Georgia Institute of Technology

Linear Circuits

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

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Superposition

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- *Use linearity (particularly superposition) to solve circuits*
- *Identify superposition as an important part of many analysis techniques*

Previous Lesson

- Linear operators
  - Superposition
  - Homogeneity
- Combined linear operators to give new linear operators

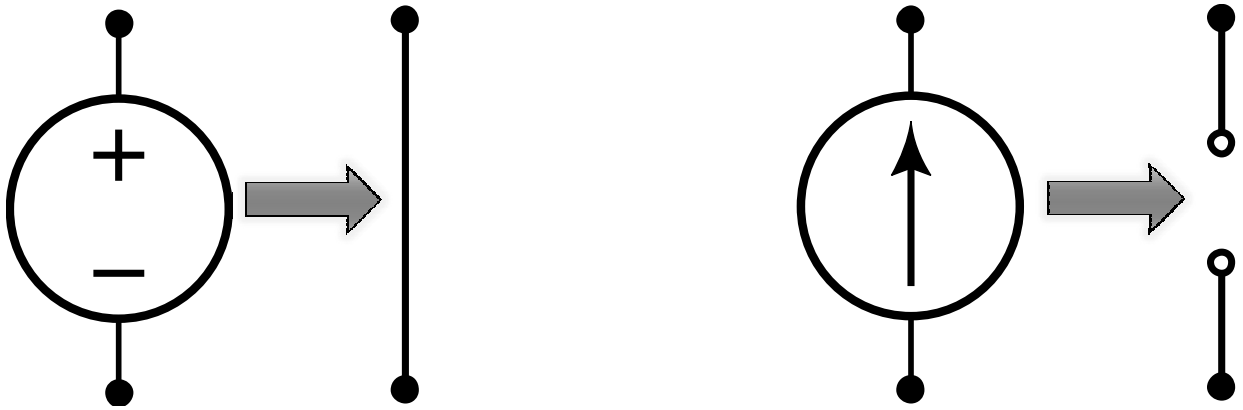
Module 2: Resistive Circuits

- Resistance and Ohm's Law
- Kirchhoff's Laws
- Resistors
- Superposition
- Obtaining Circuit Equations
- Maximum Power Transfer
- Wye-Delta and Wheatstone Bridge

Lesson Objectives

- Given a complex system, generate a set of simple systems, each with a single independent source
- Using solution of simple systems, find the complete behavior of the system

