

PLC121 LAB 1.3: CHARGING & DISCHARGING CAPACITORS

Student Name: _____

Student ID: _____

LAB OUTCOMES:

Upon completion of this lab procedure, the student should be able to:

1. Measure the capacitance of series and parallel capacitors
2. Wire and test an RC circuit with multiple capacitors in series
3. Wire and test an RC circuit with multiple capacitors in parallel
4. Discharge a capacitor
5. Test a capacitor out of circuit.

LAB PROCESS:

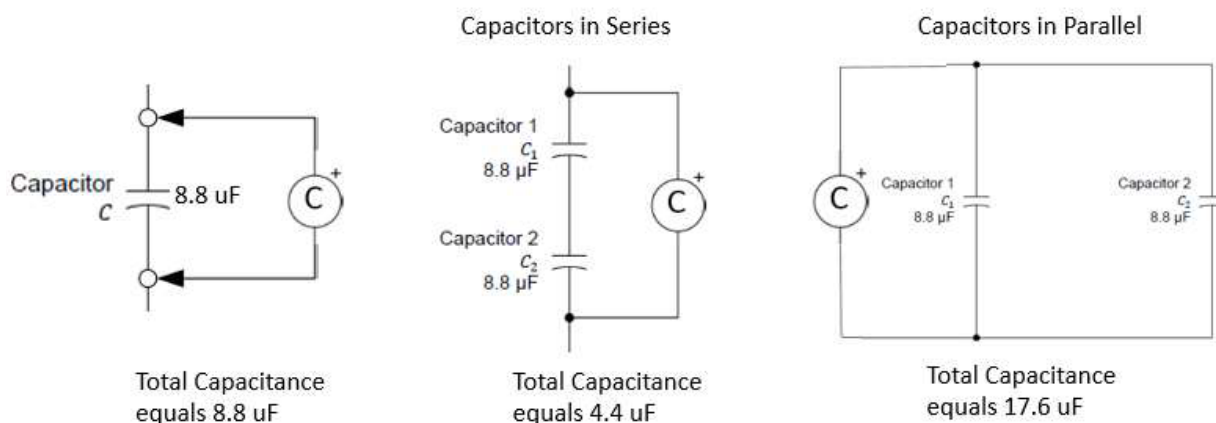
Open the AC/DC Training Unit. Setup the unit on its base, or lay flat on the work table.

Make sure all fault switches are in the 0 position.

Connect the power cord and turn off the power input switch to make sure the unit is not powered.

Part 1

Consider the following circuits:



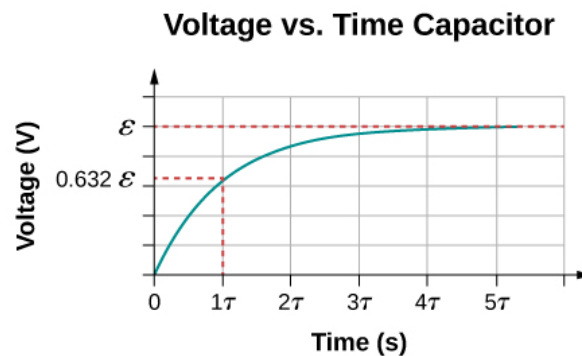
Capacitors connected in series, are like resistors in parallel. The user must use the product over sum method, or the reciprocal method to calculate the total capacitance of the circuit. Only measure capacitance with the capacitor out of the circuit.

Capacitors connected in parallel are like resistors in series. The user must use the total sum of all the capacitors that are connected in parallel. If two 8.8 μF capacitors are connected in parallel, the total capacitance would measure. 17.6 μF .

