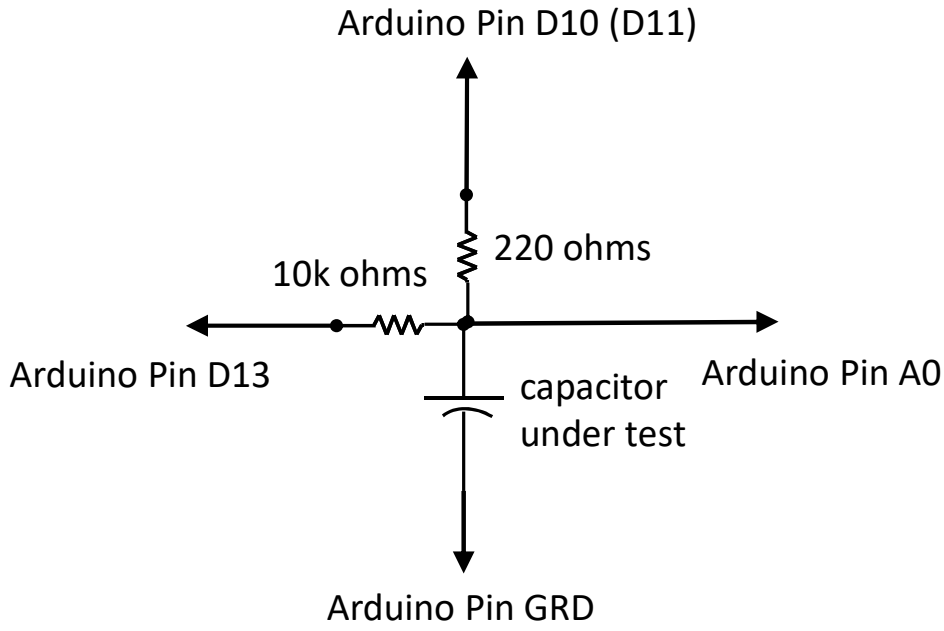
Project 3

Reading the value of a Capacitor and output to a LCD

Experiment 3: Determining the value of a Capacitor

1. Connect two known resistors (10k and 220) with a capacitor in the following fashion. If you use an electrolytic capacitor that the polarization of voltage applied matches the polarization of the capacitor terminals.



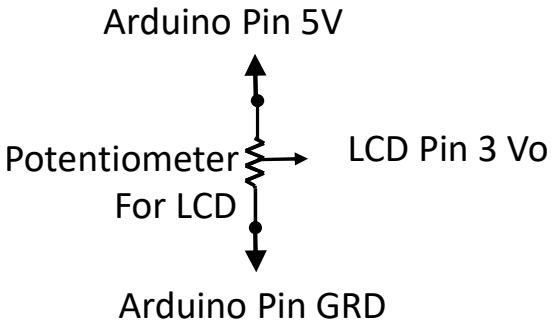
Experiment 3: Determining the value of a Capacitor Cont'd

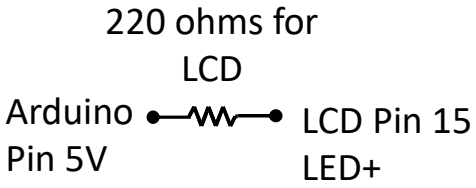
2. In the sketch, set the charge pin to LOW and start the Serial Monitor.
3. Within the loop
   a) Set the charge pin to HIGH
   b) Capture the start time
   c) Read the capacitor voltage until it reaches 648.
   d) When it is less than 648 continue to read the capacitor voltage.
   e) When it reaches 648,
      I. Determine the elapsed time from the start and print it to the serial monitor
      II. Find the capacitance from the elapsed time and 10k resistor
      III. if the capacitance is greater than 1 then print the value of capacitance as microfarads
      IV. If the capacitance is less than 1 then print the value of capacitance as nanofarads
      V. Turn off the charge pin
      VI. Ground the discharge pin and what until the capacitor voltage reaches zero.

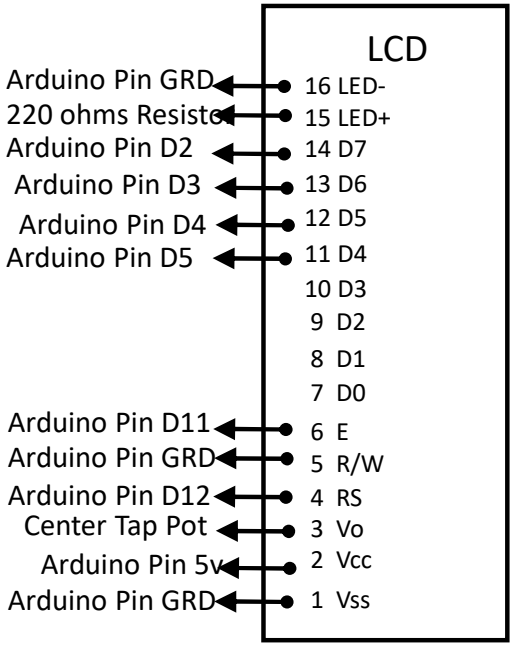
Experiment 3: Determining the value of a Capacitor Cont'd

4. Some things to do
   a) Why does the threshold of the sketch < 648? Derive the equations.
   b) Does the Capacitance reading from the sketch the same as the manufacturers designation.
5. Repeat the experiment with 2 different capacitors
6. Add an LCD to print out the results
7. Redo the sketch to handle picofarad capacitors

LCD Wiring


Arduino Pin 5V
Potentiometer
For LCD
LCD Pin 3 Vo
Arduino Pin GRD


220 ohms for
LCD
Arduino
Pin 5V
LCD Pin 15
LED+


LCD
Arduino Pin GRD
220 ohms Resisto
Arduino Pin D2
Arduino Pin D3
Arduino Pin D4
Arduino Pin D5
16 LED-
15 LED+
14 D7
13 D6
12 D5
11 D4
10 D3
9 D2
8 D1
7 D0
Arduino Pin D11
Arduino Pin GRD
Arduino Pin D12
Center Tap Pot
Arduino Pin 5v
Arduino Pin GRD
6 E
5 R/W
4 RS
3 Vo
2 Vcc
1 Vss

Experiment 4: Solution to Capacitor Sketch

$$v_c(t) = V - Ve^{-(\frac{t}{RC})}$$

$$v_c(t \to \infty)\big|_{\max} = V - Ve^{-(\frac{t \to \infty}{RC})} = V$$

$$\frac{v_c(t = RC)}{V} = 1 - e^{-1} = 0.63$$

Analog outputs range from 0-1023

Therefore, $0.63 \times 1023 = 646.7 = 647$

Elapsed time, $t_{elapsed}$, to reach 648 or 63.2% of 5volts equals the time constant, RC seconds.

$$C = \frac{t_{elapsed}}{R}$$