

Module Overview

This module covers the properties of common types of low-voltage cable and fiber-optic cable used in signaling and communication systems. It describes the main cable types along with their physical and performance specifications. Guidelines for selecting and sizing the right cable for a given application are also presented.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 through 33207-10.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Select cables for specific applications.
2. Calculate the voltage drop for various applications.
3. Interpret and apply *NEC*[®] regulations governing conductors and cables.
4. Size cable conductors for a given load.
5. Understand and apply various formulas and charts for load calculations.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Select and size cable for specific applications.
2. Calculate the voltage drop for various applications.
3. Size cable conductors for a load using various load calculation charts.

Materials and Equipment

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Electronic Systems Technician Level Two

PowerPoint[®] Presentation Slides

(ISBN 978-0-13-257332-0)

Multimedia projector and screen

Appropriate personal protective equipment

Computer

Calculator

Samples of different types of coax and data cable

Copies of the Quick Quiz*

Module Examinations**

Performance Profile Sheets**

*Located at the back of this module

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

National Electrical Code Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.
Cabling: The Complete Guide to Network Wiring. San Francisco, CA: Sylvex.
A Practical Guide to Cable Selection. Santa Clara, CA: National Semiconductor Corporation.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Cable Selection*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Cable Selection; Fire Alarm and Security Systems	
A. Introduction	_____
B. Common Factors in Cable Selection	_____
C. Fire Alarm and Security System Cabling	_____
Session II. Coaxial Cable Selection; Telecommunications and Data Cable; Optical Multi-Fiber Cable	
A. Coaxial Cable Selection	_____
B. Telecommunications and Data Cable	_____
C. Optical Multi-Fiber Cable	_____
D. Laboratory	_____
Have trainees select and size cable for specific applications. This laboratory corresponds to Performance Task 1.	
Session III. Voltage and Power Drop	
A. Conductor Voltage Drop	_____
B. Coaxial Cable Voltage Drop	_____
C. Speaker Cable Power Drop	_____
D. Laboratory	_____
Have trainees calculate the voltage drop for various applications. This laboratory corresponds to Performance Task 2.	
E. Laboratory	_____
Have trainees size cable conductors for a load using various load calculation charts. This laboratory corresponds to Performance Task 3.	
Session IV. Review and Testing	
A. Module Review	_____
B. Module Examination	_____
1. Trainees must score 70 percent or higher to receive recognition from NCCER.	
2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.	

Module Overview

This module provides information and detailed instructions for selecting, installing, and testing connectors and other terminating devices on the various cables used in low-voltage work, including telecommunications, video and audio, and fiber optics.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*, Modules 33201-10 through 33208-10.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Describe the connectors, tools, and methods used to terminate telecommunications cable.
2. Describe the connectors, tools, and methods used to terminate coaxial cable.
3. Describe the connectors, tools, and methods that apply to solderless connectors.
4. Describe the soldering process.
5. Prepare and terminate UTP and coaxial cable.
6. Splice conductors using solderless connectors.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Properly prepare and terminate a cable or wire with various types of connectors.

Materials and Equipment

Markers/chalk	Time-domain reflectometer
Pencils and scratch paper	Wire cutters
Whiteboard/chalkboard	Stripping tools
<i>Electronic Systems Technician Level Two</i>	Coaxial cable stripper
PowerPoint® Presentation Slides (ISBN 978-0-13-257332-0)	Screwdriver
Multimedia projector and screen	Pliers
Computer	Diagonal cutting tool
Appropriate personal protective equipment	Category 1 and 2 telephone wiring jacks and connectors
Various types of coaxial cable	Category 3 and higher cable
Coaxial cable connectors, including:	Snap-in station outlet couplers
F-type connectors	Punchdown blocks
BNC connectors	Patch cord plugs
Literature and instructions from connector manufacturers	Pre-assembled patch cords
Manufacturer's literature on communications/data network equipment	Wire/cable management devices
Crimping and assembly tools, including:	Soldering iron
Punchdown tool	Solder
Plier-type crimping tool	Soldering flux
Leveraged crimping tool	Desoldering pump
Modular plug crimping tool	ANSI/TIA/EIA-586A-compliant data communications cables
Multimeter	Shielded twisted-pair cable
	Workstation coupler plugs and jacks

(continued)

Compact 5e modules
 Surface-mount box
 Modular plugs
 Type 66 and 110 blocks and block plugs
 IDC termination blocks
 Cable management hardware
 Crimp connectors for screw terminals

Splice-type crimp connectors
 Wire nuts
 Multipair punchdown/cutoff tools
 Fiber-optic connectors
 Module Examinations*
 Performance Profile Sheets*

*Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that the trainees use various electrical hand tools and a soldering iron. Ensure that trainees are briefed on basic hand tool safety, electrical safety, and shop safety policies.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Information Transport Systems Installation Methods Manual (ITSIMM), Latest Edition. Tampa, FL: BICSI.
National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.
Telecommunications Distribution Methods Manual, 11th Edition. 2006. Tampa, FL: BICSI. www.bicsi.org.
TIA/EIA Building Telecommunications Wiring Standards, 9th Edition. Englewood, CO: Global Engineering Documents.
The Cabling Handbook, 2nd Edition. 2000. Upper Saddle River, NJ: Prentice Hall.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Wire and Cable Terminations*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Coaxial Cable Terminations	
A. Introduction	_____
B. Coaxial Cable Terminations	_____
Sessions II– III. Terminating UTP Cable	
A. Types of UTP Connectors	_____
B. UTP Cable Management	_____
C. Consolidation Point or Cross-Connect Block Terminations	_____
D. Type 110 Block Terminations	_____
E. Workstation Coupler or Modular Jack Terminations	_____
F. Surface-Mount Box Terminations	_____
G. Modular Plug/Cord Fabrication and Termination	_____
H. Patch Cord and 110 Block Plug Termination	_____
I. Testing Twisted-Pair Cable	_____

