Course ID
RF-TECH
Course Duration
4 days

Course Title
RF for Technicians: A Fast-Track Workshop

Related Courses

- RF Systems: Principles, Design, and Deployment (3 days, RFSYS)
- RF Propagation, Fading, and Link Budget Analysis (2-3 days, RFPROP)
- Antennas: Characteristics, Deployment, and the Future (1 day, ANTENNA)
- State-of-the-art of Wireless Communications for Non-engineering Professionals, Managers, and Executives (2-4 days, WIRELESS-EXEC)
- Wireless All-in-One: RF Propagation, Cellular Principles, Personal Radio Services, WiFi, WiMAX, CDMA, and GSM (5 days, All-IN-ONE)
- RF Systems Optimization Workshop: GSM, GPRS, EDGE, UMTS, cdmaOne, 1xRTT, EVDO (3-5 days, RFOPT)
- WiMAX: Technology, Business, and Competitive Landscape (2 days, WIMAX-BIZ)
- State-of-the-art of WiFi for Non-engineering Professionals, Managers, and Executives (1 day, WIFI)
- State-of-the-art of Satellite Communications for Non-engineering Professionals, Managers, and Executives (1 day, SATCOM- EXEC)
- State-of-the-art of VoIP Technology for Professionals, Managers, and Executives (1 day, VOIP-EXEC)
- GSM: A Technology Overview (1 day, GSM-B)
- iDEN™: A Technology Overview (1 day, IDEN-O)
- Wireless Network Structure, Operation, and Technologies (3 days, WIRELESSNET)
- Wireless Technologies: A Comparative Study (2-4 days, COMPARISON)

Aimed At

Entry- to mid-level RF technicians who need to understand the important principles of radio frequency communications that underlie their profession.

Group Size

5-25

Prerequisites

While there are no formal prerequisites for this course, some prior exposure to RF and background as an RF or IT technician will be helpful.

Course in a Nutshell

This intensive four-day workshop will help you master the key concepts, principles, and techniques that underlie radio frequency (RF) communications. Covered are the Physics and Mathematics of RF, RF transmission and reception, RF propagation, link budgets, antennas, radio transmitters and receivers, Supervisory Control and Data Acquisition (SCADA), testing and troubleshooting techniques and equipment, and more.

Customize It!

Depending on the level of the audience's experience and requirements, the course may be customized by omitting or adding topics (thereby shortening or expanding the course), usually at little to no added cost. Let us know how we can make this course fit your job requirements.

Learn How To

- Define the various terms associated with the radio frequency technology
- Use the basic mathematical formulas associated with RF components and networks
- Understand the prefixes applicable to operating frequencies and wavelengths
- Characterize the various groups in the radio frequency spectrum
- Determine the loss in an RF signal using the inverse law formula
- Describe the impairments associated with an RF channel
- Explain the procedure for computing the dimensions of a Fresnel zone
- Describe the purpose and use of the decibel
- Define full duplex and half duplex transmission modes
- List the types of RF modulation techniques and describe how they are used in various applications, e.g., cellular, microwave, broadcasting, and satellite
- Define bits per hertz, bit rate, and symbol rate
- Describe the benefits and tradeoffs between digital and analog modulation
- Work with link budget parameters in designing a basic microwave link
- Identify the basic block diagram level components in a transmitter and receiver
- Summarize the various antenna types and their applications
- Describe the safety precautions associated with antenna/tower grounding
- Develop skills in working with antenna gain and EIRP parameters
- Describe the impact of VSWR values on antenna and feed line performance
- Explain the basic features, operation and components of SCADA networks
- Employ the basic techniques and test equipment associated with troubleshooting and maintaining RF networks and transmission systems

Course Outline

- Introduction to Radio Frequency (RF) Communications
    - Definition of RF
    - Concepts, terms, and acronyms of RF propagation
    - Electric (E) and magnetic (H) fields
    - (E) and (H) field antenna polarization
    - Operating frequency or wavelength prefixes
    - Channel center frequency and channel bandwidth
    - Electromagnetic spectrum
    - Spectrum groups
        - The ITU bands
        - The IEEE band definitions
- Radio Frequency (RF) Transmission, Reception, and Propagation
    - Sky wave vs. ground wave propagation
    - Line-of-Sight (LOS) and non-Line-of-Sight (non-LOS) propagation
    - Free space path loss models

- The inverse power loss model
- Factors affecting the behavior of radio waves
  - Reflection
  - Refraction
  - Scattering
  - Diffraction
  - Fading
  - Ducting
  - Electromagnetic interference
  - Earth curvature
  - Fresnel Zones
- Wireless transmission systems operational modes
  - Simplex
  - Half duplex
  - Full duplex
- Basic modulation theory
  - Types of modulation
  - Amplitude modulation
  - Frequency modulation
  - Introduction to digital modulation techniques
  - On-off keying
  - Coherent phase shift
  - FSK
  - PSK
  - BPSK and QPSK
  - QAM
  - Spread spectrum modulation
  - Frequency hopping spread spectrum
  - Direct sequence spread spectrum
- Bits per second per hertz efficiency
- Bit rate vs. symbol rate
- Digital and analog modulation techniques: Advantages and disadvantages

- Lab 1: Mastering the RF Mathematics
  - Using the decibel
  - Frequency and wavelength relationship
  - Calculating frequency and wavelength values
  - Using the powers of 10
  - Frequency and wavelength prefixes
  - Impedance measurement
  - Forward and reflected power
  - Voltage Standing Wave Ratio (VSWR)
- Lab 2
  - Computing the dimensions of a Fresnel zone
  - Using the decibel

- Lab 3
  - Planning a microwave site installation
  - Using the link budget worksheet
- Radio Transmitter and Receiver Components
  - Transmitter chain components
  - Receiver chain components
  - Frequency conversion units
  - Up and down block converters
  - RF amplifiers
  - Synthesizers
  - Source coding and error correction techniques
  - Voice compression schemes
  - Tradeoff between greater compression and voice quality
  - Multiplexers
  - Analog to digital converters
  - Coding and encryption
  - Antenna designs and configurations: HF, VHF, UHF and SHF
    - Antenna polar radiation pattern plots
    - The isotropic antenna standard
    - Dipole
    - Vertical
    - Yagi
    - Parabolic reflectors
    - Horns
    - Antenna feeds and impedance matching
      - Hard-line
      - Waveguide
    - Antenna gain and EIRP
    - Antenna tower grounding requirements
- Lab 4
  - Calculate the gain and EIRP of an antenna
  - Calculate the dimensions for a half-wave dipole antenna
  - Calculate the loss in an antenna transmission feed line
  - Determine the VSWR using a specified transmission line
- Introduction to Supervisory Control and Data Acquisition (SCADA)
  - Data acquisition
  - Networked data communication
  - Data presentation
  - Control
  - Sensors and RTUs
  - Master units
  - Data backhaul
  - Telemetry groups

- RF Testing, Troubleshooting and System Measurement Techniques
    - Measuring link performance
    - Carrier to interference and signal to interference ratio
    - Bit error rate (BER)
    - Burst errors
    - Dropouts due to rain
    - Minimum discernable signal
    - Intermodulation distortion
    - 3rd order intermodulation definition
    - Measuring Intersymbol interference
    - Parasitic oscillations and spurs
    - Rain attenuation and link margins
- Lab 5: Calculate the Rain Margin Required for a Microwave Link at a Specific Carrier Frequency
- Testing, Diagnostic, and Trouble-shooting Equipment
    - Oscilloscopes
    - Microwave network analyzers
    - Spectrum analyzers
    - Signal generator
    - Noise figure meter
    - Power meters
    - SWR meters
    - Volt meters
    - BER testers
- Lab 6: Select the Proper Test Equipment for a Given Troubleshooting Problem
- Wrap-up: Course Recap, Questions/Answers, Evaluation

How You Will Learn

- This course will be taught in lecture/workshop format by an instructor who's an expert on a host of RF technologies and equipment as well as an excellent teacher.
- If you already know something about RF, we will build on that knowledge. We will use graphics, examples, and analogies to simplify the more theoretical or complex topics and relate them to your job.
- The Participant Handbook will provide you with a structure to which you can add the information and insight gained in real-time, turning it into a useful reference tool you can use back on your job.

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