Georgia Institute of Technology

Linear Circuits

Nathan V. Parrish
PhD Candidate & Graduate Research Assistant
School of Electrical and Computer Engineering

An introduction to linear electric circuit elements and a study of circuits containing such devices.

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Resistors

Nathan V. Parrish
PhD Candidate & Graduate Research Assistant
School of Electrical and Computer Engineering

- *Introduce resistors as a circuit element*
- *Consider resistors in series and parallel*
- *Calculate equivalent resistance by combining parallel/series resistors*

Previous Class

- Ohm's Law – current/voltage relationship within an element
- Kirchhoff's Laws – relationships between elements in a circuit

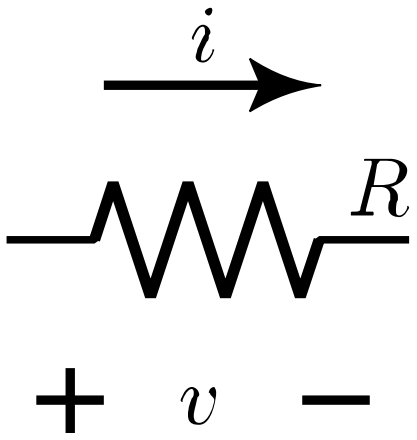
Module 2: Resistive Circuits

- Resistance
- Kirchhoff's Laws
- Resistors
- Superposition
- Obtaining Circuit Equations
- Maximum Power Transfer
- Wheatstone Bridge

Learning Objectives

- Apply Ohm's Law and Kirchhoff's Laws to simple resistive circuits
- Calculate an equivalent resistance of resistors in parallel/series
- Find equivalent resistance through successive application of combining parallel and series resistors

