LAB MANUAL

Fundamental of Electrical & Electronics Engg.

Subject Code – P2420103

Department of Mechanical Engineering



KAMESHWAR NARAYAN SINGH GOVERNMENT POYTECHNIC SAMASTIPUR

Experiment No. 1

Aim: Identify various passive electronic components in the given circuit.

Apparatus required: An electronics circuit.

Theory:

What is a Passive component ?

A **passive component** is an electrical component which can only receive energy, which it can either dissipate, absorb or store it in an electric field or a magnetic field. Passive elements do not need any form of electrical power to operate.

As the name 'passive' suggests – passive devices do not provide gain or amplification. Passive components cannot amplify, oscillate, or generate an electrical signal.

Common examples of passive components include:

- Resistors
- Inductors
- Capacitors
- Transformers

Resistor: It is a passive element that oppose the flow of current. It is a linear and bilateral element.



Carbon film resistor

Inductor: It is a passive element which store energy in the form of magnetic field and delivers it as and when required. It is also a linear and bilateral element.



Capacitor: It is a passive element which store energy in the form of electric charge and delivers it as and when required. It is also a linear and bilateral element.



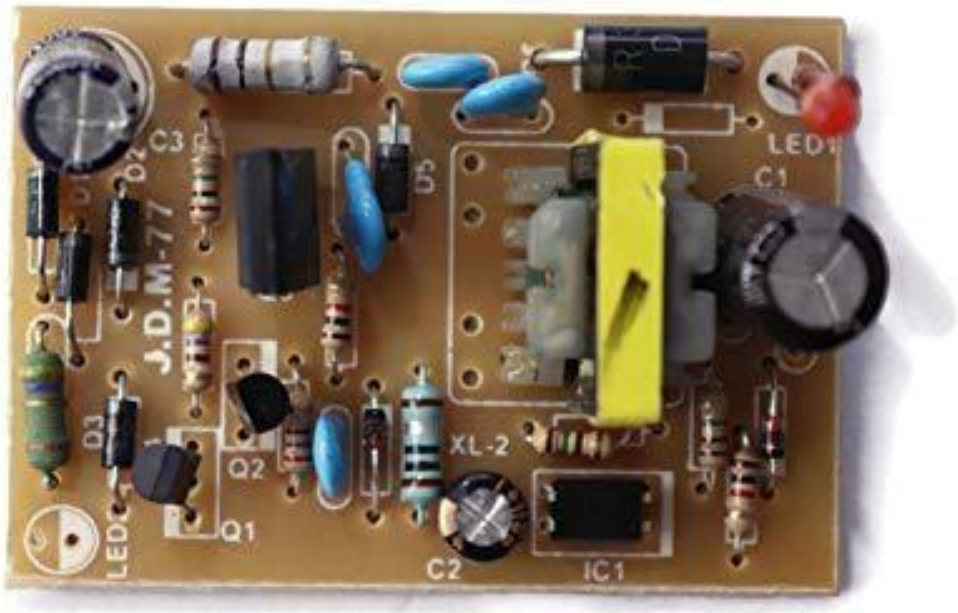
Electrolytic Capacitor



Ceramic Capacitor



talum Capacitor.



Identify the passive component in the above ckt.

**********The end**********

Experiment No. 2

Aim: Determine the value of given resistor using digital multimeter to confirm with colour code.

Apparatus required:

Resistor

Digital multimeter

Theory:

Types of Resistors

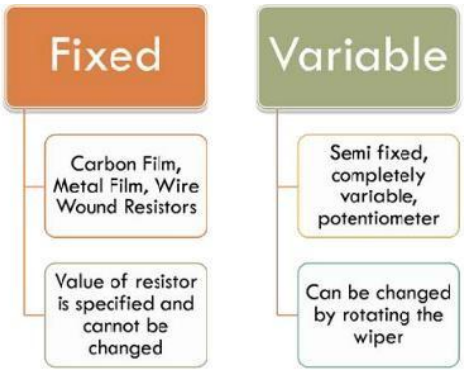


Figure:1

Reading Value of Fixed Resistors

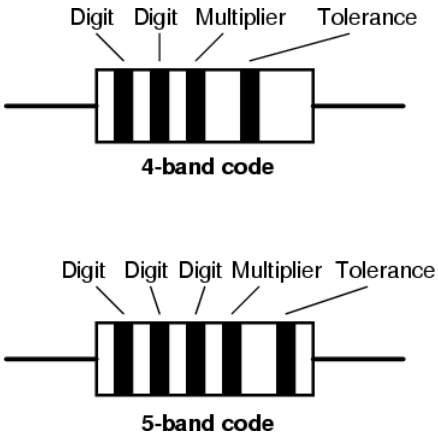


Figure:2

- Resistors are color coded as they are too small for the value to be written on them.
- There are 4 or 5 bands of color . Value of a Resistor is decoded from these band of colors.

Reading of values:Step1.

- If your resistor has four color bands ,turn the resistor so that the gold or silver band is on right hand side or the end with more bands should point left.

