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EXPERIMENT No. 2
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 $I_C = 4\text{mA}$ and $V_{CE} = 4\text{V}$. 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 $I_C = 4\text{mA}$ and $V_{CE} = 4\text{V}$. With $R_{B1} \parallel R_{B2} = \beta_F R_E / 10$, the operating point will be relatively insensitive to variations in β_F . Why is this so?

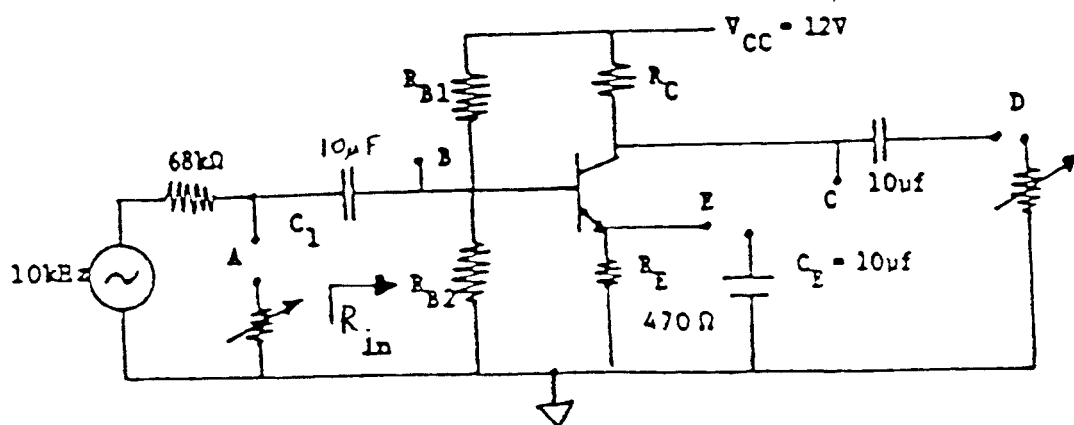


Figure 1.

(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 68k Ω 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 10 μ F coupling capacitor) from the emitter. This configuration is called an *emitter follower* or *common collector*.

EEEC114 Lab Results: Experiment #2 - THE AMPLIFIER

II. COMMON EMITTER AMPLIFIER WITH DEGENERATION

(1) Curve tracer data: $\beta_F =$ _____ $\beta_0 =$ _____

(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 AMPLIFIER

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

IV. EMITTER FOLLOWER AMPLIFIER

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