EXPERIMENT E6: COMMON BASE AMPLIFIER

Related course: KIE1007 (Electronic Circuit I)

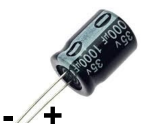
OBJECTIVES:
To measure the input impedance, voltage gain, current gain and power gain of a common base amplifier circuit

EQUIPMENT:
Oscilloscope; function generator; DC power supply; breadboard; multimeter; wires/jumpers; BJT BC547 (1 unit), resistors: 10kΩ (2), 6.8kΩ (1), 1.2kΩ (2), 1kΩ (2), 330Ω (1); capacitor 10uF (3); variable resistor 1kΩ (1)

INSTRUCTIONS:
1. Record all your results and observations in a log book / paper
2. Follow the demonstrator's instructions throughout the experiment


Resistor

REFERENCE(S):
Refer to the main references of KIE1007



Capacitor

INTRODUCTION:

The position of the input and output of the amplifier with respect to ground determines the type of amplifier configuration. Each of the three configurations has unique characteristics which can be utilized for particular application. In common base amplifier circuit, the emitter of the transistor serves as the input, the collector as the output and the base is common to both (for example, it may be connected to ground). It is typically used as a current buffer or voltage amplifier.

Parameter	Common Base	Common Emitter	Common Collector
Voltage gain, V_{gain}	High	High	< 1
Current gain, I_{gain}	< 1	High	High
Input resistance, r_{in}	Low (~Ω)	Moderate (~kΩ)	High (~kΩ)
Output resistance, r_{out}	High (~MΩ)	Moderate (~kΩ)	Low (~Ω)

PROCEDURE:

1. Construct the circuit according to Figure 1 on a breadboard. Turn ON the DC power supply only and set the DC power supply to +15V (This is for DC level calculation and biasing). You should be able to obtain V_B, V_C and V_E approximately as shown in Figure 1. V_B, V_C and V_E are measured using a multimeter, where its black wire is connected to the ground. Adjusting R_1 at this step will not change V_B, V_C and V_E.

2. Turn ON the function generator and set to sinusoidal voltage with 1 kHz frequency. Adjust the amplitude of the function generator and variable resistor R_1 until the output voltage V_O is 5.66 Vpp (or 2V rms). V_O is measured across R_L using an oscilloscope (Vpp value) by connecting CH1 across R_L or using a multimeter (Vrms value).

3. Measure V_i' rms from the circuit using a multimeter. V_i' = _____________ Vrms

4. Use the following voltage-divider formula to calculate the actual input voltage V_i.

$$V_i = V_i'\left(\frac{R_3}{R_2+R_3}\right) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \text{ Vrms}$$

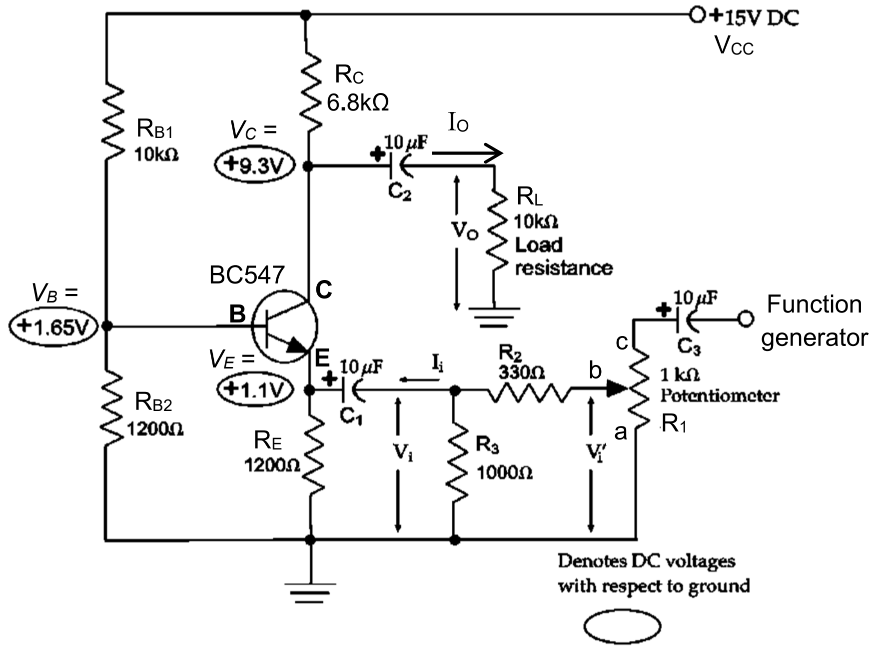


Figure 1

5. Calculate the voltage gain of the amplifier using the formula $A_v = V_O / V_i$ = ____________. (V_O was obtained from step 2 and V_i was obtained from step 4)

