EXPERIMENT NO. 1

RESISTORS AND OHM'S LAW

OBJECTIVE:

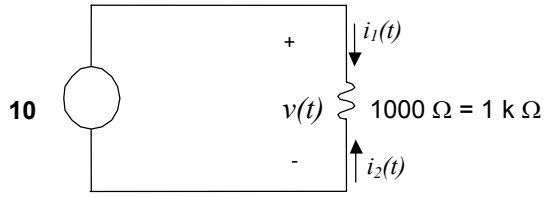
1- To determine the value of a selection of resistors using three different methods:

- **a. Using the color codes (to give the nominal value)**
- **b. Using the digital Ohmmeter.**
- **c. Using Ohm's Law.**

2- To determine qualitatively the effect of increased power dissipation on carbon resistor.

Pre-Lab Assignment

For the circuit shown in the Figure below, calculate $v(t)$, $i_1(t)$ and $i_2(t)$:



APPARATUS: DC Power Supply
Digital Multimeter
Resistor: 100 Ω , 470 Ω , 1 KΩ, 3.3 KΩ and 10 KΩ

THEORY:

1- The basic relationship between voltage, current, and resistance is determined by Ohm's law:

$$V = I R \qquad (1)$$

where: V = Voltage across the resistor (in Volts)
I = Current through the resistor (in Amperes)
R = Resistance of the resistor (in Ohms)

2- Given any resistor, its resistance can be found by one of the four methods:

a- Using the color codes . This value is called the nominal value, and it is only approximate.
b- Direct measurement using an Ohmmeter .
c- Measuring the voltage across the resistor and the current through the resistor, then applying Ohm's law.

3- The product of the voltage across a resistor and the current through the resistor gives power P (in Watts), namely:

$$P = V\,I = I^2\,R = V^2/R \qquad (2)$$

Where equation (1) has been used to express P in terms of I^2 and in terms of V^2.

The power absorbed by the resistor appears in the form of heat. The physical size of the resistor determines the amount of power that it can safely dissipate. This amount is referred to as the power rating. The dissipation of power that exceeds the power rating can damage the resistor physically.

When the resistor gets heated due to excessive power dissipation, its resistance changes .It will either increase or decrease depending on the temperature coefficient. A carbon resistance is expected to decrease as the temperature increases.

Resistance that are operated over the power rating will deviate from the straight line relationship between V and I. The resistor in this case is operating in the non-linear region. In such a case, the resistance is no longer equal the slope of the V versus I graphs. It may however, be calculated using the ratio V/I.

PROCEDURE:

You will be supplied with sets of 5 resistors.

1- Find the nominal value and the tolerance of each resistance using the color codes. Note the relation between the power rating and the physical size of the resistance.
2- Using the digital multimeter as an ohmmeter, measure and record the resistance of each resistor.
3- Connect the circuit as shown in Figure 2 for R = 100 Ω and perform the following :
   a- Set the source voltage V_s to 12 V.
   b- Measure V and I.
   c- Repeat steps 3a and 3b for remaining resistors.
   d- Record your results in Table 1.

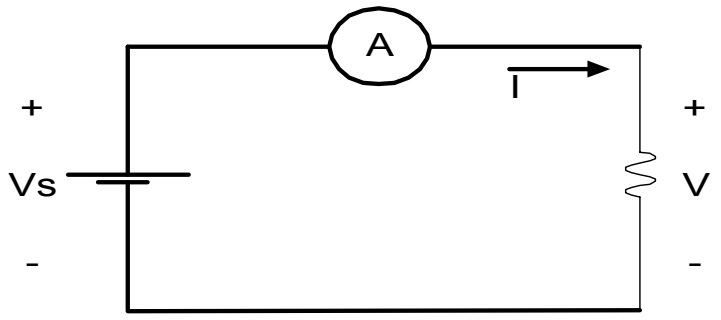


Figure 2

4- Using a 1 W resistor (R = 470 Ω), vary the input voltage from 6 to 24 volts. Measure V and I and calculate the resistance R (by calculating the ratio V/I) and the power dissipated in the

resistance (by calculating the product VI). As the measurement proceeds, touch the resistor from time to time to observe the temperature rise. Record the results in Table 2.

REPORT:

a- For resistance measurements (steps 1,2, and 3), tabulate the nominal and measured values of the resistors. Find the maximum percentage deviation from the nominal values.
b- Plot R versus P from the measured data obtained in step 4. Comment on the value of R as P increases.

QUESTIONS:

1- Does the resistor in step 4 operate in the linear region or non-linear region? Explain by considering the power rating of the resistor.
2- An electric heater takes 1.48 kW from a voltage source of 220 V. Find the resistance of the heater?
3- If the current in a resistor doubles, what happens to the dissipated power? (Assume the resistor operates in the linear region).
4- A 4 Ω resistor is needed to be used in circuit where the voltage across the resistor is 3V .If two 4 Ω resistors with 2 W and 3 W power rating are available, which will you use and why?

TABLE 1

Resistor Values:

Resistor	R1	R2	R3	R4	R5
Nominal value / Tolerance					
Ohmmeter reading					
V / I					
% Deviation from nominal value					
Actual value within tolerance?					

Maximum percent deviation from nominal value =

TABLE 2

Power rating: (R = 470 Ω, 1W)

V (volt)	6	8	10	12	14	16	18	20	22	24
1 (mA)										
R (Ohm) = V/I										
P (Watt)										

The Resistor Color Code table is given at the end of the manual under Appendix