Sessions IV– VI. Solderless Connections

- A. Crimp Connectors for Screw Terminals _____
- B. Splice-Type Crimp Connections _____
- C. Wire Nuts _____
- D. Cable/Conductor Routing and Inspection _____
- E. Termination of Conductors/Cables to Solderless Connectors _____
- F. Terminating Typical Shielded Cable _____

Sessions VII and VIII. Solder-Type Connectors

- A. Solder _____
- B. Soldering Flux _____
- C. Soldering Irons _____
- D. The Soldering Process _____
- E. Soldering Safety _____
- F. Terminating an RCA Connector _____
- G. Terminating an XLR Connector _____

Session IX. Optical Fiber Cable Connectors; Legacy Connectors; Laboratory

- A. Optical Fiber Cable Connectors _____
- B. Legacy Communications Connectors and Terminations _____
- C. Laboratory _____

Have trainees properly prepare and terminate cables and wires with various types of connectors. This exercise corresponds with Performance Task 1.

Session X. Review and Testing

- A. Module Review _____
- B. Module Examination _____
 - 1. Trainees must score 70 percent or higher to receive recognition from NCCER.
 - 2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.
- C. Performance Testing _____
 - 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
 - 2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to the applications and operation of CCTV systems. The trainee will learn to select the correct components for an application and troubleshoot a CCTV system.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Describe the typical uses and configurations of CCTV systems.
2. Describe the operation of CCTV systems.
3. Identify and describe the components of a CCTV system, including:
 - Cameras
 - Lenses
 - Amplifiers
 - Recorders
 - Switchers/multiplexers
4. Describe how light affects camera selection.
5. Define installation and test requirements for CCTV systems.
6. Select the correct lens for a given CCTV application.
7. Select the correct equipment for a CCTV installation.
8. Troubleshoot a CCTV system.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Select the correct lens for a given CCTV application.
2. Select the correct equipment for a CCTV installation.
3. Troubleshoot a CCTV system.

Materials and Equipment

Multimedia projector and screen
Electronic Systems Technician Level Four Power-Point® Presentation Slides
(ISBN 978-0-13-266258-1)

Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and paper

Appropriate personal protective equipment

A working digital CCTV system with manufacturer's instruction manual

Video cameras and lenses

Waveform monitor

Vectorscope

Color bar generator

Test cables

Manufacturer catalogs or data sheets (or Internet access) to support equipment selection

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

www.video-surveillance-guide.com contains articles and links related to video surveillance.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 30 hours are suggested to cover *CCTV Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; CCTV System Overview	
A. Introduction	_____
B. CCTV System Overview	_____
1. Typical CCTV System	_____
2. Multiple Cameras with a Switcher	_____
3. Viewing Multiple Cameras with a Splitter	_____
4. Viewing Multiple Cameras with a Multiplexer	_____
5. A Video Recorder Used to Archive Video	_____
Session II. CCTV Technology	
A. CCTV Technology	_____
1. Digital vs. Analog	_____
2. Review of Internet Protocols	_____
3. Client-Server CCTV for the Internet Age	_____
4. Recording and Retrieving Network Video	_____
5. Factors that Affect Digital CCTV	_____
6. Monitoring Video in a Digital CCTV System	_____
7. Network and User Authentication	_____
8. Encryption and Decryption	_____
B. Laboratory	_____
Have the trainees practice programming CCTV system options using the manufacturer's instructions.	

Sessions III–VI. CCTV System Components

A. CCTV System Components

- 1. Cameras
- 2. The Camera Lens
- 3. Camera Mounts and Housings
- 4. Date and Time Generators
- 5. Controllers
- 6. Alarm Interface Units
- 7. Motion Detection
- 8. CCTV Keyboards
- 9. Recorder-Controllers
- 10. Video Monitors

B. PT/Laboratory

Have the trainees select the correct equipment for a CCTV installation. This laboratory corresponds to Performance Task 2.

Session VII. Signal Distribution; Power Sources

A. Signal Distribution

- 1. CCTV Signal Amplifiers
- 2. Distribution Amplifiers for CCTV
- 3. Signal-to-Noise Ratio
- 4. The Importance of Impedance Matching
- 5. Ground Loops
- 6. The Advantages of Fiber Optic Cable in CCTV Applications

B. Power Sources

Sessions VIII and IX. Lighting and Illumination

A. Lighting and Illumination

- 1. Working with Light Conditions
- 2. Measuring Light
- 3. Measuring Reflectivity
- 4. Light Sensitivity of Cameras
- 5. Infrared Lighting and Cameras
- 6. Illumination and Beam Angles
- 7. Managing Backlighting

B. PT/Laboratory

Have the trainees select the correct lens for a given application. This laboratory corresponds to Performance Task 1.

Sessions X and XI. Medium to Large CCTV Systems; Testing CCTV System Video

A. Medium to Large CCTV Systems

1. Control Systems for Large CCTV Installations

B. Laboratory

Have trainees practice programming options for a CCTV System.

