

# Radio Frequency Identification - RFID - Technical Specialist Competency Requirements



The **Radio Frequency Identification** Technical Specialist will have a working fundamental knowledge of electronics communication principles. This basic criterion can be found in the [Associate CET \(CETa\)](#) and other RF Communications area <http://www.eta-i.org/communications.html> certification programs. The following **RFID** competencies are a listing of the knowledge and abilities necessary to perform configuration and maintenance of RFID hardware and software including NFC (Near Field Communications) as an RFID Technical Specialist.

## 1.0 Introduction to Radio Frequency Identification (RFID) Fundamentals

- 1.1 Explain basic electrical theory and uses including:
  - 1.1.1 Ohms law
  - 1.1.2 Watts law
  - 1.1.3 Kirchoff's law
- 1.2 Describe basic DC circuit concepts of series and parallel
- 1.3 Describe basic AC circuit concepts of RLC (resistive, inductive and capacitive) circuit
- 1.4 Describe basic semiconductors circuitry including:
  - 1.4.1 diodes
  - 1.4.2 transistors
  - 1.4.3 amplifiers
  - 1.4.4 oscillators
- 1.5 Explain electrical and network infrastructure site analysis
- 1.6 Identify symbols used in electronic circuitry and blueprints
- 1.7 Define RFID (Radio Frequency Identification) including:
  - 1.7.1 origin, history and early RFID uses:
    - 1.7.1.1 tag
    - 1.7.1.2 reader
  - 1.7.2 the EPC (Electronic Product Code)
  - 1.7.3 current RFID market awareness
- 1.8 Describe Near Field Communications (NFC) in relation to RFID
- 1.9 Describe how RFID technology is different than magnetic secure transmission (MST)

## 2.0 RF Safety

- 2.1 Describe Radio Frequency (RF) safety protocols per industry standards
  - 2.1.1 Explain the FCC OET65 Bulletin
  - 2.1.2 Explain the IEEE/ANSI C-95 standard
- 2.2 Describe general safety guidelines:
  - 2.2.1 List the National Electrical Codes (NEC<sup>®</sup>) as they apply to RFID technology
  - 2.2.2 List Occupational Safety and Health Administration (OSHA) requirements for working with RFID technology
  - 2.2.3 List personal protection equipment (PPE) used in RFID work
  - 2.2.4 RFID power applications including:
    - 2.2.4.1 AC power
    - 2.2.4.2 Battery systems
    - 2.2.4.3 Lock Out / Tag Out procedures
  - 2.2.5 Describe safety measures used with tower and elevated surfaces
  - 2.2.6 Describe grounding and surge/lightning protection safety measures
- 2.3 Explain how to protect components from Electrostatic Discharge (ESD)

## 3.0 RF Fundamentals Applied in RFID

- 3.1 Explain basic RF fundamental operating principles and terminology
- 3.2 Describe basic RF spectrum and propagation
- 3.3 Explain basic principles of radio communication
- 3.4 Explain RF modulation and demodulation to include:
  - 3.4.1 Transmitter modulation

- 3.4.2 Receiver demodulation
- 3.4.3 Receiver bandwidth must match the transmitter modulation scheme
- 3.5 Describe RFID or NFC digital modulation methods including:
  - 3.5.1 ASK (amplitude-shift keying)
  - 3.5.2 FSK (frequency-shift keying)
  - 3.5.3 PSK (phase-shift keying)
  - 3.5.4 PJM (phase jitter modulation)
- 3.6 Describe a site survey requirements:
  - 3.6.1 RF
  - 3.6.2 Physical
- 3.7 Describe RFID coverage area
- 3.8 Explain RFID Antenna:
  - 3.8.1 characteristics including:
    - 3.8.1.1 Tag Antennas
    - 3.8.1.2 Reader Antennas
  - 3.8.2 wave propagation
  - 3.8.3 field performance