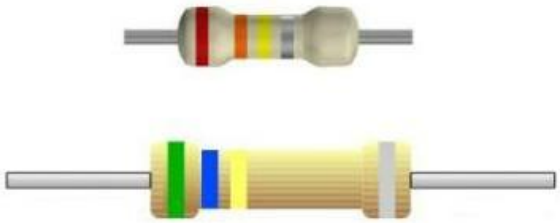
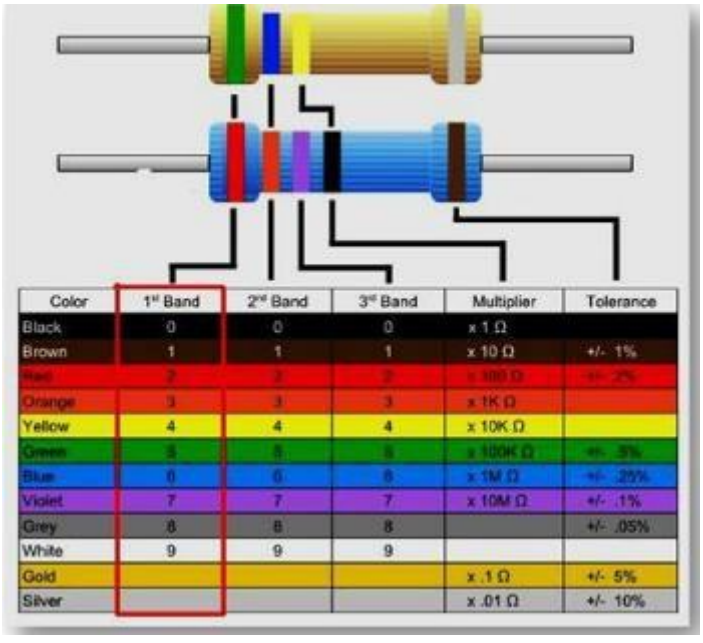


Figure :3

Step 2.

- The first band is now on the left hand side. This represents the first digit .Based on the color make a note of the digit.In this case- 4 band its '5' and for 5 band its '2'.

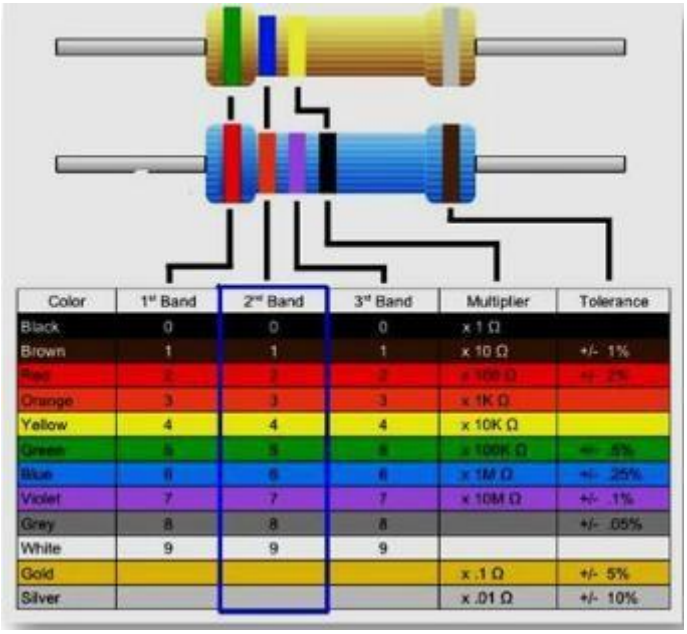


Color	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	0	x 1 Ω	
Brown	1	1	1	x 10 Ω	+/- 1%
Red	2	2	2	x 100 Ω	+/- 2%
Orange	3	3	3	x 1K Ω	
Yellow	4	4	4	x 10K Ω	
Green	5	5	5	x 100K Ω	+/- .5%
Blue	6	6	6	x 1M Ω	+/- .25%
Violet	7	7	7	x 10M Ω	+/- .1%
Grey	8	8	8		+/- .05%
White	9	9	9		
Gold				x .1 Ω	+/- 5%
Silver				x .01 Ω	+/- 10%

Figure: 4

Step 3.

- The second band represents the second digit. The colors represent the same numbers as did the first digit .In this case -4 band its'6' and for 5 band its'3'.

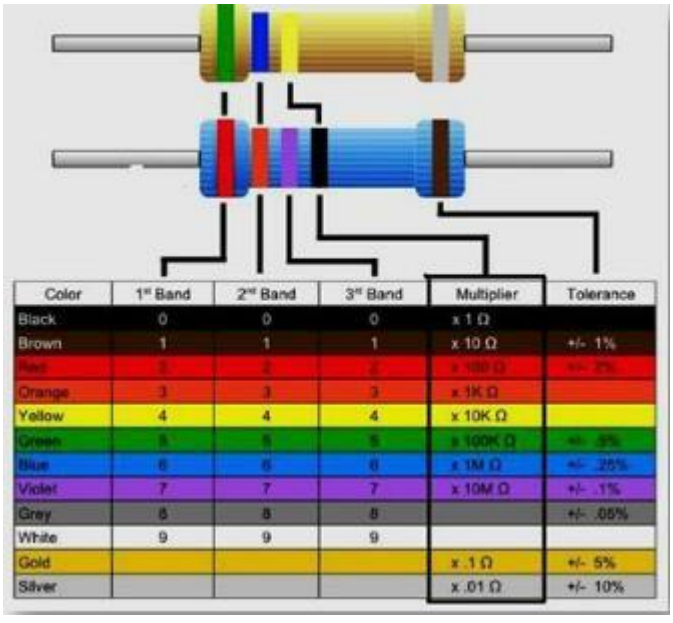


Color	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	0	x 1 Ω	
Brown	1	1	1	x 10 Ω	+/- 1%
Red	2	2	2	x 100 Ω	+/- 2%
Orange	3	3	3	x 1K Ω	
Yellow	4	4	4	x 10K Ω	
Green	5	5	5	x 100K Ω	+/- .5%
Blue	6	6	6	x 1M Ω	+/- .25%
Violet	7	7	7	x 10M Ω	+/- .1%
Grey	8	8	8		+/- .05%
White	9	9	9		
Gold				x .1 Ω	+/- 5%
Silver				x .01 Ω	+/- 10%

Figure :5

Step 4.

The third band divulges how many zeros to add/divide to the first two numbers –for a 4 band Resistor . In this case – 4 band its '4' zeroes to be added . So value is 560K.



