



COLLEGE OF ENGINEERING SUNY POLYTECHNIC INSTITUTE

ECE 260

Name: _____

Date: _____

Laboratory 4 – KCL

Purpose: The purpose of this lab is to become familiar with Kirchhoff's Current Law (KCL). KCL states that the sum of the currents coming into a node is equal to the sum of the currents leaving the node. It can be used to determine unknown voltage and currents in a circuit. In this experiment, you will use Multisim and the NI ELVIS II to build and test circuits to verify KCL as a way of analyzing parallel circuits.

Equipment Required

- Breadboard and power supply
- Digital Multimeter (DMM)
- Various resistors (or similar)
 - Two $1\text{ k}\Omega$ resistors
 - Three $3.3\text{ k}\Omega$ resistors

Learning Objectives

1. Become familiar with KCL by calculating the current through the different pathways within a circuit, given that you know the supply voltage and the resistor configuration
2. Build and analyze circuit using a simulation program.
3. Build and analyze a circuit you built.

Procedure

1) Applying KCL to Calculate an unknown voltage in a circuit.

Two elements are in parallel when they share two nodes. When a voltage or current source is in parallel to the two branches, one can use KCL to determine either the current in each branch or the total current feeding the two branches. See the figure below.

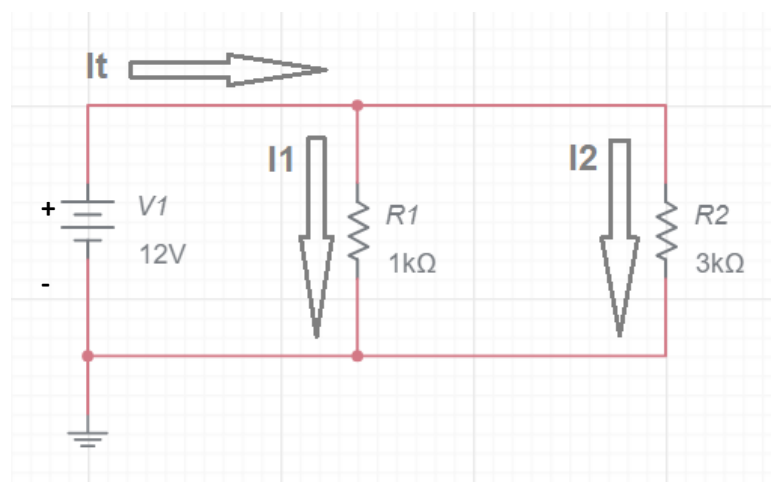


Figure 1

Here you will use circuit laws to calculate the total current in the circuit and the current at each resistor when you add resistors in parallel to a circuit. You will then build a circuit and observe these values experimentally and compare your measured results with your calculated results.

- a) For the circuit shown below, calculate the total resistance, the total current in the circuit and the current through each component. Record your values in Table 1 under Circuit 1.

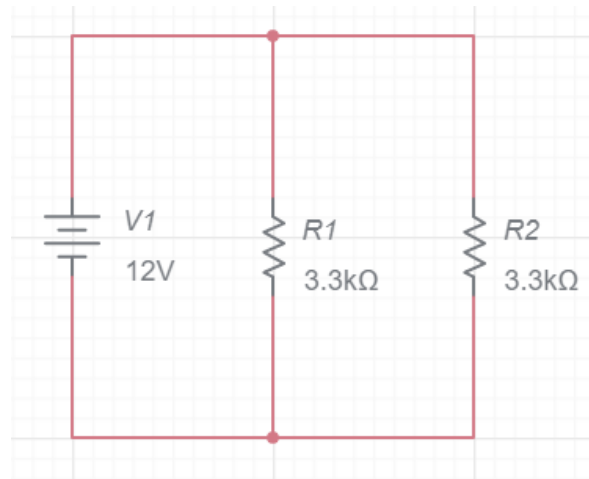


Figure 2

Table 1

Circuit	Calculate Total R	Calculate Total I ($I=V/R$)	Calculate I in R1	Calculate I in R2	Calculate I in R3	Calculate I in R4	Calculate I in R5
1					N/A	N/A	N/A
2						N/A	N/A
3							

- b) Add another parallel $3.3\text{ k}\Omega$ resistor to the previous circuit to form Circuit 2. See figure below. Calculate the total current, total resistance, and the current through each resistor. Record your values in Table 1, under Circuit 2.

