Name: ..... Student ID: .....

Circuits and Electronics Lab 01

Introduction to Electronic Components and Symbols

Objective:

1. Learn how to identify electronic devices and components and its values
2. Learn how to use multi-meter (VOM) to measure parameters of electronic devices and components

Resistor, capacitor, and inductor are three passive linear circuit elements that make up electronic circuits. This lab provides you a brief introduction of these components

Resistor

Resistor (R) is a two-terminal passive component. It is a basic element of an electronics circuits. Its primary use is to limit amount of current flow in the circuit. There are many types and varieties of size, shape and material used to build the resistor, depending on its applications.

Resistor is typically specified by two important parameters, resistance, and Watt. Resistance is a quantity indicating how much the material resists the flow of current. The higher amount is the lower current can flow. The unit of the resistance is **Ohm**. Because resistor resists a flow of current, when current flows through resistor, power dissipation (heat) occurs. Amount of this power dissipation that the resistor can tolerate is specified by **Watt**.

Types of Resistor

Fixed Resistor. The value of its resistance is fixed. It can be made from different materials and structures such as carbon film, metal film, wire-wound, metal oxide, ceramic

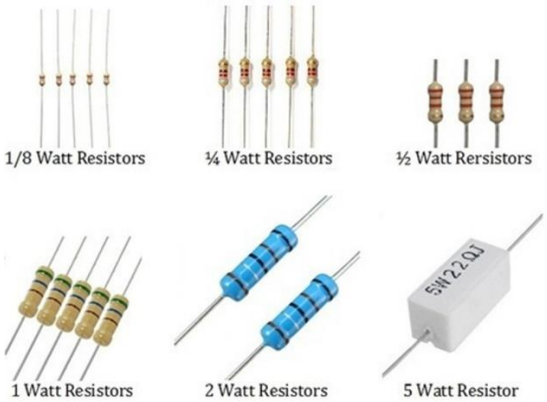
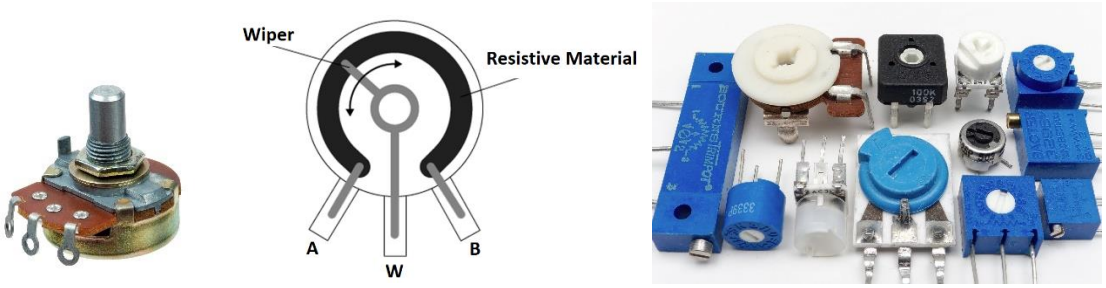


Fig.1.1 Carbon film fixed resistor

Fig.1.2 SMD fixed resistor

Variable Resistor. The value of its resistance is adjustable. The common names are a volume, a potentiometer (POT). A small one also called a trimmer. To allow the adjustable, a variable resistor usually has additional terminal for adjusting in the middle. The adjusting terminal is connected to either a wiper or a slider. Adjustment mechanism is based on turning a wiper or sliding a slider terminal up or down to increase or decrease its resistance value.



Volume Potentiometer

Fig.1.3 Variable resistor

Variable resistor (volume) is divided into four types: Type A logarithmic, Type B linear, Type C antilogarithmic, and S-shape depending how its value change when turning a wiper. Type and resistance value are usually printed on the surface of the component.