1. The Extech DMM can measure capacitance. Dial the rotary switch to the position to measure capacitance, the toggle the mode key until it show measuring Capacitance.
1. On the AC/DC training unit, there are two, 8.8 μF capacitors. Using the DMM to measure the following capacitors in micro Farads:
 - a. Measure each of the Capacitors: Capacitor 1 = _____ Capacitor 2 = _____
 - b. Measure the two capacitors connected in series. Capacitance = _____
 - c. Measure the two capacitors connected in parallel. Capacitance = _____

Part 2

Consider the following graph:



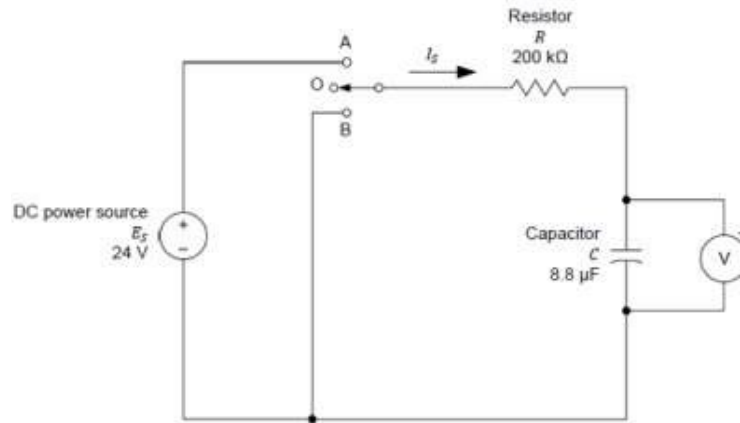
1 time constant (τ) equals the resistance * capacitance.

200Kohms * 8.8 μF written out is 200,000 * 0.0000088, which equals 1.76 seconds.

It takes about 5 time constants to fully charge a capacitor, when using 24V DC.

In this example, it would take 5 * 1.76 seconds, or 8.8 seconds.

Wire the following circuit on the AC/DC training system:



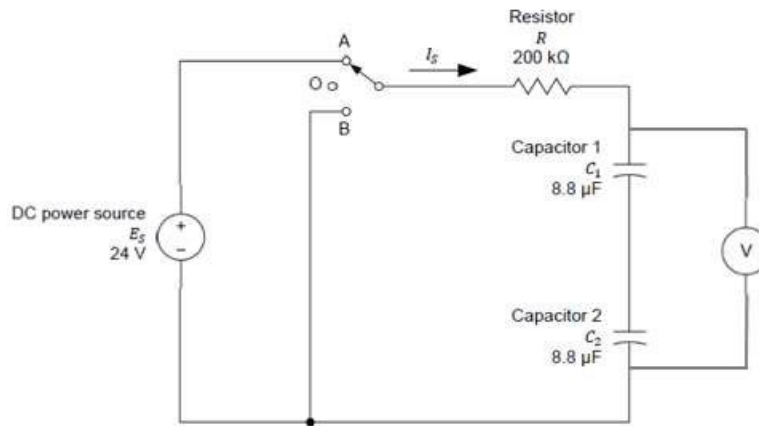
1. Connect the voltmeter across the capacitor as shown.
2. If you have a stop watch or timer on your smart phone, set it for 5 time constants (8.8 seconds). Turn the training unit on and turn the selector switch to position A. The capacitor should start charging.

How much voltage is on the capacitor after the 5 time constant? _____

3. Turn the selector switch to position B. What happens to the voltage on the capacitor?
4. Does the capacitor discharge immediately? Explain.
5. Turn the selector switch to position A again. Let the capacitor charge to supply voltage. Now turn the selector switch back to the center position. The user may think that the capacitor should just hold a charge, and not discharge, but notice it still gradually discharges. This is due to the voltmeter. The voltmeter looks like a large resistance when it is used as a voltmeter. The capacitor is discharging through the voltmeter.

Part 3

Wire the following circuit on the AC/DC training system:



