A6 Electricity & Electronics 4th Edition

Chapter 16 CAN & Network Communications

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Electricity and Electronics 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 a result of attending this session or class.	Explain the chapter learning objectives to the students. 1. Describe the types of networks and serial communications used on vehicles. 2. Discuss how the networks connect to the data link connector and to other modules. 3. Explain how to diagnose module communication faults **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.

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1. SLIDE 1 CH16 CAN & NETWORK COMMUNICATIONS

2. **SLIDES 2-3 EXPLAIN OBJECTIVES**

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WEB SITE IS CONSTANTLY UPDATED

4. **SLIDE 4 EXPLAIN MODULE COMMUNICATIONS & NETWORKS**

5. **SLIDE 5** EXPLAIN **Figure 16-1** 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?

6. **SLIDE 6** EXPLAIN NETWORK FUNDAMENTALS

7. **SLIDE 7** EXPLAIN **Figure 16-2** network allows all modules to communicate with other modules

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

TRAINER TASK: HAVE STUDENT DO THE SETUP SHOWN IN PREVIOUS DEMONSTRATION

8. **SLIDE 8** EXPLAIN : MODULE COMMUNICATIONS CONFIGURATION

9. **SLIDE 9** EXPLAIN **Figure 16-3** Ring link network reduces # of wires it takes to interconnect all of modules.

10. **SLIDE 10** EXPLAIN **Figure 16-4** In star link network, all of the modules are connected using splice packs

11. **SLIDE 11** EXPLAIN: NETWORK COMMUNICATIONS CLASSIFICATIONS

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12. **SLIDE 12** EXPLAIN Figure 16-5 BUS system showing module CAN communications and twisted pairs of wire.

<u>DISCUSSION:</u> DISCUSS CAN NETWORK PICTURED IN FIGURE 16-5. DO ALL OF MODULES ON THIS BUS NEED TO BE ABLE TO TALK TO EACH OTHER?

<u>INTERNET TASK: SEARCH INTERNET:</u> HAVE STUDENTS USE THE <u>INTERNET</u> TO RESEARCH SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) STANDARDS FOR THE 3 CATEGORIES OF IN-VEHICLE NETWORK COMMUNICATIONS. DO THESE STANDARDS APPLY IN EVERY COUNTRY? ASK STUDENTS TO REPORT THEIR FINDINGS TO CLASS.

13. **SLIDE 13:** EXPLAIN GM COMMUNICATIONS PROTOCOLS
14. **SLIDE 14** EXPLAIN **Figure 16-6 UART** serial data master control module connected to DLC at pin 9
15. **SLIDE 15** EXPLAIN **Figure 16-7** E & C serial data is connected to data link connector (DLC) at pin 14.
16. **SLIDE 16** EXPLAIN **Figure 16-8** Class 2 serial data communication accessible at DLC at pin 2.
17. **SLIDE 17** EXPLAIN **GM PROTOCOLS**
18. **SLIDE 18** EXPLAIN **Figure 16-9** 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).
19. **SLIDE 19** EXPLAIN **Figure 16-10** GMLAN uses pins at terminals 6 and 14.
20. **SLIDE 20** EXPLAIN **Figure 16-11** twisted pair is used by several different network communications protocols to reduce interference that can be induced in the wiring from nearby electromagnetic sources.

22. **SLIDE 22** EXPLAIN **Figure 16-12** **CANdi** module will flash green LED rapidly if communication is detected.
23. **SLIDE 23** EXPLAIN: FORD NETWORK COMMUNICATIONS PROTOCOLS
24. **SLIDE 24** EXPLAIN **Figure 16-13** A Ford OBD-I diagnostic link connector showing that SCP communication uses terminals in cavities 1 (upper left) and 3 (lower left).

