Name _____

Date _____

Instructor _____

EXPERIMENT

26

Class-A and Class-B Power Amplifiers

OBJECTIVE

To calculate and measure DC and AC voltages, and power input and output for both class-A and class-B power amplifiers.

EQUIPMENT REQUIRED

Instruments

Oscilloscope
DMM
Function generator
DC power supply

Components

Resistors

(1) 20-Ω
(1) 120-Ω, 0.5-W
(1) 180-Ω
(2) 1-kΩ, 0.5-W
(1) 10-kΩ

Capacitors

(3) 10-μF
(1) 100-μF

Transistors

(1) npn medium power, 15-W (2N4300 or equivalent)

(1) pnp medium power, 15-W (2N5333 or equivalent)
(2) Silicon diode

EQUIPMENT ISSUED

Item	*Laboratory serial no.*
DC power supply	
Function generator	
Oscilloscope	
DMM	

RÉSUMÉ OF THEORY

A class-A amplifier draws the same power from the voltage supply regardless of the signal applied. The input power is calculated from

$$P_i\,(\text{DC}) = V_{CC}I_{DC} = V_{CC}I_{CQ} \tag{26.1}$$

The power provided by the amplifier can be calculated using

$$P_o(\text{AC}) = \frac{V_C^2(\text{rms})}{R_C} = \frac{V_C^2(\text{peak})}{2R_C} = \frac{V_C^2(\text{p-p})}{8R_C} \tag{26.2}$$

with the amplifier's efficiency being

$$\%\eta = 100 \times \frac{P_o\,(\text{AC})}{P_i\,(\text{DC})}\% \tag{26.3}$$

A class-B amplifier draws no power if no input signal is applied. As the input signal increases, the amount of power drawn from the voltage supply and that delivered to the load both increase. The input power to a class-B amplifier is

$$P_i\,(\text{DC}) = V_{CC}I_{DC} = \frac{2V_{CC}V_C\,(p)}{\pi R_L} \tag{26.4}$$

The amplifier efficiency is calculated using Eq. 26.3.

$$P_o(\text{AC}) = \frac{V_L^2(\text{rms})}{R_L} = \frac{V_L^2(\text{p})}{2R_L} = \frac{V_L^2(\text{p-p})}{8R_L} \tag{26.5}$$

PROCEDURE

Part 1. Class-A Amplifier: DC Bias

a. Calculate the DC bias values for the circuit of Fig. 26.1.

R_1 = _____
R_2 = _____
R_C = _____
R_E = _____

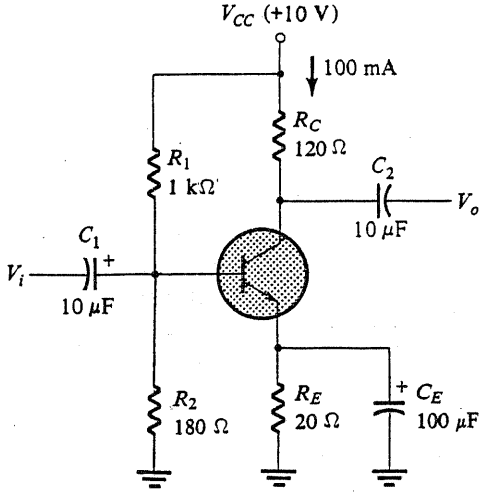

Figure 26-1

V_B (calculated) = _____
V_E (calculated) = _____
I_E (calculated) = I_C = _____
V_C (calculated) = _____

b. Construct the circuit of Fig. 26.1. If desired, measure and record actual resistor values in the space provided in Fig. 26.1. Adjust the supply voltage to V_{CC} = 10 V and measure and record DC bias voltages:

V_B (measured) = _____
V_E (measured) = _____
V_C (measured) = _____

Calculate the value of DC bias current:

$I_E = I_C = V_E/R_E$ = _____

Part 2. Class-A Amplifier: AC Operation

a. Using the DC bias values calculated in Part 1 and the equations given in the Résumé of Theory section, calculate power and efficiency values for the largest signal swing in the class-A amplifier of Fig. 26.1.

