Tutorial #2: RC Circuit

In this tutorial, we will build and simulate the RC circuit shown in **Figure 1**. For simplicity, wires are referred to as w1-w5.

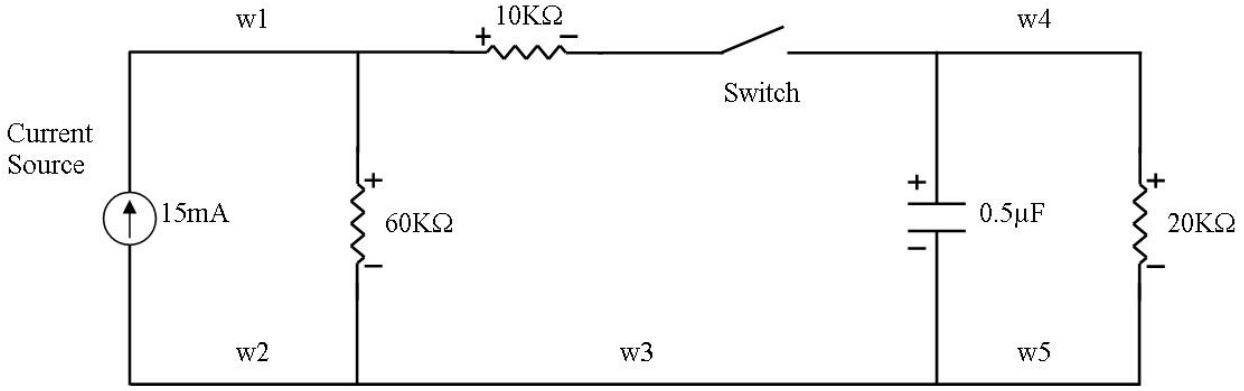

Figure 1: Circuit to be simulated

Step 1. Open the circuit simulator and create a blank circuit.

Step 2. Start by placing the 10kΩ resistor as shown in **Figure 1**. Right click on the circuit board and select "Add Resistor (r)". Then click anywhere on the circuit board and drag to draw a resistor. To change the resistance, right click on the resistor and select "Edit". Enter the new resistance (10kΩ for this tutorial) in the dialog box and press "OK".

Step 3. Place a 60kΩ resistor as shown in **Figure 2**.