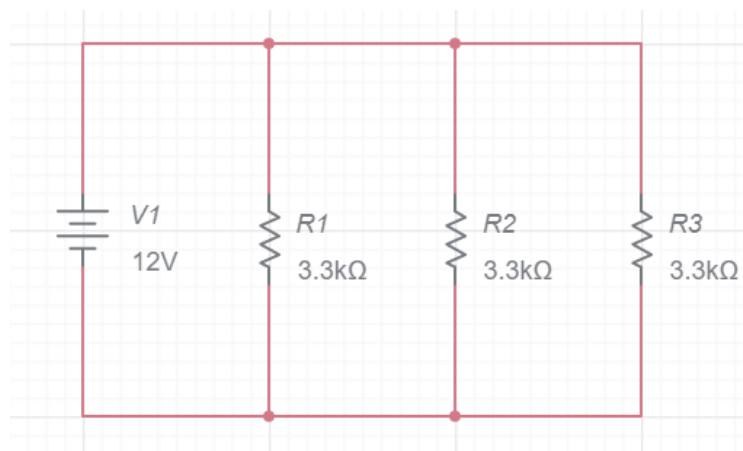


Figure 3

- c) Add two parallel $1\text{ k}\Omega$ resistors to the previous circuit to form Circuit 3. Recalculate the total current, total resistance and the current through each resistor. See figure below. Record your values in Table 1, under Circuit 3.

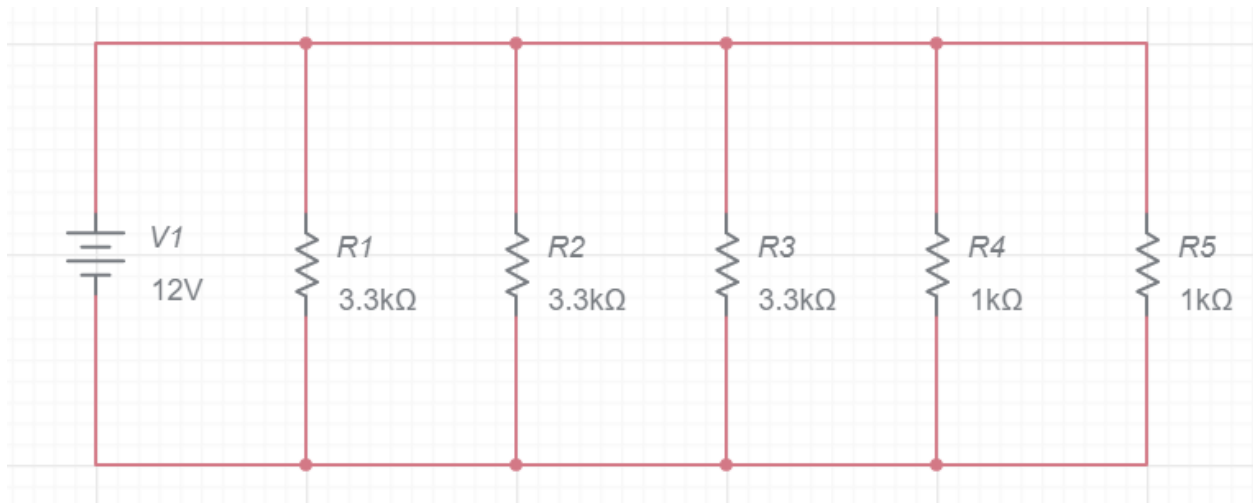


Figure 4

2) Simulate the circuit above using Multisim Live to check your answers

3) Build and implement KCL Circuits

Now you will build the circuits presented in the calculation exercises and take actual measurements of the values for which you calculated the theoretical values

Circuit 1

- a) Connect the following circuit on your breadboard (Circuit 1 in the previous exercise). Remember to turn off the power supply while wiring. Use $3.3\text{k}\Omega$ resistors and connect them in parallel with the variable power supply. See Figure 5.

