

# Chapter 2 - Circuit Elements

## Lecture 3

Sections 2.6-2.7

Learning Objectives

2.6 Meters

2.7 Dependent  
Sources

Summary

## MEMS 0031 Electrical Circuits

Mechanical Engineering and Materials Science Department  
University of Pittsburgh



# Student Learning Objectives

Chapter 2 - Circuit Elements

MEMS 0031

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

- ▶ Understand the underlying assumptions made when using voltmeters and ammeters
- ▶ Identify dependent sources and understand the four types (CCVS, VCVS, VCCS, CCCS) and their associated gains

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# Circuit Elements

- ▶ We don't always model voltage potential and currents, we measure them using **voltmeters** and **ammeters**, respectively
- ▶ Often times, these are one-in-the same and are referred to as a **multimeter**



Learning Objectives

2.6 Meters

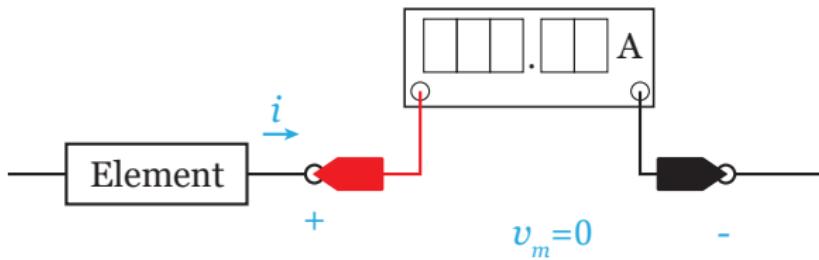
2.7 Dependent Sources

Summary



# Ammeter

- ▶ An **ammeter** measures current:



Learning Objectives

2.6 Meters

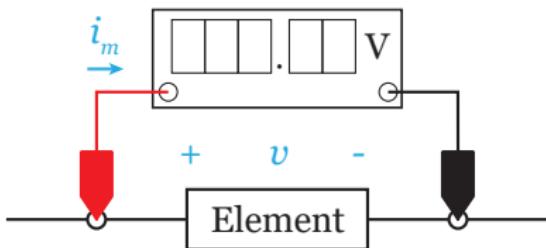
2.7 Dependent Sources

Summary



# Voltmeter

- ▶ A **voltmeter** measures voltage potential:



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# Dependent Sources

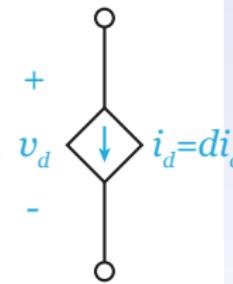
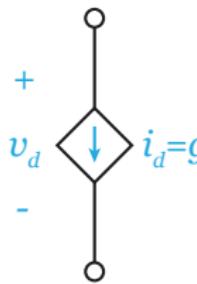
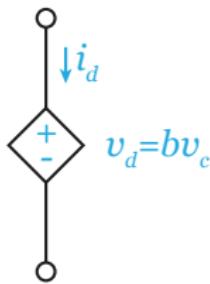
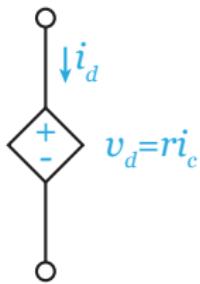
- ▶ Current-Controlled Voltage Source (CCVS):
- ▶ Voltage-Controlled Voltage Source (VCVS):
- ▶ Voltage-Controlled Current Source (VCCS):
- ▶ Current-Controlled Current Source (CCCS):

