LAB# 00

Objective

Introduction of Basic Electronics

Theory

Diodes

Diodes allow electricity to flow in only one direction. The arrow of the circuit symbol shows the direction in which the current can flow. Diodes are the electrical version of a valve and early diodes were actually called valves.

Example:  Circuit symbol: 

Transistors

A **transistor** is a semiconductor device commonly used to amplify or switch electronic signals. A transistor is made of a solid piece of a semiconductor material, with at least three terminals for connection to an external circuit.

Oscilloscope

An **oscilloscope** (abbreviated sometimes as **scope** or **O-scope**) is a type of electronic test instrument that allows signal voltages to be viewed, usually as a two-dimensional graph of one or more electrical potential differences (vertical axis) plotted as a function of time or of some other voltage (horizontal axis).

Function Generator

A **function generator** is a piece of electronic test equipment or software used to generate electrical waveforms. These waveforms can be either repetitive or single-shot, in which case some kind of triggering source is required (internal or external).Function Generators are used in development, testing and repair of electronic equipment, e.g. as a signal source to test amplifiers, or to introduce an error signal into a control loop.

Analog function generators usually generate a triangle waveform as the basis for all of its other outputs. The triangle is generated by repeatedly charging and discharging a capacitor from a constant current source. This produces a linearly ascending or descending voltage ramp. As the output voltage reaches upper and lower limits, the charging and discharging is reversed using a comparator, producing the linear triangle wave. By varying the current and the size of the capacitor, different frequencies may be obtained. Sawtooth waves can be produced by charging the capacitor slowly, using a current, but using a diode over the current source to discharge quickly - the polarity of the diode changes the polarity of the resulting sawtooth, i.e. slow rise and fast fall, or fast rise and slow fall.

A 50% duty cycle square wave is easily obtained by noting whether the capacitor is being charged or discharged, which is reflected in the current switching comparator's output. Other duty cycles (theoretically from 0% to 100%) can be obtained by using a comparator and the sawtooth or triangle signal. Most function generators also contain a non-linear diode shaping circuit that can convert the triangle wave into a reasonably accurate sine wave. It does so by rounding off the hard corners of the triangle wave in a process similar to clipping in audio systems.

A typical function generator can provide frequencies up to 20 MHz. RF generators for higher frequencies are not function generators in the strict sense since typically produce pure or modulated sine signals only.

Function generators, like most signal generators, may also contain an attenuator, various means of modulating the output waveform, and often the ability to automatically and repetitively "sweep" the frequency of the output waveform (by means of a voltage-controlled oscillator)

between two operator-determined limits. This capability makes it very easy to evaluate the frequency response of a given electronic circuit.

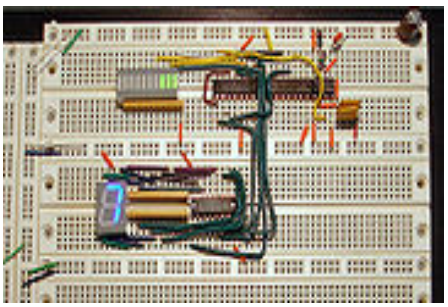
Some function generators can also generate white or pink noise.

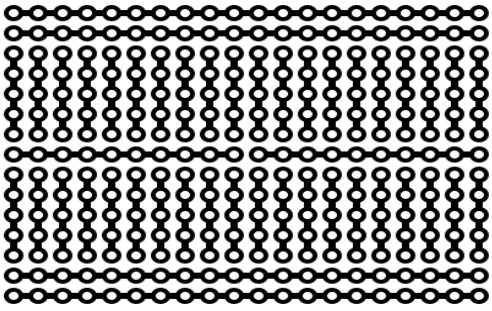
Multimeter

A **multimeter** or a **multitester**, also known as a **volt/ohm meter** or **VOM**, is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter may include features such as the ability to measure voltage, current and resistance. There are two categories of multimeters, **analog multimeters** and **digital multimeters** (often abbreviated **DMM** or **DVOM**.) A multimeter can be a hand-held device useful for basic fault finding and field service work or a bench instrument which can measure to a very high degree of accuracy. They can be used to troubleshoot electrical problems in a wide array of industrial and household devices such as batteries, motor controls, appliances, power supplies, and wiring systems.

Breadboard

A **breadboard** (**protoboard**) is a construction base for a one-of-a-kind electronic circuit. In modern times the term is commonly used to refer to a particular type of breadboard, the **solderless breadboard** (**plugboard**). Because the solderless breadboard does not require soldering, it is reusable, and thus can be used for temporary prototypes and experimenting with circuit design more easily.