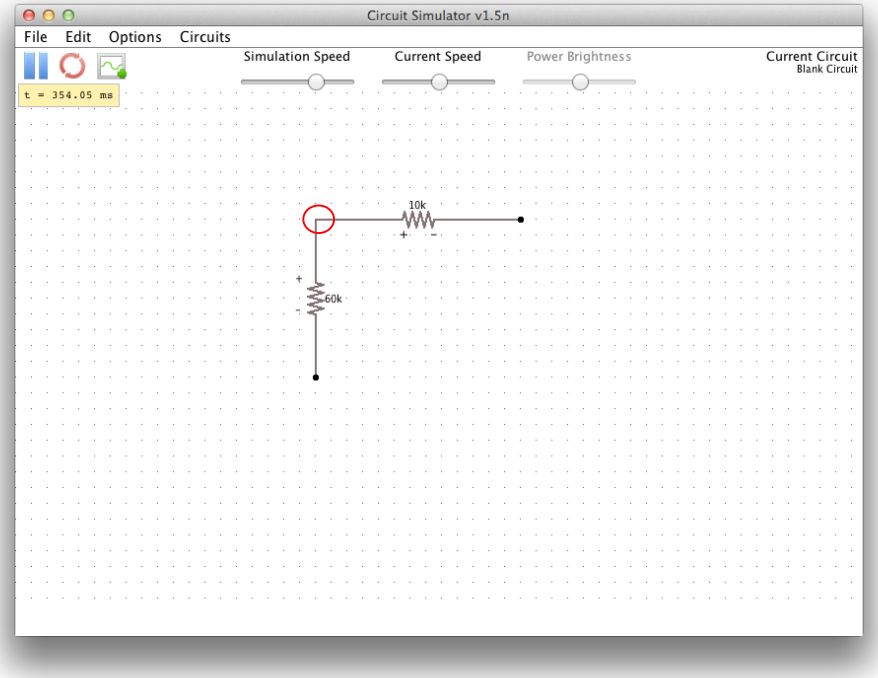

Figure 2: Circuit after placing 10kΩ and 60kΩ resistors

Step 4. Now place wire ‘w1’ as shown in **Figure 1**. To add a wire, right click on the circuit board and select “Add Wire (w)”. Then click anywhere on the circuit board and drag to draw the wire. Draw a wire extending left from the terminal between the 10kΩ and 60kΩ resistors as shown in **Figure 3**.

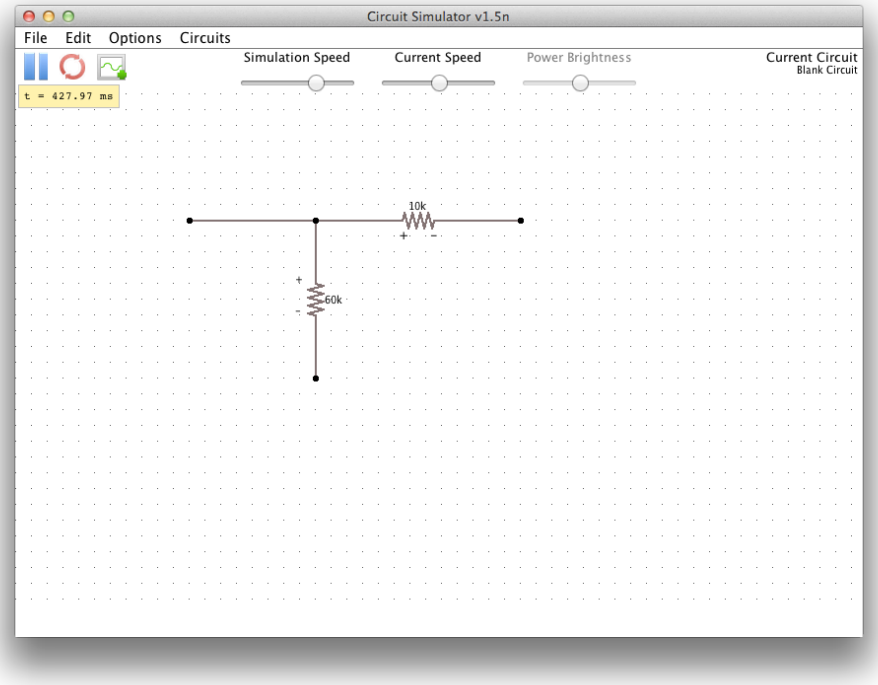

Figure 3: Circuit after placing wire w1

Step 5. To place wire ‘w2’ shown in Figure **1**, repeat step 4 to draw a wire of the same length from the lower terminal of the 60kΩ resistor.

Note**:** If you want to redraw the same type of component that you have just drawn, you do not need to select the component type from the right click menu again.

Step 6. Place a current source between the loose terminals of wires w1 and w2. The complete circuit should look like **Figure 4**. To place a current source, right click on the circuit board and select "Add Current Source" from the "Inputs/Outputs" menu. Then click anywhere on the circuit board and drag to draw the current source. The default value of current sources is 10mA. To change this value, right click on the current source and select "Edit". Enter the new value (15 mA for this tutorial) in the dialog box and press "OK".

