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
- 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.


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.

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<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<td>A. Introduction</td>
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<td>B. Common Factors in Cable Selection</td>
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<td>C. Fire Alarm and Security System Cabling</td>
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<tr>
<td><strong>Session II. Coaxial Cable Selection; Telecommunications and Data Cable; Optical Multi-Fiber Cable</strong></td>
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<tr>
<td>A. Coaxial Cable Selection</td>
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<td>B. Telecommunications and Data Cable</td>
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<td>C. Optical Multi-Fiber Cable</td>
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<tr>
<td>D. Laboratory</td>
<td>Have trainees select and size cable for specific applications. This laboratory corresponds to Performance Task 1.</td>
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<td><strong>Session III. Voltage and Power Drop</strong></td>
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<td>A. Conductor Voltage Drop</td>
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<td>B. Coaxial Cable Voltage Drop</td>
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<td>C. Speaker Cable Power Drop</td>
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<tr>
<td>D. Laboratory</td>
<td>Have trainees calculate the voltage drop for various applications. This laboratory corresponds to Performance Task 2.</td>
</tr>
<tr>
<td>E. Laboratory</td>
<td>Have trainees size cable conductors for a load using various load calculation charts. This laboratory corresponds to Performance Task 3.</td>
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<td><strong>Session IV. Review and Testing</strong></td>
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<td>A. Module Review</td>
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<td>B. Module Examination</td>
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</tr>
<tr>
<td>1. Trainees must score 70 percent or higher to receive recognition from NCCER.</td>
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<tr>
<td>2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.</td>
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<tr>
<td>C. Performance Testing</td>
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<tr>
<td>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.</td>
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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.

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


**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.

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<td>D. Type 110 Block Terminations</td>
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<td>G. Modular Plug/Cord Fabrication and Termination</td>
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<td>I. Testing Twisted-Pair Cable</td>
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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
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 PowerPoint® Presentation Slides
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.


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.

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<td>B. CCTV System Overview</td>
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<td>3. Viewing Multiple Cameras with a Splitter</td>
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<td>4. Viewing Multiple Cameras with a Multiplexer</td>
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<td>5. A Video Recorder Used to Archive Video</td>
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<td>A. CCTV Technology</td>
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<td>1. Digital vs. Analog</td>
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<td>2. Review of Internet Protocols</td>
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<td>3. Client-Server CCTV for the Internet Age</td>
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<td>4. Recording and Retrieving Network Video</td>
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<td>5. Factors that Affect Digital CCTV</td>
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<td>6. Monitoring Video in a Digital CCTV System</td>
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<td>7. Network and User Authentication</td>
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<td>8. Encryption and Decryption</td>
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<tr>
<td>B. Laboratory</td>
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</table>

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
- 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, program, 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.


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 2 ½ 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.

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<thead>
<tr>
<th>Topic</th>
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<tbody>
<tr>
<td><strong>Sessions I and II. Introduction; Entry and Access Control Systems; Controllers and Power Supplies</strong></td>
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</table>
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 Mac OS® (if available) |
| EST Level Three PowerPoint® Presentation Slides | Access to a website |
| (ISBN 978-0-13-266251-2) | Special receiver module for controlling lighting and appliances |
| Multimedia projector and screen | POE network switch |
| Computer | Equipment and computers for setting up a network |
| Diagrams of various network topologies | Module Examination* |
| RS-232 cable | Performance Profile Sheets* |
| USB cable | Sufficient networked computers with Internet access |

* 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.


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.

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<td>3. Dedicated Channel</td>
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<td>4. Token Passing</td>
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<td>C. Network Security</td>
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<tr>
<td>1. Firewalls</td>
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<td>2. Antivirus Software</td>
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</tbody>
</table>
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
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

* 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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
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<td><strong>Session I. Introduction; Fiber Optics Theory</strong></td>
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<tr>
<td>A. Introduction</td>
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<td>2. Applications</td>
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<td>B. Fiber Optics Theory</td>
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<td>1. Light Generation and Coupling</td>
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<td>2. Light Transmission</td>
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<td>3. Operational Considerations</td>
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<th>Topic</th>
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<tr>
<td><strong>Session II.</strong></td>
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<td><strong>Session III.</strong></td>
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<td><strong>Session IV.</strong></td>
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<tr>
<td><strong>Session V.</strong></td>
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</table>
**Sessions II and III. Fiber Optic Components; Understanding Light Transmission**

A. Fiber Optic Components
   1. Optical Fiber
   2. Cabling
   3. Types of Cables
   4. Cable Characteristics

B. Understanding Light Transmission
   1. Signal Types
   2. Speed
   3. Light Sources

**Sessions IV and V. Receivers; Connectors, Splices, and Splitters; Installation**

A. Receivers
   1. Basic Receiver Elements
   2. Speed

B. Connectors, Splices, and Splitters
   1. Connectors and Splices
   2. Connector Requirements
   3. Causes of Connection Losses
   4. Splices
   5. Splitters

C. Installation
   1. Direct and Indirect Burial Installation
   2. Aerial Installation
   3. Indoor Installation
   4. Tray and Duct Installation
   5. Conduit Installation
   6. Blown Fiber
   7. Pulling Fiber Optic Cables
   8. Enclosures and Organizers
   9. Distribution Hardware

**Sessions VI–VIII. Terminating Optical Fiber Cable**

A. Terminating Optical Fiber Cable
   1. Mechanical Considerations
   2. Basic Connector Structure
   3. Connector Installation: Field vs. Factory
   4. Fiber Connectors
   5. Connector Installation

B. Laboratory
   Have trainees perform a fiber optic termination. This laboratory corresponds to Performance Task 1.
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

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description</th>
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<tbody>
<tr>
<td>Overhead projector and screen</td>
<td>Appropriate personal protective equipment</td>
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<tr>
<td>Transparencies</td>
<td>PLC</td>
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<tr>
<td>Blank acetate sheets</td>
<td>Programmable device</td>
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<tr>
<td>Transparency pens</td>
<td>Ladder logic printout</td>
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<tr>
<td>Whiteboard/chalkboard</td>
<td>Module Examinations*</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Performance Profile Sheets*</td>
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<tr>
<td>Pencils and scratch paper</td>
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</tbody>
</table>

*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.