#### **4.0 Communication Methods and Protocol in RFID**

- 4.1 Describe coupling including:
  - 4.1.1 inductive
  - 4.1.2 electromagnetic backscatter
  - 4.1.3 close loop or capacitive
- 4.2 Define collisions (contentions) including:
  - 4.2.1 Tag collisions
  - 4.2.2 Reader collisions
- 4.3 Describe anti-collision tree protocols:
  - 4.3.1 Tree-base
  - 4.3.2 Query tree
  - 4.3.3 Binary tree
- 4.4 Describe the TCP/IP (transmission control protocol/internet protocol) fundamentals:
  - 4.4.1 wired
  - 4.4.2 wireless
  - 4.4.3 cybersecurity / https secure socket layer
- 4.5 Define tag authentication
  - 4.5.1 Describe RFID tag forgery security countermeasures
    - 4.5.1.1 Define “skimming” and “cloning”
      - 4.5.1.1.1 Explain “replay” signal security vulnerabilities
    - 4.5.1.2 Describe tag/card “anti-cloning”
  - 4.5.2 Describe “denial of service” (DoS) prevention including virus protection
    - 4.5.2.1 Describe Distributed Denial of Service (DDoS)

#### **5.0 Tag Characteristics**

- 5.1 Describe passive tags including:
  - 5.1.1 BAPS (battery assisted passive tags)
  - 5.1.2 advantages and disadvantages of using passive tags
  - 5.1.3 NFC (near field communications tags)
- 5.2 Describe active tags including:
  - 5.2.1 “Read / Write” tags
  - 5.2.2 advantages and disadvantages of using active tags
- 5.3 Describe active/passive tags/readers including:
  - 5.3.1 AVI (automated vehicle id) systems with or without transponders
- 5.4 Explain how tags are designed
- 5.5 Explain signal strengths pertaining to communication range including:
  - 5.5.1 reader to tag requirements
  - 5.5.2 tag to reader available strengths
- 5.6 Describe a Smart Label
- 5.7 Explain Tag Implementation

## 6.0 Fundamentals of Interrogator Communications

- 6.1 Describe how readers (interrogators) function in an RFID system
- 6.2 Define the Interrogation Zone
- 6.3 Explain the parameters of a Dense Interrogators Environment including:
  - 6.3.1 Deployment Environments
- 6.4 Explain Interrogator international power regulations
- 6.5 Explain how a host computer is connected to tag reader
  - 6.5.1 Describe common specific wired and wireless network interfaces
- 6.6 Explain how a Device Driver works
- 6.7 Explain the role Middleware and Edgeware has in RFID architecture including:
  - 6.7.1 software on the reader
  - 6.7.2 middleware used between reader and computer
- 6.8 Explain ONS (object naming service) and the role it plays in an enterprise RFID System
- 6.9 Describe basic programming techniques including:
  - 6.9.1 Basic C structure
  - 6.9.2 XML namespace

## 7.0 RFID System Design Selection and Installation

- 7.1 Describe which Frequency selection is used including:
  - 7.1.1 LF
  - 7.1.2 HF
  - 7.1.3 UHF
- 7.2 Explain the applications of selection and installation/configurations including:
  - 7.2.1 Tag types
  - 7.2.2 Reader/Interrogator types
  - 7.2.3 Antenna types
  - 7.2.4 power distribution including:
    - 7.2.4.1 power supply
    - 7.2.4.2 cable/wiring considerations
  - 7.2.5 RFID peripherals
  - 7.2.6 NFC tag uses instead of RFID tags

## 8.0 RFID Standards and Regulations

- 8.1 Define the EPC (Electronics Product Code)
- 8.2 Describe how EPCglobal Network and GS1 incorporate sharing information including:
  - 8.2.1 ONS
  - 8.2.2 EPC Discovery services
  - 8.2.3 EPC Information services
  - 8.2.4 EPC Security services
- 8.3 Describe common ISO Standards as it related to RFID including:
  - 8.3.1 18000 series (air interface frequency standards)
  - 8.3.2 11784 (tag data structure)
  - 8.3.3 11785 (air interface protocol – a.i.p.)
  - 8.3.4 14443 (proximity systems definitions for a.i.p.tags – payment systems)
  - 8.3.5 15693 (vicinity cards)
  - 8.3.6 18046 (tag and interrogator performance test methods)
  - 8.3.7 refer to the many other RFID related standards
- 8.4 Define the GEN 1 and GEN 2 RFID standards differences
- 8.5 Define the Class 0,1,2,3,4,5 tags
- 8.5 Define SSCC (Serial Shipping Container Code)
- 8.6 Define EDI (electronic data interchange) Transaction including:
  - 8.6.1 ASN (Advanced Shipping Notice)
- 8.7 Describe how the PCI DSS (Payment Card Industry Data Security Standard) is designed to keep information secure
  - 8.7.1 Explain how tokenization is different than encryption (E2EE)