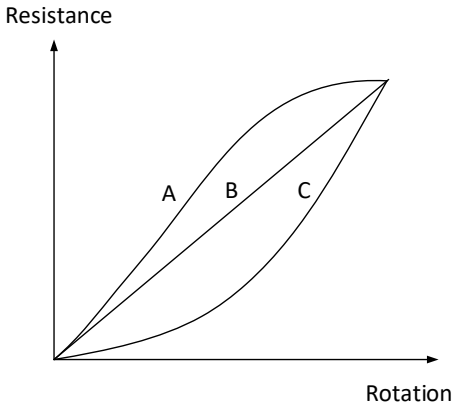


Fig.1.4 Curve of volume characteristic

Resistor Color Code

For small resistor such as 0.125W – 2W is used to display the resistance value, percent error (tolerance). The chart of color code is display below.

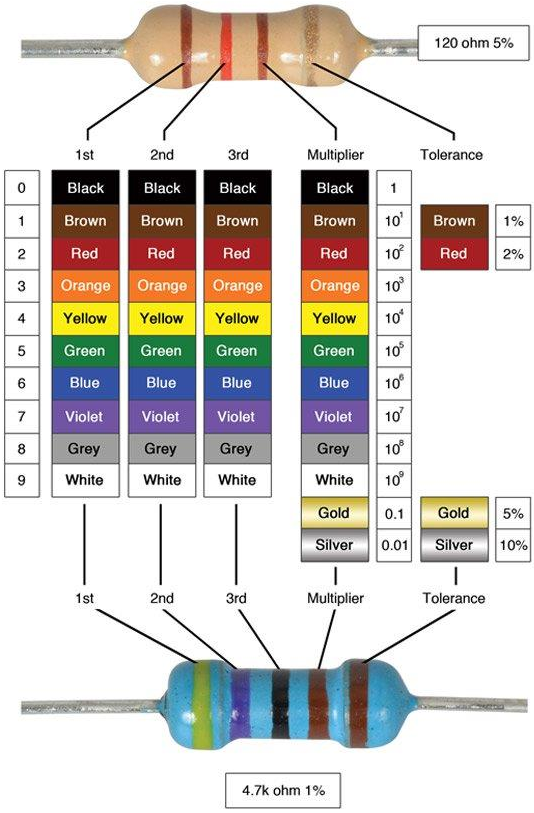


Fig.1.5 Resistor color code (www.jameco.com)

Capacitor

Capacitor (C) is a two-terminal passive component that can stores electrical energy as an electric field. A capacitor consists of two parallel-plate conductors filled with dielectric material in between. Each plate is connected to each capacitor terminal. When there is a voltage across the terminals (plates), it allows positive charges and negative charges to accumulate on the plate connected to positive voltage and negative voltage, respectively. As a result, it creates electric field which stores electrical energy.

In the operation of electronic circuit, it often requires to store electrical energy temporary and to perform frequency manipulation. Therefore, capacitor is used for these purposes. Amount of energy stored depends on amount of charge the capacitor can accumulate which is proportional to the size of its capacitance value.

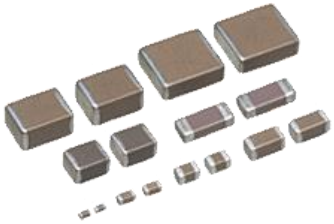
The important parameters of a capacitor are its capacitance value which has a unit of **Farad: F** and the maximum voltage (rating voltage: V) it can withstand without being damaged. Typical value of capacitance used in electronic circuits is in the range of pF – uF. Both parameters are usually displayed on its package as the numbers and the letter codes.

Types of capacitor

Fixed capacitor The value of its capacitance is fixed. It can be made from different materials and structures such as electrolytic, ceramic, plastic film (polystyrene, polyester/mylar, polycarbonate), mica, tantalum. Difference materials give different qualities of the capacitor in terms of capacitance value, charge leakage, rating voltage and percent of error. In addition, due to chemical reaction of materials used inside, electrolytic and tantalum capacitors are polarized capacitors. It has polarity signs displayed on its package. Plus (+) terminal must connect to higher voltage while minus (-) terminal must connect to lower voltage. Otherwise, it can explode.