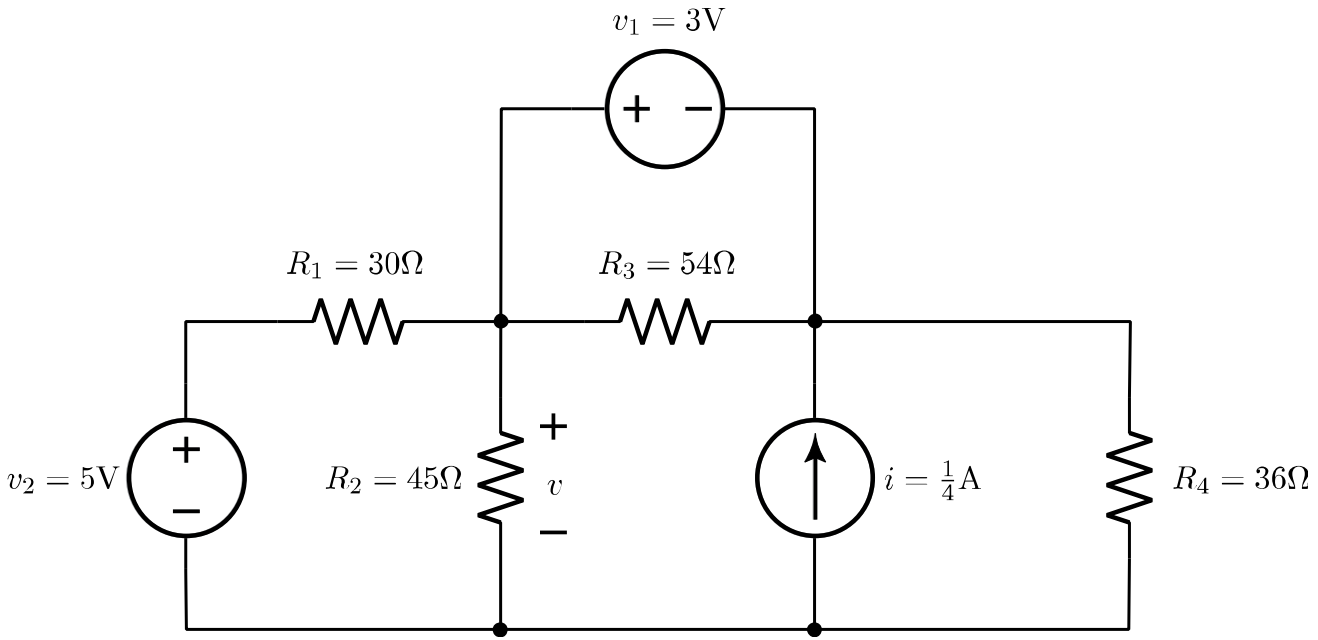
Isolating Independent Sources



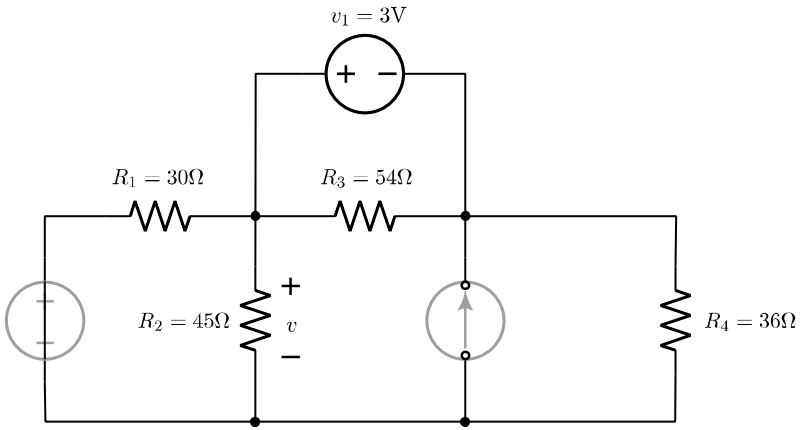
Steps For Superposition

- Zero-out all independent sources
- Return sources one at a time and solve for value of interest in simplified system
- Take the arithmetic sum of these values to find the final quantity

Example 1

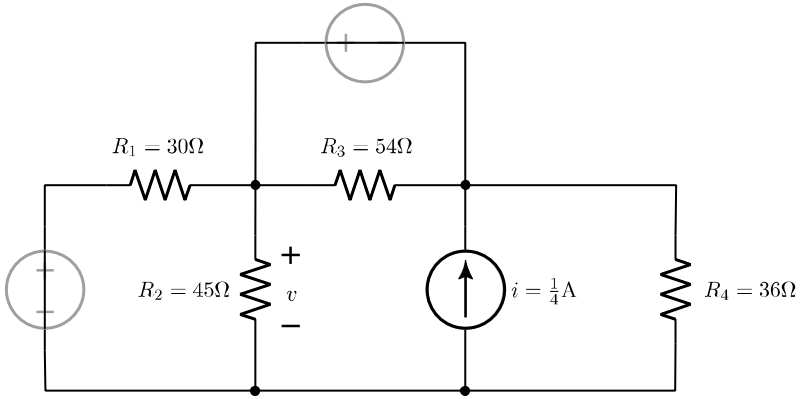

$v_1 = 3\text{V}$
$R_1 = 30\Omega$
$R_3 = 54\Omega$
$v_2 = 5\text{V}$
$R_2 = 45\Omega$
v
$i = \frac{1}{4}\text{A}$
$R_4 = 36\Omega$

