

## CS 257 Lesson 2

### Activity 3: Using Transistors & Delay Circuits

Working with Resistors & Capacitors to create a delay

#### Introducing RC Time Constants

In this activity, we will modify our circuit so that the LED will light up after a short delay. See figure 1. You will also discover that it will go dim after a delay and slowly turn off. To accomplish this, we will add a 10K resistor and a 1000uF electrolytic capacitor to the circuit. Be sure to connect your capacitor correctly. The neg (-) lead must be connected to ground.

When the switch is closed, current begins to charge the capacitor. Since a capacitor is like a battery, it stores electrons. As it fills up, it cannot store any more so electrons begin moving through the circuit.

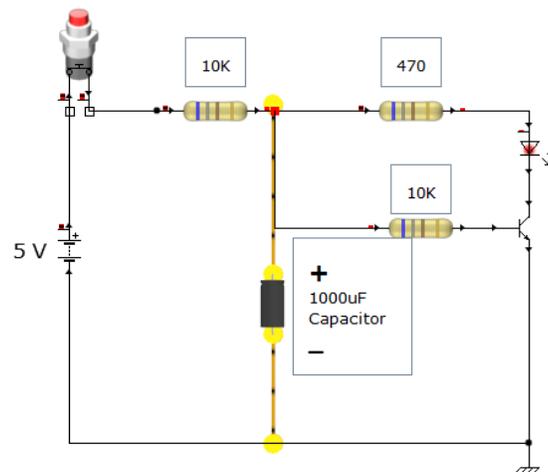
When a capacitor reaches 65% of capacity, we say it is charged. It will continue to charge and store more electrons but at a much slower rate. As the voltage increase the transistor will be turned on. Notice there is another 10K resistor connected to the base of the transistor. This limits current flow.

When the switch is opened, no more current flows out of the battery. But there are plenty of stored electrons in the capacitor. At this point, they are released and keep the transistor on. As the flow of electrons diminishes, the voltage at the base drops and the LED slowly goes off.

You can adjust the rate at which a capacitor fills (charges) by changing the value of the resistor or the capacitor, or both. The time of the delay is based on  $T = R * C$ . Resistance is in ohms and capacitance is in farads. Be sure to convert from uF to farads. You may recall that  $1000\mu F = .001\text{Farad}$ . A uF is one-millionth of a farad.

Figure 1- RC Timer

Using a resistor and capacitor to create a time delay.



Closing the switch causes electrons to fill the capacitor. When it is about 65% full, the voltage continues to rise until it reaches about .8 volts. At that time, the base voltage of the transistor increases enough to turn it on. This allows current to pass from the collector to the emitter and allows current to flow through the LED and turning it on.