ELECTRIC CIRCUITS
LABORATORY MANUAL
(EECS 70A LAB)

Section 6

Instructor

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EXPERIMENT 6:

MAXIMUM POWER TRANSFER

Prelab: Study the maximum power transfer theorem.

Objectives:
a) To verify by measurement, that maximum power is developed in a load when the load resistance is equal to the internal resistance of the source.
b) To construct a graph, using measured values of voltage, current and load resistance and calculated power to verify graphically objective a)**.**

I. BACKGROUND

The maximum power transfer theorem states that when the load resistance is equal to the source's internal resistance, maximum power will be developed in the load. Since most low voltage DC power supplies have a very low internal resistance (10 ohms or less) great difficulty would result in trying to affect this condition under actual laboratory experimentation. If one were to connect a low value resistor across the terminals of a 10 volt supply, high power ratings would be required, and the resulting current would probably cause the supply's current rating to be exceeded. In this experiment, therefore, the student will simulate a higher internal resistance by purposely connecting a high value of resistance in series with the DC voltage supply's terminal. Refer to Figure 1 below. The terminals (a & b) will be considered as the power supply's output voltage terminals. Use a potentiometer as a variable size of load resistance. For various settings of the potentiometer representing R_L, the load current and load voltage will be measured. The power dissipated by the load resistor can then be calculated. For the condition of $R_L = Ri$, the student will verify by measurement that maximum power is developed in the load resistor.

II. PROCEDURE

1. Refer to Figure 1, select R_{in} equal to 1 KΩ representing the internal resistance of the power supply used and select a 10 KΩ potentiometer as load resistance R_L.

a) Using the DMM set the potentiometer to 500 Ohms.

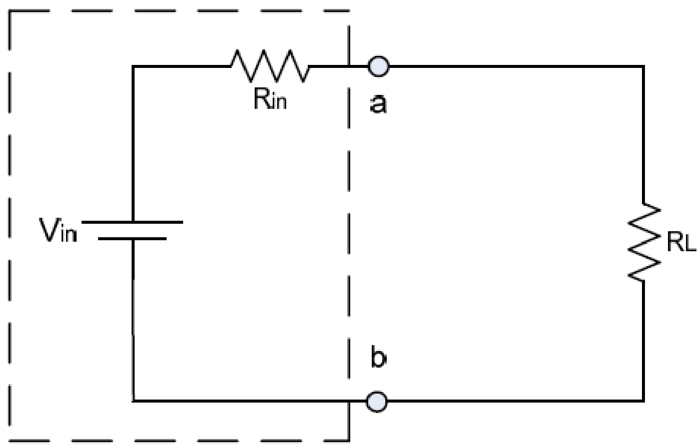

Figure 1.

b) Connect the circuit shown above. Measure the current through and the voltage across R_L. Record this data in Table 1.
c) Remove the potentiometer and set it to 1000 ohms. Return it to the circuit and again measure the current through and the voltage across R_L. Record.
d) Continue increasing the potentiometer resistance in 500 ohm steps until the value 10 k ohms is reached, each time measuring the current and voltage and recording same in Table 1. Be sure the applied voltage remains at the fixed value of 10 volts after each adjustment in potentiometer resistance.

2. For each value of R_L in Table 1, calculate the power input to the circuit using the formula:

$$P_{input} = V_{input} \times I_L$$
$$= 10 \times I_L,$$

since V_{input} is always a constant 10 volts.

3. For each value of R_L in Table 1, calculate the power output (the power developed in R_L) using the formula:

$$P_{out} = V_{RL} \times I_L.$$

4. For each value of R_L in Table 1, calculate the circuit efficiency using the formula:

$$\%\ efficiency = P_{out}/P_{in} \times 100.$$

5. On linear graph paper, plot the curve of power output vs. R_L. Plot R_L on the horizontal axis (independent variable). Plot power developed in R_L on the vertical axis (dependent variable). Label the point on the curve representing the maximum power.

R_L (Ω)	I_L (mA)	V_{RL} (V)	P_{input} (mW)	P_{output} (mW)	% eff.
500					
1000					
1500					
2000					
2500					
3000					
3500					
4000					
4500					
5,000					
6,000					
7,000					
8,000					
9,000					
10,000					

Table 1.