Example 1 (a)



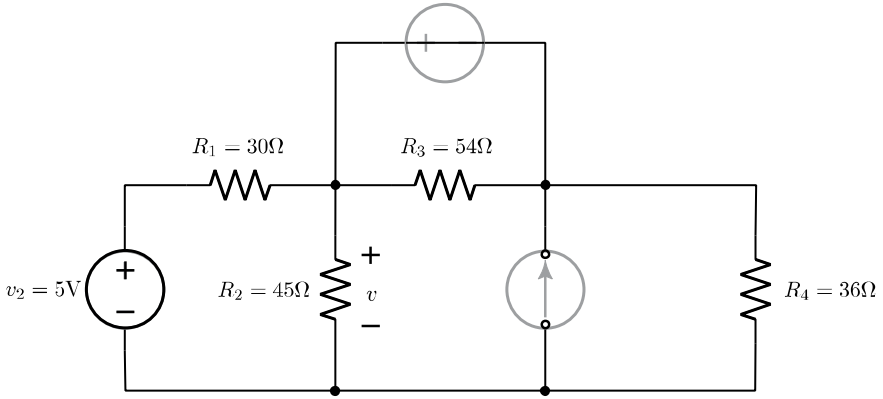
Example 1 (b)

$v_{(a)} = 1V$



Example 1 (c)

$v_{(a)} = 1V$
$v_{(b)} = 3V$



Working with Dependent Sources

- Dependent sources must be analyzed in each solution
- Must be a linear operator

