ESC201 Introduction to Electronics General Lab Manual for Some Elements Resistor, Potentiometer, and Breadboard

Part A: Resistor Colour Coding and Resistance Values

Resistors: Resistors are usually classified according to the following three properties:

(a) Composition (e.g., carbon granule, carbon film, metal film, wire wound, etc.)
(b) Power rating (e.g., 1/8 W, ¼ W, ½ W, 1 W, etc.)
(c) Tolerance (e.g., 20%, 10%, 5%, 1%, etc.)

The first two specifications (as given in (a) & (b) above) have to be found from the manufacturer's specification sheet. Tolerance is usually indicated on the body of the resistor itself along with the value of the resistance. The value and the tolerance are either printed on the resistor, or are indicated by colour bands.

Resistor Colour Code: The resistance values along with the tolerance are colour-coded on the resistors using 4 bands. The 1st and the 2nd bands give the first two significant digits of the resistor value, while the 3rd band gives the number of zeros to the right of the two significant digits (called the multiplier band). The ten colours and the corresponding digits (0-9) are as follows: ***Black*** (***0***), ***Brown*** (***1***), ***Red*** (***2***), ***Orange*** (***3***), ***Yellow*** (***4***), ***Green*** (***5***), ***Blue*** (***6***), ***Violet*** (***7***), ***Grey*** (***8***), ***White*** (***9***). A resistor with its colour band is shown in Fig. 1a.
There is a famous statement which makes the remembering of the order of these colour codes easy, it goes as: '***BB ROY*** of ***G***reat ***B***ritain was ***V***ery ***G***ood and ***W***ise', noting that the first ***B*** is ***Black*** with ***0*** value.

The 4th band specifies the tolerance: the ***Absence*** of the 4th band implies a tolerance of ***20%***, while a ***silver*** band indicating a tolerance of ***10%***, a ***golden*** band indicates ***5%***, and a ***brown*** band indicates ***1%***. All resistors with a particular tolerance value constitute a particular E-series. Each E-series is given a different number: tolerance 20%: E6 series, tolerance 10%: E12 series, tolerance 5%: E24 series, tolerance 1%: E96 series.
The values of all available resistor within a particular tolerance series are calculated based on the following: let us order all resistance values starting from the minimum as $R_0 < R_1 < R_2 < \ldots < R_{(i-1)} < R_i < R_{(i+1)} > \ldots$
If x is the tolerance value in percentage, then two consecutive resistance values are calculated such that $(1+x/100)R_i = (1 - x/100)R_{(i+1)} \Rightarrow R_{(i+1)} = R_i\,(100 + x)/(100 - x)$. The number n given to a particular E-series is based on the tolerance value x such that $10^{1/n} \approx (100 + x)/(100 - x)$. The colour coding is shown in Fig. 1b.

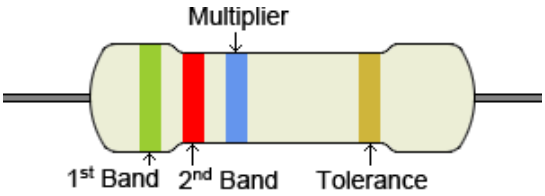

Figure 1a

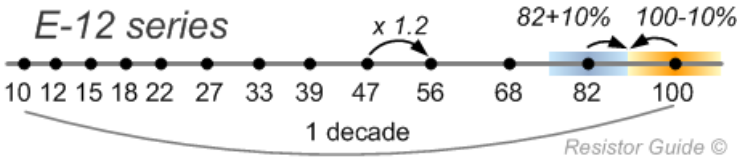

Figure 1b

Potentiometer – A Variable Resistor:

A potentiometer is a three-terminal potential divider circuit with a sliding or rotating contact inside which forms an adjustable voltage divider. The resistance between the two end terminals is constant. If one end terminal and the middle one are used, then it will act as a variable resistor. Fig. 2 shows a typical single-turn potentiometer (pot) that you will use in ESC201 lab. The pots you will use are 1 kΩ pot and 10 kΩ pot. For example, the resistance between two end terminals of a 1 kΩ pot will be 1 kΩ.


Figure 2

Part B: Breadboard or Protoboard

The figure below shows a typical breadboard. It is also called a protoboard since it is used for making prototype circuits. In ESC201 Lab, you will be using the breadboard for setting up all of your circuits. Hence, you must understand the connection in a breadboard. Some of the underlying connections in a breadboard are shown in solid lines. Each of these solid lines define a node, i.e., the pins associated with a particular line are connected. For example, among all pair of points shown below, only the pairs P_2P_3, P_4P_5 and P_6P_7 are connected.