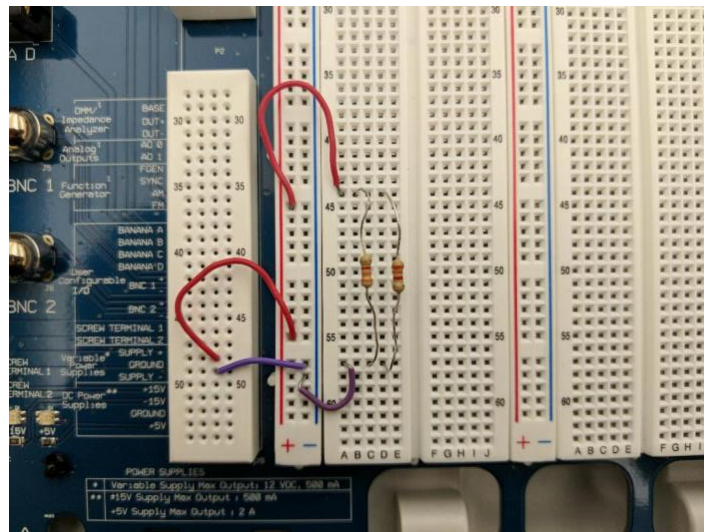


Figure 5

- Connect the DMM to the circuit
- Measure the total circuit resistance using the DMM in resistance mode. Record your results in Table 2.
- Set the variable power supply to 12 V.
- Measure the total circuit current (see Figure 6) and current at each resistor using the DMM as an ammeter (see Figure 7). Record your results in Table 2.