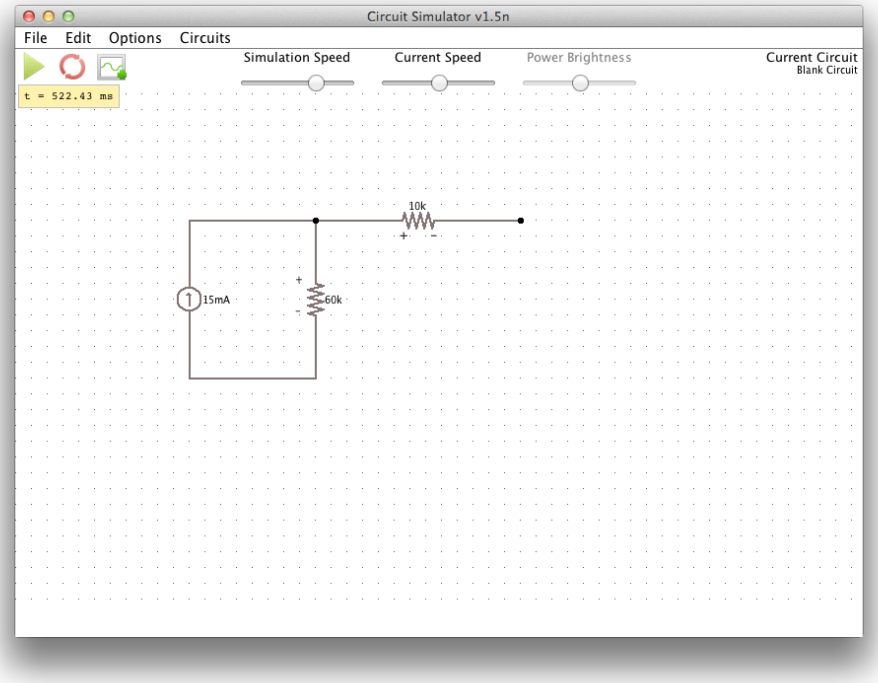

Figure 4: Circuit after placing current source

Step 7. Place a switch extending right from the loose terminal of the 10kΩ as shown in **Figure 5**. To place a switch, right click on the circuit board and select "Add Switch" from the "Passive Components" menu. Then click anywhere on the circuit board and drag to draw the switch.. Switches are closed (ON) by default. Clicking on a switch will toggle it between open and closed.

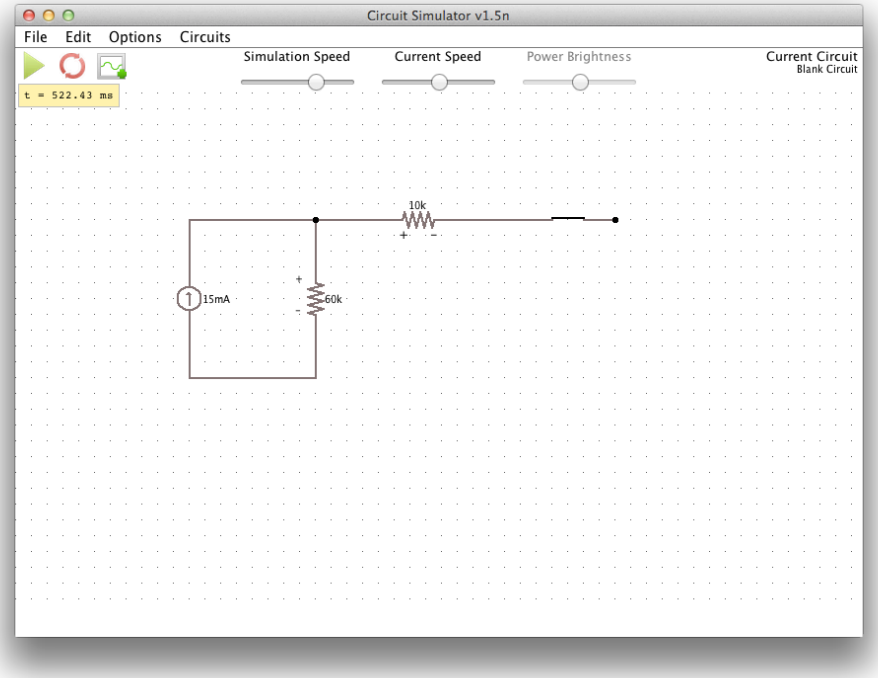

Figure 5: Circuit after placing switch

Step 8. Draw wire w3 extending right from the lower terminal of the 60kΩ resistor to below the loose terminal of the switch as shown in **Figure 6**.

