California State University, Fresno
Department of Electrical and Computer Engineering

ECE 90L Principles of Electronic Circuits Laboratory

Experiment No. 3: DC Power and Power Balance in Circuits

Objective

The objective of this laboratory is to calculate and measure power in DC circuits, and to verify the principle of the summation of powers. Since you will be working with relatively high voltages and currents, you will also gain an appreciation for laboratory safety procedures, and for verifying the power ratings of your elements before performing your experiments.

Prelab

1.) For the given circuit (Figure 1), let V_i and I_i be the voltage and and current associated with the i^{th} branch, where $i = 1, \ldots, 4$. Define the polarities of all voltages and currents on the circuit diagram.

2.) Perform the following preliminary calculations.

a) Predict I_1 using resistance combination.
b) Predict I_2 and I_3 using current division.
c) Predict V_{12}, V_{24}, V_{23}, and V_{34} using voltage division.
d) Predict the power absorbed by each resistor.
e) Predict the total power absorbed by all of the resistors and the power delivered by the voltage source.

Be sure that your calculations agree with the reference directions you assigned in Part 1.

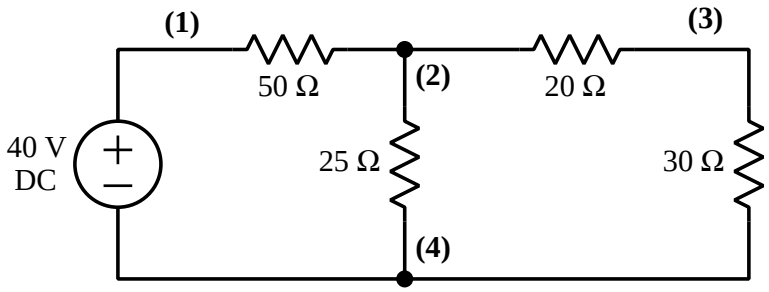

Figure 1: A Resistive Ladder Circuit

Procedure

1.) Select four resistors to be used in constructing the given circuit.

NOTE: Refer to your calculations above to be **certain** that the current and power ratings for the resistors are not exceeded. Can you use 1/4 W resistors in this experiment? If not, be sure to choose appropriate resistors from the cabinet. Measure the resistances.

Design and hook up your circuit, but do not hook up the voltage source. We are using relatively high voltages and currents in this experiment, so from this point forward, make sure that you perform the following steps **every** time you wish to setup a circuit:

a) Setup your circuit without attaching the power supply.
b) Verify that the power supply is disconnected from the circuit.
c) Turn on the power supply and adjust the voltage/current, as necessary.
d) Turn off the power supply.
e) Hook the power source up to your circuit.
f) Verify that everything in your circuit is correct.
g) Turn on the power supply and perform the experiment.

Whenever you wish to make a modification to your circuit, be sure to turn the power supply off **first**. Once the power supply is off, then—and only then—make your modifications to the circuit. Once the changes have been made, verify that the circuit is correct, and finally, turn the power supply back on. This procedure should be followed even if you think that the voltages and currents you may be working with are extremely small. It should become a habit, so that you treat every circuit equally: with respect.

These steps are so important that one day they may actually save your life.

To create the 40 V power supply, set each of the Mastech Power Supplies to 20 V and tie them together. The $-$ terminal of the first power supply should be tied to ground *GND,* and the $+$ terminal of the first power supply to the $-$ terminal of the second power supply to create your 40 V potential. Draw a diagram and explain why. Use the voltmeter adjust the voltage to 40 V.

2.) Repeat Part 2 of the Prelab, using the measured values of the resistance in place of the theoretical, ideal values indicated in the circuit diagram.

3.) Connect up the circuit as shown in Figure 1 and measure the total voltage and current being sourced by the coupled PS 503A power supplies, the branch currents, and the voltage across each of the 4 resistors. Using the measured values, calculate the power associated with each circuit element. Also, calculate the percent error of your measured values with respect to the new, theoretical values obtained in Part 2.

4.) Using a Wattmeter, measure the total power absorbed by the resistors. Ask your instructor to demonstrate how to use the meter before attempting to perform your measurements. Calculate the percent error.

Conclusion

Briefly discuss your conclusions regarding the relationship between voltage, current, and power. Comment on linearity in resistive circuits and linear systems in general, based upon your calculations and measurements in lab. How accurate are the mathematical models used to describe these types of circuits?

Group Report

Include all calculations from Part 2 of the Prelab, and Parts 2 and 3 of the Procedure in the report. Tabulate the results (voltage, current, and power) obtained for each resistor so that:

1. The comparison of the preliminary calculations,
2. The calculations using the measured resistances,
3. The measured values of the current, voltage, and power,

can be clearly seen. Discuss the results of the experiment, in addition to answering the questions posed in the Conclusion of the Procedure.