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EXPERIMENT No. 3
THE AMPLIFIER

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 β_o and β_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 β_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 β_F. Why is this so?

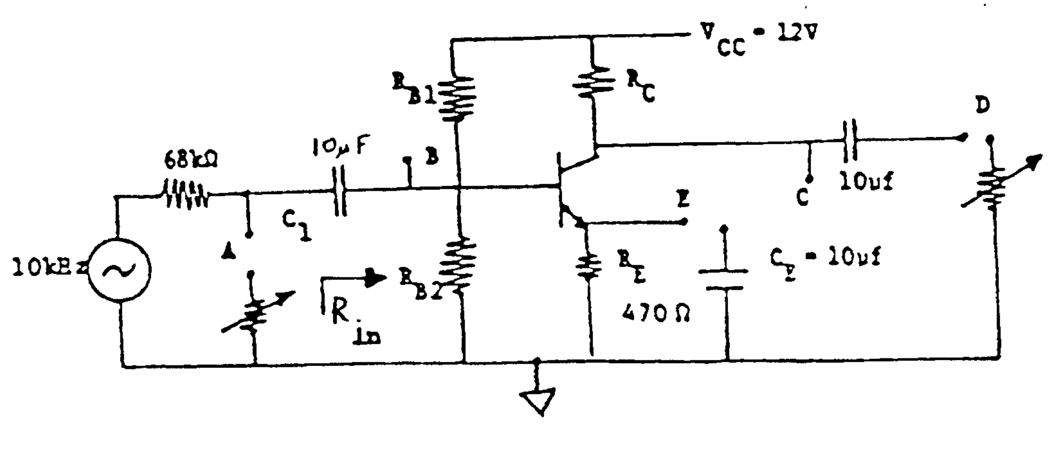

Figure 1.

(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 68kΩ 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: β_F= ________ β_0= ________

(2) R_{B1}= ________ R_{B2}= ________ R_C= ________

(3,4,5)	Calculated	Measured
A_v=	________	________
R_{in}=	________	________
R_{out}=	________	________
$V_{out(max)}$=	________	________
$V_{out(min)}$=	________	________

III. COMMON EMITTER AMPLIER

A_v=	________	________
R_{in}=	________	________
R_{out}=	________	________
$V_{out(max)}$=	________	________
$V_{out(min)}$=	________	________

IV. EMITTER FOLLOWER AMPLIFIER

A_v=	________	________
R_{in}=	________	________
R_{out}=	________	________
$V_{out(max)}$=	________	________
$V_{out(min)}$=	________	________