GENERAL SERVICES ADMINISTRATION

CONTRACT NUMBER: GS-35F-261GA

FEDERAL SUPPLY SERVICE CATALOG/PRICELIST

CONTRACT END DATE: March 1, 2022

BRYANT SOLUTIONS
RF ENGINEERING & TRAINING SERVICES

A Veteran-Owned Small Business (VOSB)
Certified by the U.S. Department of Veterans Affairs

GSA SIN 132-50 TRAINING COURSES
SIN 132-50 NAICS Code: 611420 and 611430

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On-line access to contract ordering information, terms and conditions, up-to-date pricing, and the option to create an electronic delivery order is available through GSA Advantage!, a menu-driven database system. The INTERNET address for GSA Advantage! is https://www.gsaadvantage.gov.

GSA Contract No. GS-35F-261GA
Document Number: 0210-03170-CO
Last Updated: 10/15/2020
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ABOUT BRYANT SOLUTIONS, INC.

OUR CORE FOCUS: RADIO FREQUENCY (RF) TRAINING

WHO WE ARE

Have you ever passionately worked on something you just couldn’t figure out and then miraculously, after hard work and determination, the solution presented itself? Remember the great feeling of accomplishment you had at that moment? This is exactly what we strive for with our training material, training style, and most importantly, with the students we teach. It is a never ending and very passionate journey to find better and better ways to get people to that point where you can see it in their eyes, they “get it”.

Bryant Solutions, Inc. provides customizable hands-on RF training that inspires people to learn, while focusing on the ultimate goal, which is mission success.

Jim Bryant founded Bryant Solutions, Inc. in 2002. Mr. Bryant served 4 years in the United States Air Force (USAF) working on laser guidance systems for the F-111F fighter jet. After leaving the service, Jim officially began his career in the RF industry working on particle (ion) accelerators, which included a system prototype for detecting explosives in luggage using protons and systems for the Superconducting Super Collider. Jim received his BSEE from the University of California, Davis.

Today, our technical advisors ensure we are on the leading edge of technology. We are constantly improving our proprietary equipment and training material to enhance a client’s experience. Our ultimate goal is to provide the best training a client has ever had.
TRAINING OVERVIEW
SIN 132-50, NAICS CODES: 611430, 611519, 611710

Bryant Solutions, Inc. takes proprietary and dynamic hands-on training to a higher standard compared to traditional canned training. Our core focus is manufacturer-neutral RF, fiber, and network security training.

We develop unique and distinct training for our clients. The company’s specialized hardware and material along with a client’s test equipment and systems are used to recreate real-life scenarios in our courses. Our proven and effective methodologies empower clients and enable organizations to exceed targeted goals.

Bryant Solutions, Inc. has developed proprietary automated online validation processes to augment our classroom training. These self-paced processes replace tests and are based on repetition and learning by making mistakes. This gives our client’s the highest probability of mission success. Typical canned training uses a written exam to test knowledge learned and the teaching process ends when the instructor leaves the classroom. We feel the most important part of the learning process begins after the classroom.

Our validation (testing) processes are a combination of pseudorandom online questions, labs using test equipment, fieldwork, and an exit phone interview. The online questions and fieldwork are an opportunity to apply learned topics, determine current knowledge level, and where additional assistance is required. It works.

The following is a partial list of training topics and equipment we cover:

- RF Fundamentals to Advanced Topics
- Time vs. Frequency Domain
- RF Systems - Customer Specific
- RF Components - Customer Specific
- RF Signal Analysis & Tracking
- Microwave Systems
- Radar Systems
- Satellite Communications
- Land Mobile Radio Systems (LMRS)

- Electronic & Information Warfare
- Technical Surveillance Countermeasures (TSCMs)
- Spectrum Analyzers & Receivers
- Oscilloscopes
- Power Meters/Sensors
- Vector Signal Analyzers (VSAs)
- Vector Network Analyzers (VNAs)
- Vector Voltmeters (VVMs)
- Cable & Antenna Analyzers
COURSE TITLE: FIELD MENTORING

COURSE NUMBER: 1704-00185-EN

DAY: 1-Day

GSA PRICE: $2,421.82 Per Day, 3-Students Maximum
(Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom and/or Field

RECOMMENDED PREREQUISITES: Completion of Bryant Solutions course(s) being reviewed.

DESCRIPTION: This is a customizable one-on-one and continuing education course. Mentoring can be presented in the classroom and/or in the field. This is a great avenue for individuals who need a refresher or want to get more in depth with course material from one or more Bryant Solutions courses. Individuals apply learned topics, determine their current knowledge level, and where they need to concentrate more effort and/or need additional direction from Bryant Solutions. Normally when an individual becomes more knowledgeable, they in turn become confident enough to break old “bad” habits. This in turn leads to the defined objectives for this course. The frequencies, pertinent signals, and network testing scenarios are tailored to each specific customer’s requirements.