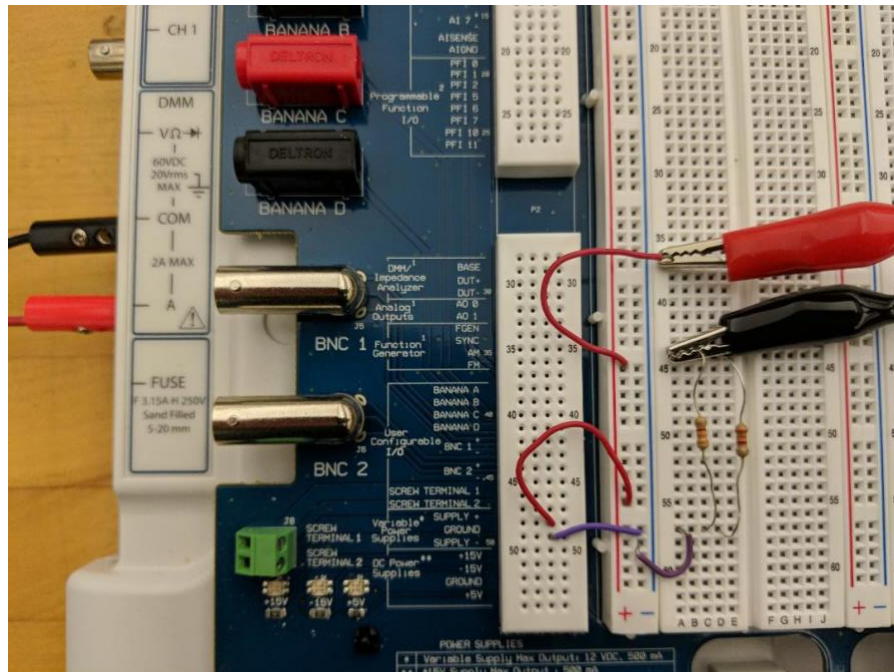


Figure 6

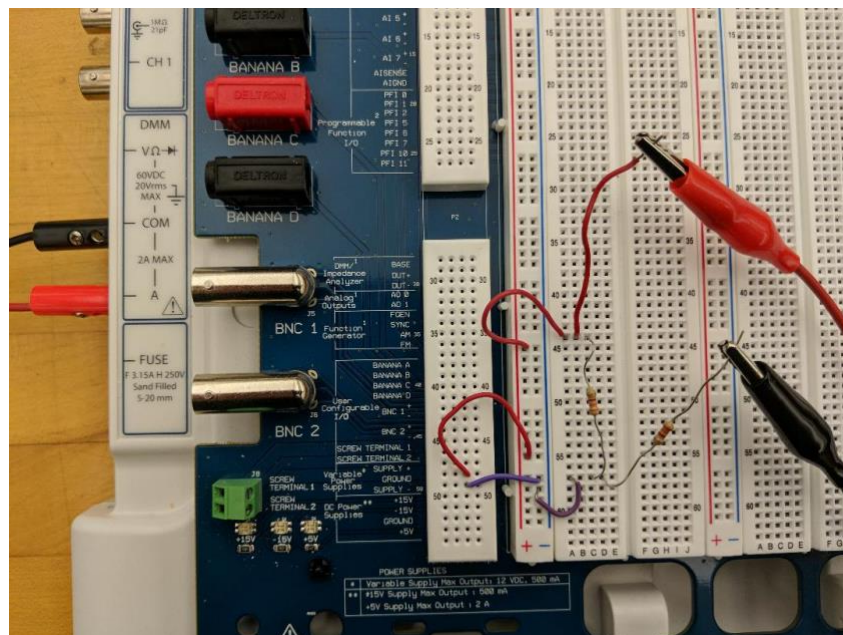


Figure 7

Table 2

Circuit	Measure Total R	Calculate Total I (from measured V and R) ($I=V/R$)	Measure Total I	Measure in R1	Measure I in R2	Measure I in R3	Measure I in R4	Measure I in R5
1						N/A	N/A	N/A
2							N/A	N/A
3								

Circuit 2

- b) Add another parallel $3.3\text{ k}\Omega$ resistor to the previous circuit to form Circuit 2. See Figure 8 below
- Repeat the measurements you took for Circuit 1 (total resistance, total current and current at each resistor).
 - Record your results in Table 2.

