Resistors Lab (Lab 4)

Resistors in Circuits

Leonardo Fusser, 1946995

Experiment Performed on **23 September 2019**
Report Submitted on **30 September 2019**

Department of Computer Engineering Technology
Circuit Analysis & Simulation I
Mohamed Tavakoli

VANIER
CÉGEP / COLLEGE
Learning today Leading tomorrow

TABLE OF CONTENTS

1.0 Purpose

- Understand resistor functions in circuits.
- Understand Series and Parallel circuits.
- Understand how to use the desktop Ohmmeter.
- Understand how to use the desktop Power Supply.
- Understand how to use the electronics breadboard.

2.0 Equipment Needed

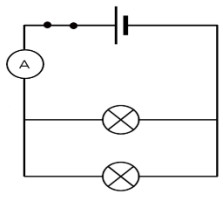
- (9x) 4-band ¼ watt axial resistors.
- (1x) desktop Ohmmeter.
- (1x) desktop Power Supply.
- (1x) electronics breadboard.

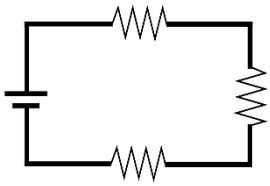
3.0 Theory

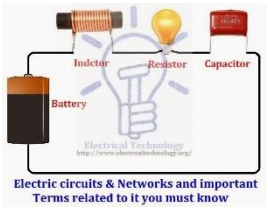
Parallel & Series Circuits

- A ***CIRCUIT*** is a path where electrons from a voltage or current flow. The point where those electrons enter an electrical circuit is called the "source" of electrons. The point where the electrons leave an electrical circuit is called the "return" or "earth ground" (refer to document #3 for reference).
- A ***PARALLEL*** circuit is a circuit where two elements share two points between themselves (they have two points in common) (Refer to document #1 for reference).
- Unlike in a parallel circuit, a ***SERIES*** circuit is where two elements share one point between themselves (they have one point in common) (Refer to document #2 for reference).

(Document #1-Parallel Circuit) (Document #2-Series Circuit) (Document #3-Circuit)







Resistors in Parallel & Series Circuits

- The behavior of a resistor differs from circuit to circuit. In *SERIES* circuits, the total resistance (Req) is equal to the sum of all the resistors that are in that specific circuit (Req = R1 + R2 +Rn…). In *PARALLEL* circuits, the rules are slightly different. The total resistance of the resistors is found by adding up the reciprocals of the resistance values, and then taking the reciprocal of the total (1 / Req = 1 / R1 + 1 / R2 + 1 / Rn…) (Document #4 proves these details).

(Document #4-Requivalent in Series & Parallel)

Series

$$R_{equivalent} = R_1 + R_2 + R_3 + \ldots$$

$$R_{equivalent} = \frac{V}{I} = \frac{V_1 + V_2 + V_3 + \ldots}{I} = \frac{V_1}{I_1} + \frac{V_2}{I_2} + \frac{V_3}{I_3} + \ldots = R_1 + R_2 + R_3 + \ldots$$

Series key idea: The current is the same in each resistor by the current law.

Parallel

$$\frac{1}{R_{equivalent}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

Parallel:

$$\frac{V}{R_{equivalent}} = I = I_1 + I_2 + I_3 + \ldots = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} + \ldots$$

$$\frac{1}{R_{equivalent}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

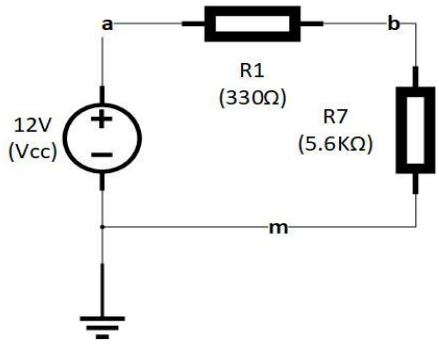
Parallel key idea: The voltage is the same across each resistor by the voltage law.

4.0 EXPERIEMNTAL RESULTS

Measuring resistors (Circuit 1)

- Circuit 1 involves measuring the voltage across given nodes in a circuit (circuit 1 is a voltage divider). Refer to circuit 1 schematic for reference.