OUTLINE: To be determined by customer. Involves the review of material from a course(s) offered by Bryant Solutions. This is performed via a whiteboard in a classroom and/or in the field using customer specific systems and equipment.
TRAINING COURSE

COURSE TITLE: WIRELESS NETWORK SECURITY

COURSE NUMBER: 0300-00980-EN

DAY(S): 3-Days

GSA PRICE: $1,971.27 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: None

DESCRIPTION: No prior knowledge of networking is required. The goal of this course is to teach individuals how to properly setup wireless (WiFi) networks against varying levels of external threats. Students will implement actual networks in class and then see how well they survive against external threats. Topics include a review of the various levels of network security, how to identify and avoid rogue devices, improper network segmentation and protocols, MAC address limitations, and the various tools available to evaluate and monitor your network’s security against external threats. Our approach is different in that we teach by giving students the tools to learn through classroom labs.

OUTLINE

1. Ethical and Legal Discussion
2. Terminology
   a. Wireless vs. LAN Networks
   b. Networking (TCP, Packets, Etc.)
   c. Routing and Network Segmentation
3. Threats
   a. Open Networks
   b. Weak and Default Passwords
   c. Privileged Escalation
   d. Rogue Devices
4. Sniffing Wireless Networks
5. Security
   a. Encryption
   b. SSID Broadcasting
   c. Mac Address Limitations
   d. Network Segmentation
   e. Intrusion Detection Devices
6. Monitor and Record Attacks
COURSE TITLE: COUNTER SURVEILLANCE & SPECTRUM ANALYSIS

COURSE NUMBER: 0300-03160-EN

DAY(S): 2-Days

GSA PRICE: $1,576.43 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: None

DESCRIPTION: This workbook-based manufacturer neutral course focuses on locating surveillance devices using spectrum analyzers and counter-surveillance equipment for technical surveillance counter-measure (TSCM) professionals. No prior knowledge of spectrum analysis or counter surveillance equipment is required. Surveillance devices include cameras, listening devices, and tracking devices.

OUTLINE

1. Ethical and Legal Discussion
2. Terminology
3. RF Fundamentals – Basic Review
4. Spectrum Analyzers and/or Receivers
   a. Screen Definitions
   b. Frequency Span vs. Sensitivity
   c. Internal Attenuation and Preamplifier
   d. Identifying Test Unit Saturation
   e. VBW & Basic RBW
   f. Span vs. RBW vs. Noise Level
   g. Test Unit Saturation (Overloading)
5. Signal/Device Identifications
6. Counter Surveillance Devices
7. Scenarios
TRAINING COURSE

COURSE TITLE: ADVANCED NOISE APPLICATIONS FOR WIRELESS SYSTEMS

COURSE NUMBER: 0300-00204-EN

DAY(S): 4-Days

GSA PRICE: $2,339.73 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: Firm understanding of RF fundamentals, cable/antenna analyzers, and spectrum analyzers. Call for recommended courses we offer.

DESCRIPTION: This course covers the absolute power, noise and signal power density, noise figure (NF), and signal-to-noise (SNR) of customer specific RF components, frequencies, and systems. Customer specific system configurations are recreated in the classroom, so students learn by using their spectrum analyzers and/or watt meters to determine the NF impact of various designs. Y-Factor diagrams are created in class to determine the NF. Students learn the drawbacks of using a spectrum analyzer versus a watt meter. Multiple approaches are provided to determine SNR. Also includes a more detailed look at band pass filters and their equivalent noise bandwidth (ENBW) and shape factor.

OUTLINE

1. Signal-to-Noise (SNR) Ratio
   a. SNR
   b. Noise Density (ND)
   c. Sum of Noise
   d. kT

2. Noise Figure (NF) Definition
   a. SNR
   b. Noise Density (ND)
   c. Sum of Noise
   d. kT

3. Measuring NF
   a. Spectrum Analyzer
   b. One Gain Stage
   c. Multiple Gain Stages
   d. Wireless Systems

4. How NF Combines
   a. Friis’ Equation
   b. Level Diagrams
   c. Signal Chain
   d. Design Considerations
   e. Splitters/Combiners
   f. Loss/Gain Calculations

   a. Absolute Power
   b. Watt Meter vs. Spectrum Analyzer Measurements
   c. Power Spectral Density (PSD)
      • Noise Power Density (NPD)
      • Noise Figure Density (NFD)
      • Signal Power Density (SPD)
      • kTB

6. Filter Shape Factor

7. Equivalent Noise Bandwidth (ENBW)

8. Filters
   a. Vector Network Analyzer (VNA)
   b. Spectrum Analyzer
COURSE TITLE: COMPRESSION AND ITS MEASUREMENTS

COURSE NUMBER: 0300-00228-EN

DAY(S): 3-Days

GSA PRICE: $1,971.27 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: Firm understanding of RF fundamentals, noise, power meters, and spectrum analyzers. Call for recommended courses we offer.

DESCRIPTION: This course covers the analysis of the non-linear (top end) portion of a system’s performance parameters. Students use their knowledge and hands-on experience gained from our noise applications course to calculate and measure a system’s dynamic range. Spectrum analyzers, power meters, and/or receivers are used on various in-class labs to learn topics via hands-on analysis. Topics include the generation and analysis of a system’s transfer function and its 1 dB and 3 dB saturation points, the impact to a system’s transfer function as the input power changes, and the impact of intermodulation (mixing). Students learn how to measure and calculate the system 3rd order input intercept point (IIP3).

