PE 13

Capacitor Transients

(Updated 02 OCT 2008)

A Practical Exercise Name:_____ Section: _____

I. Purpose.

1. Review the operation of the oscilloscope.
2. Review the measurement of DC voltages using an oscilloscope.
3. Introduce the capture and display of an electrical signal with the oscilloscope.
4. Introduce the variation of voltage across a capacitor during charging and discharging.
5. Introduce the determination of energy stored in a capacitor.

II. Equipment.

Agilent E3620A Dual DC Power Supply
Oscilloscope
1-kΩ resistor
10-kΩ resistor
100-μF capacitor
Shorting bar

III. Preparation.

Review PE 12 – Introduction to Oscilloscopes

IV. Lab Procedure.

You must **read** and complete each step.

Step One: Construct a RC circuit

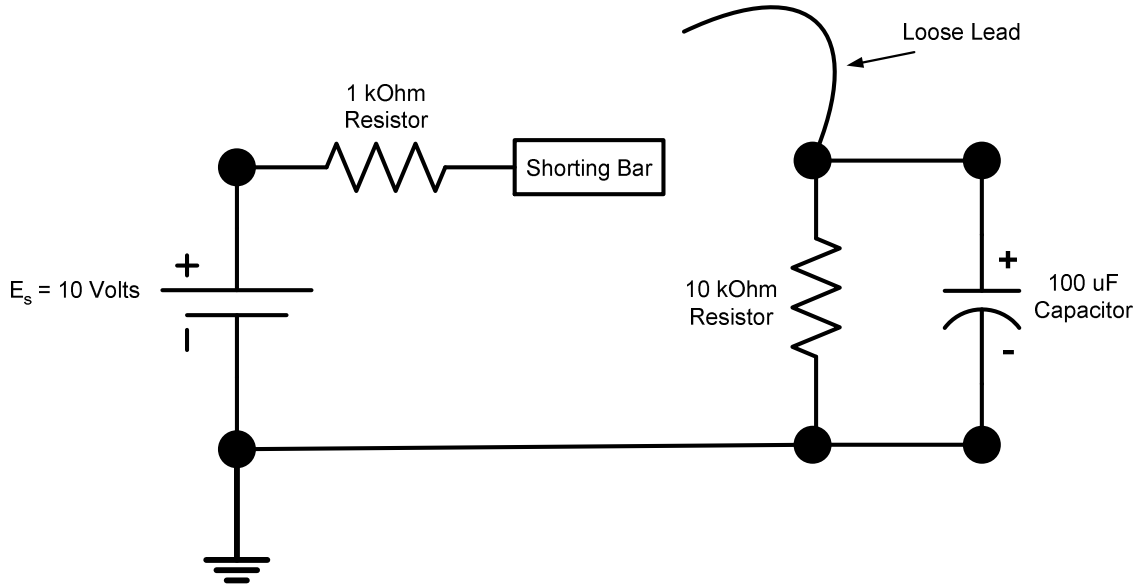

Figure 1

☐ On your QUAD board construct the Resistor / Capacitor (RC) circuit in Figure 1.
Note: to close this circuit we will touch the end of the loose lead to the center plate of the shorting bar. Before closing the circuit, ensure that the capacitor's polarity is correct IAW Figure 1.

Step Two: Adjust oscilloscope

☐ Locate CH 1 on your oscilloscope. Ensure that it has a two-input (RED / BLACK) banana plug adaptor.

☐ Connect CH 1 to the circuit (figure 1), so that it will read the voltage across the capacitor.

☐ Press the AUTOSET button on the oscilloscope.

☐ Press the CH 2 MENU button twice so that CH 2 is turned off. It is not necessary for this PE.

☐ Press CH 1 MENU on the oscilloscope and make the following settings.

- Coupling: DC
- BW Limit: OFF
- Volts/Div: COARSE
- Probe: 1X
- Invert: Off

☐ Adjust the CH 1 Volts/Div scale to 2 VOLTS/DIV.

☐ With CH 1 menu selected adjust the position of the vertical axis zero level by rotating the position knob under the vertical section in the CH 1 column, so that the "1→" on the left side of the LCD is adjacent to -4 V or two major divisions below the center horizontal major axis. Note that this adjustment will help provide a better display of the capacitor transients.

☐ Press the HORIZONTAL MENU on the oscilloscope and make the following settings.

- Main (not window zone or window)
- Trig knob: Level

☐ Adjust the SEC/DIV knob under the horizontal axis, so that the oscilloscope indicates 1 second per major division on the LCD.