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.

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

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
**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.

- 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.

<table>
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<tr>
<th>Topic</th>
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<td><strong>Sessions I and II.</strong> Introduction; Evolution of CATV Systems; Architecture of Cable Systems; Broadband System Basics; Satellite Technology</td>
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<tr>
<td>A. Introduction</td>
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<td>B. Evolution of CATV Systems</td>
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<td>C. Architecture of Cable Systems</td>
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<tr>
<td>1. CATV Architecture</td>
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<td>2. MATV and SMATV Architecture</td>
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<td>D. Broadband System Basics</td>
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<td>1. Prefixes</td>
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<td>2. Scientific Notation</td>
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<td>3. Frequency Spectrum</td>
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<td>4. TV Channels</td>
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<td>5. Units of Measure</td>
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<tr>
<td>6. Common CATV Symbols</td>
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</table>

* 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.
### 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.
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.

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<td>A. Introduction</td>
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<td>B. Manufacturing</td>
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<td>1. Wet and Dry Processes</td>
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<td>2. Plant Management</td>
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<td>C. Definition</td>
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<td>D. Evolution</td>
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<tr>
<td>1. Traditional Control Loop</td>
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<td>2. Central Monitoring</td>
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<td>Session II. Human Interface</td>
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<td>Session III. Maintenance</td>
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<td>D. Acquiring Expertise</td>
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<td>A. Review</td>
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<td>B. Module Examination</td>
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<td>2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.</td>
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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.

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 PowerPoint® Presentation Slides
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.


**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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tr>
<td><strong>Session I. Introduction; Intrusion System Overview; Types of Intrusion System Sensors</strong></td>
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<td>A. Introduction</td>
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<td>B. Intrusion System Overview</td>
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<td>2. Monitored</td>
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<td>3. Types</td>
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<td>C. Types of Intrusion System Sensors</td>
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<td>1. Perimeter</td>
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<td>2. Interior</td>
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<td><strong>Sessions II and III. Annunciation (Notification) Devices; Control Panels</strong></td>
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<td>A. Annunciation (Notification) Devices</td>
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<td>1. Strobes</td>
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<tr>
<td>2. Bells, Buzzers, Horns, Chimes, and Sirens</td>
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<tr>
<td>3. Voice Messages</td>
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</table>

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

Copies of the latest edition of the *National Electrical Code®*
B. Control Panels
   1. Control Units and Combination Systems
   2. Operating Panels (Control Points)
   3. Control Unit/Panel Circuit Labeling
   4. Types of Control Unit Outputs
C. PT/Laboratory
   Have trainees identify types of security sensors, notification devices, and control panels. This laboratory corresponds to Performance Task 1.

Sessions IV and V. Communication and Monitoring; System Design
A. Communication and Monitoring
   1. Communications Options
   2. Monitoring Options
   3. Communication Methods and Systems

B. System Design
   1. Applications
   2. Methods for Connection
   3. UL Certificated Requirements
   4. False Alarm Prevention and False Alarm Control Teams (FACT)
C. PT/Laboratory
   Have trainees select the correct sensors, notification devices, and control panels for various applications. This laboratory corresponds to Performance Task 2.

Session VI. General Installation Guidelines
A. General Installation Guidelines
   1. General Wiring Requirements
   2. Workmanship
   3. Access
   4. Circuit Identification
   5. Power-Limited Circuits in Raceways
   6. Mounting of Detector Assemblies
   7. Outdoor Wiring
   8. Fire-Stopping
   9. Air-Handling Spaces
   10. Hazardous Locations
   11. Wet or Corrosive Environments
   12. Underground
   13. Remote Control Signaling Circuits
   14. Wiring Protection
   15. Floor to Floor Cables
   16. Cables in Raceways
   17. Raceways-Cable Support
   18. Cable Spacing
   19. Elevator Shafts
   20. Wiring Methods
   21. Primary Power
   22. Secondary Power
   23. Grounding
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
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.


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.

<table>
<thead>
<tr>
<th>Topic</th>
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<tr>
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<td>A. Introduction</td>
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<td>2. Volume, Pressure, and Speed</td>
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<td>3. Audio Systems Applications</td>
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<td>B. Elements of a Sound Reinforcement System</td>
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<td>1. Microphone Basics</td>
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<td>2. Microphone Classifications</td>
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<td>3. Speakers</td>
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<td>4. Classification of Speaker Types</td>
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<td>5. Processing Equipment</td>
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<td>6. Signal Processing</td>
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<td>7. Amplifiers for Sound Reinforcement</td>
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<td>8. Constant-Voltage Audio Distribution</td>
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<td>9. Audio Transformers</td>
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<td>C. PT/Laboratory</td>
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<tr>
<td>1. Have the trainees mount a speaker. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>2. Have the trainees read and interpret specifications and shop drawings. This laboratory corresponds to Performance Task 6.</td>
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</table>
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.
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
- 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.

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