OUTLINE

1. Transfer Function (TF)
   a. PSAT / Limiting
   b. P1dB
   c. P3dB
   d. Gains (GS and GR)

2. Multi-Signal (Electrical)
   a. Mixing Products
   b. IM3, IM5, etc.
   c. Input and Output Intercept Points (IIP and OIP)
   d. Relation to Transfer Function (Variable PIN)
   e. Limiting (Signal Suppression Effect)

3. Multi-Signal (Environment): PIM Effects

4. Dynamic Range ≡ Top End - Bottom End
   a. Bottom End
      • Noise Figure
      • Noise Floor
   b. Top End
      • Compression Effects
      • System Metrics Limits
TRAINING COURSE

COURSE TITLE: RF FUNDAMENTALS
COURSE NUMBER: 0300-00642-EN
DAY(S): 5-Days
GSA PRICE: $2,591.88 pp (Does not include instructor travel expenses.)
TRAINING TYPE: Instructor-Led Classroom
RECOMMENDED PREREQUISITES: None

DESCRIPTION: Our workbook-based and exercise-intensive RF Fundamentals course takes a very detailed step-by-step approach to building a strong RF background. This course requires no background in RF. It is a combination of RF theory presented via a whiteboard and exercises to strengthen concepts presented. Individual and group exercises are used to remove stress and make learning RF a fun process. Course content is customizable using our secure online form. Spectrum analyzers and cable/antenna analyzers will be introduced in this course. No prior experience with RF test equipment is required. Students who successfully fulfill the requirements for the classroom training, are eligible to complete its related online certification. We recommend completing this course back-to-back with our Spectrum Analyzers and Power Meters/Sensors Course (0300-00455-EN).

OUTLINE
1. dB, dBx, and dBx/xHz Fundamentals
2. Composite, Peak Power, Thermal Noise, Noise Figure, and Noise Factor
3. Attenuators/Couplers/Combiners/Splitters/Filters/Coaxial Cable
4. Amplifier TOI, IIP3, OIP3, P1dB, and PSAT
5. Cascaded Amplifiers Noise, Noise Figure, Noise Factor, and Gain
6. Antenna Patterns, Parameters, and Isolation
7. Harmonics and Intermodulation Products
8. Return Loss, Distance-to-Fault (TDR and/or FDR), and Insertion Loss
9. Link Budget, EIRP, Free Space Loss, and Inverse Square Law
TRAINING COURSE

COURSE TITLE: SPECTRUM ANALYZERS & POWER METERS/SENSORS

COURSE NUMBER: 0300-00455-EN

DAY(S): 3-Days

GSA PRICE: $1,971.27 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: RF Fundamentals Course (0300-00642-EN)

DESCRIPTION: This workbook-based and exercise-intensive course takes a very detailed step-by-step approach to building a strong understanding of spectrum analyzers and power sensors. This course requires a strong background in RF Fundamentals. It is a combination of RF theory presented via a whiteboard and exercises to strengthen concepts presented. Individual and group exercises are used to remove stress and make learning RF a fun process. Course content is customizable using our secure online form. No prior experience with spectrum analyzers and power meters/sensors is required. Students who successfully fulfill the requirements for the classroom training, are eligible to complete its related online certification. We recommend first completing the course RF Fundamentals (0300-00642-EN) and both courses should be completed back-to-back.

OUTLINE

1. Screen Functionality and Key Functions/Ratios
2. Internal/External Attenuation and Internal LNA vs. Noise Level
3. RBW vs. Peak Power, Power Density, and Noise Level
4. Test Unit Saturation, Spectrum Analyzer Detectors
5. Signal Analysis
6. Power Meters/Sensors
7. Power Meters/Sensors vs. Spectrum Analyzer Power Measurements
TRAINING COURSE

COURSE TITLE: RF FUNDAMENTALS, SPECTRUM ANALYZERS, & POWER METERS/SENSORS

COURSE NUMBER: 0300-01045-EN

DAY(S): 5-Days

GSA PRICE: $2,591.88 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: Prior Experience/Training or BSEE degree (or similar).

DESCRIPTION: This course focuses on strengthening knowledge of RF Fundamentals, cable/antenna analyzers, spectrum analyzers, and power meters/sensors. Our classroom process is a combination of RF theory via a whiteboard, hands-on labs to validate information presented, and tests using customer-specific equipment. Students who successfully fulfill the requirements for the classroom training, are eligible to complete its related online certification. All our certifications are designed to validate course objectives in the field on customer-specific systems at normal operating power levels. Students completing this process will be prepared for advanced RF courses and certifications.