6. Turn OFF the function generator and DC power supply. Modify a certain part of your circuit in Figure 1 according to Figure 2 by removing the resistor R_3 and short the resistor R_2 with a jumper/wire. Then, add a 1000Ω resistor (R_{10}) in series with C_3, as shown in Figure 2. Turn ON the function generator and DC power supply. Adjust R_1 and function generator amplitude so that the output voltage V_O across R_L is 5.66 Vpp (or 2V rms).

7. Remove the jumper/wire across R_2 and measure the output voltage V_O = _______ Vrms.

8. Calculate the input voltage V_i required to obtain the output voltage V_O you recorded in step 7 and by using the voltage gain you recorded in step 5.
   V_i = V_O (step 7) divided by voltage gain (step 5) = __________ Vrms

9. Calculate the voltage drop across R_2, where it is the difference between the voltage recorded in step 4 and the voltage calculated in step 8.
   Voltage across R_2 = ____________ Vrms

10. Calculate the input current I_i, where I_i is the voltage across resistor R_2 (step 9) divided by R_2 (330Ω). I_i = ______________ mA rms

11. Calculate the output current I_O, where I_O is the output voltage V_O (step 7) divided by the load resistance R_L (10kΩ). I_O = __________ mA rms

12. Calculate the current gain using the output current I_O (step 11) divided by the input current I_i (step 10). Current gain $A_i = I_O / I_i$ = ______________.

13. Calculate the power gain using the current gain A_i (step 12) multiplied with the voltage gain A_v (step 5). Power gain $A_P = A_i \times A_v$ = ___________________.

14. Calculate the input impedance R_i using the input voltage V_i (step 8) divided by the input current I_i (step 10). $R_i = V_i / I_i$ = _______________ Ω.

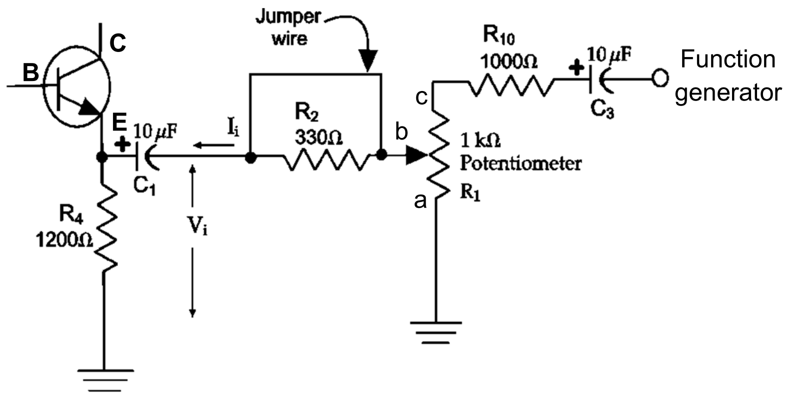


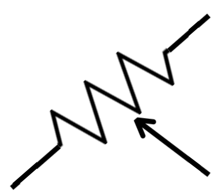
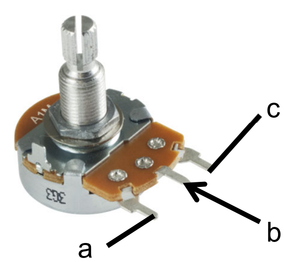
Figure 2

DISCUSSION:

1. What is the purpose of removing the resistor R_3, short the resistor R_2 with a jumper/wire and then add a 1000Ω resistor (R_{10}) in series with C_3 in step 6?
2. Describe the operation of the common base amplifier.
3. What is the importance of input and output resistance of a common base amplifier?
4. What is the importance of current gain and power gain of a common base amplifier?
5. State some applications of a common base amplifier.
6. What are the functions of the capacitors?

END OF EXPERIMENT

APPENDIX:

Component	Symbol	Figure
Variable resistor / potentiometer	 The resistance is fixed between points a and c. The resistance can be changed between points a and b or points b and c.	
BJT BC547