PRINCIPLES OF EE1 LAB

Lab 1

Introduction to Electric Circuit Laboratory

Full name: ………………………………………………

Student number: ……………………………………….

Class: ……………………………………………………....

Date: ……………………………………………………….

I. Objectives

In this laboratory, you will be introduced:

- Lab schedule and policies.
- The use of breadboard.
- How to read resistor color codes?
- The equipment will be used during this laboratory.

II. Introduction to Electric Circuit Laboratory

Lab Policies

a. ***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.
- Prepare previously all Pre-Lab calculation and simulation
- There is no make-up lab. Not attending a lab implies that the student has no grade for that lab.
- The presentation of a previous year's or someone else's lab is considered cheating.
- The penalty for cheating on any graded item is an automatic **zero** in the course.

b. ***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.

c. ***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.

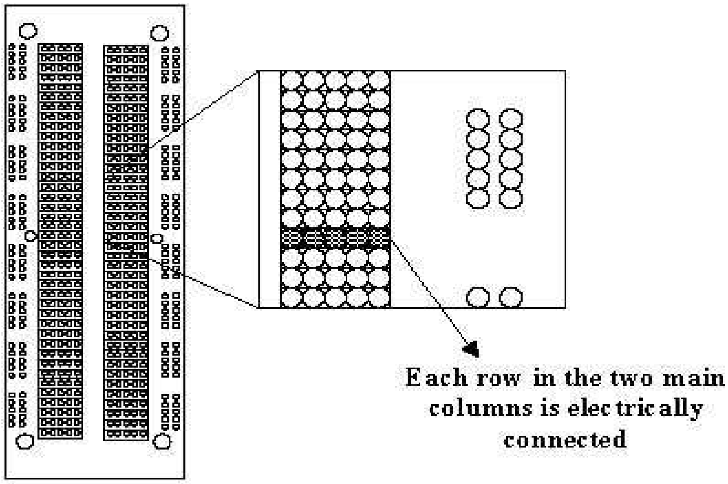
d. ***Precautions.*** Electronic test equipment can be damaged if incorrectly used.

- 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.

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

III. Breadboard

1. Uses of breadboard



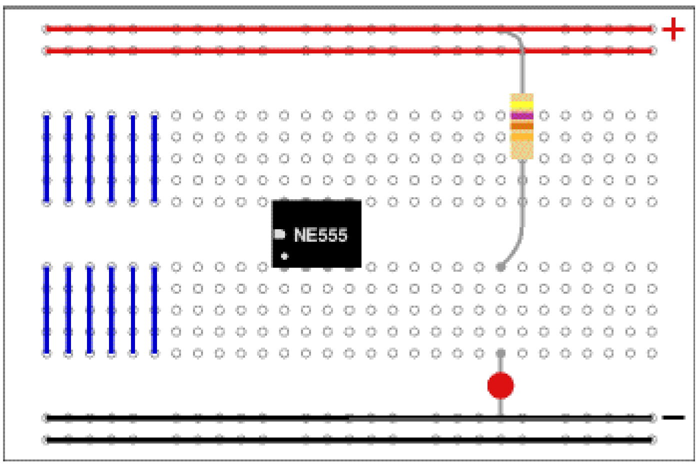
A breadboard is used to make up temporary circuits for testing or to try out an idea. No soldering is required so it is easy to change connections and replace components. Parts will not be damaged so they will be available to re-use afterwards.

2. Connections on breadboard

Breadboards have many tiny sockets (called 'holes') arranged on a 0.1" grid. The leads of most components can be pushed straight into the holes. ICs are inserted across the central gap with their notch or dot to the left.

Wire links can be made with single-core plastic-coated wire of 0.6mm diameter (the standard size). Stranded wire is **not** suitable because it will crumple when pushed into a hole and it may damage the board if strands break off.

The diagram shows how the breadboard holes are connected:



The top and bottom rows are linked **horizontally** all the way across as shown by the **red** and **black** lines on the diagram. The power supply is connected to these rows, + at the top and 0V (zero volts) at the bottom.