C. Testing CCTV System Video

1. Video Equipment Calibration
2. Signal Synchronization

D. Laboratory

1. Have trainees practice measuring and verifying video levels.
2. Have trainees practice syncing and phasing multiple cameras.

E. PT/Laboratory

Have the trainees troubleshoot a CCTV system. This laboratory corresponds to Performance Task 3.

Session XII. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to access control systems, the systems that allow controlled entry or access to areas and resources within a facility. The trainee will learn to identify types of access control equipment and to install readers and access control systems.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Explain the application and operation of access control systems.
2. Identify and explain the uses of the following types of entry equipment:
 - Entry barriers
 - Locking devices, fail safe, and fail secure
 - Entry/exit readers
3. Explain the types of controller topologies.
4. Describe general installation guidelines for entry control system equipment.
5. Install a reader for an entry control system.
6. Install an access control system.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Select components for an access control system.
2. Install an access control system.
3. Troubleshoot an access control system.

Materials and Equipment

Multimedia projector and screen
Electronic Systems Technician Level Four
PowerPoint® Presentation Slides
(ISBN 978-0-13-266258-1)
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Coded credentials
Magnetic stripe cards
Proximity cards
Proximity key ring tags
Smart cards

Electric lock strikes and electric locksets
Electric bolt locks
Electromagnetic locks and push bars
Touch sense bars and cables
Exit switches and accessories
Electric locking device, exit touch bar, controller,
key pad, and tools necessary to install, pro-
gram, test, and troubleshoot an access control
system
Copies of Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* Located at the back of the module.

**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

The Design and Evaluation of Physical Protection Systems, 2001. M.L. Garcia. Burlington, MA: Butterworth Heinemann.

Security, ID Systems, and Locks: The Book on Electronic Access Control, 1997. J. Konicek/K. Little. Burlington, MA: Butterworth-Heinemann.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 35 hours are suggested to cover *Access Control Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction; Entry and Access Control Systems; Controllers and Power Supplies	
A. Introduction	_____
B. Entry and Access Control Systems	_____
1. Non-Staffed Entry Control System	_____
2. Non-Staffed Entry Control System Considerations	_____
3. Access Control Systems	_____
4. Coded Credentials	_____
5. Protective Distribution Systems	_____
C. Controllers and Power Supplies	_____
Session III. Entry/Exit Readers	
A. Entry/Exit Readers	_____
1. Swipe, Insert, and Proximity Readers	_____
2. Biometric Readers	_____
Sessions IV–VI. Locking Devices and Accessories	
A. Locking Devices and Accessories	_____
1. Electric Strikes	_____
2. Electric Bolt Locks	_____
3. Electric Locksets (Latches)	_____
4. Electromagnetic Locks	_____
5. Exit Devices	_____
6. Cable Supervision	_____
7. Door Status Devices	_____

Sessions VII and VIII. Entry Control Barriers

A. Entry Control Barriers

- 1. Gates
- 2. Turnstiles and Rotary Security Doors
- 3. Mantraps
- 4. Doors

Sessions IX–XIII. Installation Guidelines

A. Installation Guidelines

- 1. Installation Tips
- 2. Installation Procedures

B. PT/Laboratory

- 1. Have trainees select components for an access control system. This laboratory corresponds to Performance Task 1.
- 2. Have trainees install an access control system. This laboratory corresponds to Performance Task 2.
- 3. Have trainees troubleshoot an access control system. This laboratory corresponds to Performance Task 3.

Session XIV. Review and Testing

A. Review

B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to networks, the communication links between two or more intelligent devices or components within a computer system. The bus, or data bus, provides the communication pathway for all the devices within the network.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Describe the characteristics, connections, and uses for various types of data transmission media.
2. Explain the operating principles of network topologies.
3. Explain how information is transferred using different network topologies.
4. Explain device communication in an addressable network.
5. Describe the functions of routers.
6. Identify the protocols used with networks.
7. Explain power line carrier communications.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify IP addresses of the devices on a network.
2. Demonstrate various procedures for troubleshooting media access problems to a network.
3. Design a basic network.
4. Demonstrate PC configuration of IP and serial connections.

Materials and Equipment

Markers/chalk	Computers networked with peripheral devices
Pencils and scratch paper	Network router
Whiteboard/chalkboard	Computer equipped with LINUX®, UNIX®, or
<i>EST Level Three</i> PowerPoint® Presentation Slides (ISBN 978-0-13-266251-2)	Mac OS® (if available)
Multimedia projector and screen	Access to a website
Computer	Special receiver module for controlling lighting and appliances
Diagrams of various network topologies	POE network switch
RS-232 cable	Equipment and computers for setting up a net- work
USB cable	Module Examination*
Sufficient networked computers with Internet access	Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Computer Networks. Upper Saddle River, NJ: Pearson Education.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Buses and Networks*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Data Highway; Transfer Medium; OSI Model; Relating Network Protocols to the OSI Model	
A. Introduction	_____
1. History of Networking	_____
B. The Data Highway	_____
1. Serial Communication	_____
2. Parallel Communication	_____
3. Data Buses	_____
C. Transfer Medium	_____
D. OSI Reference Model	_____
1. Protocols	_____
E. Relating Network Protocols to the OSI Model	_____
1. Network-LLC Service Interface	_____
2. LLC-MAC Service Interface	_____
3. Physical Medium Functions	_____
Session II. Network Topologies; Access Control; Security	
A. Network Topologies	_____
1. Star Topology	_____
2. Ring Topology	_____
3. Bus Topology	_____
4. Hybrid Topologies	_____
B. Network Access Control	_____
1. Random Access	_____
2. Polling	_____
3. Dedicated Channel	_____
4. Token Passing	_____
C. Network Security	_____
1. Firewalls	_____
2. Antivirus Software	_____

Session III. The Internet

A. The Internet

- 1. Background
- 2. Transmission Control Protocol/Internet Protocol (TCP/IP)
- 3. Internet Application Protocols

B. Laboratory

Have trainees identify IP addresses of the devices on a network. This laboratory corresponds to Performance Task 1.