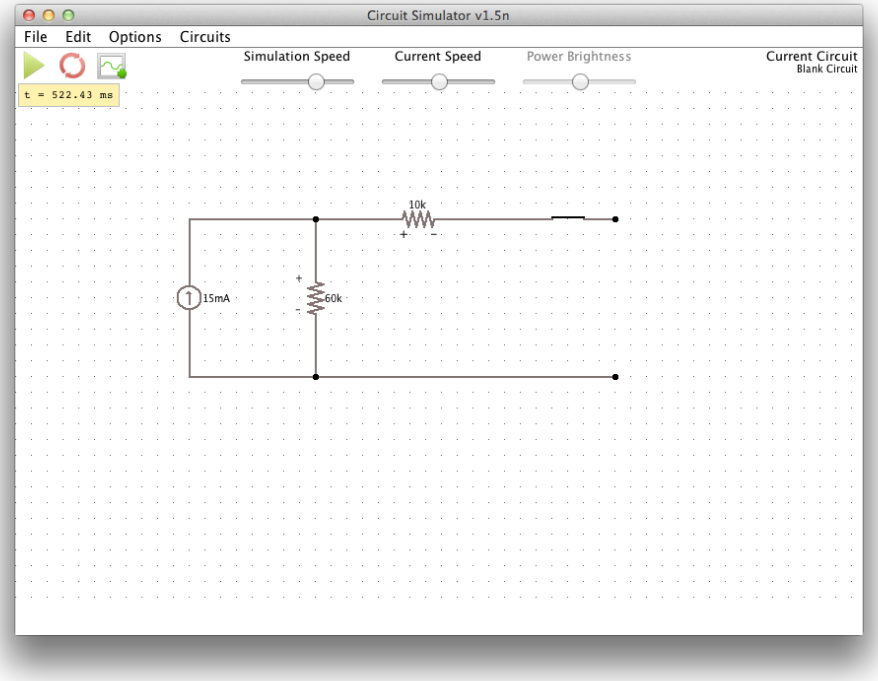

Figure 6: Circuit after placing wire w3

Step 9. To place a capacitor, right click on the circuit board and select "Add Capacitor (c)" from the "Passive Components" menu. Then click anywhere on the circuit board and drag to draw the capacitor. Place a capacitor between the loose terminal of the switch and the loose terminal of wire w3. To change the value of the capacitor, right click on it and select "Edit." Enter "0.5u" (for 0.5 microfarad). The circuit should now look like **Figure 7**.

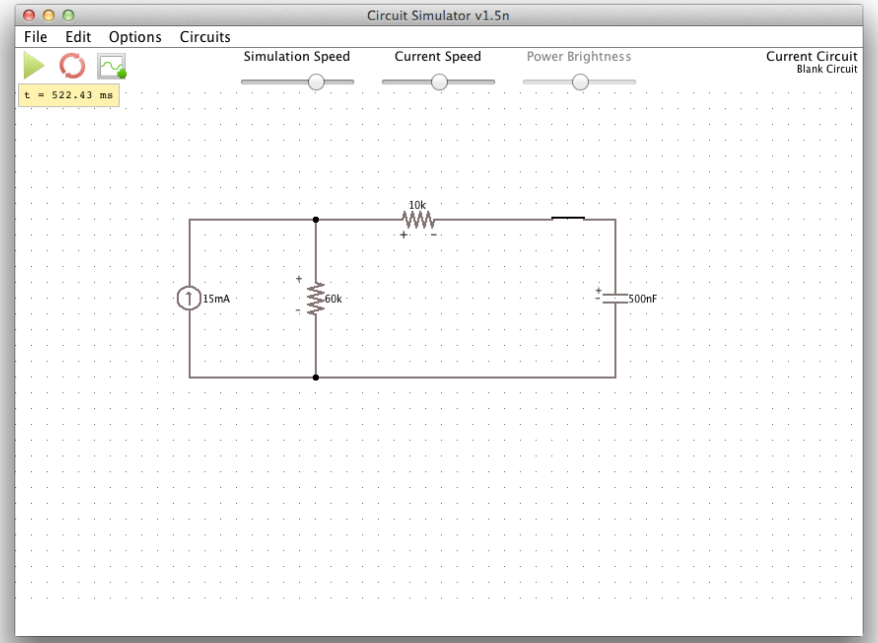

Figure 7: Circuit after placing capacitor

Step 10. Place a 20kΩ resistor parallel to the capacitor and place wires w4 and w5 (shown in Figure **1**) to connect the terminals of the capacitor and resistor as shown in **Figure 8**.