Circuit 1



Results:

Va = 12V (= Vcc)
Vb = 11.33V
Vmb = -11.33V
Vab = 0.66V (667mV)
Vbm = 11.33V

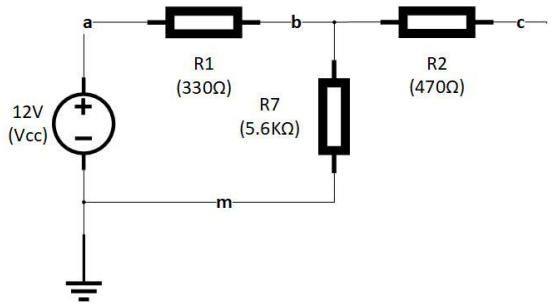
(Verify) *Vbm = Vcc * R7/(R1+R7)* :

- Vbm = 12 * 5’600/(330+5’600)…..Vbm = 11.33V

Measuring resistors (Circuit 2)

- Circuit 2 involves measuring the voltage across given nodes in a circuit. Refer to circuit 2 schematic for reference.

Circuit 2



Results:

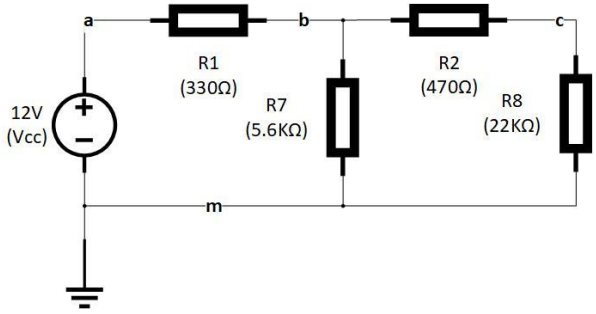
Vam = 12V (= Vcc)
Vbm = 11.33V
Vcm = 11.33V
Vab = 0.66V (667mV)
Vac = 0.66V (667mV)
Vbc = 0.005mV (0V)

Q: *What do you notice and why?*
A: Vbm, Vcm read the same result (11.33V) and Vab, Vac read the same result (667mV).

Measuring resistors (Circuit 3)

- Circuit 3 involves measuring the voltage across given nodes in a circuit. Refer to circuit 3 schematic for reference.

Circuit 3



Results:

Vam = 12V (= Vcc)
Vbm = 11.18V
Vcm = 10.95V
Vab = 0.18V (814mV)
Vac = 1.05V
Vbc = 0.27V (273mV)

Q: *What do you notice and why?*
A: Vbm, Vcm read almost the same result (11.18V & 10.95V) and Vab, Vac read almost the same result (814mV & 1.05V).

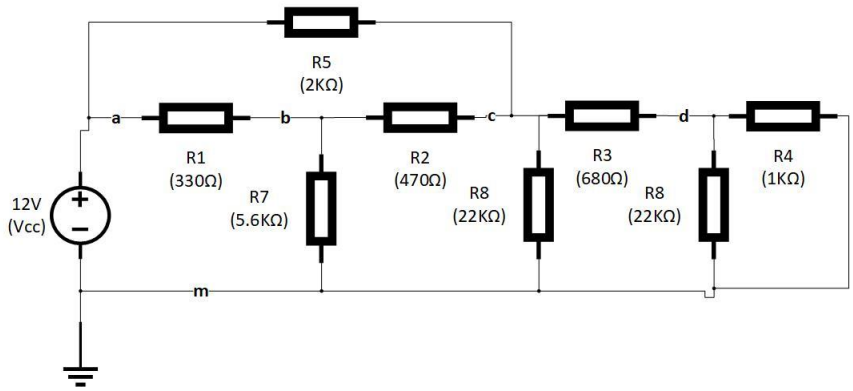
Measuring resistors (Circuit 4)

- Circuit 4 involves measuring the voltage across given nodes in a circuit. Refer to circuit 4 schematic for reference.

Results:

Va = 12V (= Vcc)
Vb = 10.1V
Vcm = 8.3V
Vab = 1.8V
Vac = 3.6V
Vbc = 1.7V
Vd = 4.9V
Vad = 7V
Vbd = 5.2V
Vcd = 3.4V

Circuit 4



5.0 Conclusion

- Purpose of this lab has been achieved.
- Understood the concept of the electronics breadboard.
- Understood the concept of the desktop Ohmmeter.
- Understood the concept of the desktop Power Supply.
- Understood circuits/types of circuits.
- Understood resistor behavior in circuits/types of circuits.
- First time results wrong because the probes were not in correct socket (circuit 2).
- First time results wrong because was measuring current instead of voltage (circuit 2).
- Solution to situation in circuit 2: change probe socket for voltmeter and set DMM to voltmeter.
- Learning experience: not all DMMs have all the functions (ohmmeter, voltmeter, ammeter…) using the same probe socket. It is important to refer to the specific DMM manual.