Sessions IV and V. Ethernet

A. Ethernet

B. Laboratory

Have trainees design a basic network. This laboratory corresponds to Performance Task 3.

Session VI. Microcomputer-Based LANs; Routers, Bridges, and Gateways

A. Microcomputer-Based LANs

- 1. Basic Input/Output Systems (BIOS)
- 2. Operating Systems
- 3. Networking Software; Network Operating Systems
- 4. Real-Time Performance Issues

B. Routers, Bridges, and Gateways

- 1. Routers
- 2. Bridges
- 3. Gateways
- 4. Repeaters

Session VII. Addressable Systems

A. Addressable Systems

- 1. Analog Addressable Systems

B. Laboratory

Have trainees demonstrate PC configuration of IP and serial connections. This laboratory corresponds to Performance Task 4.

Sessions VIII and IX. PLC Systems; POE Systems

A. Power Line Carrier (PLC) Systems

B. Power Over Ethernet (POE) Systems

C. Laboratory

Have trainees demonstrate various procedures for troubleshooting media access problems to a network. This laboratory corresponds to Performance Task 2.

Session X. Review and Testing

A. Review

B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to the types of equipment and methods used in fiber optic cable installation.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One; Electronic Systems Technician Level Two; and Electronic Systems Technician Level Three; Module 33301-11.*

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Explain the basic principles of fiber optic systems.
2. Identify the uses of various types of fiber optic cables and devices.
3. Explain the features of fiber optic connectors and splices.
4. Describe the design, operation, and performance of a fiber optic system.
5. Explain the requirements for installation of fiber optic cabling and support equipment.
6. Perform a fiber optic termination.
7. Test a fiber optic link.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Perform a fiber optic termination.
2. Test a fiber optic link.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
EST Level Three PowerPoint® Presentation Slides
(ISBN 978-0-13-266251-2)
Multimedia projector and screen
Computer
100- to 200-power microscope
Several pieces of optical fiber with the buffer removed from the ends
Selection of typical cables
Selection of different cables, including simplex, duplex, and multi-fiber
Ribbon cable
Several fibers with different color-coded coatings and buffers
LEDs
Several types of laser beams
One or more VCSELs

Examples of spliced or connected fibers
Examples of passive splitter configurations
Manufacturers' spec sheets for fiber optic cables
Standard and duplex fiber optic cable samples
Selection of distribution hardware:
 Rack box
 Patch panel
 Junction box
Parts and tools to terminate fiber optic cables
Fiber optic patch cable with connectors and pigtails
Selection of common connectors
Selection of older types of connectors
Samples of the most common connectors, including PCs, APCs, UPCs, and SPCs
Fiber optic stripping tools
Fiber optic strands
OTDR
Fiber cleavers

continued

Polishing paper and other supplies as required
Splicing tools
Mechanical splicing kit, if available
Optical power meter

Module Examination*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with fiber optic cable. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Fiber Optic Reference Guide. David R Goff. Woburn, MA: Focal Press.

The Cabling Handbook. 2nd Edition, 2001. John R. Vacca. Upper Saddle River, NJ: Prentice Hall PTR.

The Fiber Optic Association website (www.thefoa.org) contains a variety of information and links for fiber optic equipment, cables, and termination procedures.

OSHA guidelines on laser hazards can be found at: www.osha.gov.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Fiber Optics*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Fiber Optics Theory	
A. Introduction	_____
1. Benefits	_____
2. Applications	_____
B. Fiber Optics Theory	_____
1. Light Generation and Coupling	_____
2. Light Transmission	_____
3. Operational Considerations	_____

Session IX. Splicing; Fiber Optic Testing

A. Splicing

- 1. Applications of Fiber Splices
- 2. Types of Splicing
- 3. Splicing Issues

B. Fiber Optic Testing

- 1. Optical Power Meter
- 2. Insertion Loss Testing and Mode Control
- 3. Fiber Loss Measurements
- 4. Time and Frequency Domains
- 5. Optical Time-Domain Reflectometry

C. Laboratory

Have the trainees perform a light-loss test on a fiber optic link.
This laboratory corresponds to Performance Task 2.

Session X. Review and Testing

A. Review

B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module explains the function and purpose of programmable logic controllers (PLC), different numbering systems used in PLCs, and the hardware and software used in PLCs.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Instrumentation Levels One through Three; Instrumentation Level Four Modules 12401-03 through 12405-03

OBJECTIVES

When you have completed this module, you will be able to do the following:

1. Describe the function and purpose of a programmable logic controller (PLC).
2. Compare hardwired and PLC systems.
3. Count and convert between number systems.
4. Explain the purpose of binary codes.
5. Describe the purpose of the various power supplies used within a PLC.
6. Explain the general function of an input/output (I/O) module, including the following types:
 - Discrete
 - Numerical data
 - Special
 - Remote
7. Explain the power supply and ground connections to I/O modules.
8. State the function of the PLC processor module.
9. Explain the interrelations between the various microprocessor components.
10. State the characteristics of various types of memory.
11. Describe the characteristics and features of a PLC processor module.
12. Explain the purpose of PLC software and firmware.
13. Describe the features and the differences between PLC programming languages.
14. Describe the features of relay ladder logic instruction categories.
15. Explain the principles used to correlate PLC hardware components to software instructions.
16. Program and install a PLC.