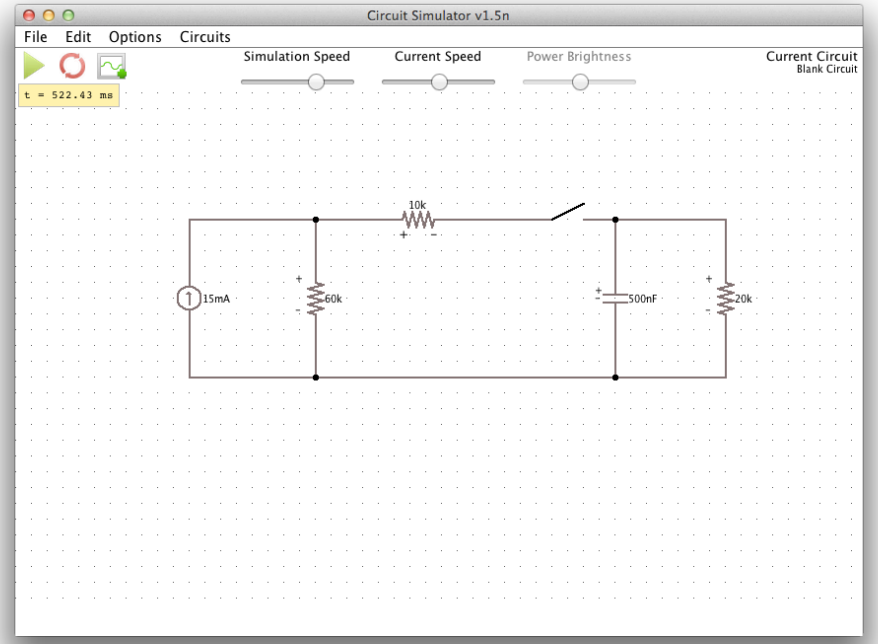

Figure 8: Completed circuit

Step 11. The circuit is now complete. An oscilloscope is a useful device to observe how voltage or current changes over time on any component. To view the capacitor in an oscilloscope, right click on the capacitor and select "View in Scope". A new window named "Oscilloscope" will open as shown in **Figure 9**. To see the instantaneous voltage, current, and power of the component, click the component's name in the top-left corner and instantaneous values for the component will be shown at the bottom of the window.

