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Triple band printed modified bow-tie antenna for RFID reader/ISM applications

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Abstract

A modified bow-tie antenna, which finds potential use in Radio Frequency Identification (RFID) / Industrial, Scientific and Medical (ISM) applications, is proposed. Triple band operation is facilitated by applying trapezoidal truncations on both arms of the bow-tie antenna. The major attractive feature of the proposed antenna is its improved bandwidth for triple band operation particularly in different RFID bands. A considerable size reduction of the patch area is also achieved for the proposed structure. The simulated results for the return loss characteristics are in good agreement with the measured results.

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Keywords: Triple Band Antenna; Modified Bow-tie Antenna;RFID Antennas;Printed Antennas;RFID Reader

1. Introduction

Radio frequency identification (RFID) is an automated wireless data collection technology which is widely being used as a substitute for barcodes in industries such as access control, parcel tracking, distribution logistics, automotive systems and people or live stock tracking. RFID system consists of reader, tag and processing unit [1]. Antennas are the key parts in an RFID system, which are used not only in the reader but also in the tag. In general, there are four RFID frequency bands: low-frequency band (125 KHz), high-frequency band (13.56 MHz), ultra high

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frequency (UHF) band (860-960 MHz), and microwave bands (2.45 & 5.8 GHz). RFID technology in UHF and microwave bands is becoming popular because of their advantages of long read range and high data rate. A number of suitable antennas are reported for efficient operation in these bands [2, 3]. However, the regulations for passive RFID in the UHF band are quite different for different countries (European Union 865-868MHz, America 902-928MHz, China 920.5-924.5MHz, Japan 952-956.4MHz etc). These types of decentralized standardizations are the major issue in international RFID based logistic control and similar applications. A universal RFID reader which covers the entire UHF band [4] and microwave bands is the best solution to overcome these problems. Multi-band antennas operating specifically in these bands are very useful in the design of RFID readers operating simultaneously in all these bands. Recently, attempts were made by some researchers to design dual band reader and tag antennas to work simultaneously in two RFID bands [5, 6]. Multi-band antennas are generally known for their poor efficiency and narrow bandwidth. However, several excellent designs of bow-tie antennas have been reported which exhibit improved bandwidth, ease of feeding and inexpensive in fabrication than the conventional form [7, 8].

In this paper, we present a triple band printed modified bow-tie antenna which covers the entire UHF RFID band and microwave RFID bands(2.45 GHz and 5.8 GHz) The triple band operation is achieved by applying trapezoidal truncations of same dimensions on both the arms of the conventional bow-tie antenna.

2. Antenna Design and Fabrication

A conventional printed bow-tie antenna consisting of two triangular shaped radiating arms of length L1 and width W1, printed on either side of a substrate is shown in Figure1.a. The top and bottom sides of the structure are shown in light and dark shades respectively. The triple band printed modified bow-tie antenna is constructed by applying trapezoidal truncations as shown in Figure 1.b.

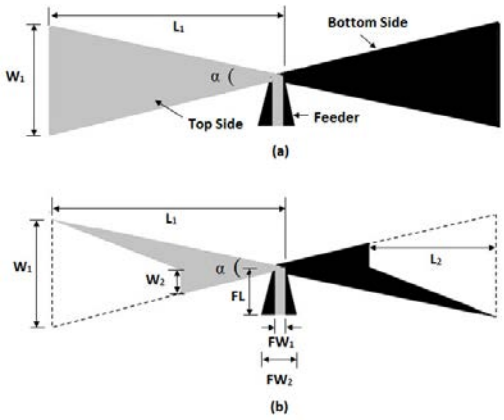

Fig 1. Geometry of the antenna configurations

a. Basic bow-tie antenna
b. Layout of the proposed antenna

The truncations are applied in the lower portion of the top arm and the upper portion of the bottom arm of the conventional bow-tie antenna. The simulation studies were performed with CST microwave studio and the parameters of the modified bow-tie antenna were optimized for triple band operation. The simulated variations of S11 with frequency for different values of L2 in comparison with the conventional bow-tie antenna are shown in Figure 2. It is clear that the required triple band for RFID applications are obtained at L2=40mm. The optimal