Advanced Engine Performance Diagnosis 6/E

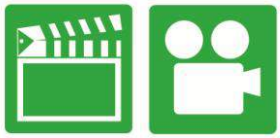
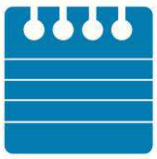
Chapter 8 Oscilloscopes and Graphing Multimeters

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. 1. Use a digital storage oscilloscope to measure voltage signals, and determine if the values are within factory specifications. 2. Explain time base and volts per division settings. 3. This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "A" (General Electrical/Electronic System Diagnosis).
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 Advanced Engine Performance Diagnosis 6/E Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 08: Chapter Images

ICONS	Ch08 Oscilloscopes & Graphing Multimeters
	1. SLIDE 1 CH8 Oscilloscopes and Graphing Multimeters
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE REGULARLY UPDATED
	At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them Crossword Puzzle (Microsoft Word) (PDF) Word Search Puzzle (Microsoft Word) (PDF)
	
	DEMONSTRATION: DEMONSTRATE AN OSCILLOSCOPE TO STUDENTS. EXPLAIN CONTROLS AND THEIR FUNCTIONS AS YOU DEMONSTRATE. SHOW THEM THE TIME AND VOLTAGE SCALES.
	DISCUSSION DISCUSS 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? 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.
	
	2. SLIDE 2 EXPLAIN Figure 8-1 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
	SCOPE DISPLAY SCOPE DISPLAY DUAL TRACE

ICONS	Ch08 Oscilloscopes & Graphing Multimeters
	3. **SLIDE 3 EXPLAIN Figure 8-2** display on a digital storage oscilloscope (DSO) displays entire waveform of a throttle position (TP) sensor from idle to wide-open throttle and then returns to idle. The display also indicates the maximum reading (4.72 V) and minimum (680 mV or 0.68 V). Display does not show anything until throttle is opened, because 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 8-2**
	**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 8-3** Ripple voltage is created from AC voltage from an alternator. Some AC ripple voltage is normal but if AC portion exceeds 0.5 volt, then bad diode is most likely cause. HIGH AC ripple can cause many electrical & 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 8-3**
	5. **SLIDE 5 EXPLAIN Figure 8-4** 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 8–4 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 8–4 WHAT IS ANOTHER NAME FOR DUTY CYCLE? (ANS: PWM) HOW IS IT MEASURED?**
	6. **SLIDE 6 EXPLAIN Figure 8-5** (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 8-6** Most automotive computer systems control the device by opening and closing the ground to the component. 8. **SLIDE 8 EXPLAIN Figure 8-7** A two-channel scope being used to compare two signals on the same vehicle. 9. **SLIDE 9 EXPLAIN Figure 8-8** (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 TRIGGER THAT MOST OFTEN STARTS A WAVEFORM DISPLAY?**
	10. **SLIDE 10 EXPLAIN Figure 8-9** 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, alternator started to charge the battery and voltage is shown as climbing.
	**DEMONSTRATION: DEMONSTRATE DUTY CYCLE READING ON OSCILLOSCOPE, SHOWING STUDENTS BOTH ON-TIME/OFF-TIME. THEN DEMONSTRATE PULSE WIDTH READING**

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  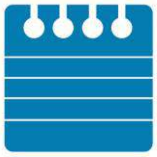  	**DEMONSTRATION:** DEMONSTRATE PROPER WAY TO CONNECT BNC TEST LEADS TO A SCOPE, MAKING SURE THAT THE STUDENTS SEE AND UNDERSTAND GROUND CONNECTION **FIGURE 8-9** **HANDS-ON TASK:** GUIDE STUDENTS THROUGH HOOKING UP TEST LEADS AND CHECKING VOLTAGE IN A 12 V BATTERY IT IS ALWAYS ADVISABLE TO CHECK INSTRUCTIONS FOR SCOPE BEING USED TO BE AWARE OF LIMITATIONS ON MEASURING HIGHER VOLTAGE CIRCUITS 11. **SLIDE 11 EXPLAIN** Graphing Multimeter & **EXPLAIN Figure 8-10** 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?