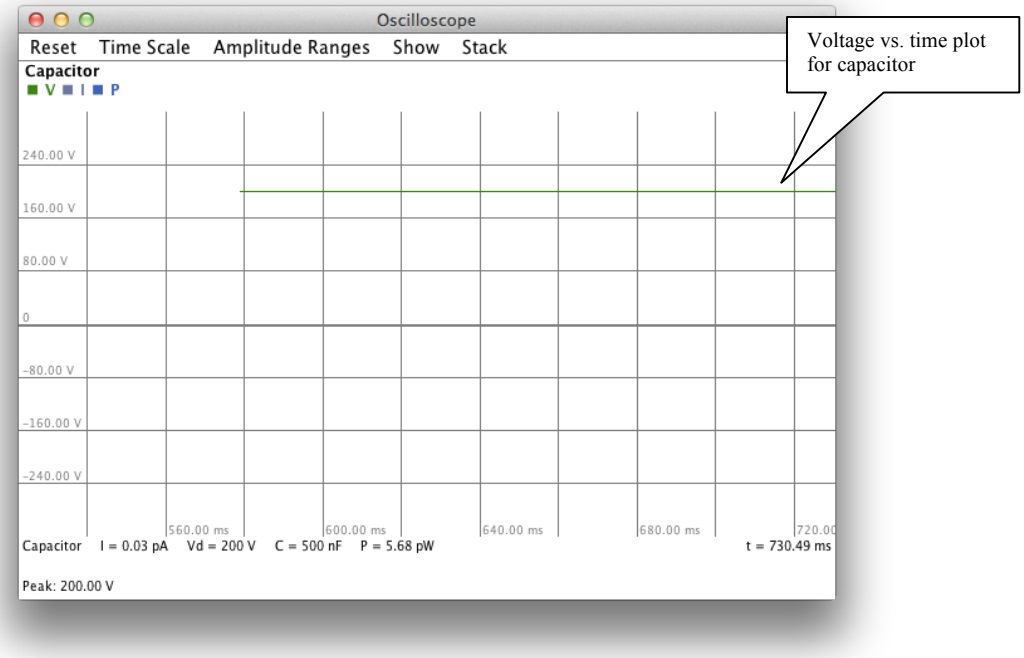

Figure 9: Oscilloscope showing capacitor voltage when switch is closed

Note: Clicking "View in Scope" in an element's right click menu will add that element to the scope window that was most recently selected. For example, to view the 20kΩ resistor in the same scope as the capacitor, click on the scope window that contains the capacitor then select "View in Scope" from the resistor's right click menu. To view the resistor in another scope window, click the "New Scope" button in the top left of the simulator window, and then select "View in Scope" from the resistor's right click menu.

Step 12. If the switch is closed for a long time and the capacitor is connected to the current source, the capacitor will become charged and behave like an open connection. In this case, the voltage across the capacitor will be equal to the voltage across the 20kΩ resistor. The capacitor can be discharged through the 20kΩ resistor by opening the switch. To open the switch, click on it. You will see an exponential decay of the voltage across the capacitor in the oscilloscope as shown in **Figure 10**. If you close the switch again, you will see a logarithmic rise in voltage across the capacitor.

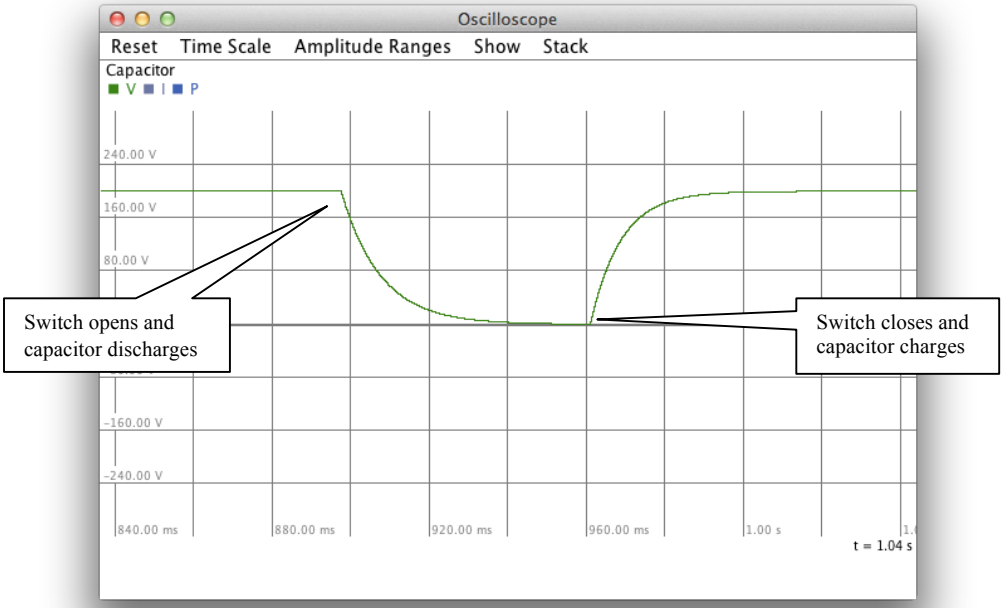

Figure 10: Oscilloscope showing charging and discharging of capacitor

Step 13. To save this circuit, go to the "File" menu, select "Save File", and enter the desired location and file name. Circuits are saved as plain text (.txt) files. You can reload a circuit by selecting "Open" in "File" menu.