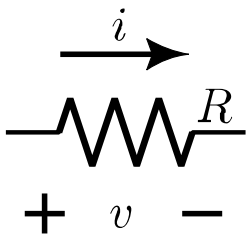
Resistors



$$v = iR$$

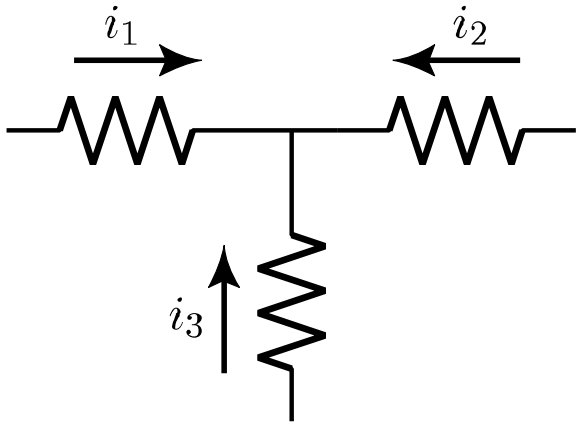
Review

Ohm's Law



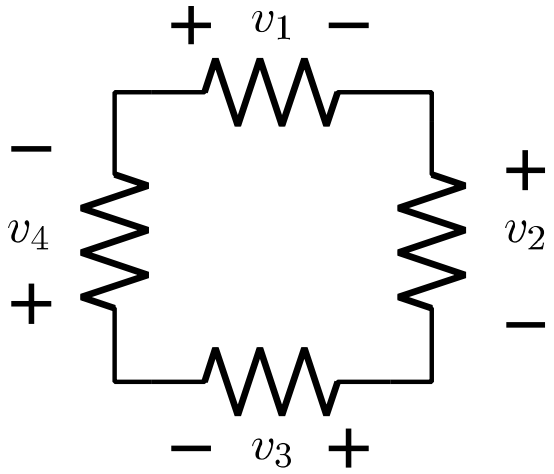
$$v = iR$$

Kirchhoff's Current Law



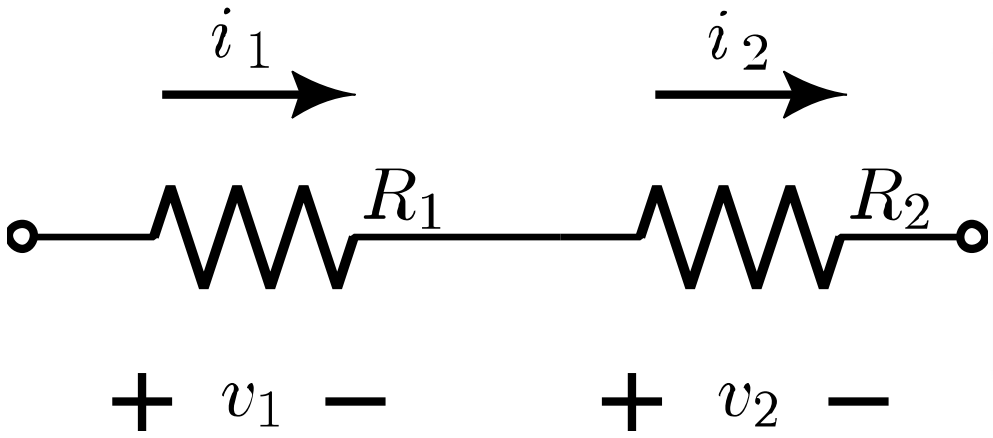
$$i_1 + i_2 + i_3 = 0$$

Kirchhoff's Voltage Law



$$v_1 + v_2 + v_3 + v_4 = 0$$

Resistors in Series



$$i_1 = i_2 = i$$

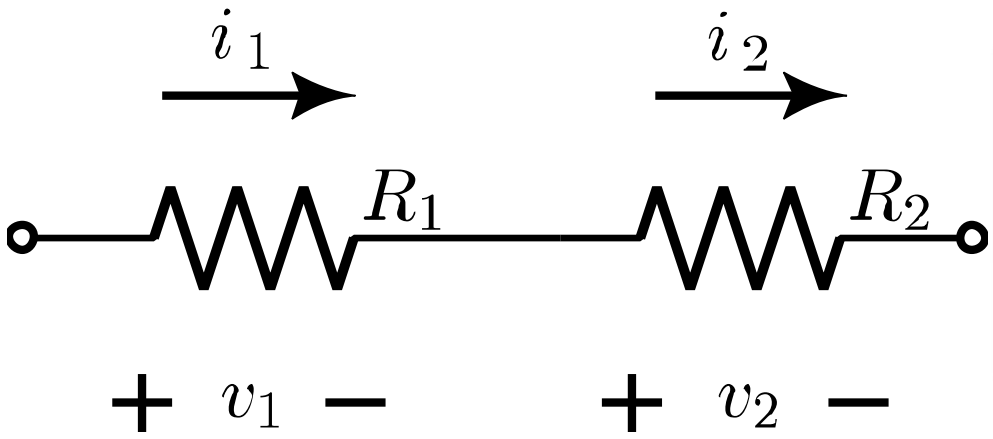
$$v_1 = iR_1 \quad v_2 = iR_2$$

$$v = v_1 + v_2 = \quad = i(R_1 + R_2)$$

$$R = \frac{v}{i} = R_1 +$$

Pause

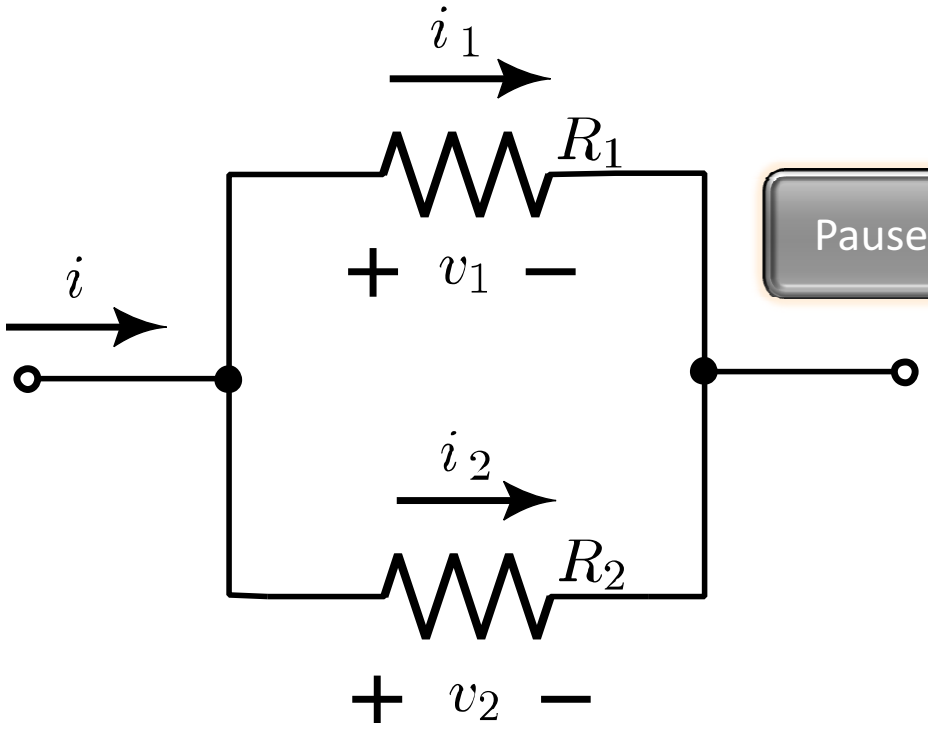
Voltage Divider



$$i = \frac{v}{R} = \frac{v}{R_1 + R_2}$$

$$v_1 = iR_1 = \frac{v}{R_1 + R_2} R_1 = \frac{R_1}{R_1 + R_2} v$$

Resistors in Parallel



Pause

$$v_1 = v_2$$

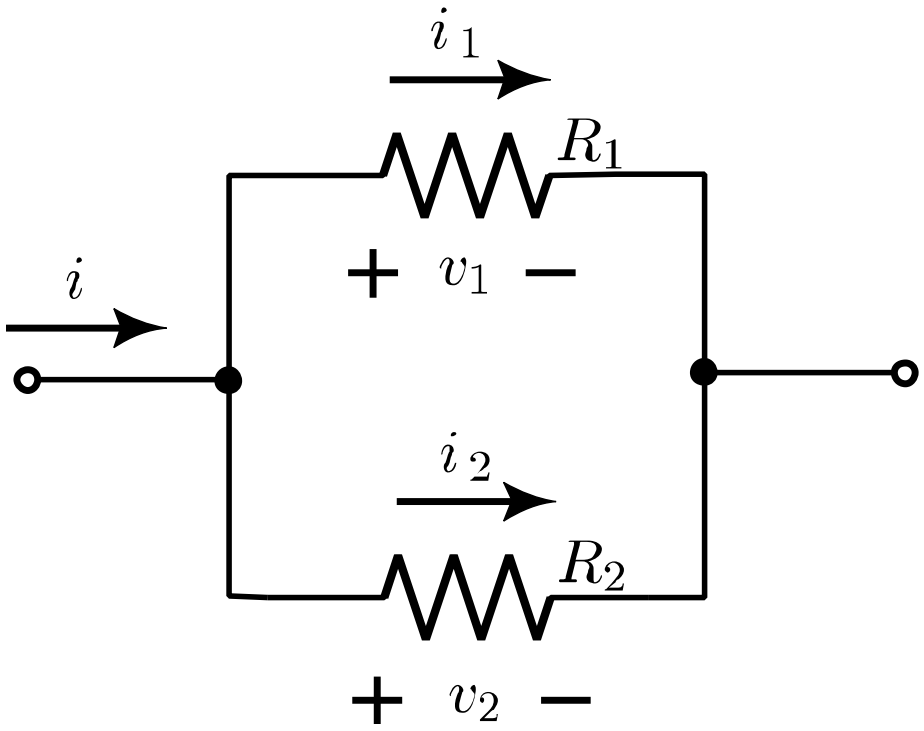
