EE 1000 Introduction to Electrical Engineering

Lab 1 – Using Laboratory Equipment

Name (s) of team members ____

The objective of the assignment is to familiarize the student with the laboratory equipment. The skills developed here will be useful for the projects that follow. Note: This assignment is worth 20 homework points when it is completed.

1 - Power Supply

A power supply is a device that supplies a constant voltage or a constant current to a circuit. Most power supplies have an adjustment for the maximum voltage (electric potential) and the maximum current they will provide. Most power supplies also have an internal meter to tell you the actual current and voltage they are producing.

Experiment 1. Make sure the leads (wires from the power supply) are not touching and turn on the power supply. Adjust the voltage to 2.0 Volts. This can be done by setting the maximum current a little above 0 and adjusting the voltage. Connect the leads across a 20Ω (20 Ohm) resistor. If the voltage drops below 2 Volts, increase the maximum current. The power supply is now in *constant voltage mode*, providing 2 Volts to the circuit.

Ohms' law tells us that the current should be 0.10A, Use the current meter on the power supply to verify that the current is about 0.10A (the resistor isn't perfect, nor is the meter on the power supply, so the current may not read exactly 0.1A, but it should be close). Write the actual voltage and current you measured in the space below.

Voltage = ____________________________ Current = ___________________________

Reduce the (maximum) power supply current until the current meter reads 0.05A. Now the power supply is in *constant current mode*, providing 50mA to the circuit. Use the voltage meter on the power supply to verify the voltage is about 1 Volt. (The voltage is still set to 2 Volts, but the current is limited to 50mA so with a 20Ω resistor in the circuit, the voltage is limited to 1 Volt.) Write the actual voltage and current you measured in the space below.

Voltage = ____________________________ Current = ___________________________

Remove the resistor and verify that the voltage returns to 2 Volts.

2 – Multi-meter

A multi-meter is a device that can be used to measure resistance, voltage and current. When measuring current, the multi-meter is vulnerable and can be easily damaged. Fortunately, it is not often necessary to measure current, so this assignment will focus only on measuring resistance and voltage.

Experiment 2. Turn on the multi-meter and configure it to measure resistance (Ohm meter), Connect the 20Ω resistor to the multi-meter leads (wires from the multi-meter) and read the resistance from the multi-meter, which should be about 20Ω. (Some multi-meters require you to set the range. If so, select a range that includes 20Ω). Write the actual resistance you measured in the space below. Repeat this procedure with a 100Ω resistor.

Resistance (20Ω) = ____________________ Resistance (100Ω) = ______________________

Configure the multi-meter to measure Voltage. (You should always leave multi-meters configured to measure Voltage when not in use because that is the state in which they are least vulnerable.)

Experiment 3: Using your breadboard, connect the 100Ω resistor and the 20Ω resistor in series. Connect the red (positive) lead of the power supply to the unconnected end of the 100Ω resistor and the black (negative) lead of the power supply to the unconnected end of the 20Ω resistor. Adjust the power supply to provide a constant 6 Volts. (See Figure 1)

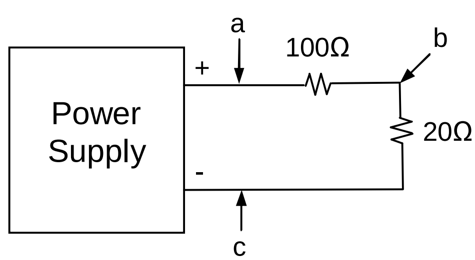

Figure 1 – A simple resistor network.

Configure the multi-meter to read Voltage (if it isn't already) and measure the voltage across the 100Ω resistor (points a and b), then across the 20Ω resistor (points b and c), then across the series combination (points a and c). Write these voltages in the space below.

V_{ab} = ________________ V_{bc} = ________________ V_{ac} = _________________

How are these three numbers related? ____

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3 – Oscilloscope

The oscilloscope (or O-scope or simply scope) is a device that plots voltage against time. The scope is connected to a circuit by means of a probe. The probe includes a grounding clamp that should be connected to the "ground" of your circuit. The probe itself is a spring hook designed to clamp onto wires. Once the probe is connected to a circuit, it waits for a "trigger," which is usually a change in voltage on the probe. Once the trigger occurs, the scope plots the probe voltage slightly before and after the time of the trigger. Most scopes have 2 or more "channels," which means they can plot the voltage at two or more points in the circuit at the same time.