## **9.0 Additional Instrumentation Used with RFID Systems**

- 15.1 Describe how to use a real time spectrum analyzer
- 15.2 Describe how to use an oscilloscope
- 15.3 Describe how to use voltage/ohm meters
- 15.4 Describe how to use field strength meters

## **10.0 Troubleshooting an RFID System**

- 14.1 Explain procedures used in Tag Data Management
- 14.2 Explain how to assess Readability and Reliability issues
- 14.3 Describe procedures to resolve Environmental Tag damage
- 14.4 Define SLRRP (Simple Lightweight RFID Reader Protocol)
- 14.5 Describe procedures used in RFID security/privacy applications

# **End of RFID Technician Specialist Competencies Listing**

Find an ETA® Test Site

<http://www.eta-i.org/testing.html>

### Additional Suggested Study Materials and Resources:

- RFID Handbook: Technology, Applications, Security and Privacy;** Colbach; ISBN 978-1792824272; (Independent); 2018
- The RF in RFID: Passive UHF RFID in Practice, 2E;** Dobkin; ISBN 978-0123945839; Newnes; 2012
- RFID Security: A Lightweight Paradigm (Analog Circuits and Signal Processing);** Khattab, Jeddi, Amini, Bayoumi; ISBN 978-3319475448; Springer; 2016
- RFID: MIFARE and Contactless Cards in Application;** Schalk/Bienert; ISBN 978-1907920141; Elektor; 2013
- Bitcoin Digital Currency and Blockchain Technology: Disruptive Computer Technology, Movement of Money, Tokenization of Assets, Mt. Gox, Advanced Cryptographic Signatures, Cyber Security, Banking;** U.S. Government, e-pub.; 1355 KB; Progressive Mgmt; Nov.2016
- RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, RFID and Near-Field Communication, 3E;** Finkenzeller/Müller; ISBN 978-0470695067; Wiley; 2010
- RFIDs, Near-Field Communications, and Mobile Payments: A Guide for Lawyers;** Hughes/Middlebrook/Jones; ISBN 978-1627221252; American Bar Ass.; 2014
- RFID Field Guide;** Bhuptani/Moradpour; ISBN 978-131853553; Sun Microsystems-Prentice Hall; 2005
- NFC for Dummies;** Sabella; ISBN 978-1119182924; For Dummies; 2016
- RFID for Dummies;** Sweeney II; ISBN 978-0764579103; For Dummies; 2005
- Everyday NFC Third Edition: Near Field Communication Explained;** Chang; ISBN 978-0982434031; Coach Seattle; 2017
- RFID: Applications, Security and Privacy;** Garfinkel/Rosenberg; ISBN 978-0321290960; Addison-Wesley; 2005
- Short-range Wireless Communication: Fundamentals of RF System Design and Application, 3E;** Bensky; ISBN 978-0128154052; Newnes; 2019
- See more Texts listed at the end of the CETa, GCT1, & GCT2 competency listings...**

### Webpages, (find more in your search engines):

<https://rfid4u.com/> ; <https://msdn.microsoft.com/en-us/library/dd352557.aspx> ; <https://www.rfwireless-world.com/Terminology/> ; <http://electronics.howstuffworks.com/gadgets/high-tech-gadgets/rfid.htm> ; <http://www.radio-electronics.com/info/wireless/radio-frequency-identification-rfid/iso-epcglobal-iec-standards.php> ; <http://www.rfidjournal.com/articles/view?1335> ; <http://www.edi-services.com/856-advanced-ship-notice-elements.htm> ; <https://www.rfwireless-world.com/Tutorials/NFC-Modulation-and-NFC-Coding.html> ; <https://www.electronicproducts.com/fundamentals-of-rfid-communications/> ; [http://transition.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet65/oet65b.pdf](http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65b.pdf)

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Accredited to the ISO 17024:2012 standard for certification programs