

Electronics Review 1

Cornerstone Electronics Technology and Robotics II Week 1

- **Administration:**
 - Prayer
 - Welcome back
 - Review Quiz 1
- **Review:**
 - Reading meters:
 - When a current or voltage value is unknown, begin with the highest meter range.
 - An ammeter must always be connected in series (in line) with a circuit component.
 - Voltmeters are always connected in parallel with the component (across the component).
 - When measuring resistance, disconnect the resistor from the circuit. Also make sure power is off to the circuit.
 - Ohm's Law:

$V = I \times R$ where:

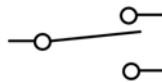
V = voltage in volts,
I = current in amperes, and
R = resistance in ohms

- Switches:
 - SPST switch example and symbol:



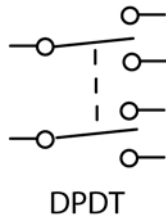
SPST

- SPDT switch example and symbol:



SPDT

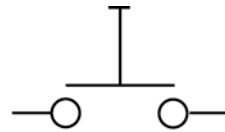
- DPDT switch example and symbol:



- Momentary switches:

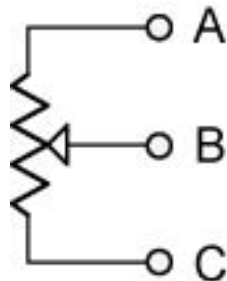


Normally Closed (NC)

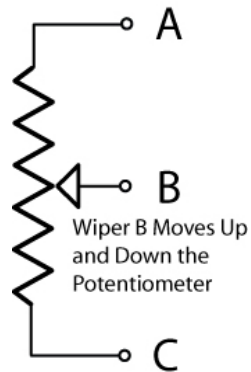


Normally Open (NO)

- Show samples
 - Potentiometer: a 3 -Terminal Variable Resistor
 - 100 Watt sample
 - Potentiometer Symbol:

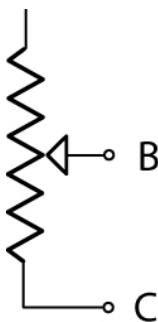


- Function:



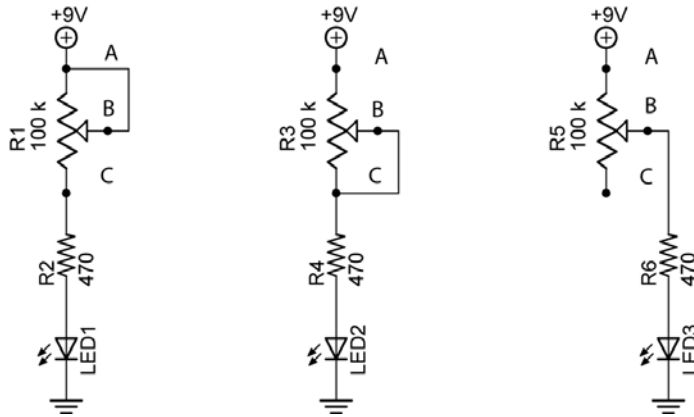
Potentiometer

- The resistance between points A and C (R_{AC}) is constant. It is the resistance rating of the potentiometer.
 - As wiper B moves up and down the potentiometer, resistances R_{AB} and R_{BC} vary, but $R_{AB} + R_{BC}$ will equal R_{AC} .
 - Set up an experiment to verify the last point.
- Rheostat: A 2 -Terminal Variable Resistor
 - Symbol:



Rheostat

- Potentiometer Wired as a Rheostat:



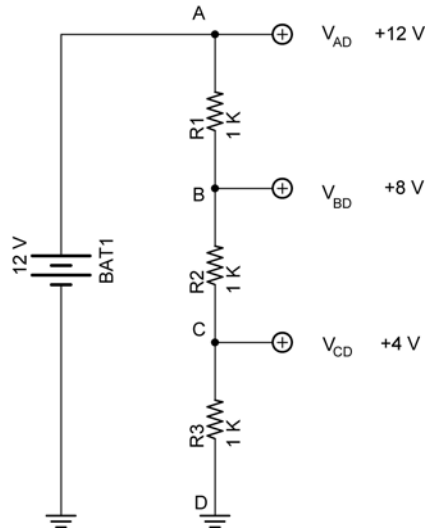
Circuit A

Circuit B

Circuit C

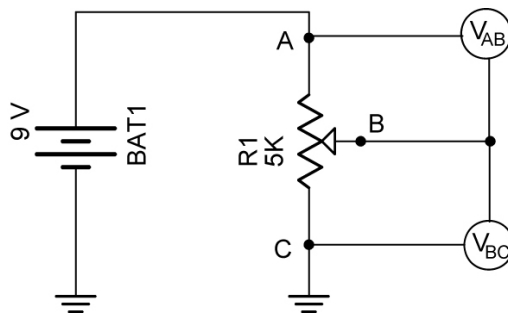
- In the Circuits A and B above, a potentiometer is used as a rheostat.
- In Circuit A above, R_{AB} is always 0 Ohms and R_{BC} varies from 0 – 100K Ohms.
- In Circuit B, R_{BC} is always 0 Ohms and R_{AB} varies from 0 – 100K Ohms.
- In Circuit C, R_{AB} varies from 0 – 100K Ohms and R_{BC} does not exist since there is no connection to C.
- What is the purpose of the 470 ohm resistor?
- Review Summary Sheet of Series and Parallel Circuits
 - See: http://www.cornerstonerobotics.org/curriculum/lessons_year_1/ER%20Week13a,%20Series%20Parallel%20Summary.pdf
- Parallel Resistors:
 - Perform Review 1 Lab 1 – Voltage Drop in a Parallel Circuit

- Voltage Dividers:
 - Series resistors can be used to divide a voltage into smaller voltages. For example, the following series resistors divide a 12 volt source into 12 volts, 8 volts, and 4 volts using the same value for each resistor. Notice that we are not measuring voltages across each resistor, but voltages from a point, e.g. B to the ground point D (V_{BD}). (The voltage drop across each individual resistor is 4 volts.)



Example of a Voltage Divider

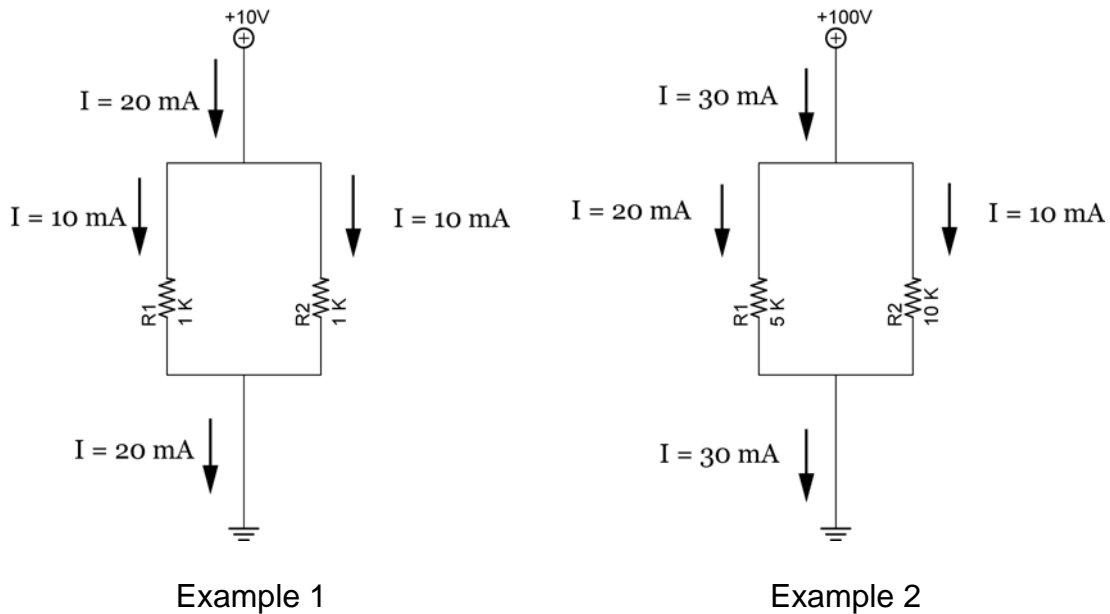
- Potentiometers can be used as voltage dividers. In the circuit below, the sum of the voltmeter measurements V_{AB} and V_{BC} equals the source voltage V_{AC} .



Potentiometer as a Voltage Divider

- Voltage dividers may be used in resistive sensor circuits
- Perform Review 1 Lab 2 – Potentiometers.

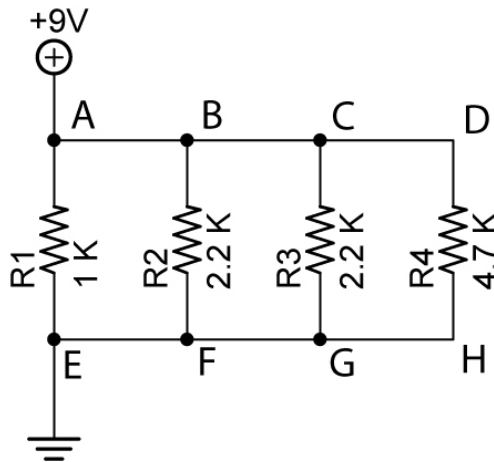
- Kirchoff's Current Law: The sum of the currents into a junction is equal to the sum of the currents leaving that junction.
 - Parallel circuits act as current dividers.