Color	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	0	x 1 Ω	
Brown	1	1	1	x 10 Ω	+/- 1%
Red	2	2	2	x 100 Ω	+/- 2%
Orange	3	3	3	x 1K Ω	
Yellow	4	4	4	x 10K Ω	
Green	5	5	5	x 100K Ω	+/- .5%
Blue	6	6	6	x 1M Ω	+/- .25%
Violet	7	7	7	x 10M Ω	+/- .1%
Grey	8	8	8		+/- .05%
White	9	9	9		
Gold				x .1 Ω	+/- 5%
Silver				x .01 Ω	+/- 10%

Figure: 6

Step 5.

The third band denotes the 3rd digit – for a 5 band Resistor. In this case -5 band its ‘7’ . So the value of the 5 band resistor is 237 Ohms as its multiplier digit is ‘0.

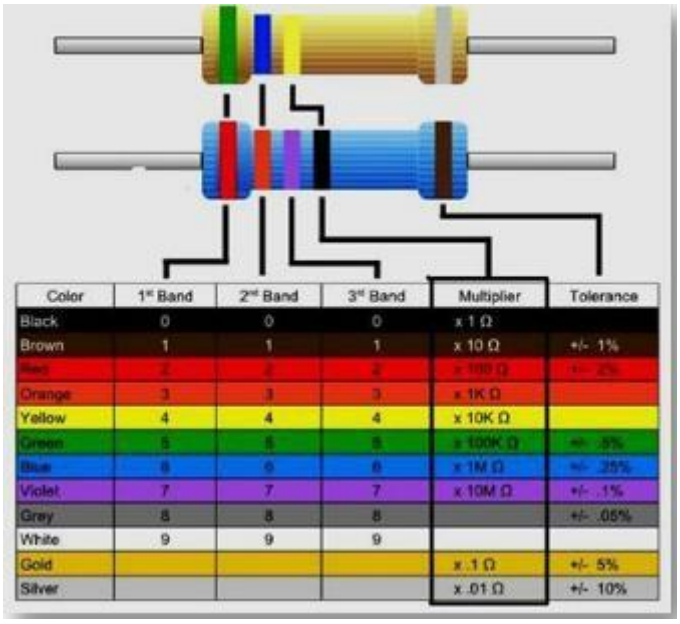


Figure 7

Step 6.

The last band denotes the tolerance . So the value of the 4 band resistor it is +/- 10% while for the 5 band resistor it is +/- 1%.

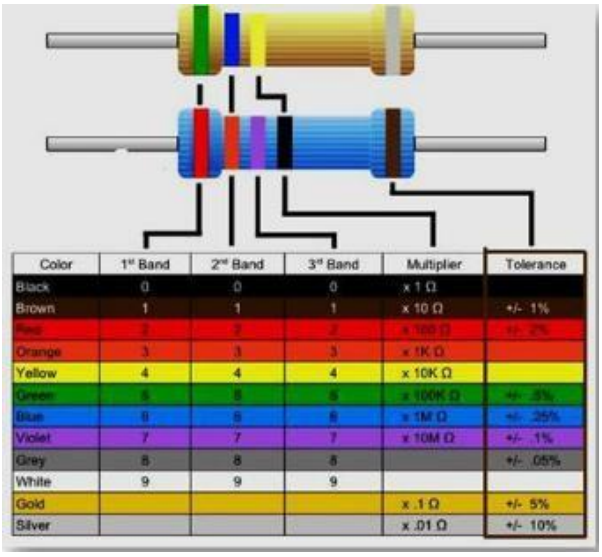


Figure: 8

*******the end*****

Experiment No. 3

AIM: Measure voltage, current and power in 1-phase circuit with resistive load.

COMPONENTS REQUIRED:

Sr. No	Suggested Resources required with vital specifications	Quantity
1.	Single phase AC source: 230 V, 50 Hz	1
2.	Connecting wires, Multistrand Copper wire, 1.5sq.mm	As required
3.	Single pole switch: 5 A	2
4.	Resistive load: 1 kW	1
5.	Voltmeter: 0-300 V AC	1
6.	Ammeter: 0-5 A AC	1
7.	Single phase wattmeter: Current coil 0-5 A, Voltage coil 0-300 V	1

THEORY:

Pure Resistive Circuit

From Ohm's law, I =V/R or V= I R

When an alternating voltage V is applied across a pure resistance R as shown in Fig., the instantaneous value of currentflowing through the resistance in given by i= I_m sin 2πf t.

Putting the value of V in terms of maximum voltage and $I_m = V_m/R$, $V = V_m$ sin 2πf t

From the expressions of v and i, we see that the quantities can be represented as shown in Fig. From the phasor diagram of a pure resistive circuit as shown in Fig. 5.11, the phasors for the voltage and the current are in the same direction for all instances, the phase angle between the voltage and the current is zero that is the phase difference is zero. Hence, the value ofpower factor or cos ø is unity, i.e. one.

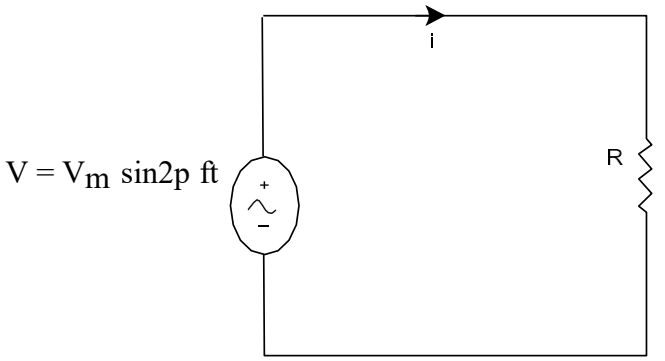


Fig.2.1 Pure Resistive Circuit with AC Source

CIRCUIT DIAGRAM:

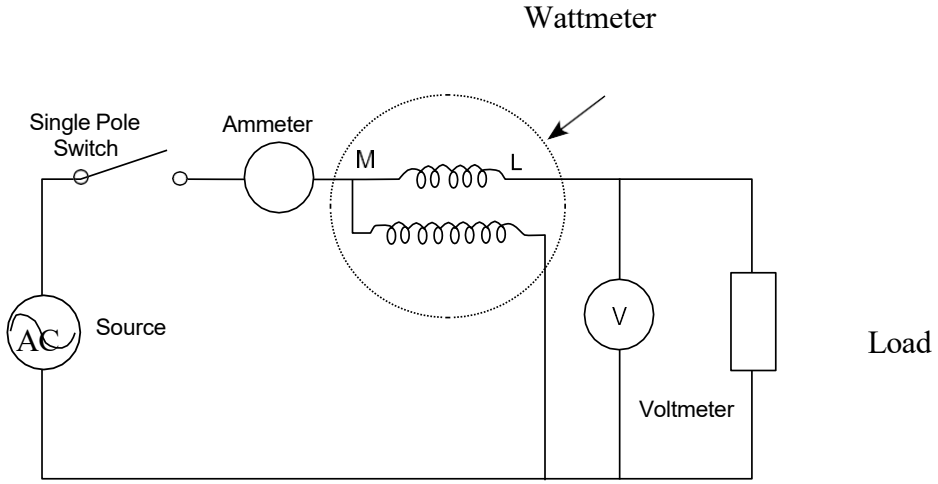


Fig.2.2 Circuit diagram for measurement of voltage, current and power

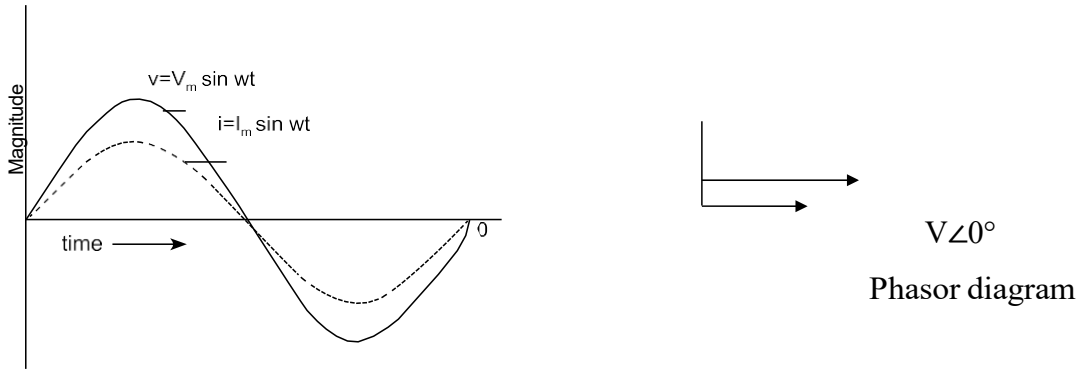


Fig.2.3 Response of a pure resistive circuit to AC voltage input

PRECAUTIONS

1. Ensure proper selection of range of measuring instruments.
2. Connect voltmeter and ammeter as shown in the circuit diagram.
3. Check the circuit connections as per circuit diagram before switching ON the power supply.

PROCEDURE

1. Connect the circuit as shown in Fig.
2. Ensure proper connection of ammeter, voltmeter and wattmeter.
3. Measure the resistance of the given resistive load.
4. Connect the single phase power supply.
5. Switch ON the single pole switch.
6. Record the multiplication factor of wattmeter according to the selected current and voltage coil rating.
7. Record the current, voltage and wattmeter reading in the observation table.

OBSERVATIONS AND CALCULATIONS

Sr. No.	Ammeter (A)	Voltmeter (V)	Wattmeter (W)
1.			

Calculations:

Calculate power of the given resistive load $P = V^2/R$ and current $I = V/R$

Where V is the reading of the voltmeter and R is the resistance of the given resistive load as measured in step 3 of the procedure.

RESULTS:

Sr. No.	Parameter Observed	Measured Value	Calculated Value	Error
1.	Current			
2.	Wattmeter			

*******the end*****

Experiment No. 4

Aim: Connect resistor in series combination on breadboard and measure its value using digital multimeter.

Apparatus required:

S No	Apparatus name	Apparatus type	Specification
1	2 Resistances		
2	Breadboard		
3	9volt Battery		
4	Connecting lead		
5	Digital multimeter		

Theory:

Resistance in series:

Series circuits are sometimes called current-coupled or daisy chain-coupled. The current in a series circuit goes through every component in the circuit. Therefore, all of the components in a series connection carry the same current. There is only one path in a series circuit in which the current can flow.

Current:

I=I1=I2=I3

Resistance:

Req=R1+R2+R3

Voltage:

VS=VR1+VR2+VR3

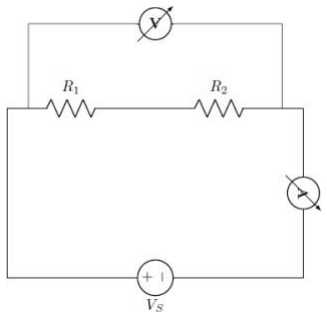


Figure : 1 Series Resistance

From the circuit:
The equivalent resistance,

$$R_{eq}=R_1+R_2$$

The total current of the circuit,

$$I_T=V_S/R_{eq}$$

Voltage across each resistance are,
For resistance R_1,

$$V_{R1}=R_1\times I_T$$

For resistance R_2,

$$V_{R2}=R_2\times I_T$$

In a series circuit, the current through each of the resistors is the same, and the voltage across the circuit is the sum of the voltages across each resistor.

