Chapter 9
Printed Antenna for UHF and SHF RFID Applications:
Reader and Tag Antenna's Design

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ABSTRACT

In this chapter, new microstrip antennas for RFID system are presented. The chapter is split into two sections. The first section deals with the design of two dual-band antennas for handheld RFID readers, and the second section is dedicated to antennas for RFID tag. In the first section, the authors describe theory and principle characteristics of microstrip antenna and the fundamentals of multiband behavior. The two proposed antennas are designed to operate in the ISM (industrial, scientific, and medical) band at 2.45 and 5.8 GHz bands. In the second section, the authors present the principles of matching techniques for tag antenna design. Then, they present two examples of tag antenna. The first one is a flexible antenna mounted on paper substrate, and the second one is designed for the identification of metallic object.

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INTRODUCTION

The Radio Frequency identifications (RFID) is an automatic wireless technology for data gathering that has been deployed in a various ranges of applications including logistics, transport, animal tagging and asset tracking offering the capabilities of the identification in different weather conditions, the identification of many items simultaneously, identifying items within a vicinity between a few centimeters to several meters and enabling the off line-of-sight communication, hence RFID is becoming more attractive (Finkenzeller, 2010). The two basic components of an RFID system are the tag and the reader; the tag consists of an antenna and a microchip transponder. The three main classes of RFID tags are: passive semi passive and active (Brown, 2007). Once activated, the content stored in the internal memory of the tag is communicated to interrogator by backscattering modulation of the signal. The reader is connected to the host computer which is used to program the reader and store information received from the transponder. The reader is a radio transceiver connected to transmit and receive antennas (Paret, 2008).

The exchange of information takes place due to magnetic or electromagnetic coupling between reader and tag. The inductive coupling operating in the near field is based on the transfer of energy from one device to another through a shared magnetic field (transformer principle). The magnetic alternating field of the reader induces at resonance frequency a voltage in the transponder coil that is used to provide the power supply. While the far-field coupling is based on the electromagnetic wave propagation and the reflection of electromagnetic wave back in the direction from which it was received. This backscattering modulation technique permits to recover data contained in the tag to the reader receiver (Nieto, 2011).

The RFID applications occupy four frequency bands over the radio frequency spectrum. The Low-frequency (LF, 125; 134 kHz) and high-frequency (HF, 13.56 MHz). These applications are based on magnetic field coupling and most of them are related to "passive tag" system showing good performance when tags are close to the reader coil. RFID systems at Ultra-high frequency (UHF, 860; 960 MHz) and microwaves (SHF, 2.45 GHz and 5.8 GHz) involve electromagnetic coupling between antennas offering higher data rates and establishing a communication link at a longer distance (Foster & Bueberry, 1999).

Amid the components of the RFID system, antenna is considered as an essential element and has been paid a great attention that is why antenna design becomes very critical and very important in the performance of the whole system due to many reasons (Rao & Nikitin, 2005);

- Tag antenna permit to recover and transfer power to the chip,
- The detection range and accuracy are directly dependent on the performance of tag antenna.
- Reducing tag fabrication cost by using low cost substrates compatible with those manufacturing process are employed.

In case of UHF and SHF frequency bands, the reader and tag antenna design depends on specific requirements such as gain, overall dimension, effective aperture and reading range. Therefore the design is mostly based on the use of dipole, helix and recently compact printed microstrip antenna (Chandra, 2010; Maicas, 2011).

The growing demand for small and compact wireless devices has increased the need for small antennas that can be easily integrated while providing acceptable overall performance, especially for the applications involving RFID handheld reader offering many advantages in terms of compactness and maneuverability. Also to comply with the expectations of the users of RFID devices that require the multi-standard capability, high data performance, security protocols and compact profile, the need to reduce the size of