**LAB 8: BJT Amplifier**

Name:

**Objective:**

To model the properties of a simple amplifier circuit based on a Bipolar Junction Tansistor (BJT).

**Learning Outcomes:**

Able to analyze the characteristics of BJT Amplifier.

**Instrument/Component:**

DC Variable Power Supply

Function Generator

Oscilloscope

Digital Multimeter

Resistors: 2.5kΩ, 5kΩ, 8kΩ, 20kΩ

Capacitors: 10uF, 47uF (polarity)

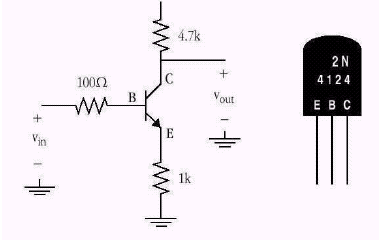
NPN transistor : 2N4124/2N3904 (or any NPN transistor)

## Prelab:

Use Proteus to obtain the results for the experiment procedure described in Task 1 and 2.

Task 1: **BJT Amplifier with DC input**

1. Construct the circuit as shown in **Figure 8.1**.



+12 V

Figure 8.1

1. Connect your scope to the circuit so that you can monitor the input signal on CH1 and the output signal on CH2.
2. Connect the output from the positive side of the dual power supply to your circuit at Vin. Apply input voltages from 0V to 5V in steps of 0.5V. Tabulated it in **Table 8.1** and plot the output voltage Vout versus Vin in **Figure 8.2**.

**Table 8.1**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Step 3** | **Vin** | | | | | | | | | | |
| **0** | **0.5** | **1.0** | **1.5** | **2.0** | **2.5** | **3.0** | **3.5** | **4.0** | **4.5** | **5.0** |
| **Vout**  **(Proteus)** |  |  |  |  |  |  |  |  |  |  |  |
| **Vout**  **(Experiment)** |  |  |  |  |  |  |  |  |  |  |  |



**Figure 8.2**

1. Based on your measurements in step (3), select a value of the input Vin which would correspond to the best bias or Q-point for this amplifier (*a value which will place the circuit in the linear part of the amplifier characteristic*.) Label this point on your plot. What is the amplifier’s voltage gain at the Q-point you selected?

Answer:

#### **Task 2: BJT Amplifier with AC input**

1. Using the same amplifier circuit as in **Figure 8.1**, disconnect the dual power supply from your circuit and replace it with function generator.
2. Apply a sinusoidal input signal Vin of 1V peak-to-peak with a dc offset corresponding to your Q-point. Record the peak-to-peak amplitude of the output signal Vout. Plot the Vin and Vout versus time on in **Figure 8.3**.



**Figure 8.3**

1. What is the dc component of the output signal Vout?

Answer:

**Task 3: BIAS STABILIZATION**

1. Construct the circuit as in **Figure 8.4**. R1=20kΩ, R2=5kΩ, RE=2.5kΩ, RL=8kΩ, C1=10uF, C2=CE=47uF.



**Figure 8.4**

1. Close S1. Measure IC in the collector circuit. Record it in **Table 8.2**. Measure the base-to-emitter voltage VBE, emitter voltage VE, and the collector-to-emitter voltage VCE. Record these voltages in **Table 8.2**.

**Table 8.2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Ic (mA)** | **Voltage, V** | | |
| **VBE** | **VCE** | **VE** |
|  |  |  |  |

1. Calculate IE using Ohm’s law *IE = VE / RE* and *IE = VTH - VBE / RE + (RTH / β)* using a β of 100. Compare and explain if there any differences in their values.

Answer:

1. Connect the signal generator set at 1000Hz sine wave and minimum output to the input terminals of amplifier. Connect the vertical input cable of an oscilloscope to the output terminals of the amplifier. (*Adjust the oscilloscope for proper viewing*)
2. Set the output of the generator just below the point of distortion, so that the maximum undistorted sine wave appears. Measure the peak-to-peak amplitude of this output waveform and of the input waveform from generator. Record the results in **Table 8.3**. Measure also and record IC, VBE and VCE. Draw the input and output waveforms in **Table 8.3**.

**Table 8.3**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Ic (mA)** | **Voltage, V** | | | **Waveform** | | | |
| **VBE** | **VCE** | **VE** | **Input** | **VP-P** | **Output** | **VP-P** |
|  |  |  |  |  |  |  |  |

**Task 4: Effect of Emitter Bypass Capacitor On Gain**

1. Using the same circuit in Figure 8.4, with the oscilloscope connected across the output of the amplifier, adjust the attenuator on the signal generator 50% of the amplifier’s maximum undistorted output.
2. Measure and record in the **Table 8.4** the peak-to-peak value of the input signal (base to ground) and output signal (collector to ground). Measure also and record the ac waveform from emitter to ground.
3. Calculate the ac gain of the amplifier and record in **Table 8.4**.
4. Do not change the attenuator setting of the generator. Remove the capacitor CE from the circuit. Repeat the step (2) & (3).
5. Place the short circuit around RE. Repeat the step (2) & (3). What is the effect on the amplifier performance of short circuiting RE?

**Table 8.4**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Waveform (to Ground)** | | | |
| **Base (VP-P)** | **Collector (VP-P)** | **Emitter (VP-P)** | **Gain** |
| **2 , 3** |  |  |  |  |
| **4** |  |  |  |  |
| **5** |  |  |  |  |

**Discussion and Conclusion**