated above.
4. Connect the positive outlet of the voltage source V_{bb} to the circuit as indicated above.
5. Connect the negative outlet of the voltage source V_{bb} to the ground as indicated above.
6. Connect an ammeter between the resistor of 1 kΣ and the collector pin of the transistor. This will measure the current Ic.

7. Connect the voltmeter between the collector and emitter pins of the transistor. This will measure the voltage V_{ce}.
8. Apply voltage to the circuit using both voltage source V_{cc} and V_{bb}.
9. Adjust the two voltage sources simultaneously until the current I_c=5mA and the V_{ce} = 3-5 Volts.
10. Then measure the current I_b which is the current between the base of the transistor and the resistor of 47KΣ
11. Using the measured value of I_b, then measure the ∀ and ∃.

Part B

1. Using the design rules, calculate the values of R_1, R_2, R_c and Re in the following circuit:



V. Results

Part A

I_c	V_{ce}	V_{bb}	I_b	∀	∃
5.07 mA	4.88 V	10 V	0.026 mA	0.994898	195

Part B

The following values were obtained using design rule. I_c and V_{cc} were given. I_c = 5 mA, V_{cc} = 12 V

R_1 || R2 = 24000 Ω
R_1 = 16000 Ω
R_2 = 8000 Ω
R_e = 639 Ω
R_c = 800 Ω Also see the calculations in the attached page.

VI. Conclusion

In the first part of the lab, the experimental result closely matches that of the Pspice simulations. The circuit is an amplifier. The parameters alpha and Beta are the coefficients that relates to how the circuit functions. The alpha is usually between 100 and 200. The closer to 200 the better. The beta also has significant impact on how the circuit performs. It is usually small than one.

In the second part of the lab, a circuit was designed with the known values of only Vcc=5 V and Ic=5mA. The other values were obtained using design rules.