Book/Software Reviews

## Applications of RFID Technology

■ **James Chu**

The first chapter of this book offers an introduction to radio-frequency identification (RFID) history, applications, business applications, and standards. The next chapter discusses radio-frequency spectrum and propagation, the theory of electromagnetism and Maxwell's equations, near field, far field, and EH field. This chapter also delves into radio-frequency (RF) propagation and interference, basic antenna parameters (such as antenna polarization and polarization diversity), impedance matching, return loss, maximum power transfer to the load, antenna bandwidth, directivity and gain, radiation patterns, antenna beamwidth, sidelobes, nulls, front-to-back ratio, and antenna modeling. The second half of this chapter covers radio communication systems, including spread-spectrum communications, frequency hopping, and direct sequence. The author also thoroughly explains Bluetooth and ultrawideband specifications, requirements, and applications. The chapter closes with body area network, medical implant communication services, wireless medical telemetry services, and frequency bands.

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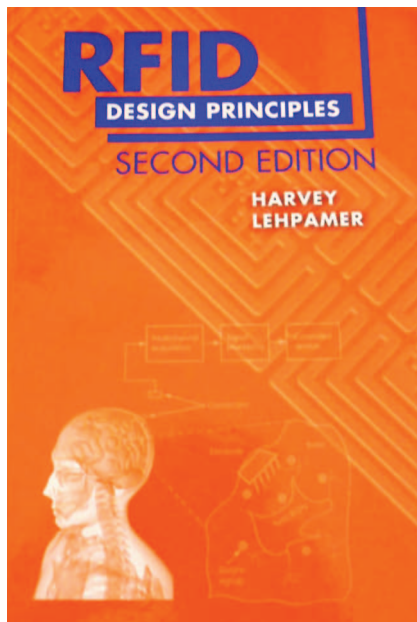
RFID Design Principles, Second Edition
By Harvey Lehpamer
ISBN 978-1-60807-470-9
Artech House
363 pages, US$142.00

In Chapter 3, automatic identification systems (AISs) are discussed. The author introduces a few AISs, such as bar codes, magnetic cards, smart cards, and optical cards. He then dives into RFID devices, providing a brief introduction to principles of operation including inductive coupling, load modulation, and backscatter modulation. The author also mentions the Savant software specification for the standard RFID middleware. The chapter ends by listing some of the challenges of RFID implementation. At this point, the author switches to wireless sensor networks and applications including sensor networks topology, standardization, and compatibility. Many types of RFID applications are discussed, such as indoor localization for first responders, passive keyless entry, and so on. The author also introduces RuBee wireless technology, the only technology approved by the U.S. Department of Energy for use in high-security, top-secret areas in which WiFi, Bluetooth, and Zigbee have all been banned.

The author next focuses on RFID standards, air interface, key players, and an example of an ultrahigh frequency (UHF) tag. The author shows various RFID frequency bands and systems, from a few kilohertz to a microwave frequency band (2.4–2.5 GHz), and describes the advantages and disadvantages of each RFID frequency band. Also discussed is the UHF Generation 2 system, the latest version which operates at the 860–969-MHz frequency range. A comparison chart lists variations of standards of UHF RFID systems from different countries in North America and Europe, as well as Singapore, Japan, Korea, Australia, Argentina, Brazil, Peru, and New Zealand.

Chapter 5 focuses on RFID near-field and far-field propagation of low-frequency systems and high-frequency/microwave systems. This chapter also discusses the different types of RFID tags, such as read-only systems, read-write systems, passive tags, active tags, and the multiple-tag operation, and the concerns surrounding them. RFID antennas are a major issue in device/system design. A few low-frequency loop antennas and UHF antennas, including fractal antennas, are discussed. A table lists RFID frequency bands, output power limits, and region of operation. This table is convenient for quick reference. RFID read/write range analysis and calculations are also included. A typical RFID block diagram and explanation of each block (such as transmit module, source module, and receiver module) and antennas are also included. A few equations, such as the read range equation (5.44), do not indicate a unit for each parameter, making the calculation difficult to follow. The author also indicates that the antenna circular to linear polarization mismatch (the read range) will be $\sqrt{2}$ times shorter than the one calculated by the previous equation (5.43) without any explanation or reference.

Chapter 6 focuses on RFID system design requirements. This chapter provides a system design checklist, which system engineers will find helpful from tag, reader, operation environment, and business perspectives. It includes RFID system frequency band selection, link budget, signal collision avoidance techniques, and data encryption. Finally, the chapter addresses the RFID system and device testing requirements, test equipment, and regulations.

The next chapter covers integrating RFIDs and sensor networks in biomedical applications. It addresses many regulations, classifications, requirements, codes, and standards. It also discusses the radio propagation inside the human body. A few useful tables list frequency bands for medical applications, comparisons of technologies for wireless body area networks, and electrical properties of the human body. The author also lists steps of development for medical products. In the final section of this chapter, the author discusses laws and regulations regarding wireless body implants.

Finally, the author discusses RFID market trends, barriers to RFID adoption, security, privacy, health risks, ethics, and moral dilemmas of RFID technology.

This book is intended for RFID system designers, program managers, and regulators. It covers broad aspects of RFID requirements and RFID environments.

Recently Published Books

Here are a few recently published books that are within the field of interest of the readership of *IEEE Microwave Magazine*. For further information, go to the publisher's Web sites or contact the editor at microwave.editor@ieee.org.

– Alfy Riddle, editor

Fawwaz Ulaby and David Long, *Microwave Radar and Radiometric Remote Sensing* (Artech House, 2014). [ISBN 978-0-472-11935-6].
A successor to the classic Artech House Microwave Remote Sensing series, this comprehensive and up-to-date resource, previously published by the University of Michigan Press, provides you with theoretical models, system design and operation, and geoscientific applications of active and passive microwave remote sensing systems. To help the reader understand and use the material, the book includes 50 MATLAB-based computer codes. The book's Web site (http://mrs.eecs.umich.edu/) also includes interactive modules based on theoretical and empirical models.

Wenhua Yu, Wenxing Li, Atef Elsherbeni, and Yahya Rahmat-Samii, *Advanced Computational Electromagnetic Methods* (Artech House, 2015). [ISBN 978-1-60807-896-7].
This new resource covers the latest developments in computational electromagnetic methods, with an emphasis on cutting-edge applications. This book is designed to extend existing literature to the latest developments in computational electromagnetic methods, which are of interest to readers in both academic and industrial areas. These include advanced techniques in method of moments (MoM), finite element method (FEM), and finite-difference time-domain (FDTD) spectral domains; Xeon Phi and other graphics processing unit hardware acceleration; metamaterials; frequency- and time-domain integral equations; and statistical methods in bioelectromagnetics.

Frédéric Fabry, *Radar Meteorology, Principles, and Practice* (Cambridge University Press, 2015). [ISBN 978-1-107-07046-2].
This practical textbook introduces the fundamental physics behind radar measurements to guide students and practitioners in the proper interpretation of radar reflectivity, Doppler velocity, and dual-polarization imagery. Operational applications are explored, such as how radar imagery can be used to analyze and forecast convective and widespread weather systems. The book concludes with an overview of current research topics, including the study of clouds and precipitation using radars, signal processing, and data assimilation. Numerous full-color illustrations are included, as well as problem sets, case studies, and a variety of supplementary electronic materials such as animated time sequences of images to help convey complex concepts. This book is a valuable resource for advanced undergraduate and graduate students in radar meteorology