I. OBJECTIVE

In this experiment you will build a transistor amplifier, bias it in the linear region, and measure several properties such as voltage gain, input resistance, and output resistance.

II. COMMON EMITTER AMPLIFIER WITH DEGENERATION

(1) Use the transistor curve-tracer to measure the A.C. and D.C. current gains $\beta_0$ and $\beta_F$ of an NPN transistor at an operating point of $I_C = 4mA$ and $V_{CE} = 4V$. Since these parameters fall off at both high and low collector currents, it is important to measure their value at the actual operating point.

(2) The amplifier circuit is shown in Figure 1. Use the value of $\beta_F$ obtained in Part (1) to compute values for $R_{B1}$, $R_{B2}$, and $R_C$ such that the operating point for the transistor is $I_C = 4mA$ and $V_{CE} = 4V$. With $R_{B1} || R_{B2} = \beta_F R_E / 10$, the operating point will be relatively insensitive to variations in $\beta_F$. Why is this so?

![Figure 1.](image)
(3) Measure the voltage gain $A_v$, input resistance $R_{in}$, and output resistance $R_{out}$ as follow *(with open circuit at point E for the CE stage)*:

a) $A_v$ - measure the amplitudes of voltage at points B and C

$$A_v = \frac{v_c}{v_b}$$

b) $R_{out}$ - measure amplitude at point C. Connect a variable resistor to point D and adjust the resistance until the amplitude at C is reduced by 1/2. The value of the variable resistor is equal to the output resistance. Why does this procedure measure output resistance?

c) $R_{in}$ - measure amplitude at B, then connect the variable resistor at point A and use the same procedure as for $R_{out}$. You can find $R_{in}$ from this measurement.

(4) Observe the clipping at the output on the oscilloscope. At what output voltages (maximum and minimum) does the clipping occur? *It may be necessary to short the 6.2kΩ resistor to observe clipping.*

(5) Calculate the theoretical values of $A_v$, $R_{in}$, $R_{out}$, and clipping levels, and compare with your experimental results.

### III. COMMON EMITTER AMPLIFIER

(1) Repeat Steps (3) through (5) from Part II with an emitter bypass capacitor connected across $R_E$. This capacitor is effectively an AC short at 10 kHz. What effect does this capacitor have on $A_v$, $R_{in}$, and $R_{out}$?

### IV. Emitter Follower Amplifier

(1) Now disconnect $C_E$, short-circuit $R_C$, and repeat Parts (3) through (5), taking the output (through a 10μF coupling capacitor) from the emitter. This configuration is called an *emitter follower or common collector.*
Lab Results:  Experiment 3 - THE AMPLIFIER

II. COMMON EMITTER AMPLIFIER WITH DEGENERATION

(1) Curve tracer data: \( \beta_f = \quad \beta_0 = \quad \)

(2) \( R_{B1} = \quad R_{B2} = \quad R_C = \quad \)

(3,4,5) Calculated Measured
\[ A_v = \quad \quad \quad \]
\[ R_{in} = \quad \quad \quad \]
\[ R_{out} = \quad \quad \quad \]
\[ V_{out(max)} = \quad \quad \quad \]
\[ V_{out(min)} = \quad \quad \quad \]

III. COMMON EMITTER AMPLIFIER

\[ A_v = \quad \quad \quad \]
\[ R_{in} = \quad \quad \quad \]
\[ R_{out} = \quad \quad \quad \]
\[ V_{out(max)} = \quad \quad \quad \]
\[ V_{out(min)} = \quad \quad \quad \]

IV. EMITTER FOLLOWER AMPLIFIER

\[ A_v = \quad \quad \quad \]
\[ R_{in} = \quad \quad \quad \]
\[ R_{out} = \quad \quad \quad \]
\[ V_{out(max)} = \quad \quad \quad \]
\[ V_{out(min)} = \quad \quad \quad \]