OUTLINE

1. RF Fundamentals
   a. dB, dBA, and dBa/Hz Fundamentals
   b. Composite, Peak Power, Thermal Noise, Noise Figure, and Noise Factor
   c. Attenuators/Couplers/Combiners/Splitters/Filter/Coaxial Cable
   d. Amplifier TOI, IIP3, OIP3, P1dB, and PSAT
   e. Cascaded Amplifiers Noise, Noise Figure, Noise Factor, and Gain
   f. Antenna Patterns, Parameters, and Isolation
   g. Harmonics and Intermodulation Products
   h. Return Loss, Distance-to-Fault (TDR and/or FDR), and Insertion Loss
   i. Link Budget, EIRP, Free Space Loss, and Inverse Square Law

2. Spectrum Analyzers and Power Meters/Sensors
   a. Screen Functionality and Key Functions/Ratios
   b. Internal/External Attenuation and Internal LNA vs. Noise Level
   c. RBW vs. Peak Power, Power Density, and Noise Level
   d. Test Unit Saturation, Spectrum Analyzer Detectors
   e. Signal Analysis
   f. Power Meters/Sensors
   g. Power Meters/Sensors vs. Spectrum Analyzer Power Measurements
TRAINING COURSE

COURSE TITLE: SHIP RADAR, SURVEILLANCE, & COMM SYSTEMS
ADVANCED RF TROUBLESHOOTING

COURSE NUMBER: 0300-03716-EN

DAY(S): 5-Days

GSA PRICE: $2,591.88 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom


DESCRIPTION: This manufacturer-neutral course focuses on ship radar, surveillance, and communication systems and how they can interact to impact performance. Our classroom process involves advanced practical RF theory via a whiteboard and hands-on labs to validate information presented. A student’s proven understanding of RF Fundamentals and test equipment is coupled with advanced RF topics and scenarios presented in this course to understand how to troubleshoot complex RF scenarios on ships. Students who successfully fulfill the requirements for the classroom training, are eligible to complete its related online certification. The certification for this course is designed to be completed while a ship is out at sea and systems are operating at normal or full power. This supported process ensures students can apply topics learned to support their mission.

OUTLINE

1. Advance RF Topics
   a. Noise Figure (NF): SNR, Noise Density, Sum of Noise, & kT
   b. Noise Summing (Non-Coherent) and Sinusoid Summing (Coherent)
   c. How NF Combines
      • Friis Equation, Level Diagrams, and Signal Chain
      • Splitters/Combiners and Loss/Gain Calculations
   d. Power Spectral Density
      • Noise Power, Noise Figure, and Signal Power Density
      • kTB
   e. Compression
   f. Dynamic Range: Noise Figure vs. Compression

2. Radar, Surveillance, and Communication System Analysis and Interaction
   a. General Terms
   b. Impact to Performance and Coverage

3. Troubleshooting Techniques and Scenarios
COURSE TITLE: ADVANCED NON-IONIZING RADIATION EMISSION & LEAKAGE TESTING

COURSE NUMBER: 0300-01035-EN

DAY(S): 3-Days

GSA PRICE: $1,971.27 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: Firm understanding of RF Fundamentals and spectrum analyzers. Call for recommended courses we offer.

DESCRIPTION: This manufacturer-neutral course focuses on non-ionizing radiation (NIR). We teach individuals how to properly identify, capture, measure, report, resolve and prevent emission issues per relevant standards. This is an advanced course that applies a student’s proven understanding of RF Fundamentals and test equipment. Our classroom process takes fundamental and complex mathematical relationships and breaks them down into simple to understand hands-on steps using whiteboard practical examples and hands-on labs to validate information presented. Students who successfully fulfill the requirements for the classroom training, are eligible to complete its related online certification. This supported process ensures students can apply topics learned to support their company goals. Course content is customizable using our secure online form.

OUTLINE

1. Units & Terminology
2. Emission/Leakage Propagation
   a. Electromagnetic Fields
   b. Spherical Wavefront (Inverse Square Law)
3. Standards (Local/Regional)
   a. Absorption Rate vs. Resonance
   b. Percent Standard – Multiple Signals (Masks)
4. Over-the-Air Analysis Considerations
   a. True Power vs. Power Density (Peak Power/RBW)
   b. Near vs. Far Fields (Distance Effects)
5. Meters vs. Spectrum Analyzers
6. Probe Properties
7. Environmental Measurement Scenarios
TRAINING COURSE

COURSE TITLE: RF FUNDAMENTALS, MICROWAVE COMMUNICATIONS & INTERFERENCE ANALYSIS

COURSE NUMBER: 0300-00355-EN

DAY(S): 5-Days

GSA PRICE: $2,591.88 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: None

DESCRIPTION: This workbook-based manufacturer neutral course focuses on RF fundamentals, microwave optimization, internal system troubleshooting, and external interference analysis. Course can be customized for coaxial and/or waveguide transmission lines depending on customer requirements. Test equipment includes microwave cable and antenna analyzers and spectrum analyzers. Classroom lab exercises are coupled with customer specific equipment and systems when possible (details can be provided via our secure online customization form). Discussion of theory (presented via whiteboard) is coupled with hands-on exercises to validate points and strengthen understanding. This is not a canned PowerPointTM presentation. Our workbook-based approach allows examples and labs to be easily customized to each customer’s needs.

