

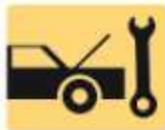
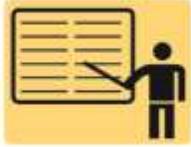
## Chapter 21 ELECTRICAL CIRCUITS

### Opening Your Class

KEY ELEMENT	EXAMPLES
<b>Introduce Content</b>	This course or class serves as an introduction to the world of automotive service. It correlates material to task lists specified by ASE and NATEF.
<b>Motivate Learners</b>	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.
<b>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.</b>	Explain the chapter learning objectives to the students. <ol style="list-style-type: none"><li>1. Prepare for ASE Electrical/Electronic Systems (A6) certification test content area "A" (General Electrical/Electronic Systems Diagnosis).</li><li>2. Explain Ohm's law.</li><li>3. Identify the parts of a complete circuit.</li><li>4. Describe the characteristics of an open, a short-to-ground, and a short-to-voltage.</li></ol>
<b>Establish the Mood or Climate</b>	Provide a <b>WELCOME</b> , Avoid put downs and bad jokes.
<b>Complete Essentials</b>	Restrooms, breaks, registration, tests, etc.
<b>Clarify and Establish Knowledge Base</b>	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.

## ICONS

## Chapter 21 Electrical Circuits



### 1. SLIDE 1 TITLE: ELECTRICAL CIRCUITS

### 2. SLIDES 2-3 READ & EXPLAIN CIRCUITS

4. SLIDE 4 EXPLAIN Figure 21-1 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.

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

**DEMONSTRATION:** Demonstrate basic electrical circuit on **PROJECT BOARD.** Show (Figure 21-1) what happens when circuit is shorted to ground

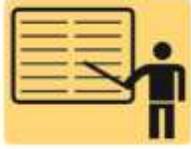
**PROJECT BOARD TASK:** Allow students to blow fuse by creating short circuit, observing what it takes to create short circuit & what results are found

5. SLIDE 5 EXPLAIN Figure 21-2 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.
6. SLIDE 6 EXPLAIN Figure 21-3 electrical switch opens the circuit and no current flows. The switch could also be on the return (ground) path wire.
7. SLIDE 7 EXPLAIN CIRCUIT FAULTS
8. SLIDE 8 EXPLAIN Figure 21-4 Examples of common causes of open circuits. Some of these causes are often difficult to find.
9. SLIDE 9 READ & EXPLAIN Short-to-Voltage
10. SLIDE 10 EXPLAIN Figure 21-5 short circuit to voltage 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?

## ICONS

## Chapter 21 Electrical Circuits



11. SLIDE 11 **EXPLAIN** Figure 21-6 A fuse or circuit breaker opens the circuit to prevent possible overheating damage in the event of a short circuit.
12. SLIDE 12 **READ & EXPLAIN** Circuit Faults
13. SLIDE 13 **EXPLAIN** Figure 21-7 **short-to-ground** affects 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.
14. SLIDE 14 **READ & EXPLAIN** TEXT Circuit Faults



**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. 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.*



**Basic Electronics Part 2 Ohm's Law**  
**Show GM Video on Ohm's Law**



15. SLIDE 15 **READ & EXPLAIN** OHM'S LAW
16. SLIDE 16 **EXPLAIN** Figure 21-8 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.
17. SLIDE 17 **EXPLAIN** Chart 21-1 Ohm's law relationship with the three units of electricity.

## ICONS

## Chapter 21 Electrical Circuits



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



**Ohm's Law, Current**  
Show Current Animation



**Ohm's Law, Resistance**  
Show Resistance Animation



**Ohm's Law, Volt**  
Show Voltage Animation



18. SLIDES 18-19 **READ & EXPLAIN** Ohm's Law

20. SLIDE 20 **EXPLAIN** FIGURE 21-9 Electrical flow through a circuit is similar to water flowing over a waterwheel. The more the water (amperes in electricity), the greater the amount of work (waterwheel). The amount of water remains constant, yet the pressure (voltage in electricity) drops as the current flows through the circuit



**Complete Task Sheet on Electrical Circuits**



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)



**Homework:** complete Ch21 crossword puzzle:  
[http://www.jameshalderman.com/links/book\\_intro/cw/crossword\\_ch\\_21.pdf](http://www.jameshalderman.com/links/book_intro/cw/crossword_ch_21.pdf)