

Name _____ Date _____ Lab Section _____

Introduction

In this exercise you will verify the maximum power transfer theorem by theoretically and experimentally determining the load values for which maximum power is transferred to a load under various operating conditions.

Prelab Calculations (To be completed before the laboratory session)

Assume a load is connected between terminals A and B in the circuit shown in Figure 1. Maximum power is to be transferred from the source to the load. Utilizing Mathcad, determine the following:

- a) The load value if the load is purely resistive. ($f = 2.4\text{kHz}$) $R_{\text{Load}} =$ _____
- b) If the load consists of a $800\ \Omega$ resistor in series with a variable capacitor, determine the value of the capacitor. ($f = 2.4\text{kHz}$) $C_{\text{Load}} =$ _____
- c) If the load consists of a $800\ \Omega$ resistor in series with a $18.6\ \text{nf}$ capacitor, determine the source frequency. $\text{Freq.} =$ _____

Have your instructor verify your prelab calculations and results. Instructor Initials: _____

Procedure

1. Connect the circuit shown in Figure 1. This circuit will be used as a practical voltage source.
2. Set the generator to $3\ \text{V}_{\text{rms}}$ and $2.4\ \text{kHz}$. Use the DVM (AC volts) for voltage measurements.
Be sure to maintain the source voltage at $3\ \text{V}_{\text{rms}}$ during the following steps as either the load value or the source frequency varies.

Maximum Power into a Purely Resistive Load

3. Attach a decade resistor box from A to B. This will be the purely resistive load.
4. Make suitable measurements to determine the voltage ($V_{R_{\text{Load}}}$), current (I_{Load}), and real power (P_{Load}) delivered to the load as the load resistance is varied from $0\ \Omega$ to $3\ \text{k}\Omega$ (11 steps).
5. Record your data and results in a carefully designed table labeled Table 3-1.

Maximum Power into an RC Load with $R_{Load} = R_{TH}$

6. Add a decade capacitance box in series with the resistance box, and set the decade resistance box to $800\ \Omega$. Be sure to put the decade resistance on the ground side of the circuit.
7. Make suitable measurements to determine the voltage ($V_{R_{Load}}$), current (I_{Load}), and real power (P_{Load}) delivered to the load as the capacitance is varied from 0 nF to 100 nF (11 steps).
8. Record your data and results in a carefully designed table labeled Table 3-2.

Maximum Power as a Function of Frequency into an RC Load with $R_{Load} = R_{TH}$

9. Set the decade capacitance box to 18.6 nF. (Leave the resistance box at $800\ \Omega$)
10. Make suitable measurements to determine the voltage, current, and real power delivered to the load as the frequency of the generator is varied from 1 kHz to 6 kHz (11 steps).
11. Record your data and results in a carefully designed table labeled Table 3-3.

Phase Angles at Maximum Power

12. Determine the frequency at which maximum power was transferred to the load in steps 9-11.
13. Without modifying the circuit from the previous steps, connect an oscilloscope to the circuit to display the source voltage on channel 2 and the load resistor voltage on channel 1. Sweep the source frequency from 1kHz to 6kHz and note what happens to the phase angle of the load resistor voltage and the frequency approaches the maximum power frequency from step 12.

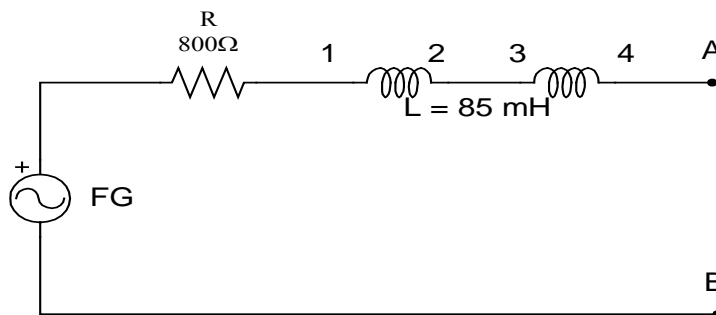


Figure 1 - Practical Voltage Source

Report Guide

1. Using the data from Table 3-1, plot a graph showing load power versus load resistance.
2. Using the data from Table 3-2, plot a graph showing load power versus load reactance.
3. Using the data from Table 3-3, plot a graph showing load power versus generator frequency.
4. Interpret your three graphs to determine the conditions for which maximum power is transferred to the load.
5. Compare the theoretical values (from the prelab) to the experimental results.

Approved by (Instructor): _____

Date: _____