$$i_1 = \frac{v}{R_1} = vG_1 \qquad i_2 = \frac{v_2}{R_2} = vG_2$$

$$i = i_1 + i_2 = vG_1 + vG_2$$

$$G = \frac{i}{v} = G_1 + G_2$$

$$R = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1}$$

Current Divider

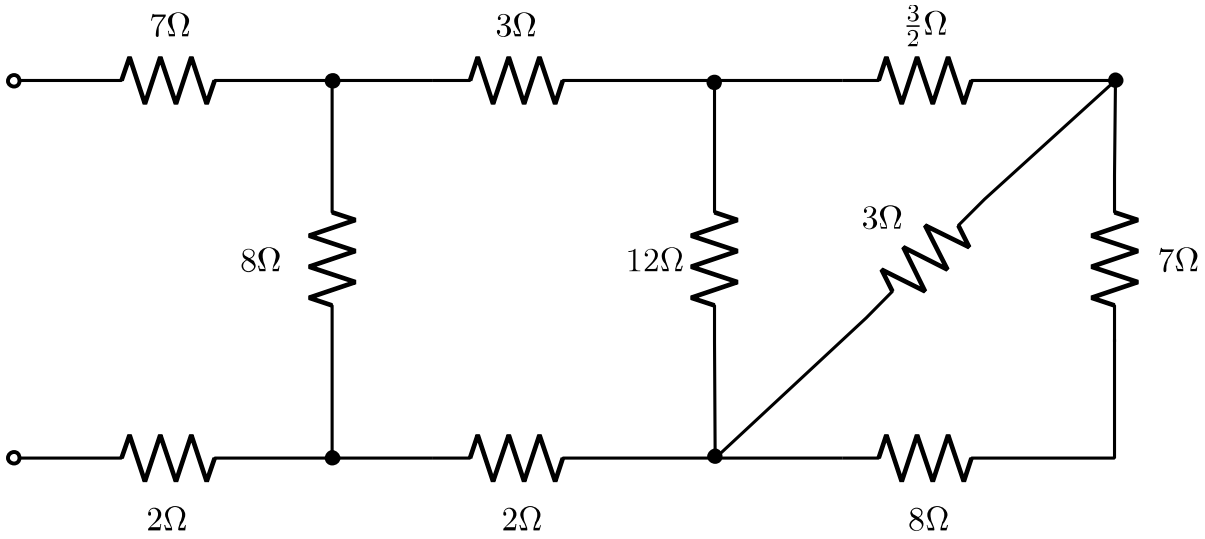


$$v = iR = \frac{i}{G_1 + G_2}$$

$$i_1 = \frac{v}{R_1} = vG_1 = \frac{G_1}{G_1 + G_2} i$$

$$\frac{G_1}{G_1 + G_2} = \frac{\frac{1}{R_1}}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{1}{1 + \frac{R_1}{R_2}} = \frac{R_2}{R_2 + R_1}$$

Example



Summary

- Introduced to resistors as a circuit element
- Combine series/parallel resistors
- Found an equivalent resistance using successive application of series/parallel resistance

Next Class

- Virtual lab: behavior of real resistors
- Superposition