PERFORMANCE TASKS

Under the supervision of the instructor, you should be able to do the following:

1. Given a PLC diagram, identify the basic components in a PLC system.
2. Given a ladder logic diagram, point out commonly used symbols and their meaning.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

PLC

Programmable device

Ladder logic printout

Module Examinations*

Performance Profile Sheets*

*Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

Instrumentation, 1975. F.W. Kirk and N.R. Rimboi. New York, NY: American Technical Society.

Basic Instrumentation, 1966. New York, NY: McGraw-Hill.

Process Control Instrumentation Technology, 1977. John Wiley and Sons. New York: NY.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Programmable Logic Controllers*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
Session I. Introduction, Overview, and Number Systems Review	
A. Introduction	_____
B. Overview	_____
1. Hardwired and PLC Systems	_____
2. Hardwired/PLC Systems Comparison	_____
C. Number Systems Review	_____
1. Binary	_____
2. Octal	_____
3. Hexadecimal	_____
4. Codes (Binary)	_____
Session II. Hardware, Processors, and Performance Testing	
A. Hardware	_____
1. Power Supply	_____
2. Input/Output Modules	_____
B. Processors	_____
1. Scanning	_____
2. Memory	_____
C. Performance Testing – Use a PLC diagram to identify the basic components in a PLC system (Task 1).	_____
Session III. Software, Hardware to Program Correlation, and Performance Testing	
A. Software	_____
1. Languages	_____
2. Ladder Diagram Instructions	_____
B. Hardware to Program Correlation	_____
C. Performance Testing – Use a ladder logic diagram to identify the basic components in a PLC system (Task 2).	_____

Session IV. Guidelines for Programming and Installation, Review, and Module Examination

A. Guidelines for Programming and Installation

- 1. Programming
- 2. Installation
- 3. I/O Wiring
- 4. Dynamic System Checkout

B. Review

C. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to the operation, maintenance, and troubleshooting procedures pertaining to broadband systems. The broadband systems covered include cable television (CATV) systems, satellite master antenna television (SMATV) systems, and master antenna television (MATV) systems.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Draw a block diagram of a selected CATV/ SMATV/MATV system headend.
2. Describe the signal flow for selected processing paths in the headend of a CATV/SMATV/MATV system.
3. Identify the different assemblies and components used in CATV/SMATV/MATV systems and describe their function.
4. Select and terminate coaxial cables used for specific applications.
5. Calculate CATV/SMATV/MATV distribution system gains and losses.
6. Use selected test equipment to make measurements and checks in CATV/SMATV/MATV systems in order to evaluate system operation.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Install a video distribution system.
2. Use a signal level meter (SLM) to measure signal strength and slope of a signal.

Materials and Equipment

Multimedia projector and screen
Electronic Systems Technician Level Four
PowerPoint® Presentation Slides
(ISBN 978-0-13-266258-1)
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and paper
Assortment of broadband equipment manufacturers' catalogs
Service manuals for various CATV/SMATV components
Copies of operational CATV/SMATV system as-built drawings and documentation
Copy of the latest edition of the *National Electrical Code*®
Compression connectors for RG-6 or RG-11 cable
Equal lengths of RG-6 and RG-11 coaxial cable for demonstration of cable attenuation loss
Sample lengths of RG-6 and RG-11 coaxial cable
Sample lengths of semiflex coaxial cable
Access to one or more operational CATV/SMATV systems

Assortment (or photos) of headend components including:
Television broadcast receiving antennas and preamps
Broadband VHF and UHF preamplifiers
Satellite-receiving antennas and down-converters
Strip amplifiers
Single-channel converters
Agile heterodyne processors
Demodulators and modulators
Satellite receivers
Stereo encoders
Combiners and splitters
Filters
Assortment (or photos) of distribution system components including:
Distribution amplifiers and line extenders
Splitters
Directional couplers and taps
Attenuators and terminators
Multimeter
Signal generator

continued

Signal level meter (SLM)
 Spectrum analyzer
 Cable tone test set
 Satellite tester
 Portable color TV receiver
 Assorted test cables and related connectors and adapters
 Cable cutter

Coaxial cable stripper
 Coaxial cable compression tool for the specific type of F-connector being used for practicing coaxial cable termination
 Torque wrench (25 to 30 inch-pound range)
 Module Examinations*
 Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

National Electrical Code Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

Wireless Cable and SMATV. Steve Berkoff and Frank Baylin. Boulder, CO: Baylin Publications.

