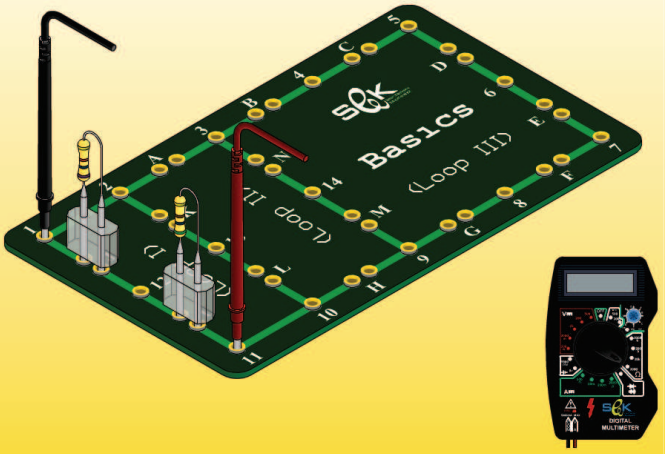
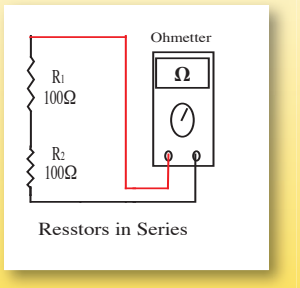
Experiment No. (9) Resistors in Series and Parallel





Objectives:

1. The student will connect resistors in series and measure their equivalent resistance.
2. The student will connect resistors in parallel and measure their equivalent resistance.
3. The student will calculate the equivalent resistance using the equations of resistors connected in series and parallel, and compare these theoretical results with the measured results.
4. The student will connect multiple resistors in series and parallel combinations and measure their equivalent resistance.

Apparatus:

- Basics Board
- DMM
- Fixed Resistors
- Jumpers

Procedure and Conclusions:

Resistors in Series:

1. Insert resistor 100Ω at the pair (J), consider it R_1.
2. Insert resistor 220Ω at the pair (I), consider it R_2
3. Turn the selection dial of the DMM to the Ohm mode (range 2000) .
4. Insert the DMM probes at the points (1) & (12) to measure the

resistance of R1

5. Insert the DMM probes at the points (12) & (11) to measure the resistance of R2
6. Insert the DMM probes at the points 1 & 11 to measure the equivalent resistance (R_{total}) of the two resistors in series.
7. Calculate the equivalent resistance (R_{total}) using resistors in series formula ($R_{total} = R_1 + R_2$) and compare this result with measured value that you obtained in the previous step.

- For R_1:
  Color bands .....
  Theoretical value ..... Ω
  Measured value ..... Ω
- For R_2:
  Color bands .....
  Theoretical value ..... Ω
  Measured value ..... Ω

- Measured equivalent resistance for R_1 & R_2 in series R_{total} = ... Ω
- Calculated equivalent resistance for R_1 & R_2 in series R_{total} = ... Ω

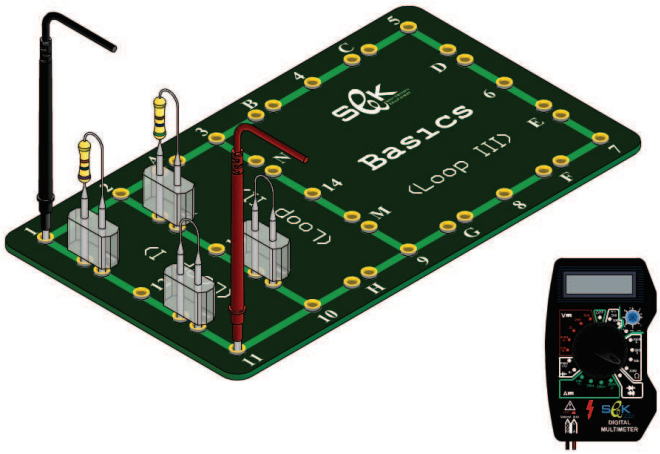
8. Insert a resistor 1 KΩ at the pair (K), consider it R_3.
9. Insert the DMM probes in points (11) and (13) to measure the equivalent resistance for the three resistors in series.

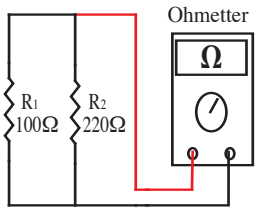
- The equivalent resistance you measured for R_1, R_2 & R_3 in series R_{total} = ... Ω
- The equivalent resistance you calculated for R_1, R_2 & R_3 in series R_{total} = ... Ω

Notes:

- Formula (equation) for the calculation of resistances connected in resistors:
  $R_{total} = R_1 + R_2 + R_3 + ...$

Resistors in Parallel:





Resstors in Parallel

1. Insert resistor 100Ω at the pair (J), consider it R_1.
2. Insert resistor 220Ω at the pair (K), consider it R_2.
3. Insert jumpers at the pairs (I, L)
4. Insert the DMM probes at the points (1) and (11) to measure the equivalent resistance of the two resistors in parallel, calculate the equivalent resistance using resistors in parallel formula: ($1/R_{total} = 1/R_1 + 1/R_2$) and compare the result with measured value.

- The equivalent resistance you measured for R_1 & R_2 connected in parallel R_{total} = ……. Ω.
- The equivalent resistance you calculated for R_1 & R_2 connected in parallel R_{total} = ……. Ω.

Notes:

- Formula (equation) for the calculation of two resistances R_1 and R_2 connected in parallel:

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R_{total} = R_1 || R_2 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

2. Insert a resistor 1KΩ at pair (N) & jumpers at the pairs (A, H, M).
3. Insert the DMM probes at points (1) and (11) to measure the equivalent resistance for the three resistors in parallel.

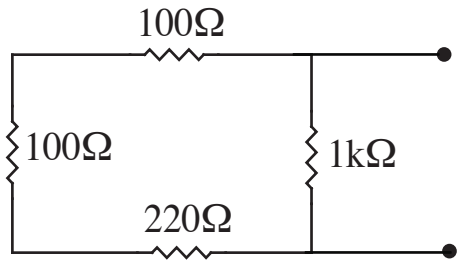
- The equivalent resistance you measured for R_1, R_2 & R_3 in parallel = ... Ω
- The equivalent resistance you calculated for R_1,R_2 & R_3 in parallel = ... Ω

4. Connect in parallel two resistors with equal values (e.g. 100 Ω) and measure their equivalent resistance.

- From the above step, we conclude that for two resistors with equal values connected in parallel, the equivalent resistance = … half / third / quarter … one of them.

5. Use Loops I & II on Basics board to combine multi resistors in series and parallel as shown in the diagram below, calculate and measure their equivalent resistance.

- Measured equivalent resistance for this combination = ... Ω
- Calculated equivalent resistance for this combination = ... Ω



Discussion

1. Four equal resistors are connected in parallel, each resistor has an ohmic value of 100 ohms, what is the expected equivalent resistance?
2. Four equal resistors are connected in series, each resistor has an ohmic value of 100 ohms, what is the expected equivalent resistance?