Aluminum electrolytic

Polyester (Mylar)



Ceramic Chip

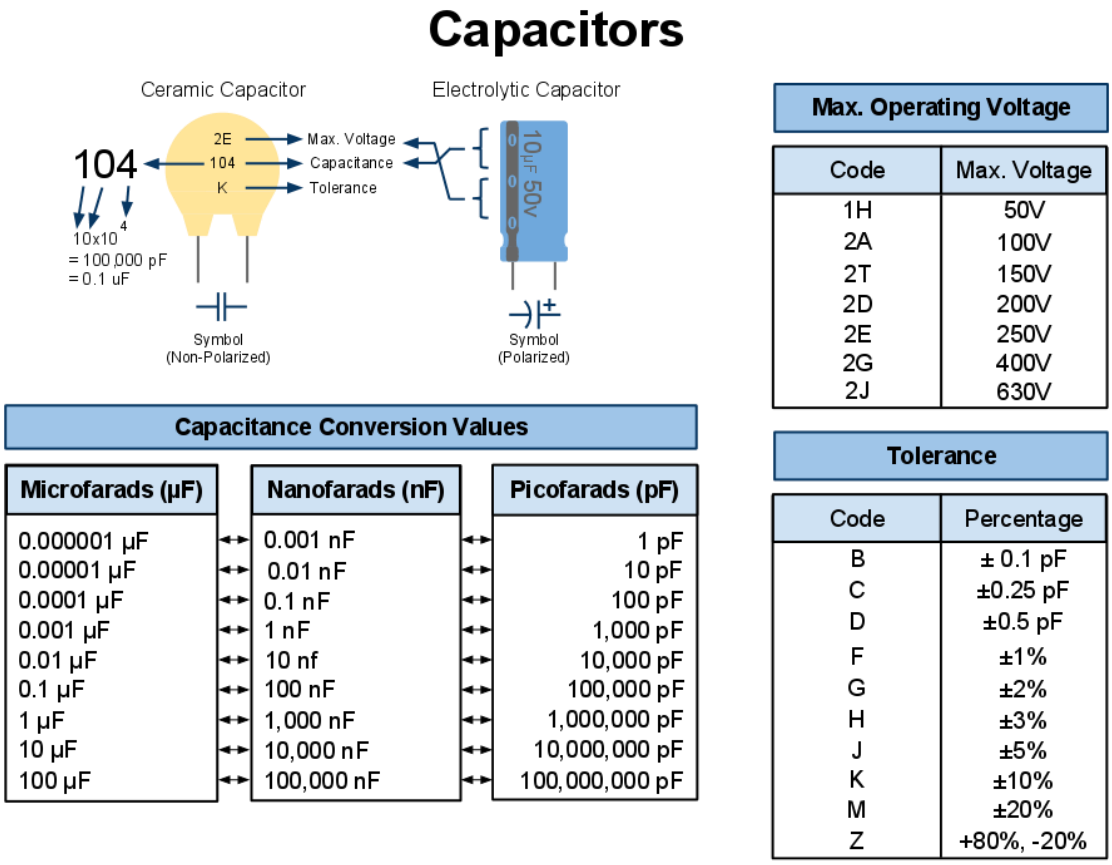
Tantalum

Polypropylene

Fig.1.6 Some types of fixed capacitor

Variable capacitor The value of its capacitance is adjustable. It is useful for circuit that need to fine tune the value of capacitance such as radio receiver circuit. The common names are trimmer capacitor, air variable capacitor.

Fig1.7 Variable capacitor



Code for capacitance value and maximum operation voltage

(Source: www.bragitoff.com/2015/09/capacitor-codes-explained/)

Inductor

Inductor (L) is a two-terminal passive component that can store energy in a magnetic field. It is characterized by its inductance in the unit of **Henry: H**. One Henry is a very large value of inductance particularly in electronic circuit where the typical value is in the range of

nH - mH. An inductor usually consists of a coil of conducting material, typically insulated copper wire, wrapped around a core which can be non-magnetic material such as plastic or a ferromagnetic material to increasing the inductance. Inductor is commonly known as a coil, a choke.

Axial leaded inductor

Solenoid shape (iron core)

Torroid shape (iron core)

RF inductors

Inductor value coding

For a small axial leaded inductor, it uses the same color code as the resistor except that the read value is in the unit of micro-Henry. A surface mount and a RF inductor usually use a numeric and text code written on its package to specify its value, also in micro-Henry. For examples, the codes 332 = 33 x 10^2 μH, and 8R2 = 8.2 μH. In addition, the current rating (the maximum current which an inductor can withstand) is needed to be considered.