☐ Press RUN/STOP button on the top right corner of the oscilloscope, so the '● STOP' is indicated on the top of your LCD.

☐ Adjust the position of the horizontal axis zero level by rotating the position knob under the HORIZONTAL MENU, so that the "↓" on the upper portion of the LCD is 3 major divisions

left of the center vertical major axis or -3 sec.
Note that this adjustment will also help provide a better display of the capacitor transients.

☐ Press the TRIGGER MENU on the oscilloscope and make the following settings.

- Edge
- Slope: Rising
- Source: CH 1
- Mode: Single
- Coupling: Noise Reject

☐ Adjust the LEVEL knob under the TRIGGER column, so that the "←" on the right portion of the LCD is 2V or one major division above the center horizontal major axis.

Step Three: Capture a capacitor charging and discharging

☐ Locate and press the Run/Stop button on the oscilloscope. Wait until the top portion of the LCD indicates ready.

☐ Firmly and quickly place the unconnected end of the loose lead to the shorting bar for 2 seconds.

☐ After 2 seconds remove the unconnected end of the loose lead from the shorting bar.

☐ After a few seconds the oscilloscope's LCD display should display a smooth picture of the capacitor charging and discharging. Press Run/Stop button on the oscilloscope, so that the top center portion of the LCD indicates '● STOP'.

☐ If you do not get a smooth picture, repeat all of step 3.

Step Four: Analyze your results

☐ Using Figure 2 sketch the picture on the LCD of the capacitor charging and discharging.

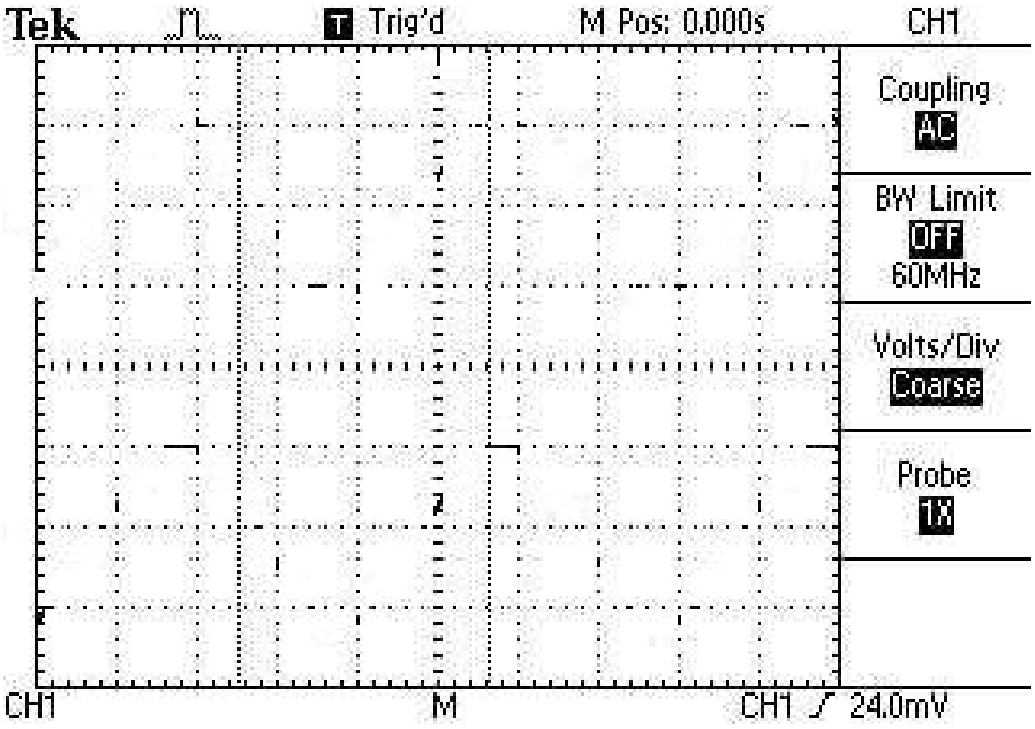

Figure 2

☐ Using the oscilloscope's cursor function to measure voltage and time, and your sketch in Figure 2, answer the following questions.

- What is the maximum voltage that your capacitor charged to? _____
- How much time did the capacitor take to fully charge? _____
- What is the minimum voltage that your capacitor discharged to? _____
- How much time did the capacitor take to fully discharge? _____
- When the capacitor reached its maximum voltage, how much current should be flowing through the capacitor? _____
- When the capacitor reached its maximum voltage, how much energy is stored in the capacitor? _____