

Chapter 5 - Circuit Theorems

Lecture 16

Sections 5.3-5.5

Learning Objectives

5.4 Thevenin's
Theorem

5.5 Norton's
Theorem

Summary

MEMS 0031 Electrical Circuits

Mechanical Engineering and Materials Science Department
University of Pittsburgh



Student Learning Objectives

Chapter 5 - Circuit
Theorems

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At the end of the lecture, students should be able to:

- ▶ Construct Norton and Thevenin Equivalents, including dependent sources

[Learning Objectives](#)

[5.4 Thevenin's Theorem](#)

[5.5 Norton's Theorem](#)

[Summary](#)

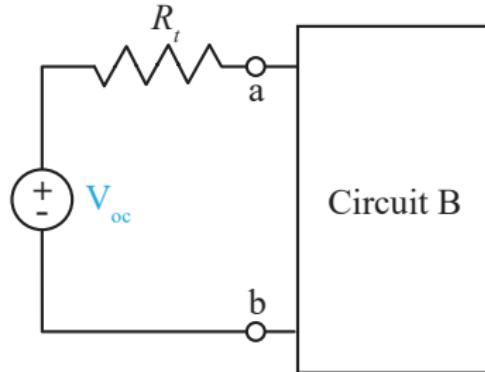
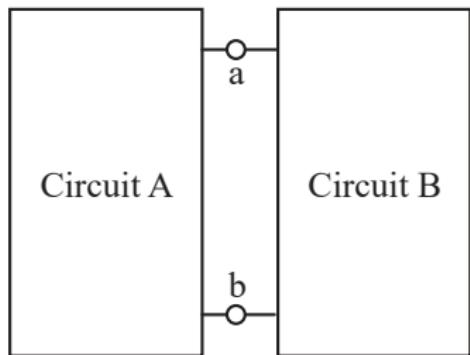


Thevenin's Theorem

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- ▶ Any part of a circuit can be represented as a “Thevenin Equivalent”
- ▶ If the replaced circuit has a dependent source, the dependency must also occur in circuit A:



Learning Objectives

5.4 Thevenin's Theorem

5.5 Norton's Theorem

Summary

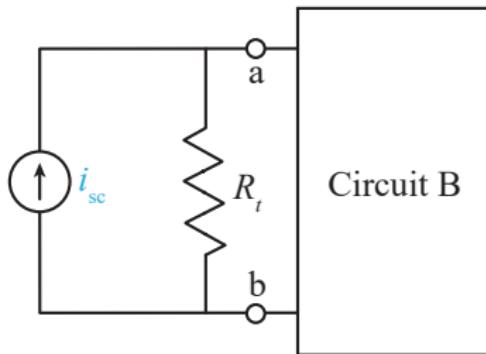
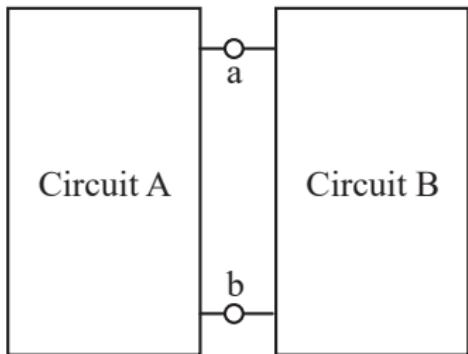


Norton's Theorem

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- ▶ Alternatively, any part of a circuit can be represented as a “Norton Equivalent”
- ▶ If the replaced circuit has a dependent source, the dependency must also occur in circuit A:



Learning Objectives

5.4 Thevenin's Theorem

5.5 Norton's Theorem

Summary

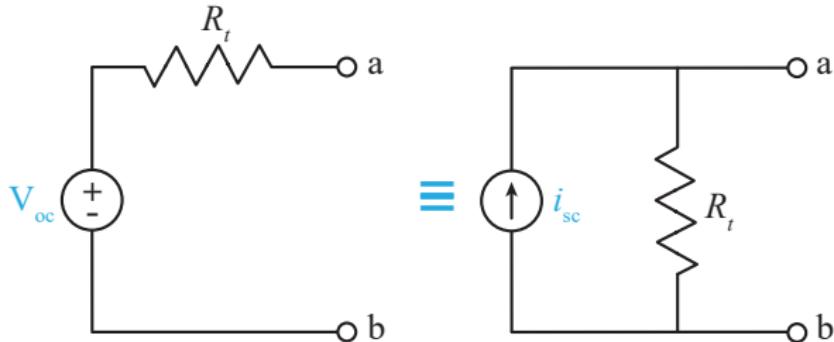


Thevenin and Norton

- ▶ To go between the equivalence:

$$R_T = \frac{V_{oc}}{i_{sc}}$$

- ▶ V_{oc} - open circuit voltage, as measured across terminals a and b with no attached circuit
- ▶ i_{sc} - short circuit current, as measured by shorting terminals a and b



