Automotive Fuel and Emissions Control Systems 4/E

Chapter 12 CAN and Network Communications

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Fuel and Emissions Control Systems.** It correlates material to task lists specified by ASE and NATEF.
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 result of attending session or class.	Explain the chapter learning objectives to the students. 1. Explain the fundamentals of module communications and their configuration. 2. Explain the classifications of network communications and the communications protocols of General Motors, Ford, and Chrysler. 3. Explain the features of Controller Area Networks (CAN) and European BUS Communications. 4. Discuss how to diagnose network communication faults.
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 Fuel & Emission Control 4th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 12: Chapter Images

ICONS	Ch12 CAN and Network Communications
	**1. SLIDE 1 CH12 CAN & Network Communications**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED** **VIDEOS**
	**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)**
	2. SLIDE 2 EXPLAIN Figure 12-1 Module communications makes controlling multiple electrical devices and accessories easier by utilizing simple low-current switches to signal another module, which does the actual switching of the current to the device
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE DIFFERENT TYPES OF COMMUNICATION BETWEEN MODULES OR NODES. WHY DO THERE NEED TO BE DIFFERENT TYPES OF COMMUNICATION?**
	**DEMONSTRATION: DEMONSTRATE OR EXPLAIN TO THE STUDENTS HOW A POWER WINDOW SYSTEM WORKED 10 YEARS AGO AND HOW A MODERN POWER WINDOW SYSTEM WORKS. USE PROJECT BOARD TO DEMO CAN & NETWORK COMMUNICATION**
	**ON-TRAINER/PROJECT BOARD TASK: HAVE STUDENT DO THE SETUP SHOWN IN PREVIOUS DEMONSTRATION**

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	**3. SLIDE 3 EXPLAIN Figure 12.2** A network allows all modules to communicate with other modules. **4. SLIDE 4 EXPLAIN Figure 12-3** Ring link network reduces # of wires it takes to interconnect all of modules. **5. SLIDE 5 EXPLAIN Figure 12-4** In star link network, all of the modules are connected using splice packs.
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**6. SLIDE 6 EXPLAIN Figure 12-5 BUS** system showing module CAN communications and twisted pairs of wire.
	**DISCUSSION: DISCUSS CAN NETWORK PICTURED IN FIGURE 2–5. DO ALL OF MODULES ON THIS BUS NEED TO BE ABLE TO TALK TO EACH OTHER?**
	**INTERNET TASK: SEARCH INTERNET: HAVE STUDENTS USE THE INTERNET TO RESEARCH SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) STANDARDS FOR THE 3 CATEGORIES OF IN-VEHICLE NETWORK COMMUNICATIONS. DO THESE STANDARDS APPLY IN EVERY COUNTRY?**
	**7. SLIDE 7 EXPLAIN Figure 12-6 UART** serial data master control module connected to DLC at pin 9 **8. SLIDE 8 EXPLAIN Figure 12-7** E & C serial data is connected to data link connector (DLC) at pin 14. **9. SLIDE 9 EXPLAIN Figure 12-8** Class 2 serial data communication accessible at DLC at pin 2 **10. SLIDE 10 EXPLAIN Figure 12-9** Keyword 82 operates at a rate of 8,192 bps, similar to UART, and keyword 2000 operates at a baud rate of 10,400 bps (the same as a Class 2 communicator). **11. SLIDE 11 EXPLAIN Figure 12-10** GMLAN uses pins at terminals 6 and 14
	**DISCUSS FREQUENTLY ASKED QUESTION**

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	**12. SLIDE 12 EXPLAIN Figure 12-11** twisted pair is used by several different network communications protocols to reduce interference that can be induced in the wiring from nearby electromagnetic sources.
	**13. SLIDE 13 EXPLAIN Figure 12-12** CANdi module will flash green LED rapidly if communication is detected.
	14. SLIDE 14 EXPLAIN Figure 12-13 A Ford OBD-I diagnostic link connector showing that SCP communication uses terminals in cavities 1 (upper left) and 3 (lower left).
	15. SLIDE 15 EXPLAIN Figure 12-14 A scan tool can be used to check communications with the SCP BUS through terminals 2 and 10 and to the other modules connected to terminal 7 of the data link connector (DLC)
	16. SLIDE 16 EXPLAIN Figure 12-15 Many Fords use UBP module communications along with CAN.
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**17. SLIDE 17 EXPLAIN CHRYSLER Figure 12-16** CCD signals are labeled plus and minus and use a twisted pair of wires. Notice that terminals 3 and 11 of the data link connector are used to access the CCD BUS from a scan tool. Pin 16 is used to supply 12 volts to the scan tool.
	18. SLIDE 18 EXPLAIN Figure 12-17 differential voltage for CCD BUS is created by using resistors in a module.
	19. SLIDE 19 EXPLAIN Figure 12-18 Many Chrysler vehicles use both SCI & CCD for module communication.
	**20. SLIDE 20 EXPLAIN Figure 12-19** CAN uses a differential type of module communication where the voltage on one wire is the equal but opposite voltage on the other wire. When no communication is occurring, both wires have 2.5 volts applied. When communication is occurring, CAN H (high) goes up 1 volt to 3.5 volts and CAN L (low) goes down 1 volt to 1.5 volts.
	21. SLIDE 21 EXPLAIN Figure 12-20 typical (generic) system showing how the CAN BUS is connected to various electrical accessories and systems in the vehicle