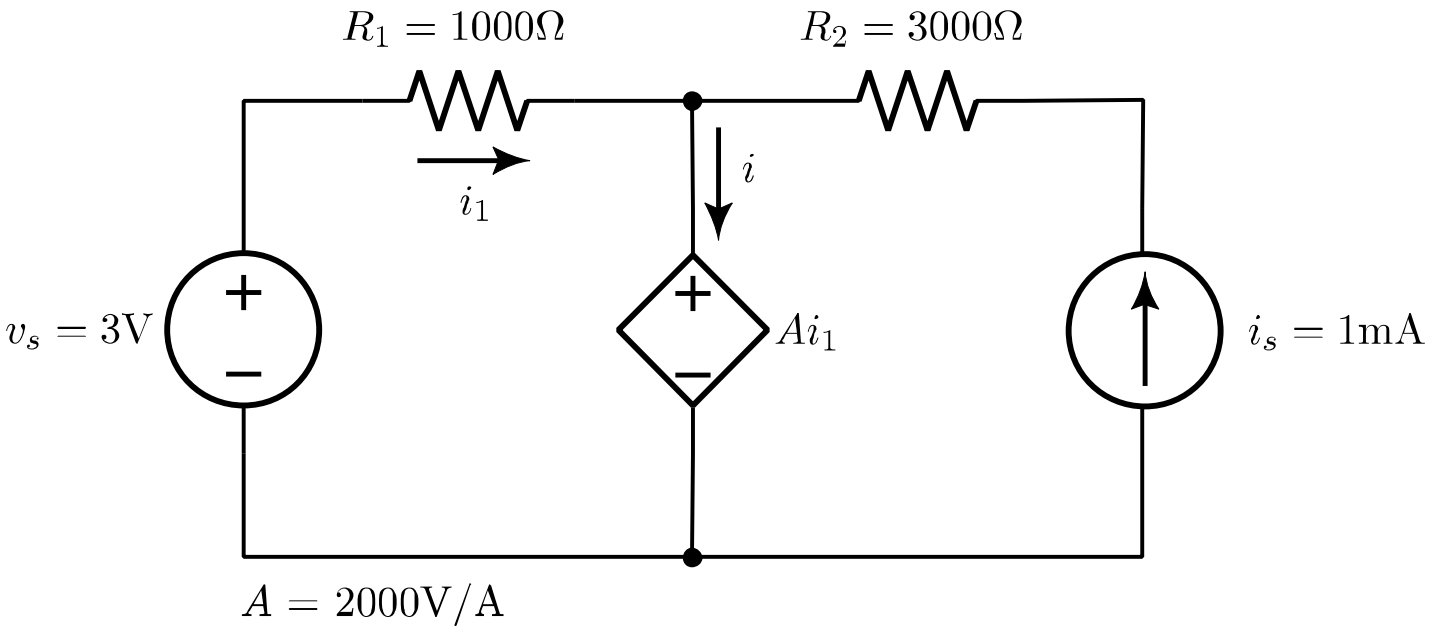
$v = K_1 v_1$

$K_1 = 2\mathrm{V/V}$

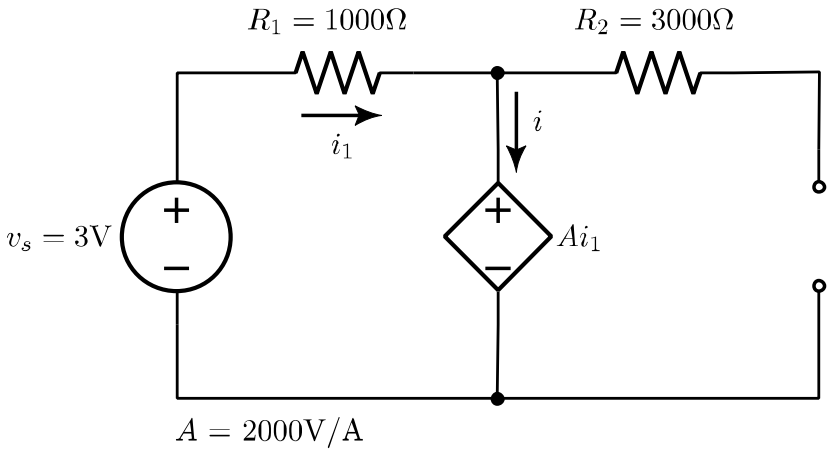
$i = K_2 {v_1}^2$

$K_2 = 2\mathrm{mA/V^2}$

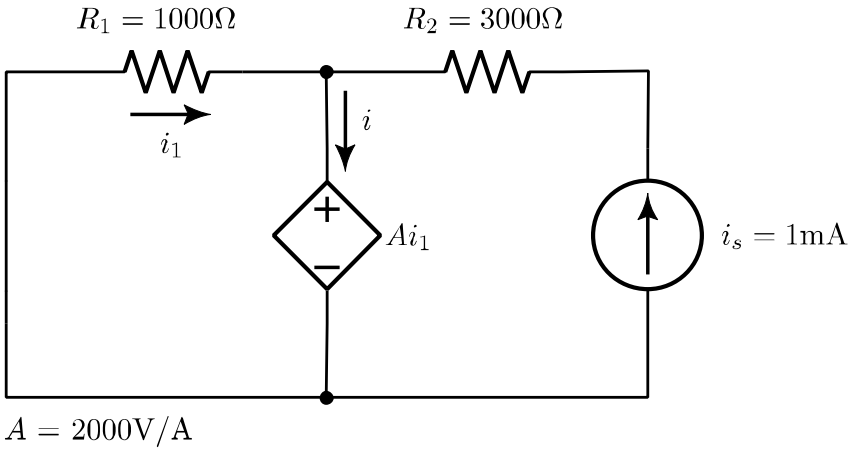
Example 2


$R_1 = 1000\Omega$
$R_2 = 3000\Omega$
i_1
i
$v_s = 3\text{V}$
Ai_1
$i_s = 1\text{mA}$
$A = 2000\text{V/A}$

Example 2 (a)



Example 2 (b)



Summary

- Used superposition to solve circuits
  - Independent sources only
  - With dependent sources

Next Lesson

- Systematic application of Ohm's Law, KCL, and KVL to generate a system of equations
- Thévenin and Norton equivalent circuits