OUTLINE

1. RF Fundamentals and Microwave Basics
2. Waveguide vs. Coax Transmission Lines for Microwave
3. Parabolic Antenna and Propagation Characteristics
4. Advanced System Analysis (Waveguide and Coax Systems)
   a. Sweep Equipment Calibration, Return Loss and Distance-to-Fault (DTF)
   b. Waveguide Polarization (If Applicable) and Components (Filters, Combiners, Antenna, Etc.)
   c. Calculation of System EIRP
5. Point-to-Point Loss Calculation (Link Budget Analysis)
   a. Fading, Distortion, Terrain, Atmospheric and Weather Effects
   b. Antenna Height vs. Performance
6. Calculating the Probability of Outages
7. External Interference
   a. Spectrum Analyzers and/or Receivers,
   b. Downconverters (If Applicable)
   c. Signal Analysis and Tracking
TRAINING COURSE

COURSE TITLE: PRINCIPLES OF ANTENNAS & RF PROPAGATION

COURSE NUMBER: 0300-00229-EN

DAY(S): 3-Days

GSA PRICE: $1,971.27 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: Firm understanding of RF fundamentals, cable/antenna analyzers, and spectrum analyzers. Call for recommended courses we offer.

DESCRIPTION: This course takes what can be a complex (and sometimes boring) subject and breaks it down into simple to understand steps via hands-on labs. Course work can also include the analysis of actual complex customer specific spectrum issues in the field. Students learn how to properly setup their spectrum analyzers to measure, capture and analyze over-the-air signals for multiple scenarios per FCC regulations. This includes interference between a public safety channel and adjacent commercial spectrum. Topics include RF propagation and its impact on modulated signals such as LTE, how to approximate the location of an interference signal, and basic antenna theory from the prospective of the design, optimization and performance engineer. This course is not manufacturer specific.

OUTLINE

1. Free Space Propagation
   a. Spherical Wavefront
   b. Inverse-Square Law
   c. W/m², µW/cm², etc.
2. Free Space Impedance
   a. Antenna Properties
   b. Length vs. Return Loss
   c. Effective Area
   d. Propagation Loss
   e. Long vs. Short
3. Directivity
   a. Antenna Patterns
   b. Aperture
   c. Gain
   d. Near vs. Far Field
   e. Polarization (H, V, etc.)
   f. System Path Loss
4. Optical Equivalence of Propagation
   a. Reflection/Refraction and Attenuation
   b. Shadowing and Delay Spread
   c. Fresnel Zone, Fading, and Doppler Shift
5. Diversity
   a. Spatial and Frequency vs. Time
   b. Channel Coherence Time
   c. Polarization
6. Measurements & Calibration
   a. Antenna Gain
   b. Field Strength vs. Rx Power
   c. Over-the-Air Equipment Setups
   d. Signal Power vs. Signal Spectral Density
   e. Maximum Permissible Exp. (MPE)
   f. Common Mistakes
7. Field Measurements
TRAINING COURSE

COURSE TITLE: RF FUNDAMENTALS & VECTOR NETWORK ANALYSIS

COURSE NUMBER: 0300-00453-EN

DAY(S): 4-Days

GSA PRICE: $2,339.73 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: None

DESCRIPTION: Focuses on RF fundamentals and vector network analyzers (VNAs) for coaxial and/or waveguide RF systems.

OUTLINE

1. RF Fundamentals
2. Test Unit Calibrations
3. Return Loss and/or VSWR
   a. Limitations
   b. Identifying the Dominant Component
4. Distance-to-Fault
   a. Resolution
   b. Identifying System Components
   c. Limitations
5. RF Components (Customer Specific)
6. System Power, Free Space Loss & Link Budgets
TRAINING COURSE

COURSE TITLE: ADVANCED ANTENNA LINE & PIM RF ANALYSIS

COURSE NUMBER: 0300-00670-EN

DAY(S): 3-Days

GSA PRICE: $1,971.27 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: Field Training and/or manufacturer-specific training courses.

DESCRIPTION: We will challenge the most seasoned individual regardless of experience and/or past training. This workbook-based manufacturer neutral course should be taken in conjunction with our 1-day Spectrum Analysis, PIM & Interference RF Course (0300-00671-EN), which provides the necessary background on spectrum analyzers/receivers and how to locate external PIM. Courses 0300-00670-EN and 0300-00671-EN each have an online certification. Topics for this course includes an in-depth review of RF Fundamentals, RF components and antenna systems, harmonics and IM (intermodulation) products, antenna polarity vs. PIM (IM) source locations, locating external PIM (and active IM) using 1-port and 2-port PIM analyzers and antenna polarity combining, cable antenna analyzers, and extensive fieldwork and classroom labs. Covers customer specific test units.

OUTLINE

1. RF Fundamentals – Includes Composite Power & EIRP
2. Common RF Components
   a. Coaxial Cables/Connectors/Attenuators/Couplers
   b. Splitters/Combiners/Amplifiers/Filters and Antennas
3. Harmonics and IM
   a. Active and Passive IM (Intermodulation)
   b. Harmonics, IM Products, Common PIM Signatures vs. LTE Bands
4. Cable/Antenna Analyzers (Manufacturer Neutral)
   a. Return Loss and Distance-to-Fault (DTF)
   b. Insertion Loss & Gain
5. PIM Test Equipment (1-Port and 2-Port Setups – Manufacturer Neutral)
   a. 1-Port (and 2-Port) Test Setups
   b. Modes: PIM vs. Time, Swept PIM, and PIM vs. Distance
6. External PIM Mitigation
COURSE TITLE: RF FUNDAMENTALS, SPECTRUM MANAGEMENT, & SIGNAL ANALYSIS/TRACKING

COURSE NUMBER: 0300-00460-EN

DAY(S): 5-Days

GSA PRICE: $2,591.88 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: RF Experience/Training or BSEE Degree (or Similar).