A more common method of temporary construction for the hobbyist is the solderless breadboard, a device made of plastic with hundreds of spring-loaded connection sockets joining the inserted ends of components and/or 22-gauge solid wire pieces. A photograph of a real breadboard is shown here, followed by an illustration showing a simple series circuit constructed on one:

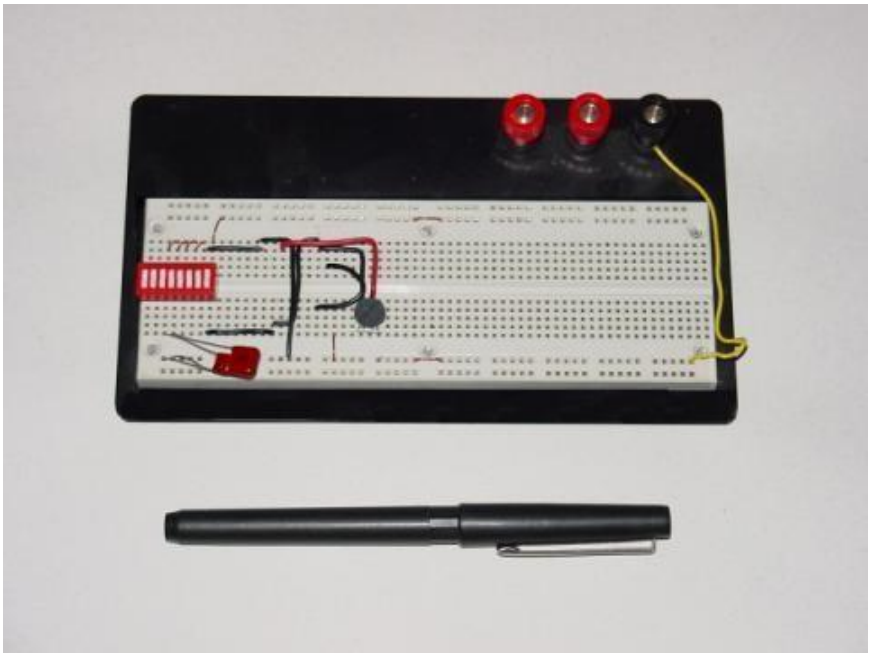
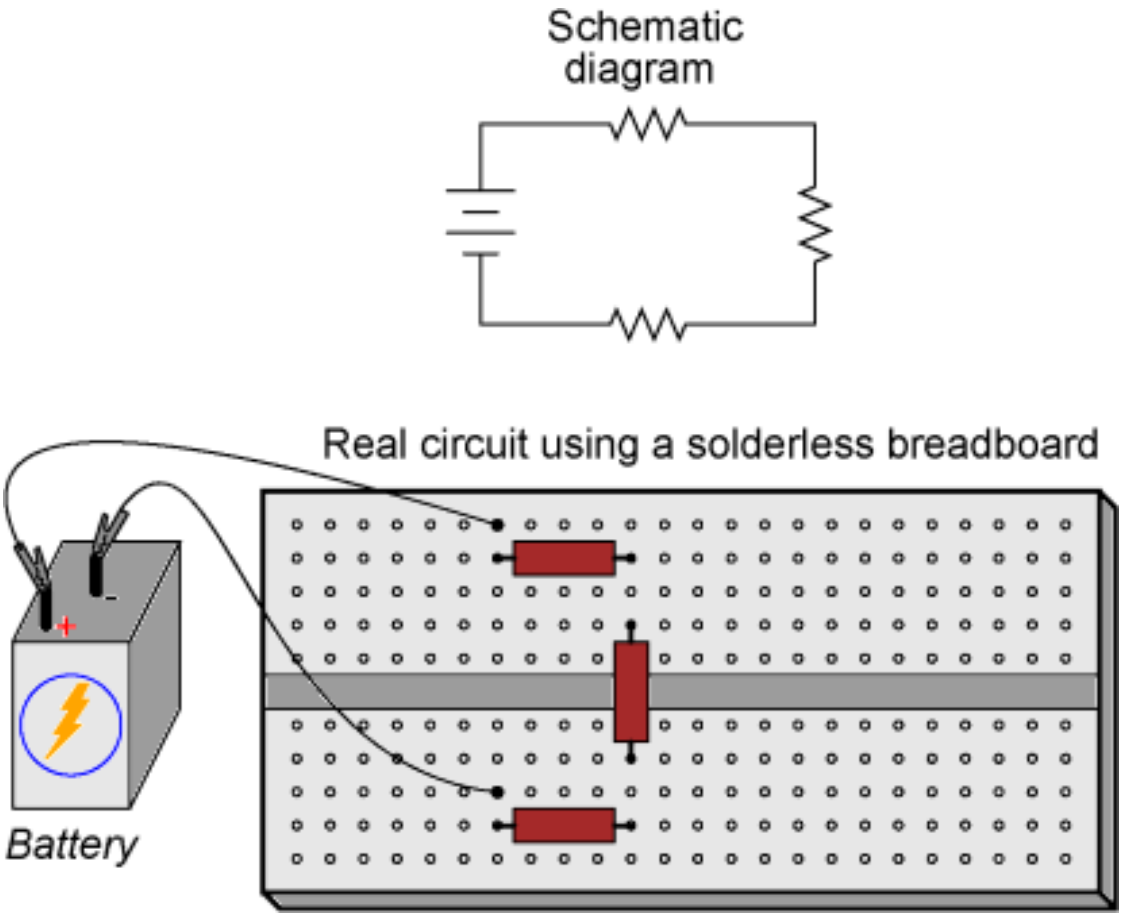


Figure: 2

Procedures : Perform the connection on the breadboard as shown in the figure.



Result: Measures the value of total resistance using multimeter and compared with its actual value.

**********The end********

Experiment No. 5

Aim: Connect resistor in parallel combination on breadboard and measure its value using digital multimeter.

