Principles of EE I Laboratory

Lab 1

Introduction to Electric Circuit Laboratory

Student A	Student B
Full name: ……………………………………	Full name: ……………………………………
Student number: ……………………………………	Student number: ……………………………………

1. Objectives

In this laboratory, you will be introduced:

- Lab policies & Lab Safety Rules.
- The use of breadboard.
- Resistor color codes and capacitor codes.
- The equipment will be used during this laboratory.

2. Introduction to Electric Circuit Laboratory

a. Lab policies & Lab Safety Rules

i. Important Notes: Read carefully the following points:

- The students should be prepared on the theoretical material of the lab topic.
- Be prepared to answer questions.
- The students should prepare previously all Pre-Lab calculations and simulations.
- The presentation of a previous year's or someone else's lab is considered cheating.
- The students need to follow SEE' official lab report template to write a PDF report for each lab.

ii. Instruments and supplies

The major instruments you will need are permanently installed in the stations. A selection of wires, cables and connectors are inside your kit. Small parts (resistors, capacitors, transistors, ICs) will be available in the bins in the lab area. They can be reused and should be left on the table in the same manner as they were obtained.

iii. Leave your workplace at least as clean and tidy as you found it.

Put everything back in its proper place. If the workplace is not tidy after you finish, it will cause to lose some points.

iv. Precautions

Electronic test equipment can be damaged if incorrectly used.

- The function generator will be damaged if a large DC or AC voltage is applied to the outputs.
- The oscilloscope also has input limitations. Do not exceed 300V on any oscilloscope input.
- Power supplies can also be damaged if an external voltage in excess of the supply output voltage is fed back into the supply.
- The most common ways multi-meters are damaged are by trying to measure voltage when the meter is set to measure current or resistance or by exceeding the maximum voltage

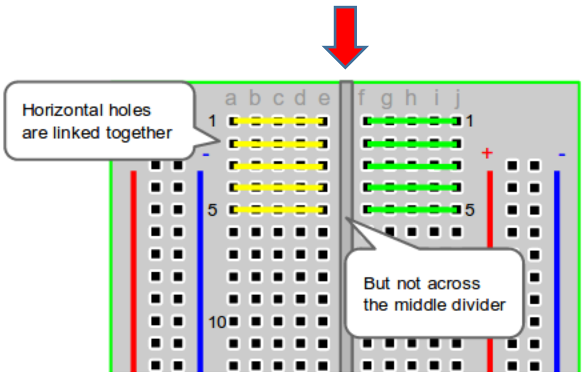
when in the voltage measurement mode. Think twice before connecting a meter. In particular, check the position of the function switch and ensure the test leads are connected to the proper inputs on the meter. If you make a mistake, you could blow the meter's internal fuse or damage the converter chip.

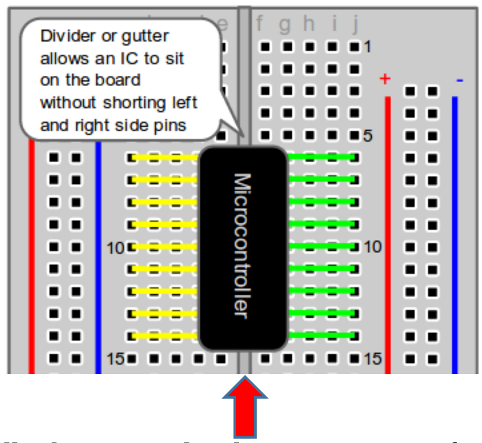
v. No foods or drinks are allowed inside the lab for any reason.

b. The use of breadboard.

i. Horizontal Rows

You can see that the horizontal rows are connected on the inside.

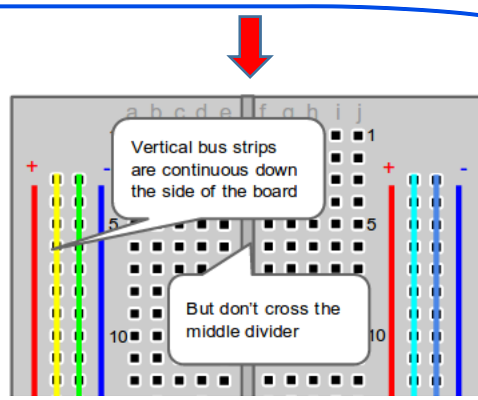




When you put your IC chip on board it should hurdle the center divider. You can see from diagram that the pins of the IC are now accessible by inserting a component or jumper wire in the available horizontal pins and connecting to another row.

ii. Vertical Columns

Vertical columns on the side of the breadboard are for power and ground.



These power rails are also isolated to the right and left side of the breadboard.

If you have to manage two different power supplies or voltages, they can be isolated by keeping them on either side of the board.

c. Resistor color codes and capacitor codes.

i. Resistor color codes

1K →

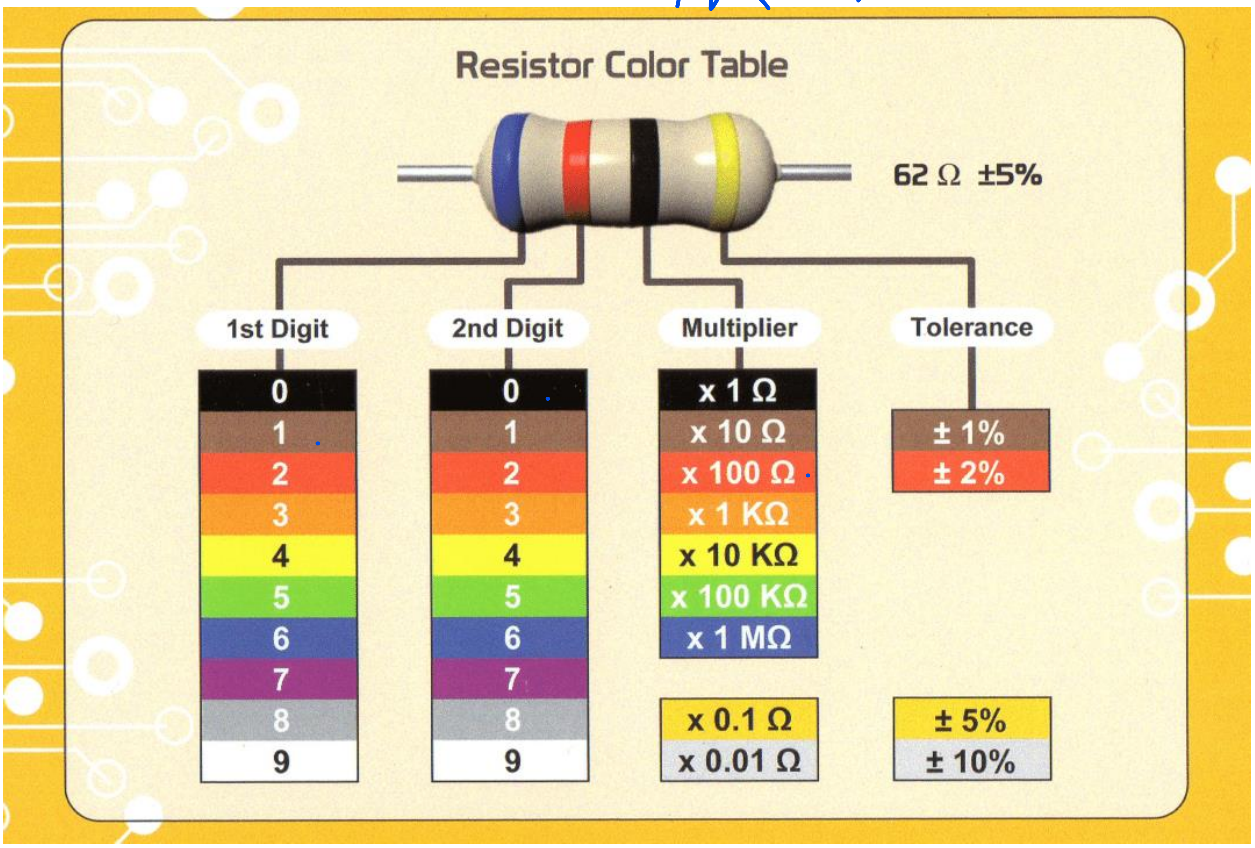
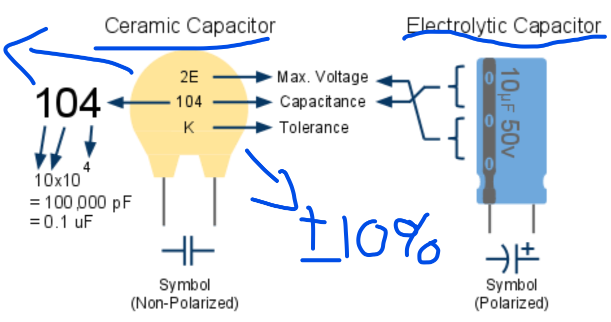


Figure 1 Resistor color codes

ii. Capacitor codes

Capacitors

250V



±10%

Max. Operating Voltage	
Code	**Max. Voltage**
1H	50V
2A	100V
2T	150V
2D	200V
2E	250V
2G	400V
2J	630V

Capacitance Conversion Values

Microfarads (µF)	Nanofarads (nF)	Picofarads (pF)
0.000001 µF	0.001 nF	1 pF
0.00001 µF	0.01 nF	10 pF
0.0001 µF	0.1 nF	100 pF
0.001 µF	1 nF	1,000 pF
0.01 µF	10 nf	10,000 pF
0.1 µF	100 nF	100,000 pF
1 µF	1,000 nF	1,000,000 pF
10 µF	10,000 nF	10,000,000 pF
100 µF	100,000 nF	100,000,000 pF

Tolerance	
Code	**Percentage**
B	± 0.1 pF
C	±0.25 pF
D	±0.5 pF
F	±1%
G	±2%
H	±3%
J	±5%
K	±10%
M	±20%
Z	+80%, -20%

Function Generator.

Figure 2 Capacitor codes

Digital Multi Meter

d. The equipment will be used during this laboratory.

Ossiloscope

Figure 3 Basic set of equipment

Power Supply

i. Power Supply

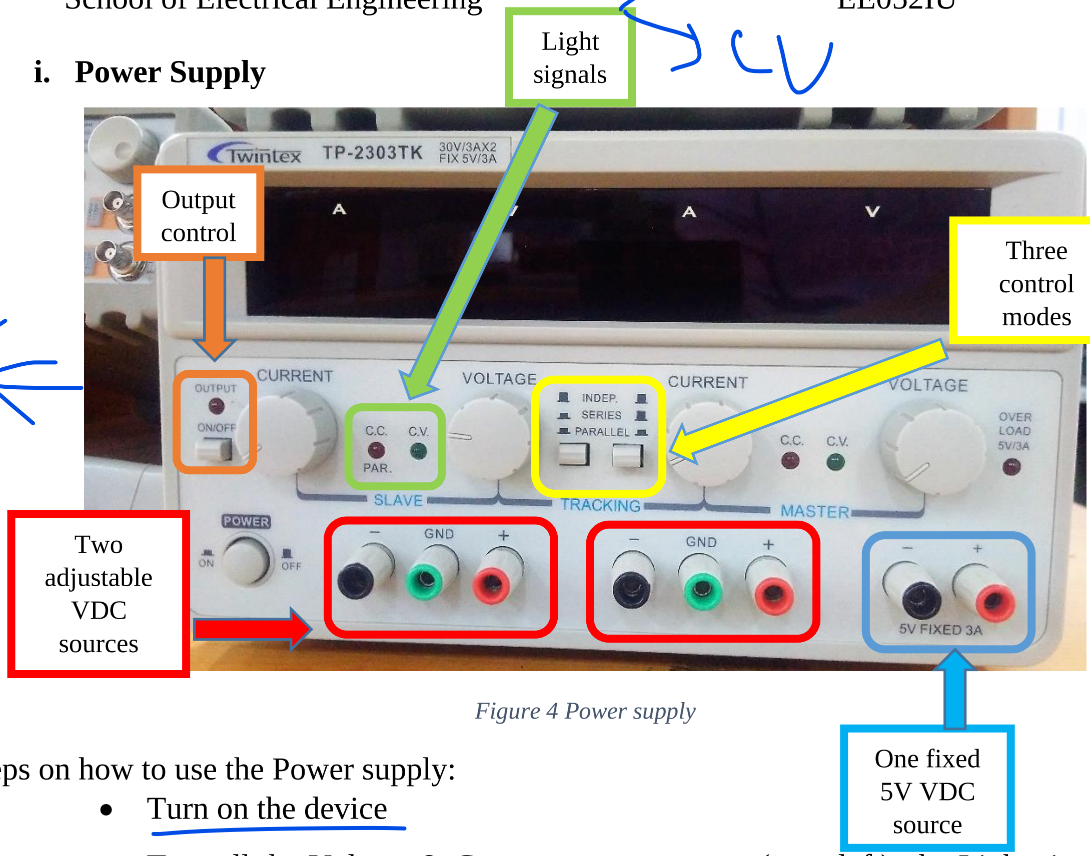


Figure 4 Power supply

Steps on how to use the Power supply:

- Turn on the device
- Turn all the Voltage & Current turners to zero (your left); the Light signal should be Red.
- Hook up your power supply to your circuit(s) (Red for Hotwire, Black for Ground)
- Turn the Voltage turner to the desirable voltage; slowly turn the Current turner up until the Light Signal turn Green.
- Hit the Output control button. (If the Light signal turn Red again, hit the Output control button again to turn off & check your circuit; it is likely to be short-circuited)
- After you done with your lab, turn off the device, return all the cables to their original places.

***About the three control modes, you mostly will only use INDEP. Or Independent mode which will separate the two adjustable sources. In the likely event that requires +15/-15 voltage supply for IC chip, request the assistance from your instructor unless you are certain of what you are doing.**

ii. Digital Multi-Meter (DMM)

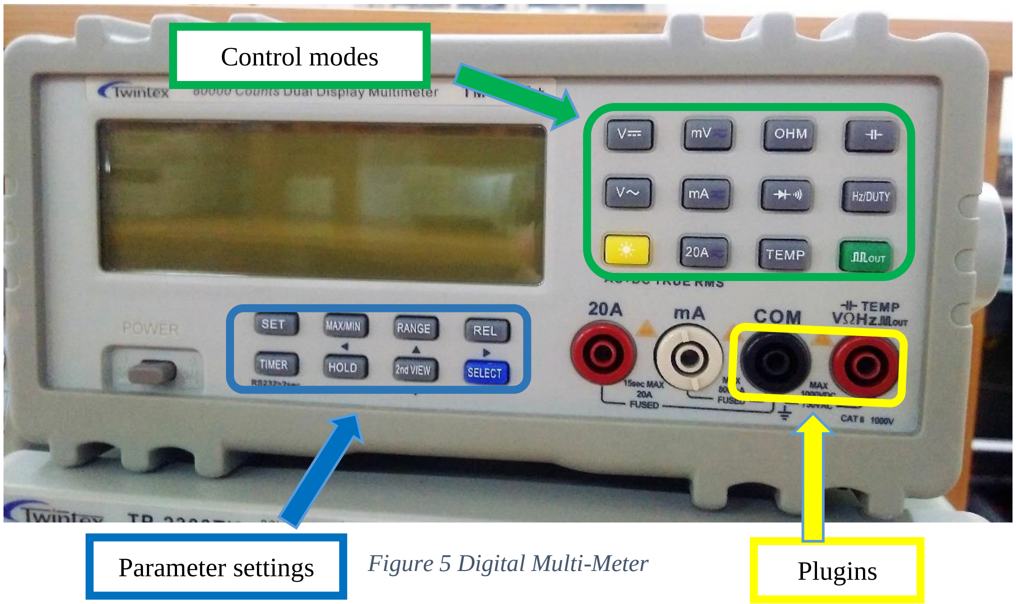


Figure 5 Digital Multi-Meter

*** Do not measure the components when they are still attached to the circuit; your measurements will likely be incorrect.**

iii. Function Generator

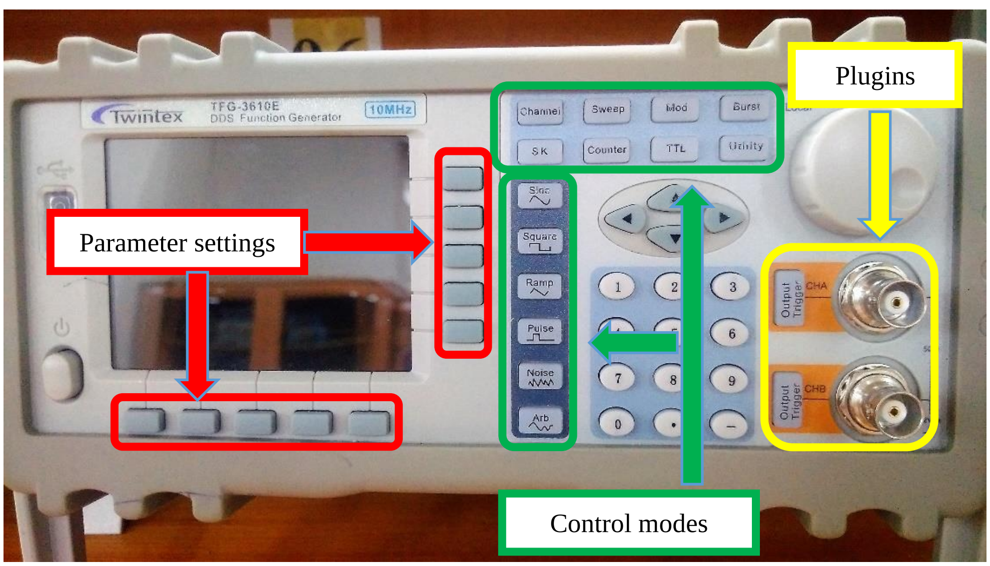


Figure 6 Function Generator

iv. Oscilloscope

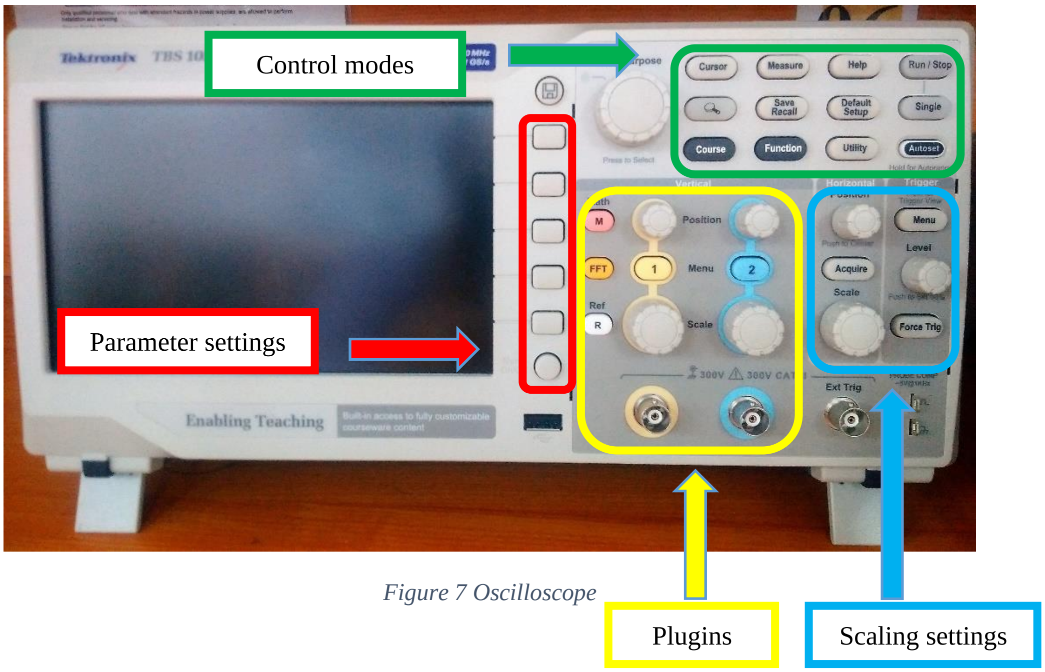


Figure 7 Oscilloscope

***How to read the oscilloscope:**

All oscilloscopes have some basic controls in common, be sure you can identify these controls on your oscilloscope:

- at least one input where an oscilloscope probe (also called a coaxial cable) can be attached (be sure you have one of these cables)
- screen with a grid overlay- this grid is useful when you want to make measurements using the scope
- volts/div- this control lets you change how many volts are represented by each vertical increment of grid overlay on the screen. Basically, it allows you to zoom in and out along the y axis.
- time/div- this control lets you change how much time is represented by each horizontal increment of the grid overlay on the screen. It allows you to zoom in and out along the x axis.
- vertical position/offset- lets you move up and down in the y direction
- horizontal position/offset- move left and right
- trigger level- this is a tool that allows you to stabilize your waveform on the screen

Turn on your oscilloscope. If nothing is plugged into the oscilloscope you should see a flat line, this means that the voltage of the input is not changing over time. If you see a line that is not flat, try disconnecting the probe from the oscilloscope. If the screen is blank try the following (remember all oscilloscopes are a little different, don't worry about pressing buttons if you're not sure, you won't break anything):

- my oscilloscope is a dual channel scope which means it has two inputs. As shown in figure 2, pressing the "channel 1" button causes that input to display on the screen in yellow. Pressing it again will cause it to disappear. Pressing channel 2 will display that input in blue. Your oscilloscope may only have one input (no channel buttons), or it may have more than 2. Analog scopes will not display separate channels as different colors, it's all green.
- you may be zoomed in tight on some blank space, try turning the volts/div knob counterclockwise to zoom out, also try turning the vertical position control until you get a flat line centered in your screen.
- make sure you scope is not in x y mode

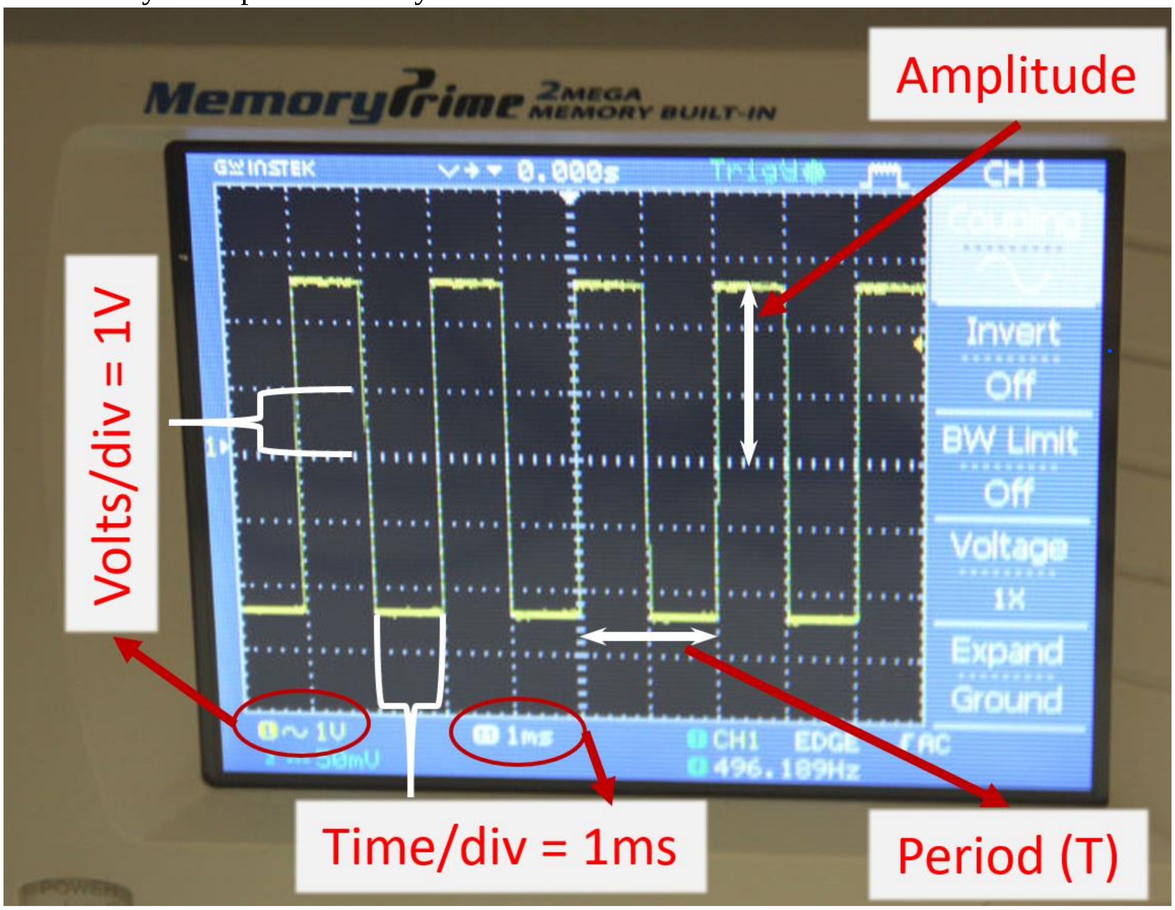


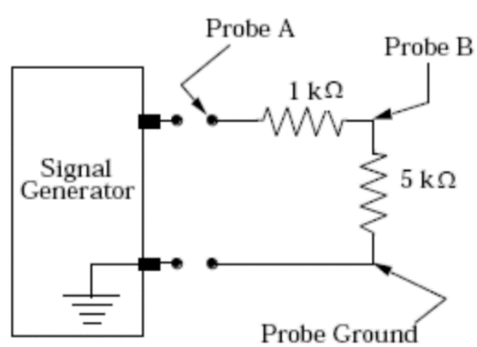
Figure 8 Oscilloscope How to 1

In Figure 7, we used the following parameters:

- **Volts/div = 1V**
- **Time/div = 1ms**

Adjust vertical position until wave oscillates around the center of the screen.

3. Lab procedures

<table>
<tr><th>Student A</th><th>Student B</th></tr>
<tr><td colspan="2">a. Reading the Resistors</td></tr>
<tr><td>150 ohm, 5% =
270 ohm, 5% =
3300 ohm, 5% =
470 ohm, 2% =
33K ohm, 5% =
1 ohm, 1% =
1200 ohm, 5% =
220 ohm, 1% =
3900 ohm, 2% =
10K ohm, 5% =</td><td>56K ohm, 5% =
1K ohm, 5% =
1M ohm, 5% =
100000 ohm, 5% =
390 ohm, 5% =
330K ohm, 2% =
3M9 ohm, 10% =
47 ohm, 5% =
10K ohm, 5% = _
1500 ohm, 2% =</td></tr>
<tr><td colspan="2">b. Measure the ~~Resistor~~ values
Each student goes to the counter and randomly pick 5 resistors. Read the nominal value from the color bands and use the DMM to measure the actual values of the resistors.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">c. Measure Voltage Differences
Build the simple circuit shown, Vi = 5sin(2π1000t) (V), then measure the amplitude of the signals at A and B with respect to ground.

</td></tr>
<tr><td>• Open the simulation platform of your choice and perform the Transient Analysis, only show the first three periods of both signals A & B.</td><td>• Take the breadboard and the components from the counter, put together the circuit and use the Function generator to power up your circuit as well as use the Digital Oscilloscope to draw first three periods of both signals A & B.</td></tr>
<tr><td colspan="2">THE END</td></tr>
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