DESCRIPTION: This workbook-based manufacturer neutral course focuses on strengthening knowledge of RF Fundamentals, spectrum analyzers, receiver, and signal identification and tracking. Our classroom process is a combination of RF theory via a whiteboard, hands-on labs to validate information presented, and tests using customer-specific equipment. Students who successfully fulfill the requirements for the classroom training, are eligible to complete its related online certification. All our certifications are designed to validate course objectives in the field on customer-specific systems at normal operating power levels. Students completing this process will be prepared for advanced RF courses and certifications. Course content is customizable using our secure online form.

OUTLINE

1. RF Fundamentals
   a. dB, dBi/RBW, dBW, dBm/Hz, dBm vs. Watt, Etc.
   b. Insertion Loss vs. Frequency vs. Time Domain
   c. Impedance vs. Return Loss vs. VSWR
   d. Composite Power
   e. Attenuators – Actual vs. Software Driven
   f. Couplers, Power Combiners & Splitters
   g. Filters – Fixed vs. Variable
   h. Antenna Patterns, Parameters, and Isolation (dBi)
   i. Harmonics and Intermodulation Products (dBc)
   j. Link Budget: EIRP, Free Space Loss, RF Absorption

2. Spectrum Analyzers and Receivers
   a. Screen Functionality and Key Functions/Ratios
   b. Internal/External Attenuation and Internal LNA vs. Noise Level
   c. RBW/VBW vs. Peak Power, Power Density, and Noise Level
   d. Test Unit Saturation
   e. Integrated vs. Peak Power Measurements
**TRAINING COURSE**

**COURSE TITLE:** SPECTRUM ANALYSIS, PIM, & INTERFERENCE

**COURSE NUMBER:** 0300-00671-EN

**DAY(S):** 1-Day

**GSA PRICE:** $957.78 pp (Does not include instructor travel expenses.)

**TRAINING TYPE:** Instructor-Led Classroom

**RECOMMENDED PREREQUISITES:** Adv. Antenna Line & PIM RF Analysis Course (0300-00670-EN).

**DESCRIPTION:** This workbook-based manufacturer neutral course should be taken in conjunction with our 3-day Advanced Antenna Line & PIM RF Analysis Course (0300-00670-EN), which provides the RF background to troubleshoot complex antenna systems and external PIM (and active IM). Courses 0300-00671-EN and 0300-00670-EN each have an online certification. Topics for this course includes an in-depth review of spectrum analyzer/receiver screen setup scenarios, VBW, RBW vs. noise level, RBW vs. composite and peak power levels, test unit saturation, signal identification, and locating external PIM (IM) very close to and far away from antennas. Includes interference analysis (hunting) procedures.

**OUTLINE**

1. Basics of Spectrum Analyzers/Receivers
   a. Screen Definitions, Parameters, Equations, and Ratios
   b. Span vs. RBW vs. Noise Level
   c. Peak & Composite Power vs. RBW vs. Detectors
   d. Occupied Bandwidth (OBW)
   e. Test Unit Saturation (Overloading)
2. Signal Analysis and Identification
3. Spectrum Analyzer/Receiver Fieldwork using 1-PORT and 2-Port PIM Test Equipment Configurations
4. External Interference Analysis (Hunting) Processes and Techniques
TRAINING COURSE

COURSE TITLE: RF SPECTRUM ANALYSIS OVER FIBER, BBU EMULATION, & OTDR TESTING

COURSE NUMBER: 0300-00354-EN

DAY(S): 2-Days

GSA PRICE: $1,576.43 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: Firm understanding of RF fundamentals, cable/antenna analyzers, and spectrum analyzers. Call for recommended courses we offer.

DESCRIPTION: This workbook-based manufacturer neutral course expands upon the RF and spectrum analysis fundamentals learned in prior courses targeting systems where users have access to coax cabling for troubleshooting. These fundamentals are expanded to include systems with both fiber optics and coax cabling. Topics include an overview of fiber optic cables and small form-factor pluggables (SFPs), fiber inspections and cleaning, refraction, return loss, distance-to-fault (DTF), DTF fault resolution, insertion loss, baseband unit (BBU) emulation, common passive intermodulation (PIM) signatures, common fiber faults and their impact on RSSI, and spectrum analysis over fiber.