Apparatus required:

S No	Apparatus name	Apparatus type	Specification
1	2 Resistances		
2	Breadboard		
3	9volt Battery		
4	Connecting lead		
5	Digital multimeter		

Theory:

Resistance in parallel:

If two or more components are connected in parallel they have the same potential difference (voltage) across their ends. The potential differences across the components are the same in magnitude, and they also have identical polarities. The same voltage is applicable to all circuit components connected in parallel. The total current is the sum of the currents through the individual components, in accordance with Kirchhoff's current law.

Voltage:

$$V=V_1=V_2=V_3$$

Resistance:

$$1/R_{eq}=1/R_1+1/R_2+1/R_3$$

Current:

$$I_T=I_{R1}+I_{R2}+I_{R3}$$

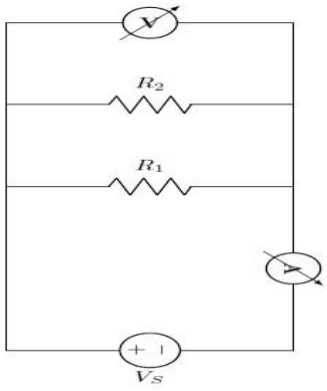


Figure:1

From the circuit:

The equivalent resistance,

$$R_{eq} = (R_1 \times R_2)/(R_1 + R_2)$$

The total current of the circuit,

$$I_T = V_S/R_{eq}$$

Current across each resistance are,
For resistance R_1,

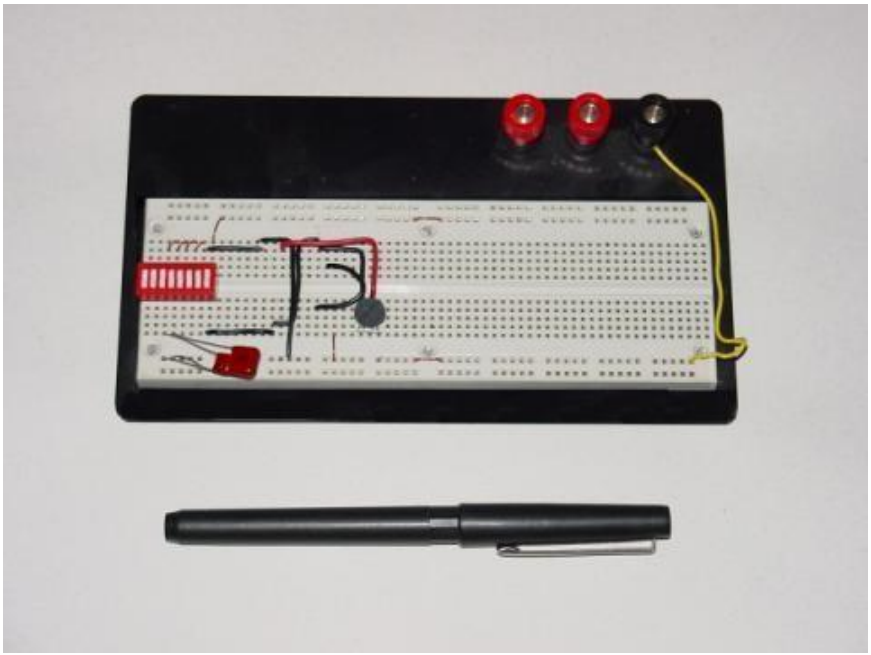
$$I_{R1} = V_s/R_1$$

For resistance R_2

$$I_{R2} = V_s/R_2$$

In a parallel circuit, the voltage across each of the resistors is the same, and the total current is the sum of the currents through each resistor.

A more common method of temporary construction for the hobbyist is the solderless breadboard, a device made of plastic with hundreds of spring-loaded connection sockets joining the inserted ends of components and/or 22-gauge solid wire pieces. A photograph of a real breadboard is shown here, followed by an illustration showing a simple series circuit constructed on one:



Procedure: Perform the connection on the breadboard as shown in the figure.

