Electronics Test Equipment
(For Engineers & Physicists)

Name_____ ID_____ TA_____

Partners_____

Date_____ Section_____

Do not set the multimeter to "Current Mode" unless you are sure that you will not exceed the maximum current for the fuse.

1. **Variable Resistors:** Record the resistance values measured between the various connector strips for the control positions indicated. (For each trial, please check the units, **kΩ** or **Ω**, carefully.)

	top-to-middle	middle-to-bottom	top-to-bottom
100k, full CCW	_____	_____	_____
100k, 10 o'clock	_____	_____	_____
100k, 12 o'clock	_____	_____	_____
100k, 2 o'clock	_____	_____	_____
100k, full CW	_____	_____	_____
1k, full CCW	_____	_____	_____
1k, 10 o'clock	_____	_____	_____
1k, 12 o'clock	_____	_____	_____
1k, 2 o'clock	_____	_____	_____
1k, full CW	_____	_____	_____

◊ Notes:
For the top-to-middle and middle-to-bottom positions, the resistance increases toward the direction of the arrow. However, for top-to-bottom, it does not change. Please think about why.

2. DC Voltages: Report your measured voltages between Ground and the strips labeled:

+5V _____ -12V _____ +12V _____

-VOLTS: full CCW _____ 12 o'clock _____ full CW_____

+VOLTS: full CCW _____ 12 o'clock _____ full CW_____

3. AC Voltages: Report your measured AC voltages between the indicated strips:

➢**Multimeter observations**

left-to-center_____ center-to-right_____ left-to-right_____

➢**Oscilloscope observations:** Be sure to connect the center strip to Ground always.

peak-to-peak voltages: left-to-center_____ right-to-center_____

Amplitude (maximum magnitude of voltage)

V_{m1}=(left-to-center)/2_____ V_{m2}=(right-to-center)/2_____

Effective Voltage (average of AC voltage)

$V_{eff_1}= V_{m1}/\sqrt{2}$_____ $V_{eff_2}= V_{m2}/\sqrt{2}$_____

Do the observations by the multimeter correspond to the effective voltages from the oscilloscope observations? _____

What is the period? _____ (⇐ Please be careful about the units.)

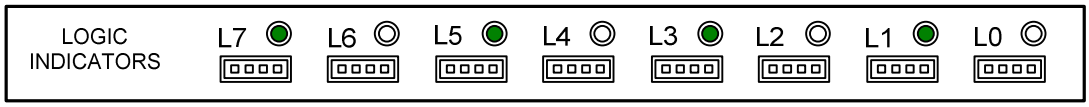
What is the frequency? _____(Hz) ⇐(This should be about 60 Hz.)

4. **Logic Connections 1:** Report whether the Logic Probe indicates "HI or "LOW" for the various connections.

Logic Switches:	A	$\overline{A}$	B	$\overline{B}$
Initial State	_____	_____	_____	_____
Switched	_____	_____	_____	_____

5. **Logic Connections 2:**

Did you succeed in making the following signal? _____



6. **Pulse and Function Generators:**

Settings: FREQ_____ FREQ MULT_____ FREQ×FREQ MULT_____

Functions: #1 Triangular Wave #2 Sinusoidal Wave #3 Square Wave

Max. Voltages #1 _____ #2 _____ #3 _____
(Max. Amplitude)

Periods (T) #1 _____ #2 _____ #3 _____

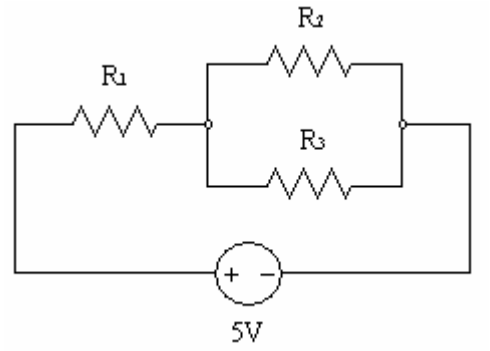
Frequencies (f) #1 _____ #2 _____ #3 _____
(f=1/T)

Are the values of frequencies close to the calculation, FREQ×FREQ MULT? _____

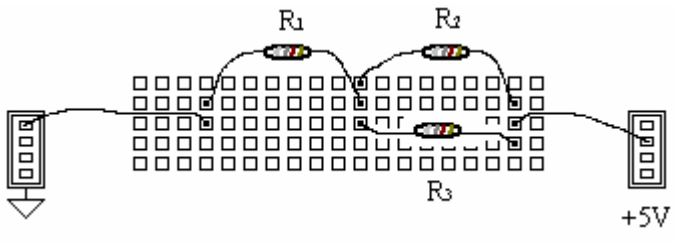
7. Implementing circuits; measuring voltage and current