Experiment 4. Turn on the scope. Connect the scope probe for channel 1 to the calibration post (the ground clamp connects to the ground post below the calibration post). When the power-up sequence concludes, press the auto-set button. You should see a "square wave" signal on the scope display.

Notice the number on the lower left of the screen. That tells how many volts each vertical division represents Using that information, measure the voltage of the square wave by counting the vertical divisions and multiplying by that number. The voltage should be about 5 Volts (if you got 500mV, it is because your probe is X10, which means any voltage you measure must be multiplied by 10).

Turn the Volt/Div knob for channel one counterclockwise one detent. What does that do to the waveform and the number in the lower left corner?

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Turn the knob two detents clockwise. What does that do?

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Notice the number at the bottom of the screen near the middle. That number indicates how much time each horizontal division represents. It should read 500µs. Turn the Sec/Div knob clockwise one detent. What does that do to the waveform and the number at the bottom?

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Turn the knob counterclockwise two detents. What does that do?

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An arrow on the right side of the screen denotes the trigger voltage level. Use the trigger level adjustment to move that arrow up above 5 Volts. What happens to your wave form?

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Why does the waveform seem to change when the trigger level is above 5 volts?

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4 – Function Generator

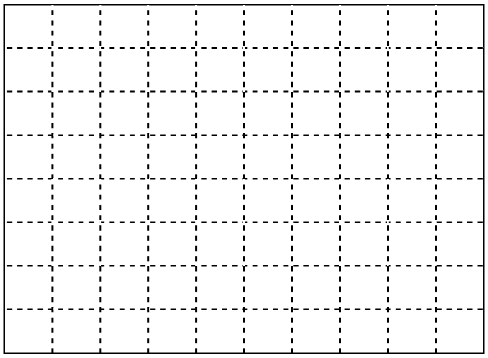
A function generator is a tool that produces waveforms at various frequencies and amplitudes. The waveform can be a sine wave, a square wave or a triangle wave.

Experiment 5. Connect scope probe to the red lead from the function generator and the ground clamp to the black lead. Turn on the function generator and adjust it to 1000Hz (1kHz) and turn the amplitude all the way up.

Make note of the waveform on the scope. If it doesn't fit on the screen, adjust the Volts/Div knob on the scope until it does, then adjust the Sec/Div knob so that one or two periods of the signal are displayed. Switch the function generator to square wave, then triangle wave, then sine wave and draw the waveforms from the scope in the spaces below. Measure the peak voltage for each waveform and record it in the space provided. Change the frequency on the function generator and observe the effect of the waveform on the scope.

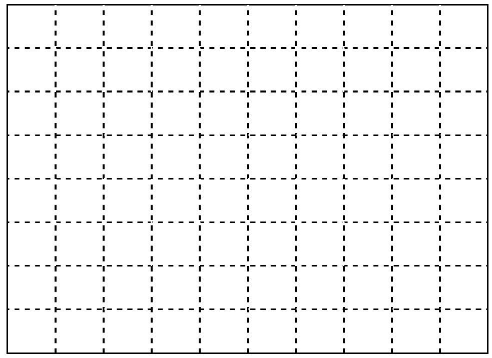
Make sure your name(s) are on the first page of this worksheet and turn in one copy per team to the instructor.

Square Wave



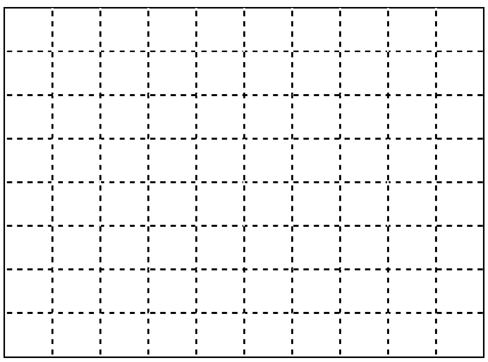
Peak Voltage ________________

Triangle Wave



Peak Voltage ________________

Sine Wave



Peak Voltage ________________

What does adjusting the frequency of the function generator do to these waveforms?

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