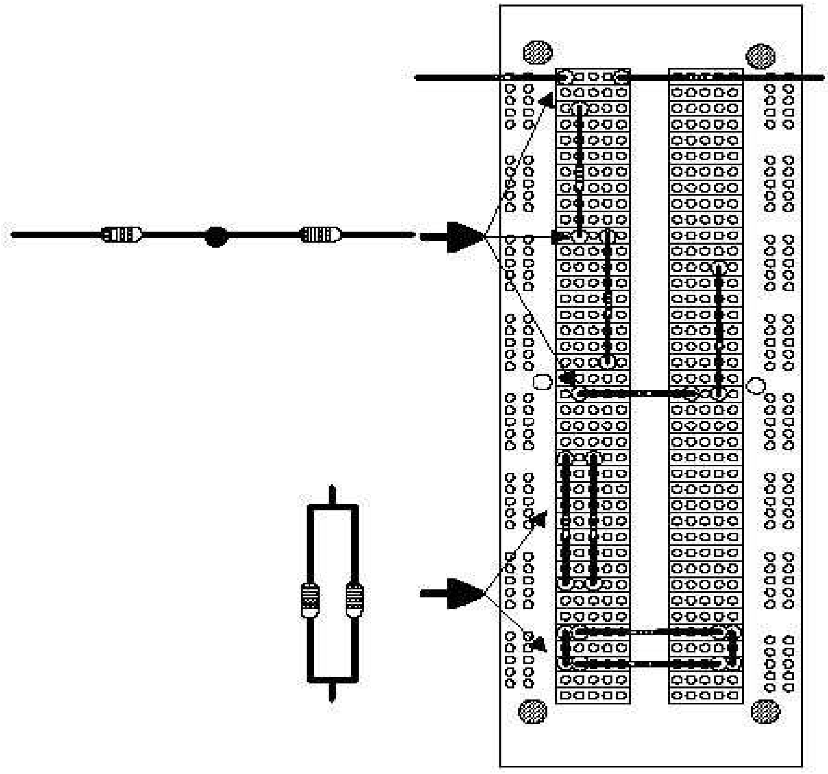
The other holes are linked **vertically** in blocks of 5 with no link across the center as shown by the **blue** lines on the diagram. Notice how there are separate blocks of connections to each pin of ICs.

3. Building a circuit on breadboard

Making a connection between two components is simple once you understand the internal wiring of the board. Let's take a simple example of connected two resistors in series or in parallel. The general wiring fabric of the breadboard provides an unlimited number of possibilities, but we want to focus on the efficient implementations. Never use more jumper wire than necessary! Let the breadboard do the work for you.

Series   Parallel

Figure below shows 3 examples of series wiring and 2 examples of parallel wiring. The pinholes where the component leads connect to the board are exaggerated with big circles.



A few general points to remember when you begin wiring a circuit:

- Try to use the breadboard to make connections, i.e. avoid the use of extra jumper wire. It is said that the more wire you use, the more likely you are to make an error by shorting two wires or incorrectly wiring the circuit.
- When you use extra jumper wire, keep it as short as possible. If your circuit looks like a bush of wires, imagine how hard it will be to debug it when it doesn't work correctly.

- Keep related components together.
- Make the circuit on the breadboard look as much as possible like the schematic you're implementing. The visual correspondence will help you differentiate the various nodes; plus, your TA can do more to help you debug if he can easily make sense of your circuit.
- Check all the connections carefully.
- Check that parts are the correct way round.
- Check that no leads are touching (unless they connect to the same block).
- Connect the breadboard to a power supply and press the push switch to test the circuit.
- If your circuit does not work, disconnect (or switch off) the power supply and very carefully re-check every connection against the circuit diagram.

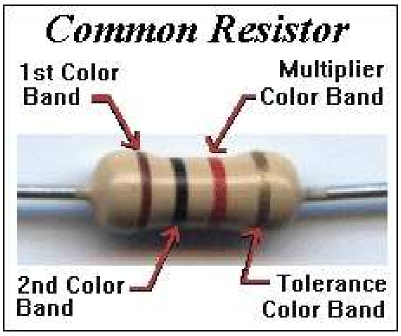
IV. Resistor Color Codes

The code

Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Gray	White
0	1	2	3	4	5	6	7	8	9

How to read the code

- First find the tolerance band, it will typically be gold (5%) and sometimes silver (10%).
- Starting from the other end, identify the first band - write down the number associated with that color; in this case Blue is 6.
- Now 'read' the next color, here it is red so write down a '2' next to the six. (You should have '62' so far.)
- Now read the third or 'multiplier' band and write down that number of zeros.
- In this example it is two so we get '6200' or '6,200'. If the 'multiplier' band is Black (for zero) don't write any zeros down. If the 'multiplier' band is Gold move the decimal point one to the left. If the 'multiplier' band is Silver move the decimal point two places to the left. If the resistor has one more band past the tolerance band it is a quality band.



V. Equipment

1. Function Generator

2. Oscilloscope

3. Digital Multi-Meter

VI. Procedure

1. Resister Value

a. Select 10 four color band resistors. Fill the following table

No.	Color band	Value R	Measurement R^*	$\frac{\lvert R^* - R \rvert}{R} \times 100\%$
1				
2				
10				

Table 1.1

b. Repeat a) with 5 five color band resistors

2. Measurement of Voltages and Currents.

a. DC Measurement

Before you start make sure you read and understand how to use the breadboard, the power supply, the function generator, the digital multimeters. Keep in mind you will be needing to connect in series the amp-meter in different places to make the measurements required, so think of a good way to place the resistors on the breadboard.