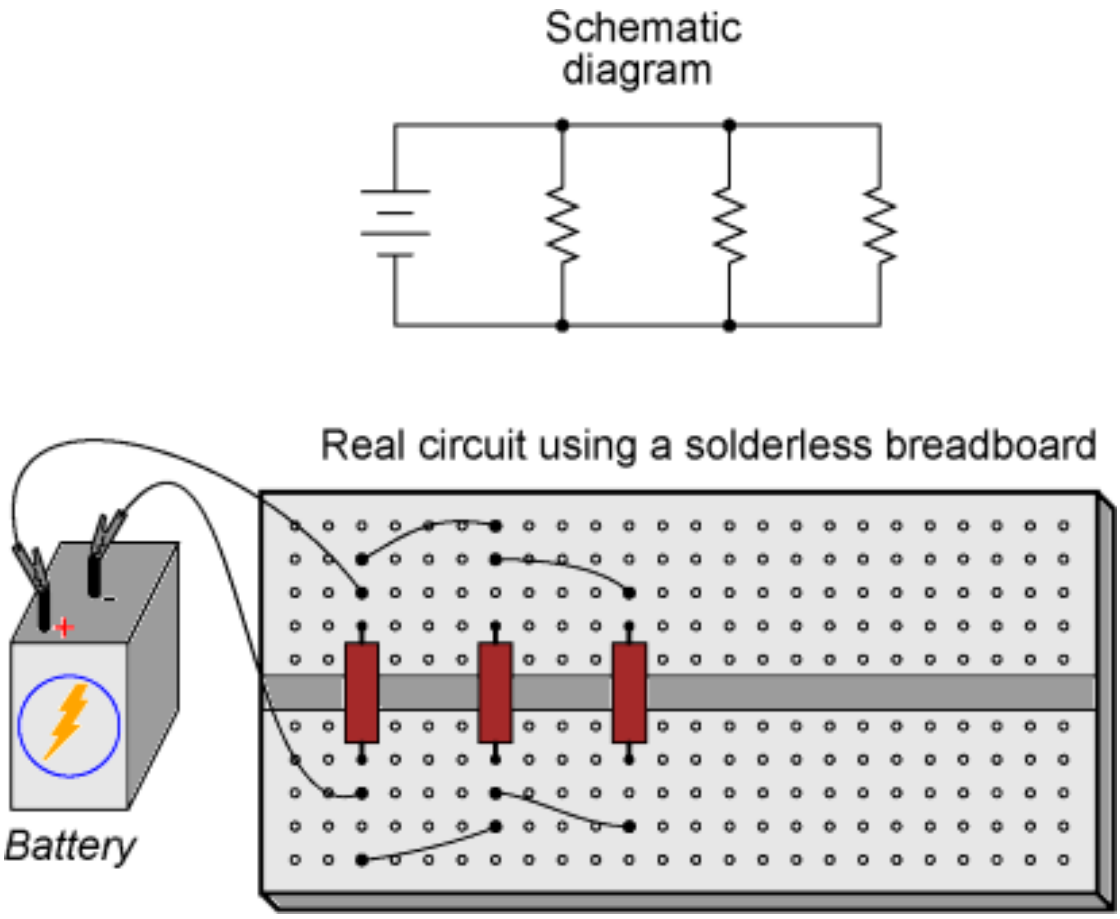


Figure: 3

Result: Measures the value of total resistance using multimeter and compared with its actual value.

**********The end**********

Experiment No. 6

AIM: Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.

COMPONENTS REQUIRED:

SL. No.	Suggested Resources required with vital specification	Specifications	Quantity
1.	Digital Multimeter	1/2 digit display with probes	3
2.	DC power supply	0- 30 V, 2A	1
3.	EMF source	Voltage=0-20 V, Ampere=0-1 A	1
4.	Ammeter	0-5 Amps	2
5.	Suitable capacitors in micro farads		2
6.	Connecting wires: Single strand Teflon coating	0.5 mm diameter	As required

THEORY:

A capacitor is a passive component that has the ability to store the energy in the form of potential difference between its plates. It resists a sudden change in voltage. The charge is stored in the form of potential difference between two plates, which form to be positive and negative depending upon the direction of charge storage.

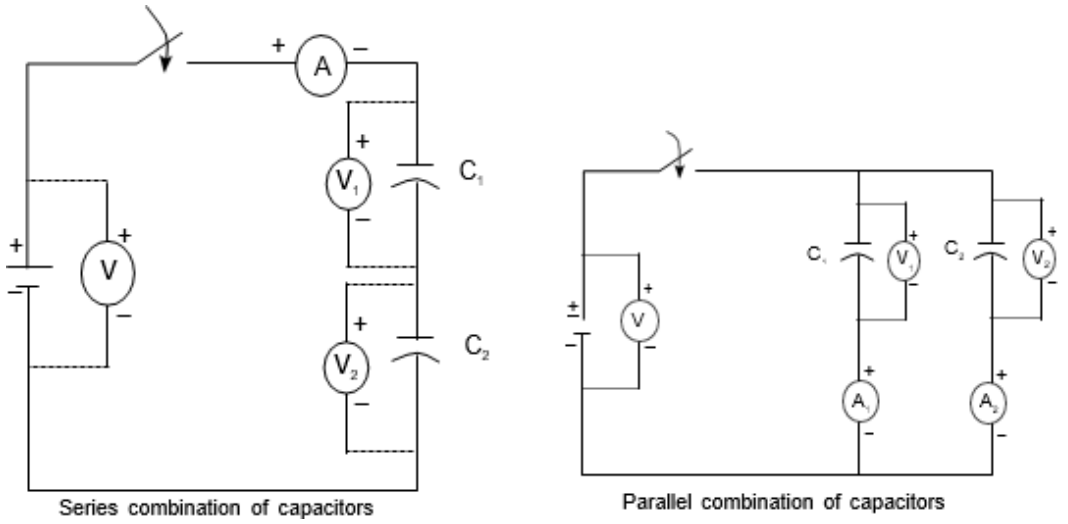


Fig Series and Parallel connection of capacitor

PRECAUTIONS:

1. Do not switch ON the multi-meter unless you have checked the circuit connections.
2. While doing the experiment select proper function of multi-meter.
3. Ensure that all capacitors are discharged completely before connecting in the circuit.
4. Ensure that your hands are not wet while touching the circuit.

PROCEDURE:

1. Connect the black lead to the COM terminal on the multi-meter.
2. Connect the red lead to the Ω terminal on the multi-meter.
3. Make sure that each capacitor is discharged (V = 0) by connecting a wire lead across the capacitor for about 30 seconds.
4. Note down the value of capacitors before connecting them in circuit.
5. Connect the capacitors in series on the bread board along with meters as given the circuit diagram, Fig.
6. Switch on the supply and note down the readings of ammeter and multimeters used as voltmeter andmeasure voltage across each capacitor and the supply voltage.
7. Switch off the supply.
8. Find out the series equivalent capacitance.
9. Connect the capacitors in parallel along with meters as given the circuit diagram, Fig.
10. Switch on the supply and note down the readings of multimeters used as voltmeter and ammeter.
11. Switch off the supply.
12. Find out the parallel equivalent capacitance.
13. Change the value of C_1 to C_1' and C_2 to C_2' and repeat steps 3 to 12 and find series equivalentcapacitance C_{TS2} and parallel equivalent capacitance C_{TP2}.

OBSERVATIONS:

1. C_1 =_____; C_2 = _____
2. C_1' =_____; C_2' = _____

Series connection

Sr. No.	V	V_1	V_2	I

Theoretically, for series connection $V = V_1 + V_2$

$Q/C = Q/C_1 + Q/C_2$

i.e. $1/C = 1/C_1 + 1/C_2$

CTS1 = $\frac{C1*C2}{C1+C2}$ = ... CTS2 = $\frac{C1'*C2'}{C1'+C2'}$ = ...

