

Automotive Technology 5th Edition

Chapter 40 ELECTRICAL CIRCUITS & OHM'S LAW

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain the chapter learning objectives to the students as listed: <ol style="list-style-type: none"> 1. Identify the parts of a complete circuit. 2. Describe the characteristics of different types of circuit faults. 3. Explain Ohm's law as it applies to automotive circuits. 4. Explain Watt's law as it applies to automotive circuits..
Establish the Mood or Climate	Provide a <i>WELCOME</i> , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: This lesson plan is based on the 5th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 40: [ATE5 Chapter Images](#)

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1 SLIDE 1 ELECTRICAL CIRCUITS & OHM'S LAW

Check for **ADDITIONAL VIDEOS & ANIMATIONS**
@ <http://www.jameshalderman.com/>
WEB SITE IS CONSTANTLY UPDATED

Videos

2. **SLIDE 2 FIGURE 40.1** All complete circuits must have a power source, a power path, protection (fuse), an electrical load (light bulb in this case), and a return path back to the power source.

TRAINER TASK: Use an electrical trainer & have students to blow fuse by creating a short circuit, observing what it takes to create short circuit and what results are found

3. **SLIDE 3 EXPLAIN Figure 40-2** return path back to the battery can be any electrical conductor, such as a copper wire or the metal frame or body of the vehicle.
4. **SLIDE 4 EXPLAIN Figure 40-3** electrical switch opens the circuit and no current flows. The switch could also be on the return (ground) path wire.
5. **SLIDE 5 EXPLAIN Figure 40-4** Examples of common causes of open circuits. Some of these causes are often difficult to find.
6. **SLIDE 6 EXPLAIN Figure 40-5** short circuit permits electrical current to bypass some or all of resistance in circuit.

DISCUSSION: Ask students to discuss ground path. Why doesn't a separate ground wire have to be run from the battery to each electrical load?

Ask students to discuss how and why a short-to-voltage occurs. What is the reason that a short-to-voltage may or may not blow a fuse?

7. **SLIDE 7 EXPLAIN Figure 40-6** A fuse or circuit breaker opens the circuit to prevent possible overheating damage in the event of a short circuit.
8. **SLIDE 8 EXPLAIN Figure 40-7 short-to-ground** affects

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power side of circuit. Current flows directly to ground return, bypassing some or all of electrical loads in the circuit. There is no current in circuit past the short. A short-to ground will also cause fuse to blow

DISCUSSION: Ask students to discuss effects of higher than-normal resistance on various components in an automotive electrical system. What can cause high resistance?

HOMEWORK: Research on Internet opportunities for technicians who specialize in electrical systems in your area. Ask them to focus on following questions: What types of work are available? What are the training and job qualification requirements? What is salary range for technician who is trained in automotive electrical systems? Have students write a summary of their findings and share it with class.

DEMONSTRATION: Use an inductive ammeter or charging system tester to show that *amount of current leaving battery on positive is returned on negative side.*

9. SLIDE 9 EXPLAIN FIGURE 40-8 Electrical flow through a circuit is similar to water flowing over a waterwheel.

10. SLIDE 10 EXPLAIN Figure 40-9 To calculate one unit of electricity when the other two are known, simply use your finger and cover the unit you do not know. For example, if both voltage (E) and resistance (R) are known, cover the letter I (amperes). Notice that the letter E is above the letter R, so divide the resistor's value into the voltage to determine the current in the circuit.

DISCUSSION: Ask students to talk about Ohm's law. What is application of Ohm's law in automotive wiring circuits?

[Ohm's Law, Current \(View\) \(Download\)](#)

[Ohm's Law, Resistance \(View\) \(Download\)](#)

[Ohm's Law, Volt \(View\) \(Download\)](#)

[Complete Task Sheet on Electrical Circuits Page 120](#)

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Students can complete [NATEF Task Sheet A6A5 on Ohm's Law: Diagnose electrical/electronic integrity of series, parallel & series-parallel circuits using principles of electricity \(Ohm's Law\)](#). (P-1)

11. **SLIDE 11 EXPLAIN Figure 40-10** This closed circuit includes a power source, power-side wire, circuit protection (fuse), resistance (bulb), and return path wire. In this circuit, if battery has 12 volts & electrical load has 4 ohms, then current through circuit is 4 amperes.

DISCUSSION: Ask students to compare Ohm's & Watt's laws. Which law can be used to determine the diameter of wire needed for a circuit?

12. **SLIDE 12 EXPLAIN Figure 40-11** Calculate 1 unit when other 2 are known, cover unknown unit to see what unit needs to be divided or multiplied to arrive at solution.
13. **SLIDE 13 EXPLAIN Figure 40-12** "Magic circle" of most formulas for problems involving Ohm's law. Each quarter of "pie" has formulas used to solve for a particular unknown value: current (amperes), in upper right segment; resistance (ohms), in lower right; voltage (E), in lower left; and power (watts), in upper left.

HOMEWORK

[Crossword Puzzle \(Microsoft Word\) \(PDF\)](#)

[Word Search Puzzle \(Microsoft Word\) \(PDF\)](#)

[Crossword](#)

[Crossw](#)