SMD Inductor

Fig. 1.8 Some types of fixed inductor

Fig.1.9 Variable inductor

Symbols of electronic component

Symbols are used to represent electronic components in a schematic diagram. Most of symbols are universal, however some components may use symbols that slightly different depending on whether the diagram is based on US, EU, or Japan standard. The Fig.1.10 shows some of common symbols.

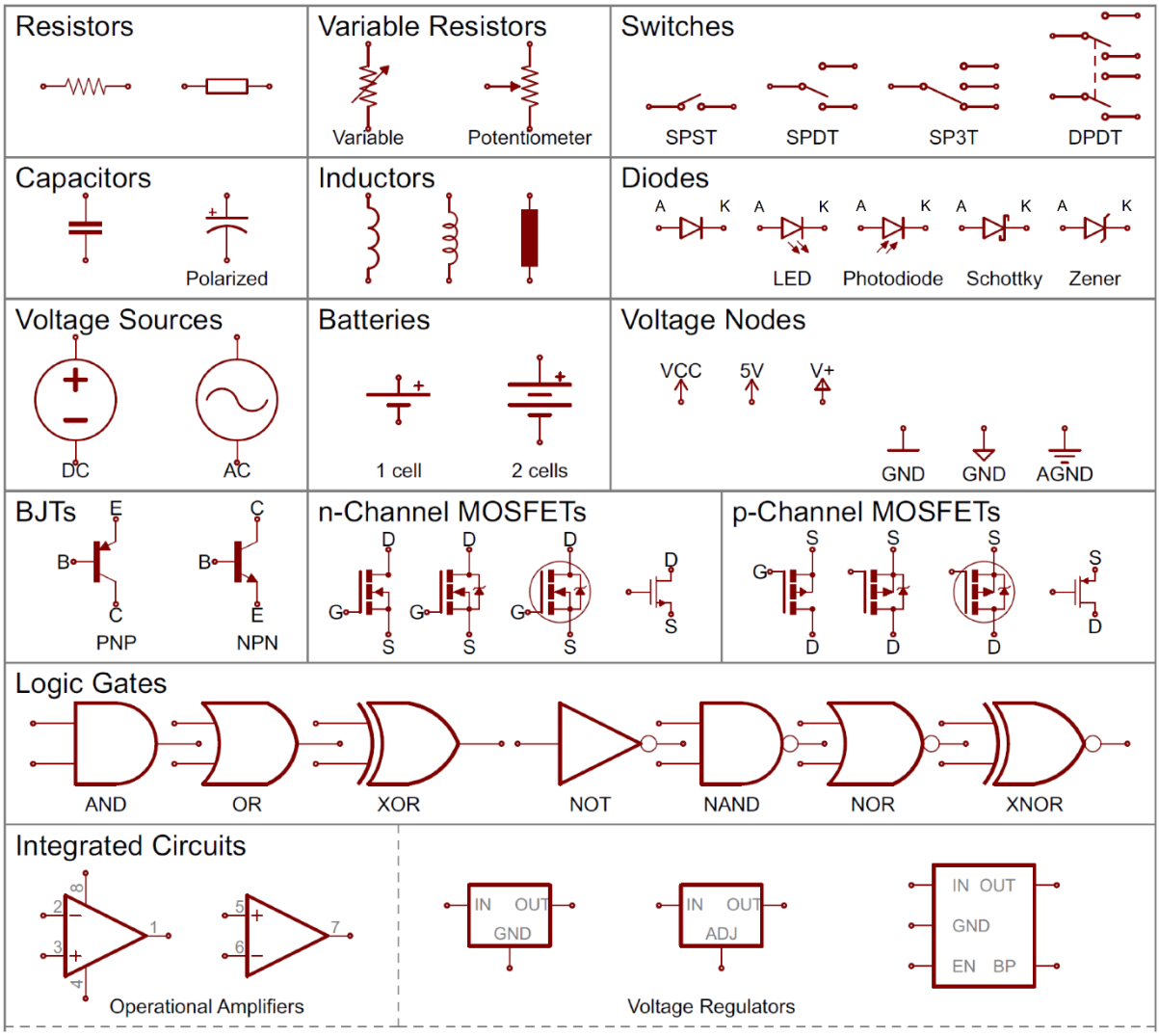


Fig. 1.10 Common symbols

Experiment

1. Take 3 resistors, 3 capacitors, 3 inductors from your component box. Read the attributes of the components and write its values down in Table 1.