Manufacturer or distributor product literature, available from various cable equipment manufacturers and/or distributors.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 30 hours are suggested to cover *Broadband Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction; Evolution of CATV Systems; Architecture of Cable Systems; Broadband System Basics; Satellite Technology	
A. Introduction	_____
B. Evolution of CATV Systems	_____
C. Architecture of Cable Systems	_____
1. CATV Architecture	_____
2. MATV and SMATV Architecture	_____
D. Broadband System Basics	_____
1. Prefixes	_____
2. Scientific Notation	_____
3. Frequency Spectrum	_____
4. TV Channels	_____
5. Units of Measure	_____
6. Common CATV Symbols	_____

E. Satellite Technology

1. Classification of Satellites
2. Television Satellite Frequency Spectrum Bands
3. Orbital Positions of Satellites
4. Downlink Signal Parameters
5. Areas of Service

Sessions III and IV. Headend Signal Processing; Headend Components

A. Headend Signal Processing

1. VHF/UHF Off-Air Signal Processing
2. Satellite Signal Processing
3. Locally Originated Channel Signal Processing

B. Headend Components

1. Television Broadcast Receiving Antennas and Preamps
2. Satellite-Receiving Antennas and Downconverters
3. Off-Air Processors
4. Demodulators and Modulators
5. Satellite Receivers
6. Stereo Encoders
7. Combiners and Splitters
8. Filters

Sessions V and VI. Distribution System Components; Distribution System Topologies

A. Distribution System Components

1. Distribution Amplifiers and Line Extenders
2. Splitters
3. Directional Couplers and Taps
4. Attenuators and Terminators
5. Coaxial Cables

B. PT/Laboratory

Have trainees install a video distribution system. This laboratory corresponds to Performance Task 1.

C. Distribution System Topologies

1. Home-Run Cable Distribution Systems
2. Loop-Through Cable Distribution Systems
3. Trunk-and-Branch Cable Distribution Systems

Sessions VII and VIII. Distribution System Gains and Losses

A. Distribution System Gains and Losses

1. Cable Losses
2. Splitter Losses
3. Directional Coupler/Tap Losses
4. Calculating Distribution System Gains and Losses

Sessions IX and X. Test Equipment

A. Test Equipment

- 1. Signal Level Meter
- 2. Spectrum Analyzer
- 3. Cable Tone Test Set
- 4. Satellite Signal Level Meter
- 5. Portable Color TV Receiver
- 6. Handling and Using Test Equipment

B. PT/Laboratory

Have trainees use a signal level meter (SLM) to measure the strength and slope of a selected signal. This laboratory corresponds to Performance Task 2.

Session XI. Headend Alignment; Troubleshooting

A. Headend Alignment

B. Troubleshooting

- 1. Customer Interface
- 2. Physical Examination of the System
- 3. Basic System Analysis
- 4. The Use of Manufacturers' Troubleshooting Aids
- 5. Guidelines for Troubleshooting the Distribution System
- 6. Guidelines for Troubleshooting the Headend

Session XII. Two-Way Transmission; Review and Testing

A. Two-Way Transmission

B. Review

C. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

D. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module introduces the instrument trainee to distributed control systems (DCS). It explains the evolution of DCS, the DCS/human interface, and the maintenance of a DCS.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following:

Core Curriculum; Instrumentation Levels One through Three; Instrumentation Level Four Modules 12401-03 through 12406-03

OBJECTIVES

When you have completed this module, you will be able to do the following:

1. Define a distributed control system (DCS).
2. Identify the typical components associated with a DCS.
3. Identify the various network configurations used with a DCS.
4. Describe uses for a DCS.
5. Explain how an instrument technician interfaces with a DCS.

PERFORMANCE TASKS

There are no performance tasks for this module.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Operational DCS or simulator

Module Examinations*

*Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

Instrumentation, 1975. F.W. Kirk and N.R. Rimboi. New York, NY: American Technical Society.

Basic Instrumentation, 1966. New York, NY: McGraw-Hill.

Process Control Instrumentation Technology, 1977. John Wiley and Sons. New York: NY.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Distributed Control Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
Session I. Introduction, Manufacturing, Definition, and Evolution	
A. Introduction	_____
B. Manufacturing	_____
1. Wet and Dry Processes	_____
2. Plant Management	_____
C. Definition	_____
D. Evolution	_____
1. Traditional Control Loop	_____
2. Central Monitoring	_____
3. Central Control	_____
4. Programmable Logic Controllers	_____
5. Distributed Control	_____
Session II. Human Interface	
A. Data Highway	_____
B. Topology	_____
C. Protocols	_____
D. Workstations	_____
E. Local Area Network	_____
F. Remote Communications	_____
Session III. Maintenance	
A. Instruments	_____
B. Calibration	_____
C. Methods	_____
D. Acquiring Expertise	_____
Session IV. Review and Module Examination	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

Module Overview

This module introduces the trainee to intrusion detection systems and notification devices. The trainee will learn how to install and wire these systems, program the control panels, and test and troubleshoot.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Identify and describe intrusion detection system sensing and notification devices.
2. Describe the control equipment and methods used with intrusion detection systems.
3. Configure an intrusion detection system to meet a specified need.
4. Describe system and equipment installation practices.
5. Describe the inspection, testing, maintenance, and troubleshooting practices associated with intrusion detection systems.
6. Install and wire an intrusion detection system consisting of sensors, notification devices, and a control panel.
7. Program a control panel and describe the different components, inputs, and programming options used in controlling intrusion detection systems.
8. Test and troubleshoot an intrusion detection system.
9. Wire an RJ-31X connector for line seizure.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify types of security sensors, notification devices, and control panels.
2. Select the correct sensors, notification devices, and control panels for various applications.
3. Install, wire, and program an intrusion detection system.
4. Troubleshoot an intrusion detection system.