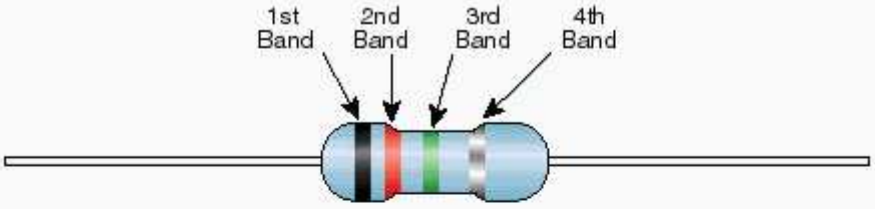


Resistors

Resistor is a two-terminal electronic component that produces a voltage across its terminals that is proportional to the electric current passing through it in accordance with Ohm's law:

$$V = IR$$

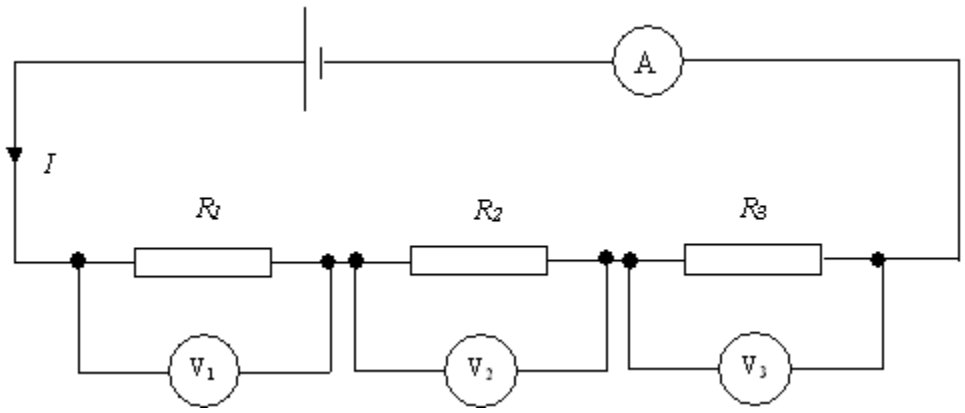
Standard EIA Color Code Table 4 Band: ±2%, ±5%, and ±10%



Color	1st Band (1st figure)	2nd Band (2nd figure)	3rd Band (multiplier)	4th Band (tolerance)
Black	0	0	10^0	
Brown	1	1	10^1	
Red	2	2	10^2	±2%
Orange	3	3	10^3	
Yellow	4	4	10^4	
Green	5	5	10^5	
Blue	6	6	10^6	
Violet	7	7	10^7	
Gray	8	8	10^8	
White	9	9	10^9	
Gold			10^{-1}	±5%
Silver			10^{-2}	±10%

Series Circuits

A **series circuit** has more than one resistor and gets its name from **only having one path for the charges** to move along. Charges must move in "series" first going to one resistor then the next. If one of the items in the circuit is broken then no charge will move through the circuit because there is only one path. There is no alternative route.

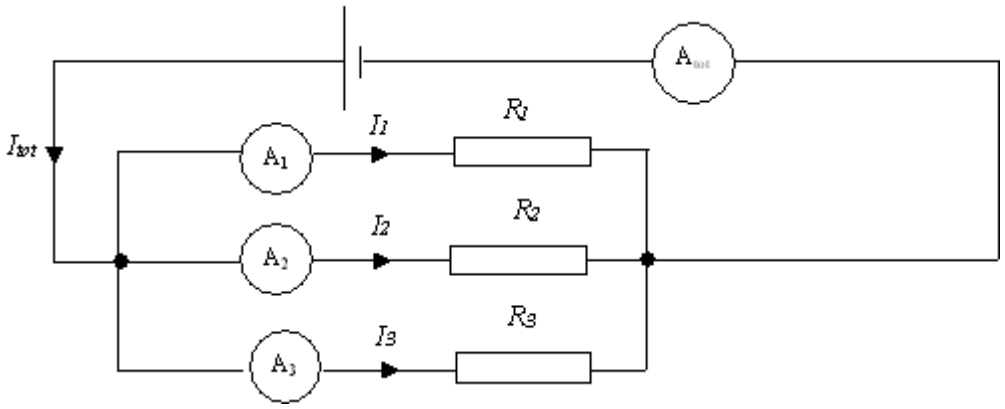


The following rules apply to a **series circuit**:

1. The sum of the potential drops equals the potential rise of the source.
$$V_T = V_{R1} + V_{R2} + V_{R3} \cdots$$
2. The current is the same everywhere in the series circuit.
$$\mathrm{I_T = I_1 = I_2 = I_3 = \ldots}$$
3. The total resistance of the circuit (also called **effective resistance**) is equal to the sum of the individual resistances.
$$R_T = R_1 + R_2 + R_3 \ldots$$
4. **Ohm's Law** may be used in a series circuit .
$$\mathrm{V_{total} = I_{total} R_{total}}$$
$$\mathrm{V_{part} = I_{part} R_{part}}$$

Parallel Circuits

Parallel circuits have their components in parallel **branches** so that an individual electron can go through one of the branches, but not the others. The current splits into the number of branches there are. Look at this circuit:



From this we can write:

$$I_{tot} = I_1 + I_2 + I_3$$

From Ohm's Law, I = V/R, we can write:

$$I_T = \frac{V}{R_T};\quad I_1 = \frac{V}{R_1};\quad I_2 = \frac{V}{R_2};\quad I_3 = \frac{V}{R_3}$$

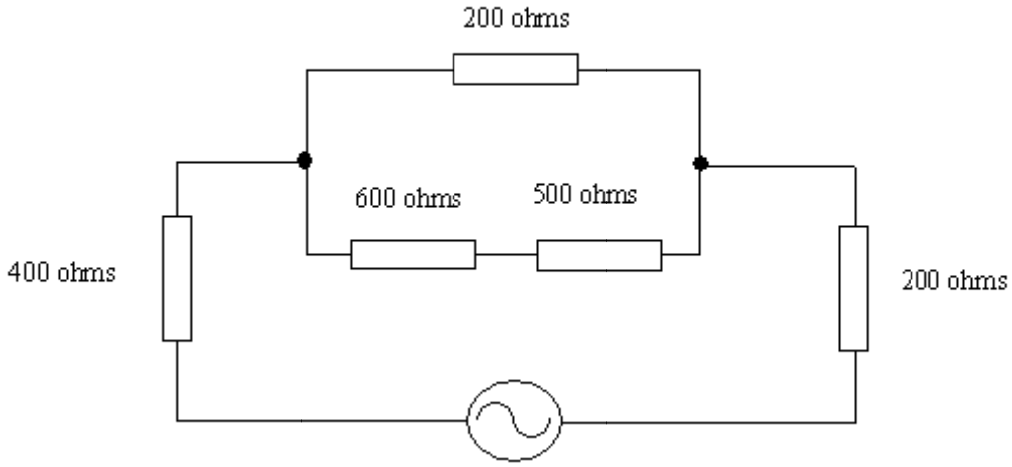
$$\Rightarrow \frac{V}{R_T} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\Rightarrow \boxed{\frac{1}{R_{Tot}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

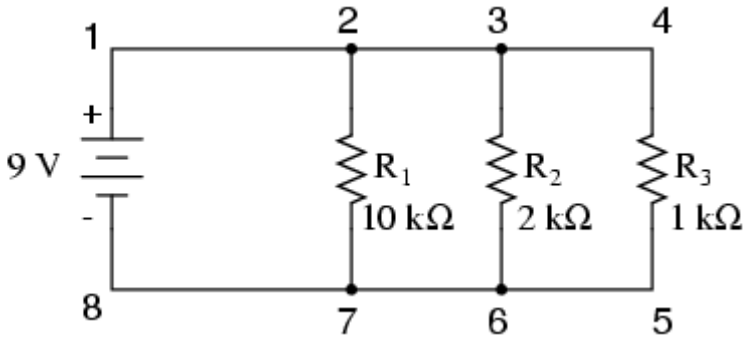
TASKS

Q1). Draw voltage and current waveforms at each of resistor in the circuit given below? You have to use the following ac sources:

1. Sine wave, 50% duty cycle, 200kHz, 5V.
2. Sawtooth wave, 50% duty cycle, 1MHz, 5V.
3. Square wave, 50% duty cycle, 2kHz, 5V.

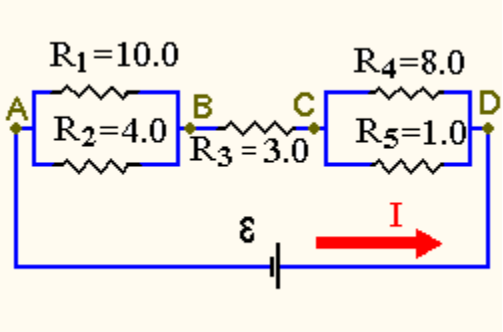


Q2) Find the current flowing through each resistor.



	R_1	R_2	R_3	Total	
E	9	9	9	9	Volts
I					Amps
R	10k	2k	1k		Ohms

Q3) Which resistors are in parallel and which are in series? Is this circuit composed of small groups of parallel resistors, all connected in series? Or is it composed of groups of series resistors, connected in parallel?



Q4) what is the equivalent resistance for resistors in parallel? In series?