   Table 1.

Component	Color code/number (as appeared)	Value and unit (use prefix)	Type and % error
Resistor			
Resistor			
Resistor			
Capacitor			
Capacitor			
Capacitor			

Inductor			
Inductor			
Inductor			

2. Redraw a schematic diagram of Fig 1.11 using symbols from Fig.1.10 and the description from Table 2. Write down its instance name and its value next to each component.

Table 2.

Number of components	Instance name	Name of the component and its value	Number in diagram
1		Battery **5 V**	1
1	SW1	Single-Pole Single-Throw Switch (SPST)	2
2	Q1, Q2	*npn* transistor	3, 4
2	R3, R4	Fixed resistor **330 Ω**	5, 6
2	R1, R2	Fixed resistor **10kΩ**	7, 8
2	C1, C2	Polarized capacitor **100 μF 16V**	9-10
		Ground	11, 12, 13
2	D1, D2	Light Emitting Diode (LED)	14, 15

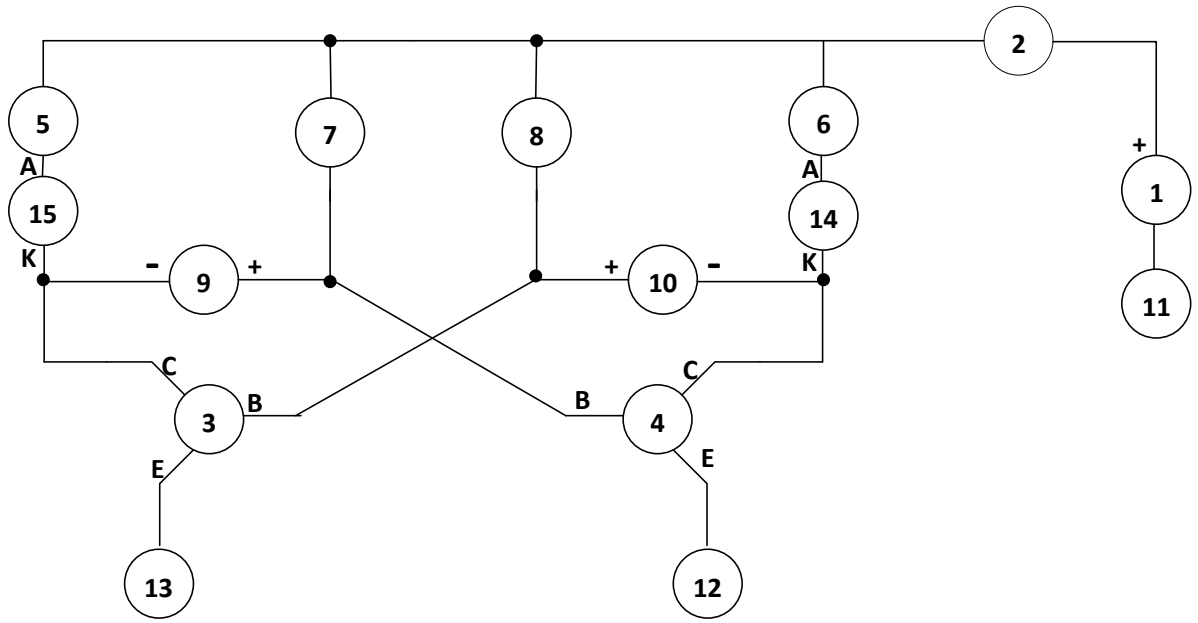


Fig 1.11

Fig.1.12 A complete schematic diagram of Fig.1.11

References: