Line and Antenna Sweep (LAS)

Competency Requirements

The following is a listing of each topic considered necessary to be included in a course of study towards the education of technicians performing a Line and Antenna Sweep using a frequency domain reflectometer (FDR).

There are 11 categories of knowledge. This COMPETENCY listing is the syllabus, or identification of each individual subject, in which the technician must be knowledgeable and skilled. A special course, fee and hands-on exam from an ETA® approved school are required pre-requisites before sitting for the knowledge exam. Technicians seeking the ETA® Line and Antenna Sweep Technician journeyman certification must also have the basic Associate CET certification.

Technicians seeking the ETA® Line and Antenna Sweep Technician stand-alone certification would be aided by having a basic education in fundamental electronics and wireless communications.

1.0 INTRODUCTION TO ANTENNA SYSTEM COMMISSIONING

1.1. Explain the purpose of antenna system commissioning
1.2. Explain the benefits of antenna system commissioning
1.3. List the technologies available for antenna system commissioning
   1.3.1. Time Domain Reflectometer (TDR)
   1.3.2. Frequency Domain Reflectometer (FDR)
1.4. Define a comparison of TDR and FDR
1.5. List system diagram requirements
1.6. List antenna system commissioning documentation requirements

2.0 RADIO FREQUENCY (RF) FUNDAMENTALS

2.1. Explain the maximum power theorem and maximum power transfer
2.2. Explain impedance mismatch
2.3. Explain signal reflections
2.4. Explain how to calculate reflection coefficient
2.5. Explain voltage standing wave ratio (VSWR)
2.6. Explain standing waves
2.7. Describe return loss
2.8. Compare impedance mismatch versus VSWR or return loss
2.9. Explain attenuation/insertion loss
2.10. Describe electromagnetic wave propagation
2.11. List antenna system components

3.0 MATHEMATICS

3.1. Explain Absolute values
3.2. Describe decibel (dB) math
3.3. Explain decibel values:
   3.3.1. dBm
   3.3.2. dBC
   3.3.3. dBd
   3.3.4. dBi
3.4. Describe power ratios
3.5. Describe voltage ratios
3.6. Explain how to add decibel values
3.7. Explain vector summing

4.0 COAXIAL CABLE FUNDAMENTALS

4.1. Describe coaxial cable construction
4.2. Explain what determines coaxial cable impedance
4.3. Explain “Skin effect” in a conductor
4.4. Explain a coaxial cable equivalent circuit
4.5. Explain coaxial cable velocity factor
4.6. Explain coaxial cable attenuation or cable loss changes with:
   4.6.1. cable size
   4.6.2. frequency

5.0 COAXIAL CABLE INSTALLATION
5.1. Describe RF transmission line hanger usage and mounting conventions
5.2. Explain the importance of hanger spacing
5.3. Describe RF transmission line grounding requirements as defined by codes and standards
5.4. Describe proper grounding kits
5.5. Describe proper weatherproofing procedures
5.6. Explain proper bending radius
5.7. Describe lightning protection recommendations

6.0 RF CONNECTORS
6.1. List connector types
6.2. Explain connector specifications
6.3. Describe connector installation requirements
   6.3.1. List cable preparation procedures
   6.3.2. Explain proper connector torque
6.4. List connector installation tools
6.5. Explain “Passive Intermodulation”

7.0 ANTENNAS
7.1. Explain antenna theory
7.2. List antenna specifications
7.3. Describe antenna wavelength
7.4. Explain velocity factor
7.5. Explain antenna types:
   7.5.1. isotropic
   7.5.2. omni directional
   7.5.3. directional
   7.5.4. dipole
7.6. Explain antenna radiation pattern
7.7. Explain antenna gain
7.8. Explain antenna beam width
7.9. Explain antenna bandwidth
7.10. Explain antenna polarization
7.11. Explain antenna beam tilt factors:
   7.11.1. mechanical
   7.11.2. electrical
7.12. Describe antenna mounting
   7.12.1. Explain the effect of improper mounting
7.13. Explain RF coverage

8.0 FREQUENCY DOMAIN REFLECTOMETER (FDR) TESTING
8.1. Describe adapter usage requirements
8.2. Describe calibration standards usage and care
8.3. Explain calibration importance and requirements
8.4. Explain phase-stable cable requirements and usage
8.5. Describe antenna testing:
   8.5.1. return loss
   8.5.2. frequency bandwidth
8.6. Describe attenuation or insertion loss testing of:
   8.6.1. specific components
   8.6.2. the antenna system
   8.6.3. the difference between insertion loss test and return loss test
8.7. Describe coax cable testing:
   8.7.1. attenuation or cable loss
8.7.2. return loss or match
8.7.3. distance-to-fault return loss

8.8. Describe antenna system testing:
  8.8.1. return loss or match
  8.8.2. distance-to-fault
  8.8.3. Antenna system sweep “signatures”

9.0 FREQUENCY DOMAIN REFLECTOMETER TEST INTERPRETATION
9.1. Compare measured component(s) return loss values with manufacturer specifications:
   9.1.1. feed line
   9.1.2. connector
   9.1.3. antenna response
   9.1.4. other components
9.2. Explain how to calculate expected system return loss value and compare to measured value:
   9.2.1. utilizing software tool(s)
   9.2.2. demonstrating knowledge of function
9.3. Compare location of component(s) on the system diagram to the measured locations
   9.3.1. Identify system components at appropriate levels
   9.3.2. Identify fault locations
   9.3.3. Identify possible fault causes
9.4. Antenna system sweep signature characteristics
   9.4.1. Identify antenna meets spec

10.0 FREQUENCY DOMAIN REFLECTOMETER OPERATION
10.1. Describe the FDR calibration process
10.2. Explain setting markers and limit lines
10.3. Describe selecting test type or mode
10.4. Describe selecting display amplitude and/or auto scale
10.5. Describe selecting test frequency range
10.6. Describe selecting test distance range
10.7. Describe selecting cable type for a DTF test
10.8. Describe setting windowing or smoothing option
10.9. Describe storing and recalling a trace
10.10. Explain how to name a trace
10.11. Describe setting FDR time and date
10.12. List software tools

11.0 TROUBLESHOOTING
11.1. Describe common antenna problems
11.2. Describe common cable problems
11.3. Describe common connector problems
11.4. Describe how to compare baseline sweep traces with current traces

End of Line and Antenna Sweep Technician Competencies Listings

Find An ETA Approved School / Test Site: http://www.eta-i.org/testing.html
Suggested Additional Study Material and Resources:
Useful white papers can be found at the following web sites:
http://birdrf.com/ and www.anritsu.com
Useful web sites:

Basic Radio, Principles & Technology; Ian Poole; ISBN 978-0750626323; Newnes; 1994; pp.224

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ETA certification programs are accredited through the ICAC, complying with the ISO/IEC 17024 standard.