- **14" Band Saw:**
 - Safety Rules:
 - See copy from the manual.
 - Operation:
 - See copy from the manual.
- **Project for the Year:**
 - Each student will design and build his own mobile autonomous robotics car. The car must be equipped to:
 - Use dc motors as the drive system
 - Have sufficient room on a breadboard for a LCD (Liquid Crystal Display), PIC microcontroller(s), H-bridge, and other supporting electronics
 - Mount several different sensors that will be studied this year
- **Practice Circuit:**
 - Perform Review 1 Lab 3 – Touch Switch.

Cornerstone Electronics Technology and Robotics II Week 1 Electronics Review 1 Lab 1 – Voltage Drop in a Parallel Circuit

- **Purpose:** The purpose of this lab is to experimentally verify that the voltage drops across parallel resistors are equal.
- **Apparatus and Materials:**
 - 1 – Solderless Breadboard with 9 V Power Supply
 - 1 – Digital Multimeter
 - 1 – 1 K Ohm Resistor
 - 2 – 2.2 K Ohm Resistors
 - 1 – 4.7 K Ohm Resistor
- **Procedure:**
 - Wire the following circuit
 - Measure and record V_{AE} , V_{BF} , V_{CG} , and V_{DH} .



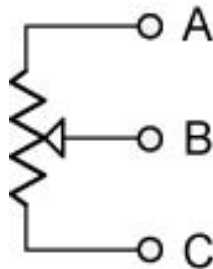
- **Results:**

Points	Voltage Drop
A - E	
B - F	
C - G	
D - H	

- **Conclusions:**
 - How do the voltage drops V_{AE} , V_{BF} , V_{CG} , and V_{DH} mathematically relate to each other?

Cornerstone Electronics Technology and Robotics II Week 1 Electronics Review 1 Lab 2 – Potentiometers

- **Purpose:** The purpose of this lab is have the student measure tripot values and to help the student understand the function of a potentiometer as a variable resistor.
- **Apparatus and Materials:**
 - 1 – Digital Multimeter
 - 1 – 5 K Ohm Potentiometer
- **Procedure:**
 - Testing potentiometers:
 - Test and record the maximum resistance of the potentiometer with a DMM, and compare with value printed on the side of the potentiometer.
 - Turn the potentiometer shaft and then flip the DMM leads. How does the maximum resistance value of the potentiometer react? Record your results.
 - Using the DMM, measure and record the resistance R_{AB} , R_{BC} , and R_{AC} at three different positions of the potentiometer. Before changing each position, apply +5v to Point A and ground to Point C, then measure and record V_{AB} , V_{BC} , and V_{AC} .



- **Results:**
 - Maximum resistance of the potentiometer:
Maximum resistance = _____ohms
Printed value of the potentiometer = _____ ohms
Resistance when potentiometer shaft turned = _____ohms
Resistance when DMM leads reversed = _____ohms

- Testing potentiometers:

Potentiometer Test 1			
	Position 1 (Ohms)		Position 1 (Volts)
R_{AB}		V_{AB}	
R_{BC}		V_{BC}	
$R_{AB} + R_{BC}$		$V_{AB} + V_{BC}$	
R_{AC}		V_{AC}	

Potentiometer Test 2			
	Position 2 (Ohms)		Position 2 (Volts)
R_{AB}		V_{AB}	
R_{BC}		V_{BC}	
$R_{AB} + R_{BC}$		$V_{AB} + V_{BC}$	
R_{AC}		V_{AC}	

Potentiometer Test 3			
	Position 3 (Ohms)		Position 3 (Volts)
R_{AB}		V_{AB}	
R_{BC}		V_{BC}	
$R_{AB} + R_{BC}$		$V_{AB} + V_{BC}$	
R_{AC}		V_{AC}	

- **Conclusions:**

- In the potentiometer test, mathematically relate R_{AC} to R_{AB} and R_{BC} .

- How does V_{AC} relate to $V_{AB} + V_{BC}$?

Cornerstone Electronics Technology and Robotics II Week 1 Electronics Review 1 Lab 3 – Touch Switch

- **Purpose:** The purpose of this lab is to reacquaint the student with wiring a circuit on a breadboard.
- **Apparatus and Materials:**
 - 1 – 555 Timer
 - 1 – 10M Ω Resistor
 - 1 – 100K Ω Resistor
 - 1 – 1K Ω Resistor
 - 1 – 0.01 μ F Capacitor
 - 1 – 4.7 μ F, 10 μ F, 22 μ F, 47 μ F, and 100 μ F Capacitors
 - 1 – LED
- **Procedure:**
 - Wire the touch switch circuit on your breadboard.
 - Use a 4.7 μ F capacitor for C2 to begin, and then substitute the 10 μ F, 22 μ F, 47 μ F, and 100 μ F in its place.
 - Use the normal jumpers as your touch leads.