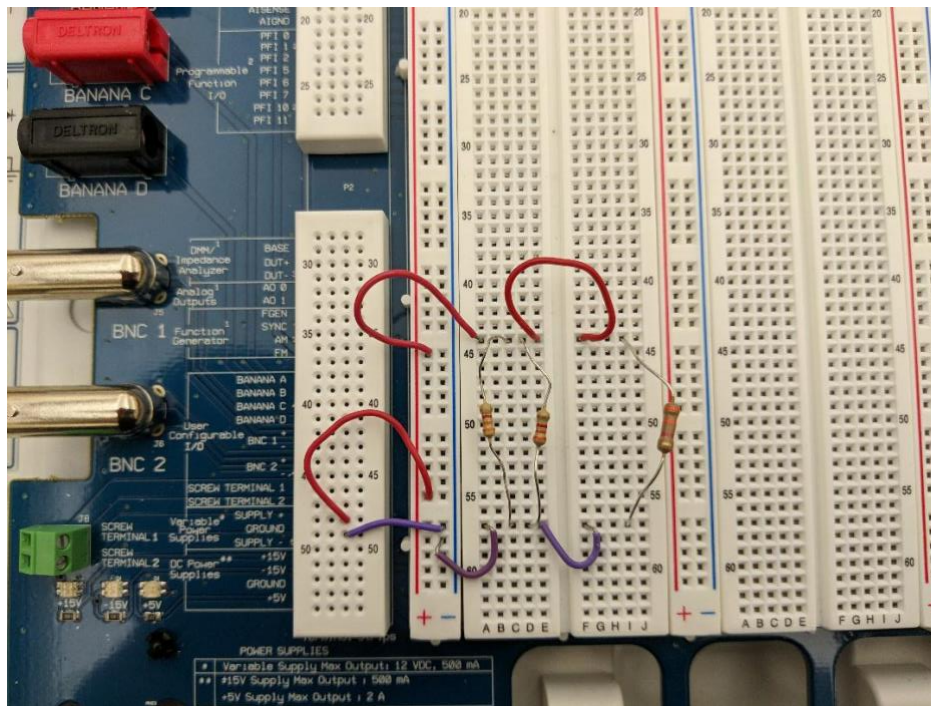


Figure 8

Circuit 3

- c) Add two parallel $1\text{ k}\Omega$ resistors to the previous circuit to form Circuit 3. See figure below.
- Repeat the measurements you took for Circuit 1 and 2 (total resistance, total current and current at each resistor).

- Record your results in Table 2.

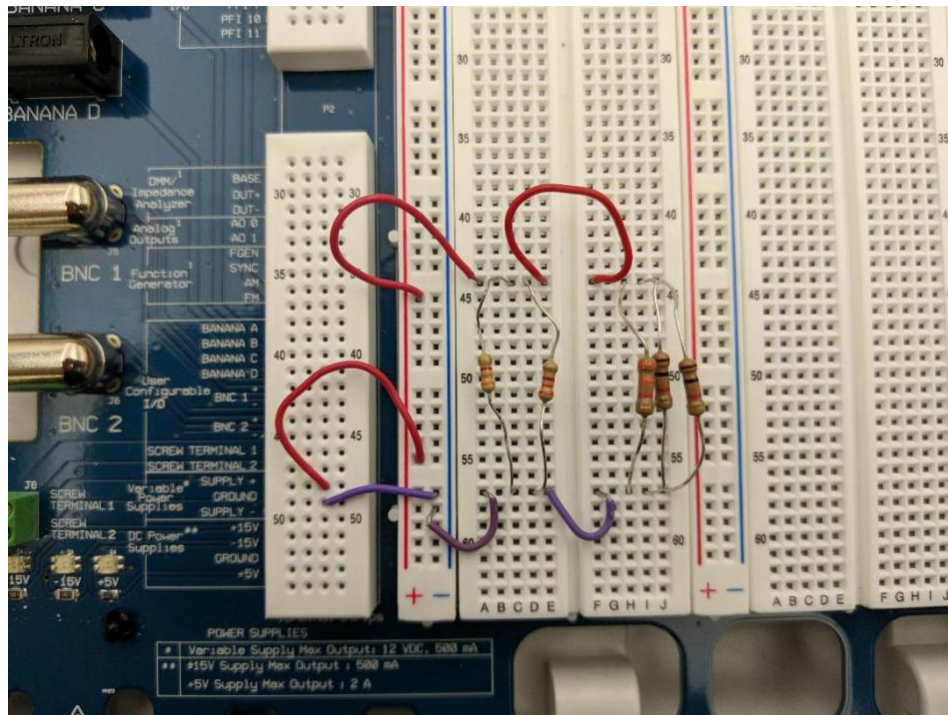


Figure 10

Conclusion

These questions will help you review and interpret the concepts learned in this lab.

In your own words, describe Kirchhoff's Current Law. Describe how KCL serves as the founding principle of a grounding strap.

Why is Kirchhoff's Law often viewed as a consequence of the principle of conservation of energy?

How does the total resistance in a circuit compare to the that of the lowest-value parallel resistor?

What happens to the total resistance when more parallel resistors are added to the circuit? What happens to the total current?

Did your results from the build and implement stage match your predicted values from the exercise stage? If not, why do you think that might be?

Record any observations from your experiments in relation to Kirchhoff's Current Law that you have not yet noted.