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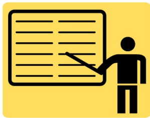
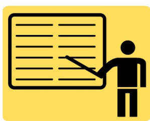
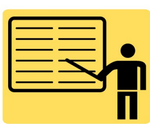
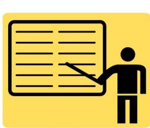
	25. **SLIDE 25** EXPLAIN **Figure 16-14** A scan tool can be used to check communications with the SCP BUS through terminals 2 and 10 and to the other modules connected to terminal 7 of the data link connector (DLC) & EXPLAIN **Figure 16-15** Many Fords use UBP module communications along with CAN. 25. **SLIDE 26** EXPLAIN: **CHRYSLER COMMUNICATIONS PROTOCOLS**
	26. **SLIDE 26** EXPLAIN **Figure 16-16** 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. 27. **SLIDE 27** EXPLAIN **Figure 16-17** differential voltage for CCD BUS is created by using resistors in a module. 28. **SLIDE 28** EXPLAIN **Figure 16-18** Many Chrysler vehicles use both SCI & CCD for module communication
	29. **SLIDE 29** EXPLAIN **CONTROLLER AREA NETWORK** 30. **SLIDE 30** EXPLAIN **Figure 16-19** 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. 31. **SLIDE 31** EXPLAIN **Figure 16-20** typical (generic) system showing how the CAN BUS is connected to various electrical accessories and systems in the vehicle
	32. **SLIDE 32** EXPLAIN **Figure 16-21** DLC from a pre-CAN Acura shows terminals in cavities 4, 5 (grounds), 7, 10, 14, and 16 (B+). 33. **SLIDE 33** EXPLAIN **Figure 16-22** Honda scan display showing a B & 2U codes, all indicating a BUS-related problem(s).

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34. **SLIDES 34-35** EXPLAIN EUROPEAN BUS COMMUNICATIONS
36. **SLIDE 36** EXPLAIN **Figure 16-23** 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.
37. **SLIDE 37** EXPLAIN **Figure 16-24** 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
38. **SLIDE 38** EXPLAIN: NETWORK COMMUNICATIONS DIAGNOSIS
39. **SLIDE 39** EXPLAIN **Figure 16-25** 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.
40. **SLIDE 40** EXPLAIN **Figure 16-26** Modules used in a GM vehicles can be "pinged" using a Tech 2 scan tool.
41. **SLIDE 41** EXPLAIN: NETWORK COMMUNICATIONS DIAGNOSIS
42. **SLIDE 42** EXPLAIN **Figure 16-27** Checking terminating resistors using an ohmmeter at the DLC
43. **SLIDE 43** EXPLAIN **Figure 16-28** 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.
44. **SLIDE 44** EXPLAIN: NETWORK COMMUNICATIONS DIAGNOSIS
45. **SLIDE 45** EXPLAIN **Figure 16-29 (a)** Data is sent in packets, so it is normal to see activity then a flat line. **(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 between messages.

HANDS-ON TASK: PRINT OUT STEPS FOR DIAGNOSING AND TESTING NETWORK DIAGNOSTIC CODE. ASK STUDENTS TO FOLLOW DIAGNOSTIC STEPS TO SEE REPAIR PATH.

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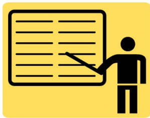
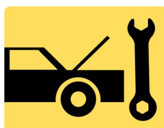
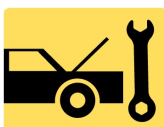
	46. **SLIDE 46** EXPLAIN: OBD-II DATA LINK CONNECTOR 47. **SLIDE 47** EXPLAIN **Figure 16-30** 16 pin OBD-II DLC with terminals identified. Scan tools use power pin (16) and ground pin (4) for power so that a separate cigarette lighter plug is not necessary on OBD-II vehicles. 48. **SLIDE 48** EXPLAIN **Figure 16-31** 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. 49. **SLIDE 49** EXPLAIN **SUMMARY**
We Support NATEF 	**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.**