OUTLINE

1. Fiber Fundamentals & Small Form-Factor Pluggables (SFPs)
2. Fiber Inspection and Cleaning
3. Optical Time Domain Reflectometer (OTDR) Trace Interpretation
   a. Refraction
   b. Return Loss
   c. Distance-to-Fault (DTF)
   d. Insertion Loss
4. BBU Emulation Measurements
5. RF Spectrum Analysis over Fiber
TRAINING COURSE

COURSE TITLE: RADAR BASICS & RF TROUBLESHOOTING

COURSE NUMBER: 0300-00510-EN

DAY(S): 3-Days

GSA PRICE: $1,971.27 pp (Does not include instructor travel expenses.)

TRAINING TYPE: Instructor-Led Classroom

RECOMMENDED PREREQUISITES: Firm understanding of RF fundamentals, cable/antenna analyzers, and spectrum analyzers. Call for recommended courses we offer.

DESCRIPTION: Students will learn to identify, locate and resolve radar RF issues using their test equipment. Radar basic theory is also covered. The frequencies, system components, common RF signals, interference challenges, and test equipment are tailored to a customer’s requirements. Internal system analysis topics include return loss and/or VSWR, distance-to-fault (DTF), transmit power, receiver sensitivity, signal-to-noise, and joints (if applicable) for systems with coaxial and waveguide transmission lines. External RF considerations include RF free space loss with propagation effects, clutter, and external interference. Field exercise opportunities can be arranged in advance.

OUTLINE

1. Electromagnetics Fundamentals
2. Trigonometry Basics
3. Antenna Fundamentals
   a. Monopole
   b. Directional
   c. Phased Array
4. Radar Components
5. System Troubleshooting (Coax and Waveguide)
   a. Insertion Loss
   b. Return Loss and/or VSWR
   c. Distance-to-Fault (DTF)
   d. DTF Fault Resolutions
   e. Power
6. Radar Principles – Pulsed/CW
   a. Radar Cross Section (RCS)
   b. Radar Range Equation
   c. Direction/Distance
   d. Maximum/Minimum Range
   e. Elevation/Height
7. Propagation Effects
   a. Atmospheric Losses
   b. Multipath
   c. Diffraction
   d. Refraction
   e. Ducting
8. Radar Clutter
9. Signal-to-Noise
10. External Interference
11. Radar Scenarios
ONLINE CERTIFICATION OVERVIEW

The majority of our classroom training includes an online certification process. These self-paced processes replace tests and are based on repetition and learning by making safe mistakes. Our process ensures individuals fully understand the content presented in the prerequisite course(s). Individuals obtain a secure online account where they are guided through the certification process, which involves a combination of:

- Pseudorandom Online Questions
- Labs using Test Equipment
- Fieldwork
- Exit Phone Interview.

The online questions and fieldwork are an opportunity to apply learned topics, determine your current knowledge level, and where you need to concentrate more effort and/or need additional direction from Bryant Solutions. Our process is based on repetition and learning by making mistakes. It works!

Certifications are broken down into two categories:

a. Public Certifications. These are certifications that are offered publically on our website. These certifications are commonly complete by technicians and engineers working on commercial systems.

b. Private Certifications. Not offered publically on our website.

Certification processes are supported.

- Individuals must demonstrate they understand the concepts presented and can implement them on customer specific equipment and scenarios.
- All training is test equipment and system neutral.
- Certifications can be verified online.
- Managers can monitor their team’s training and certifications.
- Photo identification badges available.
1) ACCESS TO BRYANT SOLUTIONS’ SECURE SERVER
   • Access is only for our customers.
   • Individuals completing one of our training courses will automatically receive login information.
   • Login information is intended solely for the individual it is provided to by Bryant Solutions, Inc. It may not be shared or transferred.
   • Login information such as date, time, and IP address is monitored and recorded.
   • Managers have the ability to monitor their team’s training (past and future) and certifications (past and in progress). Certification page scores and progress can also be monitored.

2) TRAINING RESERVATIONS
   • Payment is required to reserve a seat in a course.
   • We accept checks, credit cards, and wire transfers. Contact us for a secure link for credit card payments. Purchase orders accepted from approved companies under contract and U.S. government agencies. Payment terms are Net 10 from invoice date.
   • A minimum of $100k in training is required for companies interested in being under contract. Allow 3- to 6-months for approval process.

3) TRAINING CANCELLATIONS
   • Cancellation requests must be received in writing by email. Bryant Solutions, Inc. will reply with a written acknowledgment.
   • Credits issued can only be used for products and services offered by Bryant Solutions, Inc. and must be used within 12 months of the date of issue.
   • Customers may receive a refund (minus any incurred expenses) for acknowledged class cancellations greater than ten (10) business days before its start date. Typical expenses that we are unable to recoup are credit card transaction fees and airfare cancellation fees. Customers also have the option to reschedule or obtain a credit.
   • Cancellations received 10 business days or less of the course start date will not receive a refund. In the event we are able to fill a vacant seat due to a cancellation, a credit will be issued minus any incurred expenses.

4) TRAINING COURSE MINIMUMS AND MAXIMUMS
   Bryant Solutions, Inc. requires a minimum of 8 students and a maximum of 12 students per course for customer premise training. In the event the minimum number of seats is not met for customer premise training, the minimum will be charged.

