

Series and Parallel Circuits

**Circuits are closed pathways
for electrical current.**

Series Circuit

- 1. Only one path (no branches)
- 2. $R(\text{equivalent}) = R_1 + R_2 + R_3 + R_4 + \dots$
- 3. Current, I , is the SAME all throughout
- 4. Voltage drops across each appliance according to Ohm's Law: $IR = V$
- 5. Potential Difference starts at positive pole and then drops at each appliance so that at the negative pole it has dropped to zero volts.

Example of Series Circuit

- Given $V = 120$ volts and three appliances: $R_1 = 10$ ohms; $R_2 = 20$ ohms; $R_3 = 30$ ohms.
- $R(\text{equivalent}) = 10 + 20 + 30 = 60$ ohms
- $I = V/R = 120/60 = 2$ amps (same throughout)
- Voltage drop for R_1 : $2 \times 10 = 20$ volts
- Voltage drop for R_2 : $2 \times 20 = 40$ volts
- Voltage drop for R_3 : $2 \times 30 = 60$ volts

Parallel Circuit

- 1. More than one pathway (current splits into several branches).
- 2. Voltage is the SAME across all branches.
- 3. $1/R(\text{equivalent}) = 1/R_1 + 1/R_2 + 1/R_3 + \dots$
- 4. $I(\text{total}) = I_1 + I_2 + I_3 + I_4 + \dots$
- 5. $I(\text{total}) = V/R(\text{equivalent})$

Example of Parallel Circuit

- Given $V = 120$ volts and three appliances: $R_1 = 10$ ohms; $R_2 = 20$ ohms; $R_3 = 30$ ohms connected in parallel.
- $V = V_1 = V_2 = V_3 = 120$ volts (SAME)
- $1/R(\text{equivalent}) = 1/10 + 1/20 + 1/30 = 11/60$
- $R(\text{equivalent}) = 60/11 = 5.5$ ohms
- $I_1 = 120/10 = 12$ amps; $I_2 = 120/20 = 6$ amps; $I_3 = 120/30 = 4$ amps. $I(\text{total}) = 22$ amps.

Parallel Circuits

- $R(\text{equivalent}) < R(\text{any appliance})$
- $V = V_1 = V_2 = V_3$ (SAME throughout)
- $I(\text{total}) = I_1 + I_2 + I_3$
- $I(\text{total})$ splits into I_1 and $(I_2 + I_3)$
- $(I_2 + I_3)$ splits into I_2 and I_3

- As you add appliances to a parallel circuit, the $R(\text{equivalent})$ decreases and $I(\text{total})$ increases.

Circuit Breakers

- Circuit Breakers are to prevent overloading
- Switches that open the circuit when the current exceeds some particular value (example: 20 amps)
- If circuit breaker keeps tripping, there are either too many appliances in parallel on a given circuit or there is a short.