Automotive Technology 6th Edition

Chapter 43 Oscilloscopes & Graphing Multimeters

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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: 1. Compare the different types of oscilloscopes and explain how to setup and adjust oscilloscopes. 2. Discuss DC and AC coupling, pulse trains, channels and triggers. 3. Explain how to use a scope and discuss graphing multimeters and graphing scan tools.
Establish the Mood or Climate	Provide a ***WELCOME,*** 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 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 43 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Ch43 Oscilloscopes & Graphing Multimeters
	**1. SLIDE 1 OSCILLOSCOPES AND GRAPHING MULTIMETERS** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF** **Videos** **DEMONSTRATION: Demonstrate an oscilloscope to the students. Explain controls and their functions as you demonstrate. Show them the time and voltage scales.** **DISCUSSION: Have students talk about what an oscilloscope is. Why is a visual voltmeter with a timer useful for measuring voltage? Have students discuss time & voltage graduations on a scope screen. How & why are these used when measuring voltage?** **Tell the students that a scope can be used to check electrical motors for proper operation. Each commutator will show a voltage spike on scale. An uneven pattern indicates wear. This test is especially useful when checking electric in-tank fuel pumps.**
	**DISCUSS CHART 43-1 The time base is milliseconds (ms) and total time of an event that can be displayed.** **2. SLIDE 2 EXPLAIN Figure 43-1** A scope display allows technicians to take measurements of voltage patterns. In this example, each vertical division is 1 volt and each horizontal division is set to represent 50 milliseconds

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3. **SLIDE 3 EXPLAIN Figure 43-2** display on a digital storage oscilloscope (DSO) displays entire waveform of throttle position (TP) sensor from idle to wide-open throttle & returns to idle. The display also indicates the maximum reading (4.72 V) and the minimum (680 mV or 0.68 V). Display does not show anything until the throttle is opened, because the scope has been set up to only start displaying a waveform after a certain voltage level has been reached. Voltage is called trigger or trigger point.

DISCUSSION: Have students discuss time base on a scope. Why are different time divisions used for different tests? Explain that the scope voltage scale should be set higher than operating voltage of item to be tested in order to allow two to 4 events to be displayed. Have students talk about AC and DC current and couplings. Which type of current is used most in automotive applications? Why is DC coupling most used position on a scope?

DEMONSTRATION: Demonstrate an AC coupling scope display. Talk about the types of sensors for which AC coupling can be used to show output signal waveforms FIGURE 43-2

DEMONSTRATION: Demonstrate a DC voltage on and off pattern on a scope. Talk about pulse trains and how they differ from AC voltage signals.

4. **SLIDE 4 EXPLAIN Figure 43-3** Ripple voltage is created from the AC voltage from an alternator. Some AC ripple voltage is normal but if the AC portion exceeds 0.5 volt, then a bad diode is the most likely cause. Excessive AC ripple can cause many electrical and electronic devices to work incorrectly.

DISCUSSION: Have the students discuss AC ripple voltage. Is ripple voltage normal? What happens when excessive AC ripple occurs?

FIGURE 43-3

5. **SLIDE 5 EXPLAIN Figure 43-4** A pulse train is any electrical signal that turns on and off, or goes high and low in a series of pulses. Ignition module and fuel-injector pulses are examples of a pulse train signal.

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DISCUSSION: **Have the students refer to FIGURE 43–4 and talk about frequency. What is a hertz?**

DISCUSSION: **Have the students talk about duty cycle and pulse width, asking them to refer back to Figure 43–4 as well as the explanations on page 464. What is another name for duty cycle? (ANS: PWM) How is it measured?**

6. **SLIDE 6 EXPLAIN Figure 43-5** (a) A scope representation of a complete cycle showing both on-time and off-time. (b) A meter display indicating the on-time duty cycle in a percentage (%). Note the trigger and negative (-) symbol. This indicates that the meter started to record the percentage of on-time when the voltage dropped (start of on-time).
7. **SLIDE 7 EXPLAIN Figure 43-6** Most automotive computer systems control the device by opening and closing the ground to the component.
8. **SLIDE 8 EXPLAIN Figure 43-7** A two-channel scope being used to compare two signals on the same vehicle.
9. **SLIDE 9 EXPLAIN Figure 43-8** (a) A symbol for a positive trigger—a trigger occurs at a rising (positive) edge of the signal (waveform). (b) A symbol for a negative trigger—a trigger occurs at a falling (negative) edge of the signal (waveform)

DISCUSSION: **Have the students discuss external trigger, trigger level, and trigger slope. What is the trigger that most often starts a waveform display?**

Scope Display (View) (Download)
Scope Display Dual Trace (View) (Download)

10. **SLIDE 10 EXPLAIN Figure 43-9** Constant battery voltage is represented by a flat horizontal line. In this example, the engine was started and the battery voltage dropped to about 10 V as shown on the left side of the scope display. When the engine started, the alternator started to charge the battery and the voltage is shown as climbing.

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	DEMONSTRATION: Demonstrate a duty cycle reading on an oscilloscope, showing students both on-time & off-time. Then demonstrate a pulse width reading on an oscilloscope. **DEMONSTRATION:** Demonstrate proper way to connect BNC test leads to a scope, making sure that the students see and understand ground connection **FIGURE 43-9** **HANDS-ON TASK:** Guide students through hooking up test leads and checking voltage in a 12 V battery **It is always advisable to check instructions for scope being used to be aware of limitations on measuring higher voltage circuits** 11. **SLIDE 11 EXPLAIN Figure 43-10** A typical graphing multimeter that can be used as a digital meter, plus it can display the voltage levels on the display screen. **DISCUSSION:** Have the students talk about graphing multimeters. Where does a graphing multimeter display voltage levels? Have the students compare and contrast oscilloscopes, graphing multimeters, and graphing scanners. What are advantages and disadvantages of each?