Parallel connection

Sr. No.	V	V_2	I_1	I_2

Theoretically, for parallel connection $V = V_1 = V2$

$Q = C.(V1 + V2)$

$C_{TP1} = C_1 + C_2$ = _____ $C_{TP2} = C_1' + C_2'$

= _____

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Experiment No. 7

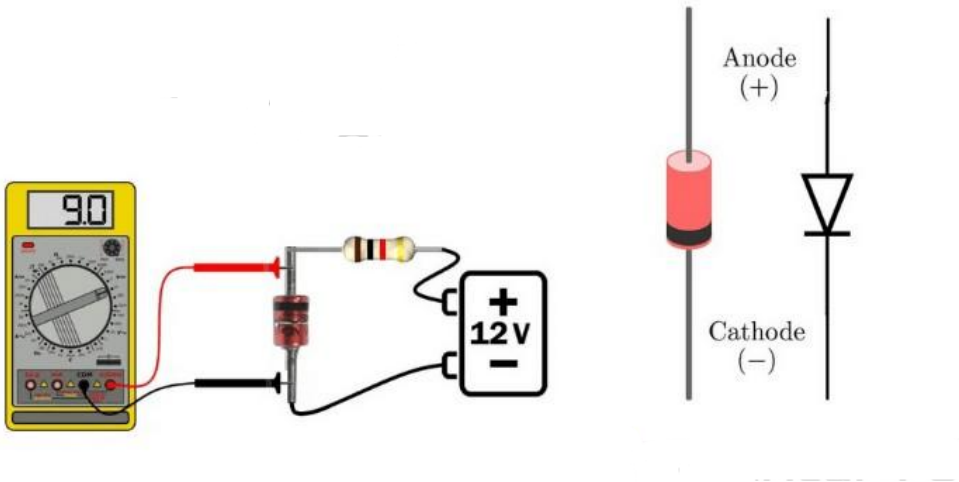
Aim: Test the PN junction diode using digital multimeter.

Apparatus required:

1. Diode
2. Digital multimeter

Theory:

It is well known that a diode is expected to operate as a unidirectional device (i.e. only permit current flow in one direction). These are expected to offer very low resistance for the flow of current under the forward biased condition and a very high resistance under the reverse bias condition. This important property of the diode can be exploited effectively to test the diode with an intention of knowing whether it is working fine or not. In other words, one can undertake diode testing by measuring the resistance across its terminals by using a piece of equipment such as a digital multimeter.

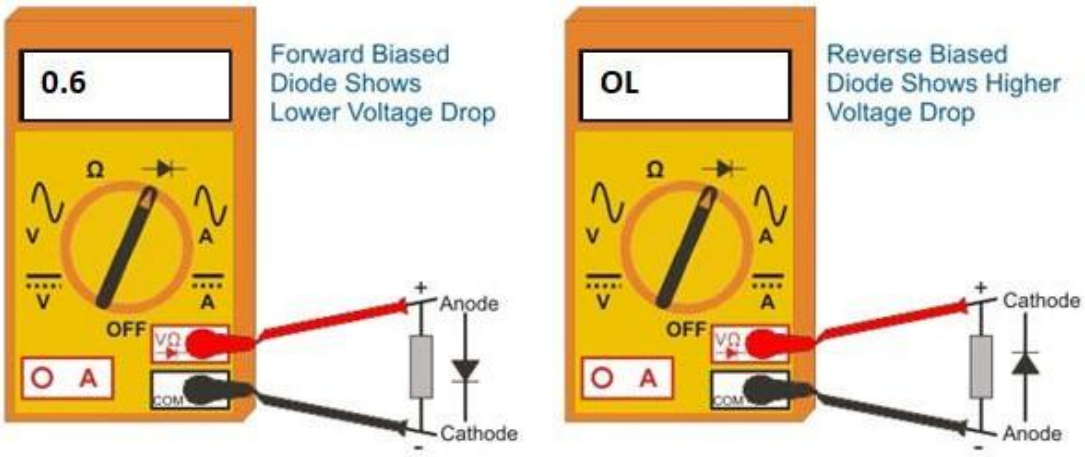


Before testing of the diode, the terminals of the diode must be identified. That means which terminal is anode and which one is cathode. Most of the PN diodes have the silver-band on its body and this white-band side terminal is the cathode. And the remaining one is anode. Some diodes may have a different color band, but the color band side terminal is the cathode.

Procedure:

Some steps behind the testing of PN junction diode.

1. Identify the diode terminals (anode and cathode).
2. Keep the digital multimeter (DMM) in diode checking mode by rotating the central knob to the place where the diode symbol is indicated. In this mode multimeter is capable to supply a current of 2mA approximately between the test leads.
3. Connect the red probe to the anode and black probe to the cathode. This means diode is forward-biased.
4. Observe the reading on the meter display. If the displayed voltage value is in between 0.6 to 0.7 (since it is silicon diode) then the diode is healthy and perfect. For germanium diodes this value is in between 0.25 to 0.3.
5. Now reverse the terminals of the meter that means connect the red probe to cathode and black to anode. This is the reverse biased condition of the diode where no current flows through it. Hence the meter should read OL (which is equivalent to open circuit) if the diode is healthy.
6. If the meter shows irrelevant values to the above two conditions, then the diode is defective.



Result:

The diode defect can be either open or short. Open diode means diode behaves as an open switch in both reverse and forward-biased conditions. So, no current flows through the diode. Therefore, the meter will indicate OL in both reverse and forward-biased conditions.

Shorted diode means diode behaves as a closed switch so the current flows through it and the voltage drop across the diode will be zero. Therefore, the multimeter will indicate zero voltage value, but in some cases it will display a very little voltage as the voltage drop across the diode.

**********the end*********