Build the circuit on figure 2-1,
Vdc = 10V, R1=1.5KOhm, R2 = 4.7 KOhm, R3 = 8.2 KOhm, R4=6.8 KOhm

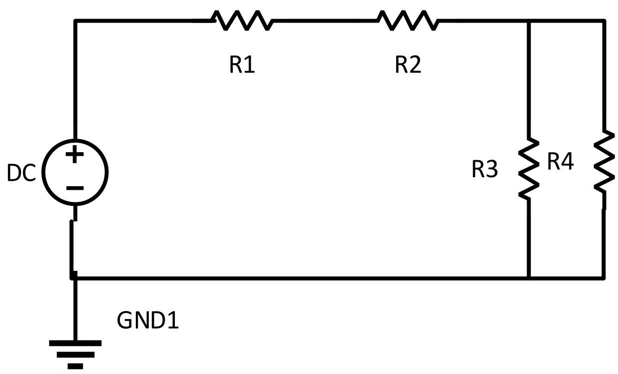


Figure 2-1: DC serial circuit

Repeat question 1 with four resistors $R1 \to R4$

Make the measurements required to fill the table

	R1	R2	R3	R4
Voltage				
Current				
Power				

Table 2.1: Measurements on a basic circuit.

$$I = \frac{U}{R}$$

$$P = U * I$$

Calculate voltage drops across each resistor, then determine the error by using the following equation:

$$error = \frac{\left|V_{measured} - V_{theoretical}\right|}{V_{theoretical}} \times 100\%$$

2.2 AC Measurement

Before you start make sure you read and understand how to use the breadboard, the power supply, the function generator, the digital multimeters and the oscilloscope. Build the circuit on figure 2-2:

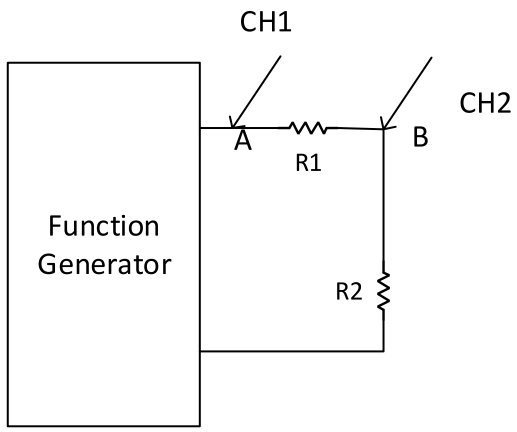


Figure 2-2: AC serial circuit

Repeat question 1 with two resistors $R1 = 470\Omega, R2 = 560\Omega$, $v_A = 5\sin\left(2\pi 1000t\right)V$

Make the measurements required to fill the table

		V_{R1}	V_{R2}
Voltage	DMM		
	Oscilloscope		

Table 2.2: Measurements on a basic serial circuit.

Calculate voltage drops across each resistor, then determine the error by using the following equation:

$$error = \frac{|V_{measured} - V_{theoretical}|}{V_{theoretical}} \times 100\%$$

2.3

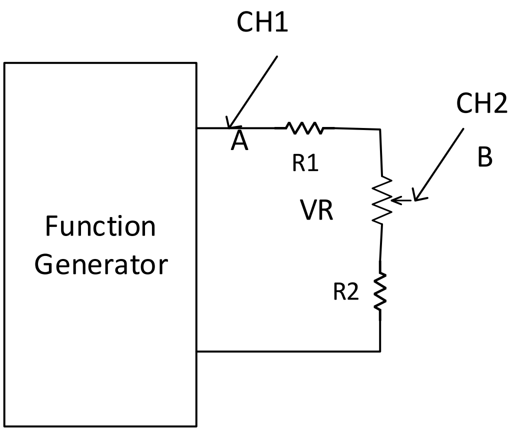


Figure 3-1: AC serial circuit with potentiometer

Repeat question 1 with two resistors $R1 = 6.8K\Omega, R2 = 8.2K\Omega,$
$VR = 10K\Omega$, $v_A = 5\sin(2\pi 1000t)V$

a. Make the measurements when sliding contact of variable resistor and fill the table

		max V_B	min V_B	V_{R2}
Voltage	DMM			
	Oscilloscope			

b. Repeat a) with figure 3-2

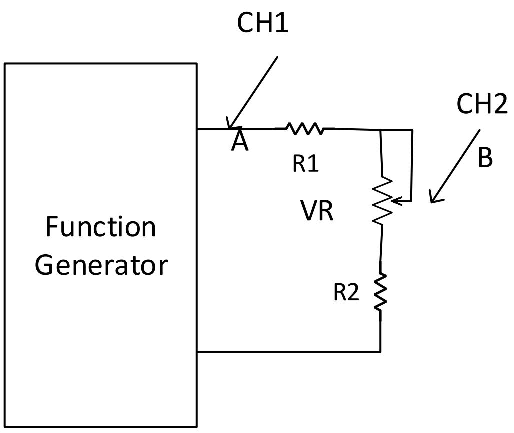


Figure 3-2: AC serial circuit with variable resistor