Materials and Equipment

Multimedia projector and screen
Electronic Systems Technician Level Four Power-Point® Presentation Slides
(ISBN 978-0-13-266258-1)
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and paper
Different types of security sensors
Magnetic switch sensors
Glass-break detectors
Burglar alarm screens
Shock (vibration) detectors
Photoelectric detectors
Seismic sensors
Proximity sensors
Different types of glass

Different types of notification devices:
Bells
Buzzers
Horns
Chimes
Sirens
Different types of control panels
Copies of NFPA codes and standards
Copies of *UL Commercial Extent Number 1*
Copies of *ANSI/SIA CP-01, Control Panel Standard – Features for False Alarm Reduction*
Blank copies of the Intrusion System Standby Battery Calculation Form found in *Appendix A*
Sensors, notification devices, control panel, and tools necessary to install, program, and test a security system or simulator

continued

Copies of the latest edition of the *National Fire Alarm Code*
Copies of the latest edition of the *National Electrical Code*®

Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Security for Building Occupants and Assets. The Whole Building Design Guide/National Institute of Building Sciences. www.wbdg.org.

The Design and Evaluation of Physical Protection Systems, 2007. Mary Lynn Garcia. Boston, MA: Butterworth-Heinemann.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 30 hours are suggested to cover *Intrusion Detection Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Intrusion System Overview; Types of Intrusion System Sensors	
A. Introduction	_____
B. Intrusion System Overview	_____
1. Local	_____
2. Monitored	_____
3. Types	_____
C. Types of Intrusion System Sensors	_____
1. Perimeter	_____
2. Interior	_____
Sessions II and III. Annunciation (Notification) Devices; Control Panels	
A. Annunciation (Notification) Devices	_____
1. Strobes	_____
2. Bells, Buzzers, Horns, Chimes, and Sirens	_____
3. Voice Messages	_____

**Sessions VII through IX. System and Equipment Installation Guidelines;
Programming Options**

A. System and Equipment Installation Guidelines

- 1. Minimum Secondary Power
- 2. Control Units
- 3. Perimeter Sensors
- 4. Perimeter Fence or Exterior Detection Systems
- 5. Interior Intrusion Systems

B. Programming Options

- 1. Controlled and 24-Hour Zones
- 2. Entry and Exit Delays
- 3. Delayed and Instant Zones
- 4. Perimeter and Interior Zones
- 5. Home and Away Feature
- 6. Interior and Perimeter Follower Zones
- 5. Panic, Duress, Medical, and Fire Zones

C. PT/Laboratory

Have trainees install, wire, and program an intrusion detection system. This laboratory corresponds to Performance Task 3.

**Sessions X and XI. Inspection, Testing, and Maintenance; Intrusion System
Troubleshooting Guidelines**

A. Inspection, Testing, and Maintenance

- 1. Purpose of Testing
- 2. Before Testing
- 3. Precautions for Occupied Buildings
- 4. Definitions
- 5. General Requirements
- 6. Testing Methodology
- 7. After Testing

B. PT/Laboratory

Have trainees troubleshoot an intrusion detection system. This laboratory corresponds to Performance Task 4.

Session XII. Review and Testing

A. Review

B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor

C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module prepares the trainee to identify equipment and components, support the installation and troubleshooting of audio systems, and commission a system. It provides a basic understanding of audio system theory.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Identify and describe the primary components of an audio system, including:
 - Input devices
 - Output devices
 - Amplifiers
 - Mixers
 - Equalizers
2. Identify typical audio system applications for sound reinforcement.
3. Identify various audio input devices and describe their effects on audio signaling.
4. Identify and describe various processing options for audio signals.
5. Specify proper cabling selection criteria for a given audio system.
6. Identify and use various measurement devices, meters, and other electronic tools used for audio systems.
7. Describe typical audio system troubleshooting techniques.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Mount a speaker.
2. Properly terminate equipment and speakers.
3. Identify audio cable types and applications.
4. Locate a cable within a bundle.
5. Use test equipment to set up a gain structure.
6. Read and interpret specifications and shop drawings.
7. Perform acceptance testing.

Materials and Equipment

Multimedia projector and screen
Electronic Systems Technician Level Four
PowerPoint® Presentation Slides
(ISBN 978-0-13-266258-1)
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and paper
Appropriate personal protective equipment
Sample frequency response diagrams from
speaker systems
Speaker cones
Microphones
Mixers
Distribution amplifiers
Compressors

Gates
Expanders
Transformers
Bulk microphone and speaker cabling
Audio equipment with a VU meter, a PPM, and
an LED meter
Real-time analyzer
Spectrum analyzer
Tone generator
Sound pressure level meter
Oscilloscope
XLR connectors
RCA connectors
Phone jack connectors
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems and with rigging. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Audio Made Easy (OR How to be a Sound Engineer Without Really Trying). Ira White. Milwaukee, WI: Hal Leonard Corporation.

Audio Systems Design and Installation. Philip Giddings. Woburn, MA: Focal Press.

Guide to Sound Systems for Worship. Jon F. Eiche. Milwaukee, WI: Hal Leonard Corporation.

Live Sound Reinforcement. Scott Hunter Stark. Vallejo, CA: Mix Books.

Sound Reinforcement Handbook. Gary Davis and Ralph Jones. Milwaukee, WI: Hal Leonard Corporation.