P_i (calculated) = _____

Using the largest signal swing around DC bias set in Part 1:

V_o (calculated) = _____
P_o (calculated) = _____
% η (calculated) = _____

b. Using the oscilloscope adjust the input signal (f = 10 kHz) to obtain the largest undistorted output signal. Measure and record these input and output voltages.

V_i (measured) = _____
V_o (measured) = _____

c. Using the measured values calculate the power and efficiency for the class-A amplifier of Fig. 26.1.

P_i = _____
P_o = _____
% η = _____

Compare the measured and calculated values of power and efficiency obtained in steps 2(**b**) and 2(**c**).

d. Reduce the input signal to one-half the level of step 2(**b**). Measure and record the input and output voltages.

V_i (measured) = _____
V_o (measured) = _____

e. Calculate the input power, output power, and efficiency using half the input voltage used in step 2(**a**).

P_i (calculated) = _____
P_o (calculated) = _____
% η (calculated) = _____

f. Using the measured values calculate the power and efficiency for the class-A amplifier of Fig. 26.1.

P_i = _____
P_o = _____
% η = _____

Compare the measured and calculated values of power and efficiency obtained in steps 2(**e**) and 2(**f**).

Part 3. Class-B Amplifier Operation

a. Calculate the power ratings for a class-B amplifier, as in Fig. 26.2 for V_o = 1 V, peak and V_o = 2 V, peak.

P_i (calculated) = _____
P_o (calculated) = _____
% η (calculated) = _____

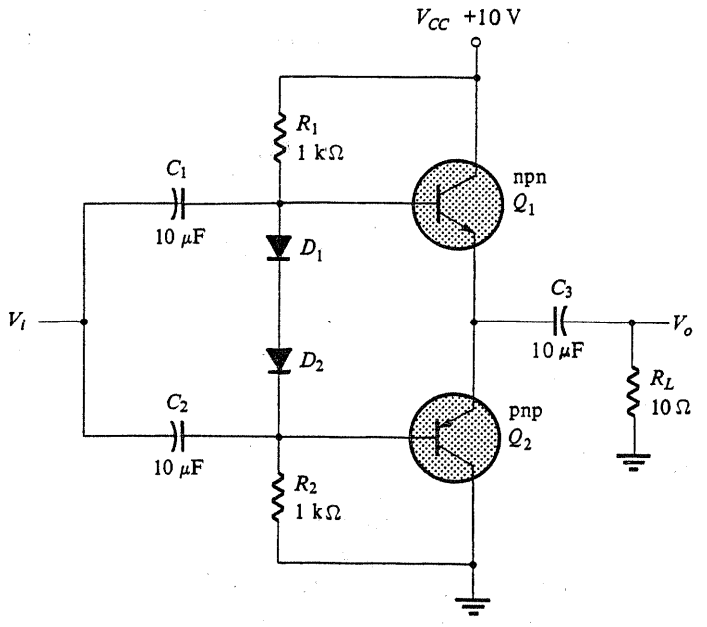

Figure 26-2

For $V_o = 2$ V, peak:

P_i (calculated) = _____
P_o (calculated) = _____
% η (calculated) = _____

b. Construct the circuit of Fig. 26.2. Adjust V_{CC} = 10 V. If desired, measure and record actual resistor values in the space provided in Fig. 26.2. Adjust the input until V_o = 1 V, peak. Measure and record AC voltages.

V_i (measured) = _____
V_o (measured) = _____

Using the measured values calculate input and output power, and circuit efficiency.

P_i = _____
P_o = _____
% η = _____

Compare values calculated in step 3(**a**) with those measured in step 3(**b**).

c. Adjust the input until V_o = 2 V, peak. Measure and record AC voltages.

V_i (measured) = _____
V_o (measured) = _____

Measure the average (DC) supply current from V_{CC}.

I_{DC} (measured) = _____

Using the measured values, calculate input and output power, and circuit efficiency:

P_i = _____
P_o = _____
% η = _____

Compare values calculated in step 3(**a**) with those measured in step 3(**c**).