1. Connect the voltmeter across the capacitors as shown.
2. Calculate the time constant for this configuration.

How long is 1 time constant for this configuration? _____

How long is 5 time constants? _____

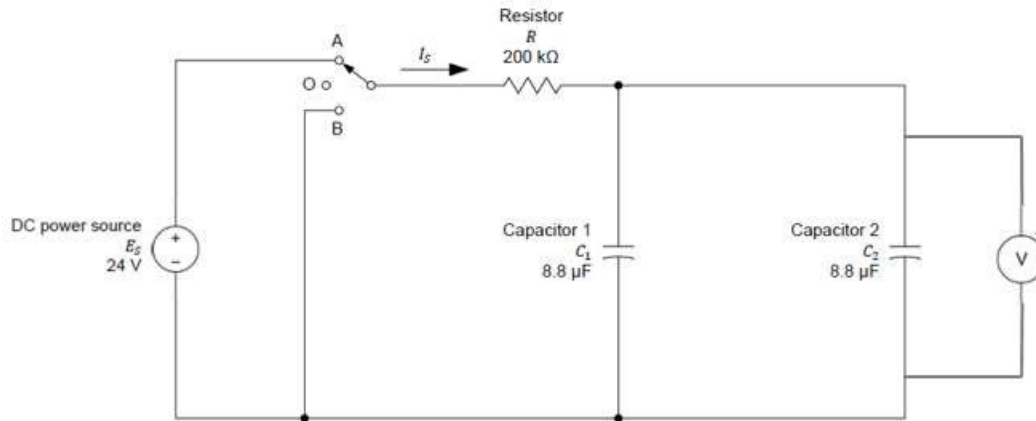
3. If you have a stop watch or timer on your smart phone, set it for 5 time constants. Turn the training unit on and turn the selector switch to position A. The capacitor should start charging.

What is the voltage on the capacitor after the 5 time constant? _____

4. Turn the selector switch to position B. What happens to the voltage on the capacitor?

Part 4

Wire the following circuit on the AC/DC training system:



1. Connect the voltmeter across the capacitor as shown.
2. Calculate the time constant for this configuration.

How long is 1 time constant for this configuration? _____

How long is 5 time constants? _____

3. If you have a stop watch or timer on your smart phone, set it for 5 time constants. Turn the training unit on and turn the selector switch to position A. The capacitor should start charging.

What is the voltage on the capacitor after the 5 time constant? _____

4. Turn the selector switch to position B. What happens to the voltage on the capacitor?

Part 5

A user can test a capacitor with an Ohmmeter when it is out of the circuit. Use the following steps:

1. Take the capacitor out of the circuit.
2. Short the capacitor to drain any residual voltage.
3. Connect the Ohmmeter across the leads of the capacitor.
4. The Ohmmeter should read a low resistance value, then gradually go up until it shows an OL reading.

5. Take the meter off the capacitor and change the meter to DC Volts. Take a reading across the capacitor. It should have about 0.3 V.
6. Short the capacitor with a test lead to discharge the voltage.
7. Try this test again on the AC/DC training units.

This test should work with any capacitor. Realize that when the DMM is set to measure resistance, an internal battery in the DMM sends out a voltage to the device being tested. In this case, the capacitor charged from this voltage. When the capacitor fully charges, the capacitor voltage opposes the battery voltage in the DMM, and makes it look like an Open Line (OL)

Questions

1. True or False: Any capacitor located on a machine should be discharged prior to troubleshooting the electrical portion of the machine.
2. What is the purpose of having a resistor across a capacitor on the output of a DC power supply?
 - a. To discharge the capacitor when the power supply is shut off.
 - b. To protect the capacitor from voltage surge.
 - c. To limit the amount of current going to a capacitor
3. If two 8.8 μF capacitors were connected in series, what would be their total capacitance?
 - a. 8.8 μF
 - b. 4.4 μF
 - c. 17.6 μF
 - d. 13.2 μF
4. If two 8.8 μF capacitors were connected in parallel, what would be their total resistance?
 - a. 8.8 μF
 - b. 4.4 μF
 - c. 17.6 μF
 - d. 13.2 μF
5. True or False: An electrolytic capacitor has polarity.
6. True or False: A quick way to discharge a capacitor after power is turned off is to short it out with a conductor.

The outcomes of this exercise (listed on page 1) specifies the skills that the Student must demonstrate to the Instructor. Once the Instructor is satisfied with the demonstration of Knowledge & Skills by the individual student, they will sign this document (for the student), then enter a 100% into the Hands-On Lab grade in Sakai.

I verify that this student has completed all of the requirements of this Hands-On Assessment:

Student Name: _____

Faculty Signature: _____ Date: _____

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