5) TRAVEL EXPENSES
   • Customer premise training held within 50 miles of HQ: $500 Setup/tear-down charge.
   • Customer premise training greater than 50 miles from HQ: Actual travel expenses invoiced. Quotes may include some estimated expenses as defined below.
a. When airfare is required:
   ii. For a single flight lasting 5-hours or less, we will charge for a refundable coach fare.
   iii. For a single flight lasting more than 5-hours, we will charge for a business class fare.
       If business class is not available, then first class fare will be charged.
   iv. For government customers, government travel regulations apply.

b. When possible, we will travel in a company vehicle. We charge the current stated IRS rate per mile ($0.575 as of January 1, 2020). This expense is estimated based on miles to/from customer location.

c. When renting vehicles, we charge for a minivan or SUV when transporting equipment and/or working in the field with students; otherwise, an economy vehicle is charged.

d. When hotel stays are required, we typically cap this expense at $160 per day. Exceptions can include (but are not limited to) areas with higher than normal rates and special events.

e. When shipping training equipment, we use United Cargo and/or American Airlines Cargo where Bryant Solutions, Inc. is a known shipper. A courier service may be used to deliver equipment to/from customer premise location.

f. Meals per diem rates range from $51 to $74 per day depending on U.S. location. Rates outside the U.S. may be different.

6) TRAINING CERTIFICATES AND COURSE CREDITS

The following must be satisfied for an individual to obtain course credit:

- Individual is required to participate in ALL exercises.
- Attendance is mandatory.

7) CERTIFICATIONS

- Prerequisite course credit is mandatory to begin related certification. See item #6 above.
- Certifications must be started within 10-workdays of completion of prerequisite course; otherwise, the system will force a start date. If completing more than one certification, subsequent certifications must be started within 10-workdays of the completion date of the prior certification.
- Certifications must be completed within the allotted time.
- All entries, times, and scores are recorded.
- Individuals will be required to redo those pages in a certification where they do not demonstrate a firm understanding of the material presented.
- Certification technical support is free for up to 1-hour of phone support or four calls (or sessions), whichever comes first. In the event more support is required, choose from the following:
  a. $136.83 for each additional 1 hour of phone support or four calls (or sessions), whichever comes first. Requires a credit card.
  b. Call to discuss a support plan for a large group.
• Certifications can be terminated for one of the following reasons:
  a. Having someone (other than the individual assigned to a certification) complete any portion of a certification.
  b. Entering random numbers/characters to complete page requirements.
  c. Using applications or other tools such as Microsoft Excel. Page instructions indicate when to use a calculator and your Bryant Solutions, Inc. Field Reference Manual.

8) TRAINING RECORDING POLICY
Bryant Solutions strictly prohibits taping or digital recording and re-broadcast of audio or video of our course without prior written approval.

9) COPYRIGHT WARNING: RESTRICTIONS ON USE
All Bryant Solutions training and class materials, including supplemental information (“materials”), are the sole property of Bryant Solutions, protected by the Copyright Laws of the United States (Title 17, United States Code), and the laws of other countries where courses are available, governing the making of copies or other reproductions of copyrighted material. Each class is designed for an authorized, single user only. Any copy, distribution or disclosure of the contents of class materials without the written authorization of Bryant Solutions is strictly prohibited. You may not use the materials for any purpose other than for your own educational purposes. You may not copy, transfer, lease, assign, make available for timesharing or sub-license Bryant Solutions copyrighted materials, in whole or in part, nor modify, reproduce or distribute the materials electronically or otherwise. No right, title or interest to any trademarks, service marks or trade names of Bryant Solutions is hereby granted. Unauthorized or improper use of materials may result in civil and criminal penalties.
1) **AWARDED SPECIAL ITEM NUMBERS (SINs)**

<table>
<thead>
<tr>
<th>SIN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>132-50</td>
<td>Training Courses</td>
</tr>
</tbody>
</table>

2) **MAXIMUM ORDER:** $250,000.00

3) **MINIMUM ORDER:** Training course meeting the minimum number of students.

4) **GEOGRAPHIC SCOPE OF CONTRACT:** Domestic and Overseas Delivery

5) **POINT OF PRODUCTION:** San Ramon, Contra Costa County, California U.S.A.

6) **DISCOUNT FROM LIST PRICES OR STATEMENT OF NET PRICE:** Prices Shown are NET Prices.

7) **PROMPT PAY TERMS:** None

8) **GOVERNMENT PURCHASE CARDS:** Accepted Below and Above Micro-Purchase Threshold.

9) **FOREIGN ITEMS:** None

10a) **TIME OF DELIVERY:** All Services: Determined Upon Request

10b) **URGENT REQUIREMENTS:** Determined Upon Request

11a) **ORDERING PHONE AND EMAIL:** +1-925-968-9265
     info@bryantsolutions.com

11b) **ORDERING AND PAYMENT ADDRESS:** Bryant Solutions, Inc.
     2603 Camino Ramon, Suite 276
     San Ramon, California 94583-9143 U.S.A.

12) **TERMS AND CONDITIONS OF GOVERNMENT PURCHASE CARD ACCEPTANCE:** Refer to Page 30

13) **DATA UNIVERSAL NUMBER SYSTEM (DUNS) NUMBER:** 004035755