- Example:

Circuit diagram

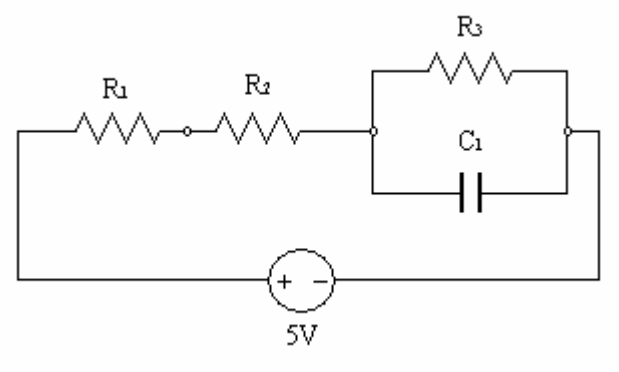


Actual connections



- Make the following circuit. (Draw the connections.)

Circuit diagram



Actual connections

- Measure the voltage and current. (Note: **Please follow the manual!**)

Voltage on the second resister, R_2 _____ (V)

Current flow of this circuit, I _____ (A)

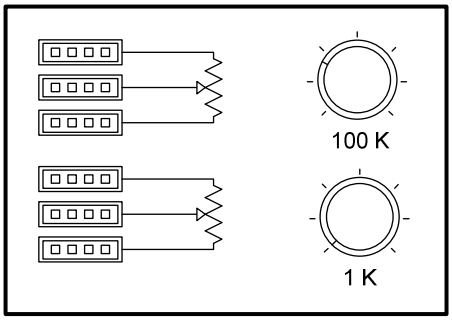
Did you succeed in measuring the voltage and current without burning the fuse in multimeter?

Lab Procedure for Electronics Test Equipment
(For Engineers & Physicists)

Please turn off power of to the Circuit Design Trainer each time you put on and take off any wires to avoid damage to the device.

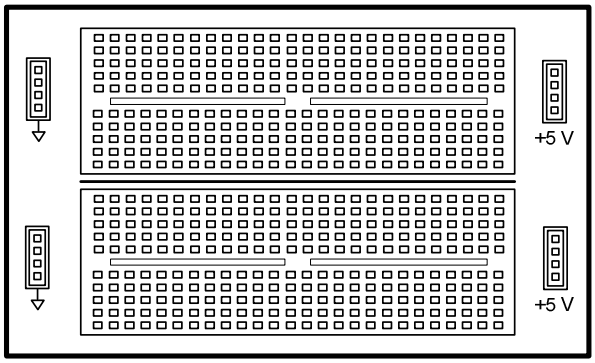
1. Variable Resistors

- **Keep the power off. Look for the variable resistors on the Circuit Design Trainer. Connect two wires to each strip in the positions of top-to-middle, middle-to-bottom, and top-to-bottom. Then measure the resistances for the specified cases with a multimeter.** You can find the variable resistors on the bottom right of the Trainer. You should change the resistors gradually, and see how much it will be altered.



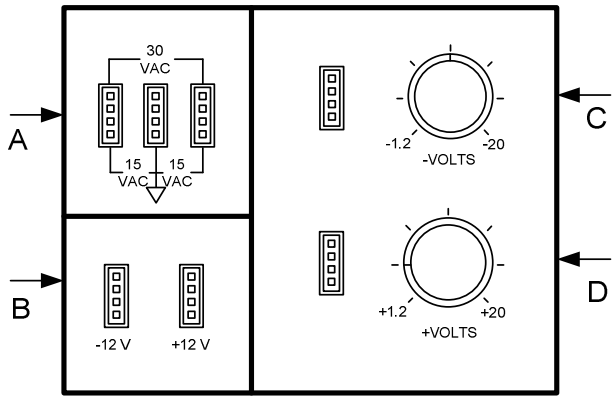
2. DC Voltages

- **Connect the wires to ground and +5V, and turn on the power; then measure the voltage with a multimeter.**
  The black wire of multimeter should be connected to Ground (the arrow represents ground in this section); otherwise, you will have negative voltages.



- **Connect the wires to ground and +12V or –12V, and turn on the power; then measure the voltage with the multimeter.**
  Use section "B" in the following figure.

- **Connect the wires to ground and the variable DC voltage sources (±), and turn on the power; then measure the voltage with multimeter.**
  Use the "C " and "D" in the following figure. This will be similar procedure to the first part of this lab (measuring variable resistors).



3. AC Voltages

- **Find the AC voltage source (Section "A" in the above figure). Measure the voltages with the multimeter.**
  First select the AC mode on the multimeter. Measure the three cases, left-to-center, center-to-right, and left-to-right.