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	**22. SLIDE 22 EXPLAIN Figure 12-21 TOYOTA** DLC from a pre-CAN Acura shows terminals in cavities 4, 5 (grounds), 7, 10, 14, and 16 (B+) **23. SLIDE 23 EXPLAIN Figure 12-22** Honda scan display showing a B & 2U codes, all indicating a BUS-related problem(s). **24. SLIDE 24 EXPLAIN Figure 12-23** typical 38-cavity diagnostic connector as found on many BMW and Mercedes vehicles under the hood. The use of a breakout box (BOB) connected to this connector can often be used to gain access to module BUS information.
	**Meter Usage Check CAN Circuit (View) (Download)** **Controller Area Network, CAN (View) (Download)** **CAN Circuit Check (View) (Download)** **CAN Signal (View) (Download)**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**25. SLIDE 25 EXPLAIN Figure 12-24** Breakout Box (**BOB**) used to access BUS terminals while using a scan tool to activate modules. Breakout Box is equipped with LEDs that light when circuits are active
	**EXPLAIN TECH-TIP**
	**ON-VEHICLE TASK: IDENTIFY PARTS ON VEHICLE RELATED TO THE CAN THAT CORRESPOND WITH LETTER ON TASK SHEET AND DESCRIBE PURPOSE OF EACH PART.**
	**26. SLIDE 26 EXPLAIN Figure 12-25** This Honda scan tool allows the technician to turn on individual lights and operate individual power windows and other accessories that are connected to the BUS system. **27. SLIDE 27 EXPLAIN Figure 12-26** Modules used in a GM vehicles can be "pinged" using a Tech 2 scan tool. **28. SLIDE 28 EXPLAIN Figure 12-27** Checking terminating resistors using an ohmmeter at the DLC **29. SLIDE 29 EXPLAIN Figure 12-28** Use front-probe terminals to access the data link connector. Always follow the specified back-probe and front-probe procedures as found in service information. **30. SLIDE 30 EXPLAIN Figure 12-29 (a)** Data is sent in

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	packets, so it is normal to see activity then a flat line between messages. **31. SLIDE 31 EXPLAIN Figure 12-29 (b)** CAN BUS should show voltages that are opposite when there is normal communications. CAN H (high) circuit should go from 2.5 volts at rest to 3.5 volts active. CAN L (low) circuit goes from 2.5 volts at rest to 1.5 volts active.
	**HANDS-ON TASK: PRINT OUT STEPS FOR DIAGNOSING AND TESTING NETWORK DIAGNOSTIC CODE. ASK STUDENTS TO FOLLOW DIAGNOSTIC STEPS TO SEE REPAIR PATH.**
	**DISCUSS REAL WORLD FIX**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**32. SLIDE 32 EXPLAIN Figure 12-30** a16 pin OBD-II DLC with terminals identified. Scan tools use the power pin (16) and ground pin (4) for power so that a separate cigarette lighter plug is not necessary on OBD-II vehicles.
	**EXPLAIN TECH-TIP**
	**33. SLIDE 33 EXPLAIN Figure 12-31** schematic of a Chevrolet Equinox shows that the vehicle uses a **GMLAN** BUS (DLC pins 6 and 14), plus a Class 2 (pin 2) and UART.
	**STUDENTS COMPLETE NATEF TASK SHEET DIAGNOSE BODY ELECTRONIC SYSTEM USING SCAN TOOL**
	**HOMEWORK: SEARCH INTERNET: RESEARCH VEHICLE COMMUNICATION NETWORKS ON INTERNET . INCLUDE A HISTORY OF NETWORKS AND IMPROVEMENTS THAT HAVE BEEN MADE THAT ARE USED IN THE PRESENT-DAY AUTOMOBILE.**