Learning Objectives

5.4 Thevenin's Theorem

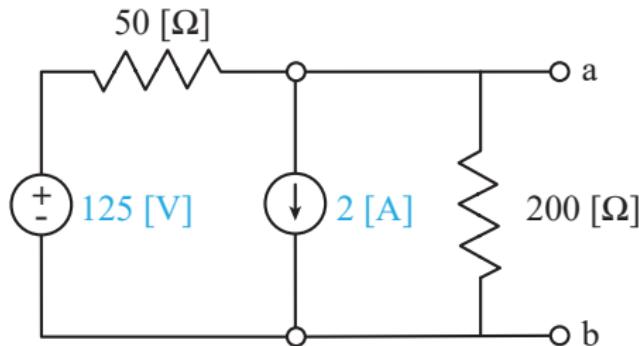
5.5 Norton's Theorem

Summary



Example #1

- ▶ Find the Thevenin Equivalent for the circuit shown using NVA:



Learning Objectives

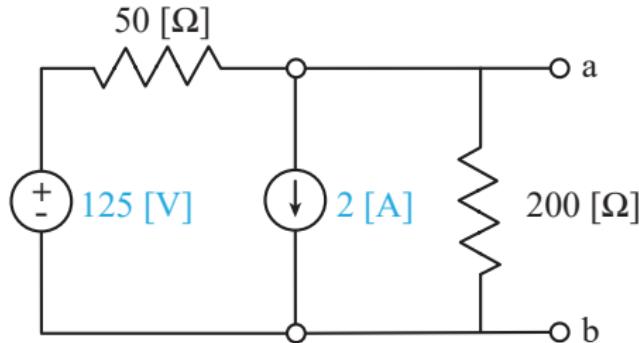
5.4 Thevenin's Theorem

5.5 Norton's Theorem

Summary



Example #1



Learning Objectives

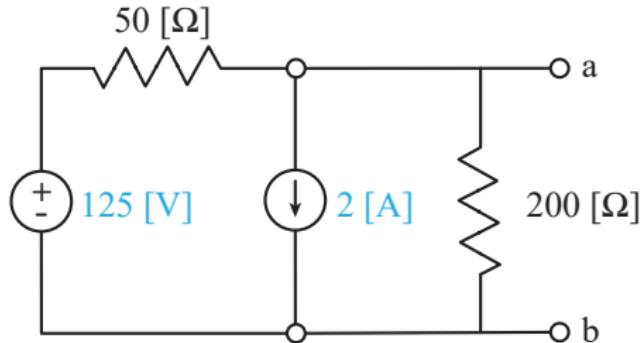
5.4 Thevenin's
Theorem

5.5 Norton's
Theorem

Summary



Example #1



Learning Objectives

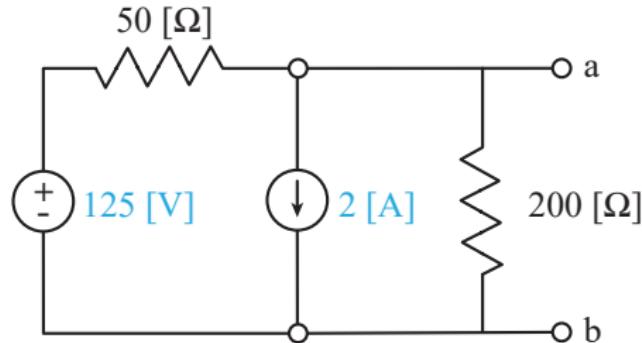
5.4 Thevenin's
Theorem

5.5 Norton's
Theorem

Summary



Example #1



Learning Objectives

5.4 Thevenin's
Theorem

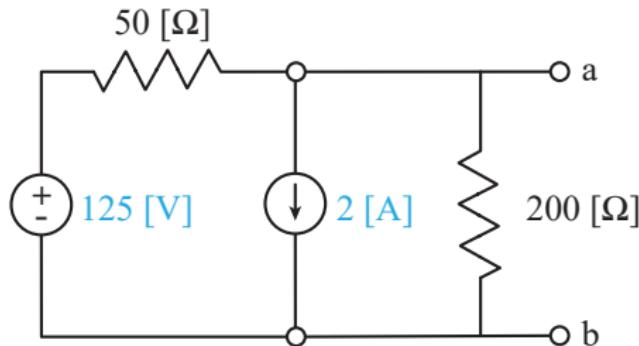
5.5 Norton's
Theorem

Summary



Example #2

- ▶ Find the Thevenin Equivalent for the circuit shown using Superposition:



Learning Objectives

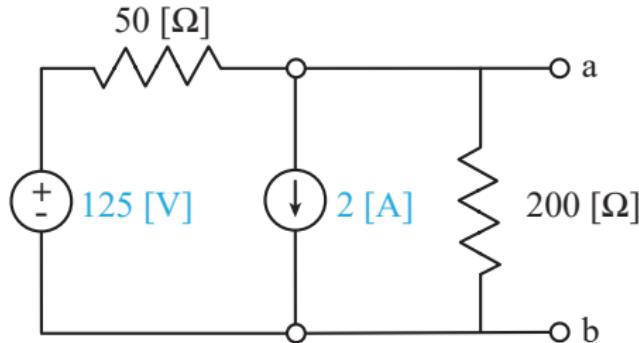
5.4 Thevenin's
Theorem

5.5 Norton's
Theorem

Summary



Example #2



Learning Objectives

5.4 Thevenin's
Theorem

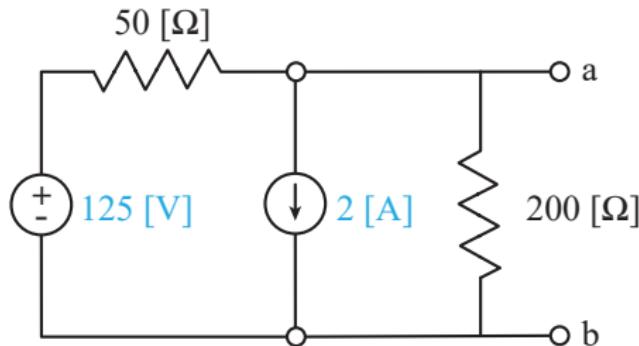
5.5 Norton's
Theorem

Summary



Example #3

- ▶ Find the Thevenin Equivalent for the circuit shown using source transformations:



Learning Objectives

5.4 Thevenin's Theorem

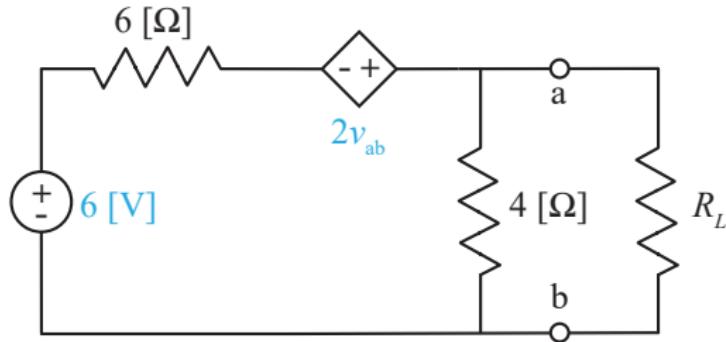
5.5 Norton's Theorem

Summary



Example #4

- Find the Thevenin Equivalent for the circuit shown below:



Learning Objectives

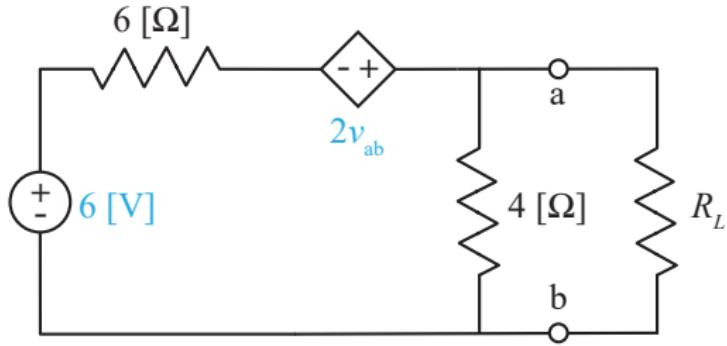
5.4 Thevenin's Theorem

5.5 Norton's Theorem

Summary



Example #4



Learning Objectives

5.4 Thevenin's
Theorem

5.5 Norton's
Theorem

Summary



Student Learning Objectives

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At the end of the lecture, students should be able to:

- ▶ Construct Norton and Thevenin Equivalents, including dependent sources
 - ▶ A Thevenin equivalent is made by reducing the circuit of interest to a voltage source, V_{oc} , in series with a Thevenin resistance, R_{Th} .
 - ▶ A Norton equivalent is made by reducing the circuit of interest to a current source, i_{sc} , in parallel with a Thevenin resistance.
 - ▶ We use Ohm's law to go between the two equivalences.

Learning Objectives

5.4 Thevenin's Theorem

5.5 Norton's Theorem

Summary



Suggested Problems

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- ▶ 5.3-8, 5.3-9, 5.3-10, 5.3-12, 5.4-1, 5.4-2, 5.4-5,
5.4-6, 5.4-7, 5.4-15, 5.4-18, 5.5-1, 5.5-2, 5.5-7,
5.5-8, 5.5-11, 5.5-12

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[5.4 Thevenin's Theorem](#)

[5.5 Norton's Theorem](#)

[Summary](#)