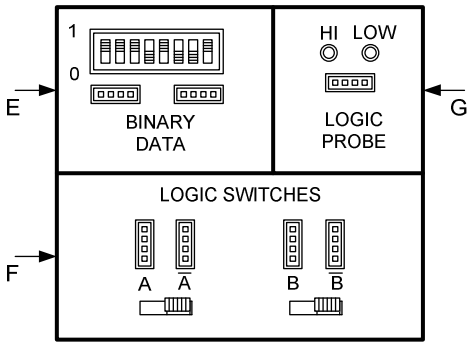
- **Using oscilloscope, measure the peak-to-peak voltages (y-axis) for left-to-center and right-to-center.**
  One calibration is 0.2 cm. Therefore, one square will be 1.0 cm. You will find the distance between peak-to-peak in centimeters, and multiply it by the indicated voltage in the VOLT/DIV dial. After this measurement, calculate the effective voltages. (Just follow the data sheet.)

- **On the x-axis, find the period, which is the time to complete one cycle.**
  You will find the distance between peak-to-peak in centimeters, and multiply it by the indicated time in the TIME/DIV dial.

- **By following the data sheet, calculate the frequency.**
  The frequency is 1/period. ($f = 1/T$)

4. Logic Connections 1

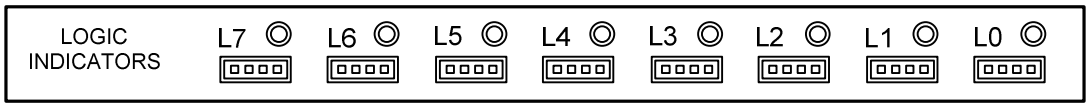
- **You are going to use the 'Logic Switches' and the 'Logic Probe' with one wire, which are B and C in the following figure. The wire will be connected to $\overline{A}$ or $\overline{B}$, and to the 'Logic Probe.'**
  You will find the initial state (high or low) of $\overline{A}$ or $\overline{B}$.



- **Switch the state into** A **or** B **to see if the state changes.**
  This is a basic operation of logic devices.

5. Logic Connections 2

- **Using 'Binary Data', which is A in the above figure, and 'Logic Indicators', you will make the following pattern. You can use as many wires as you want.**
  L7: *high*, L6: *low*, L5: *high*, L4: *low*, L3: *high*, L2: *low*, L1: *high*, L0: *low*

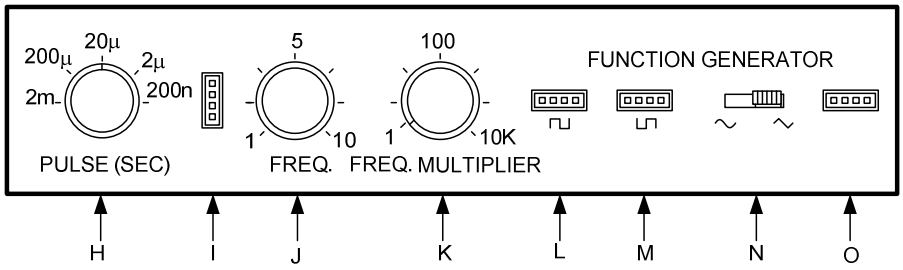


*This is an application of a previous one. You can just play with the connections and switches, and find the pattern. If you are not sure about this, please ask the TA.

6. Pulse and Function Generators

- **You are going to use 'Square', 'Sinusoidal', and 'Triangular Wave' function generators.**

- **Connect two wires to Ground and one of the following generators respectively, and using the oscilloscope, observe those patterns.**
  *Note that the black cable must be always connected to Ground.



- **Adjusting J (FREQ.) and K (FREQ. MULTIPLIER), make the appropriate pictures on the screen of the oscilloscope.**

- **From the display, you will find the maximum voltages, the periods, and the frequencies.**
  Maximum voltage means the maximum amplitude of the patterns. The period is the time interval for one cycle of the pattern. The frequency is 1/T.

7. Implementing circuits; measuring voltage and current

- **First, look at the example on the data sheet.**
  Each column has 5 holes. In the same column, those 5 holes are connected. However, different columns are disconnected from each other.

- **Then, implement the next circuit.**
  Draw the actual connections as the example shows.

- **Measure the indicated voltage and current of the circuit that you implement. (ⓘ Please ask the TA if you are not sure.)**
  Please follow the manual provided on each table. Otherwise, you might burn the fuses in multimeter. (Be careful about it when you measure the current flow.)

8. Lab report

- **Please write down what you learned, and discuss if you obtained consistent results. If not, please state why.**