Learning Objectives

2.6 Meters

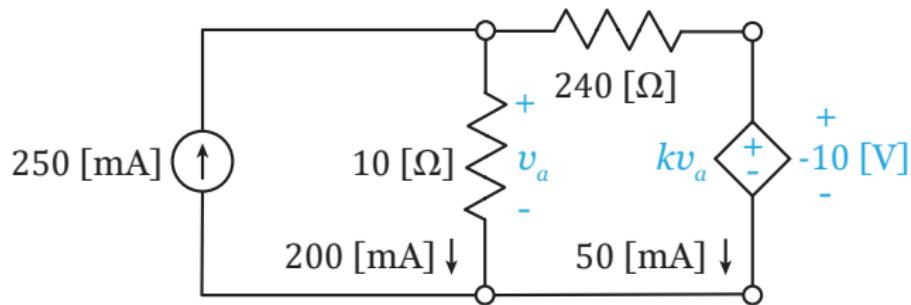
2.7 Dependent Sources

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# Example #1

- ▶ Determine the gain of the VCVS:



Learning Objectives

2.6 Meters

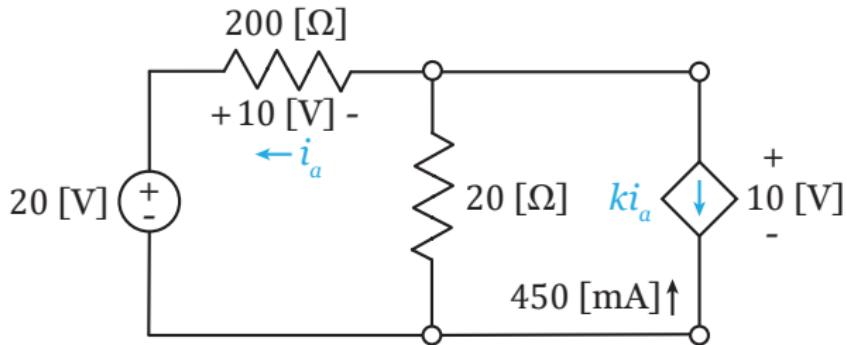
2.7 Dependent Sources

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# Example #2

- ▶ Determine the gain of the CCCS:



Learning Objectives

2.6 Meters

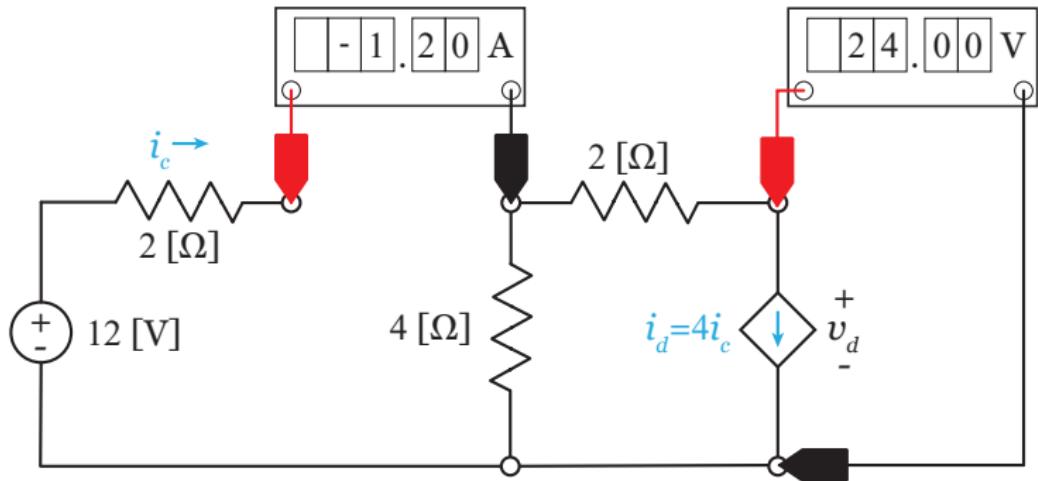
2.7 Dependent Sources

Summary



# Example #3

- Determine the power absorbed by the CCCS:



Learning Objectives

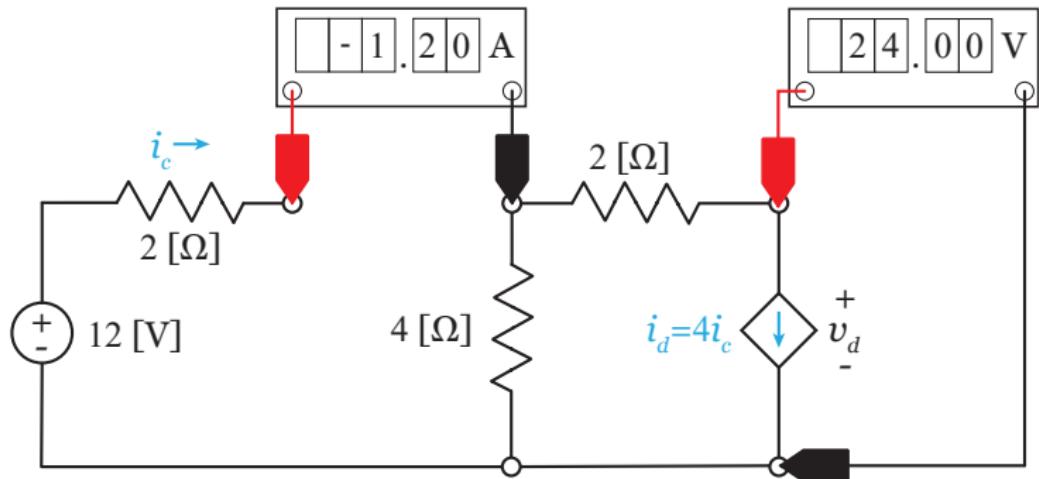
2.6 Meters

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# Example #3



Learning Objectives

2.6 Meters

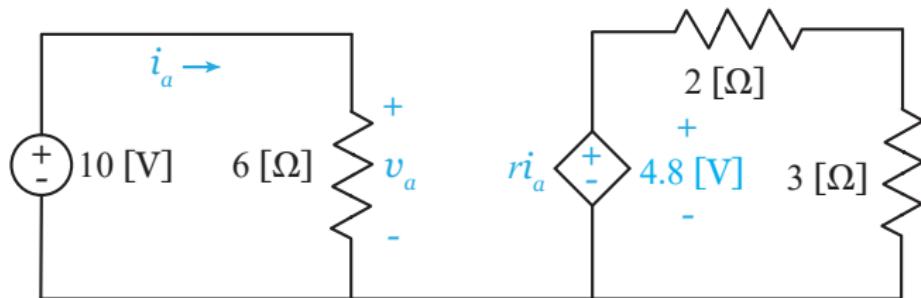
2.7 Dependent Sources

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# Example #4

- ▶ Determine the gain of the CCVS:



Learning Objectives

2.6 Meters

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# Student Learning Objectives

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

- ▶ Understand the underlying assumptions made when using voltmeters and ammeters
  - ▶ A voltmeter is assumed to have infinite resistance, such that current does not flow through it. The terminals of a voltmeter are placed across an element, measuring the voltage drop - open circuit.
  - ▶ An ammeter is assumed to have zero resistance, such that it does not effect the current running through the element. An ammeter is placed in-line with the circuit element, such that it measures the current through the element - short circuit.

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# Student Learning Objectives

Chapter 2 - Circuit Elements

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- ▶ Identify dependent sources and understand the four types (CCVS, VCVS, VCCS, CCCS) and their associated gains
  - ▶ CCVS - current controlled voltage source - the voltage output is proportional to a designated current within the circuit. Gain has units of  $[\Omega]$ .
  - ▶ VCVS - voltage controlled voltage source - the voltage output is proportional to a designated voltage potential within the circuit. Gain is dimensionless.

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# Student Learning Objectives

Chapter 2 - Circuit Elements

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- ▶ Identify dependent sources and understand the four types (CCVS, VCVS, VCCS, CCCS) and their associated gains
  - ▶ VCCS - voltage controlled current source - the current output is proportional to a designated voltage potential within the circuit. Gain has units of  $[\Omega^{-1}]$ .
  - ▶ CCCS - current controlled current source - the current output is proportional to a designated current within the circuit. Gain is dimensionless.

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# Suggested Problems

Chapter 2 - Circuit  
Elements

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- ▶ 2.6-1, 2.6-2, 2.6-3, 2.6-4, 2.7-1, 2.7-2, 2.7-3, 2.7-5

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