The Audio Dictionary. Glenn D. White. Seattle, WA: University of Washington Press.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 30 hours are suggested to cover *Audio Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I-III. Introduction; Elements of a Sound Reinforcement System, Part One	
A. Introduction	_____
1. What is Sound?	_____
2. Volume, Pressure, and Speed	_____
3. Audio Systems Applications	_____
B. Elements of a Sound Reinforcement System	_____
1. Microphone Basics	_____
2. Microphone Classifications	_____
3. Speakers	_____
4. Classification of Speaker Types	_____
5. Processing Equipment	_____
6. Signal Processing	_____
7. Amplifiers for Sound Reinforcement	_____
8. Constant-Voltage Audio Distribution	_____
9. Audio Transformers	_____
C. PT/Laboratory	_____
1. Have the trainees mount a speaker. This laboratory corresponds to Performance Task 1.	
2. Have the trainees read and interpret specifications and shop drawings. This laboratory corresponds to Performance Task 6.	

Session IV. Applications of Sound Reinforcement Systems

A. Applications of Sound Reinforcement Systems

- 1. Auditorium Sound Systems
- 2. School and Talkback Intercom Systems
- 3. Paging Systems
- 4. Background Music
- 5. Noise Masking
- 6. Room Combining Systems
- 7. Distributed Residential Audio Systems

Sessions V and VI. Audio Cabling Options

A. Audio Cabling Options

- 1. Impedance Versus Resistance
- 2. Balanced Versus Unbalanced
- 3. Cabling and Wire
- 4. Connectors

B. PT/Laboratory

- 1. Have the trainees identify audio cable types and applications. This laboratory corresponds to Performance Task 3.
- 2. Have the trainees locate a cable within a bundle. This laboratory corresponds to Performance Task 4.
- 3. Have the trainees properly terminate equipment and speakers. This laboratory corresponds with Performance Task 2.

Sessions VII–IX. Instrumentation and Test Equipment

A. Instrumentation and Test Equipment

- 1. Understanding Console Instruments
- 2. Audio Test Instruments
- 3. Real-Time Analyzer
- 4. Impedance Bridges
- 5. Spectrum Analyzers
- 6. Sound Pressure Level Meters

B. PT/Laboratory

- 1. Have the trainees use test equipment to set up a gain structure. This laboratory corresponds to Performance Task 5.

Session X. Installing Audio Systems

A. Installing Audio Systems

- 1. Overview of Installation Activities
- 2. Speaker Rigging
- 3. Troubleshooting an Audio Installation

Session XI. System Commissioning

A. System Commissioning _____

1. General Commissioning Activities _____

B. PT/Laboratory _____

1. Have the trainees perform acceptance testing. This laboratory corresponds to Performance Task 7. _____

C. Commissioning a PA or Intercom System _____

D. Commissioning an Audio System _____

Session XII. Review and Testing

A. Review _____

B. Module Examination _____

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing _____

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Overview of Nurse Call and Signaling Systems

Annotated Instructor's Guide

Module 33409-12

Module Overview

This module introduces the trainee to the basic types and components of nurse call systems used in health care facilities. There are many variations on components but all are strictly controlled by authorities such as NFPA, UL, and NEMA. The trainee will learn some of the components and features and how the systems are used.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Explain key terms related to nurse call systems.
2. Identify the codes and standards that apply to the installation and operation of nurse call systems.
3. Describe the different types of nurse call systems and explain their differences.
4. Explain the limitations on connections between nurse call systems and other systems.
5. State the general installation guidelines that apply to nurse call systems.
6. Install and connect nurse call system components.

Performance Task

Under the supervision of the instructor, the trainee should be able to do the following:

1. Install and connect nurse call system components.

Materials and Equipment

Multimedia projector and screen
Electronic Systems Technician Level Four
PowerPoint® Presentation Slides
(ISBN 978-0-13-266258-1)
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and paper
Copies of *NFPA 70®*, *NFPA 99*, and *UL Standard*
1069 for reference
UPS

If possible, a microprocessor-based audiovisual nurse call system, a pager, or samples of system components
If possible, a three-wire and/or a five-wire pillow speaker
If possible, a pager from a nurse call system
Nurse call system components and a compatible annunciator or central microprocessor
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Overview of Nurse Call and Signaling Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Important Terms; Codes and Standards; Types of Nurse Call Systems	
A. Introduction	_____
B. Important Terms	_____
C. Codes and Standards	_____
1. National Fire Protection Association (NFPA)	_____
2. Underwriters Laboratory (UL)	_____
3. Joint Commission on Accreditation of Health Care (JCAHO)	_____
4. National Electrical Manufacturers Association (NEMA)	_____
D. Types of Nurse Call Systems	_____
1. Visual Systems	_____
2. Audiovisual Systems	_____
3. Microprocessor-Based Audiovisual Systems	_____
Session II. Call Management; Skilled Living and Assisted Living Facilities; System Interfaces	
A. Call Management	_____
B. Skilled Living and Assisted Living Facilities	_____
C. System Interfaces	_____
1. Telephone Equipment	_____
2. Entertainment Equipment	_____
3. Paging Systems	_____
4. Fire Alarm Systems	_____
5. Security Systems	_____
6. Auxiliary Alarm Devices	_____
7. Computers and Printers	_____

Sessions III and IV. Installation Practices

A. Installation Practices

1. Electrical Power Requirements
2. Installation Guidelines
3. Programming

Session V. System Checkout/Commissioning

- A. System Checkout/Commissioning
- B. PT/Laboratory

Have trainees install and connect nurse call system components. This laboratory corresponds to Performance Task 1.

Session VI. Review and Testing

- A. Review
- B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
