CIRCULARY POLARIZED WIDEBAND SLOT ANTENNA FOR RFID

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Abstract

This paper presents a high gain, circulary polarized, wideband rectangular microstrip patch Radio Frequency Identification (RFID) reader antenna at UHF band. In order to obtain the circulary polarization and wide band characteristics, edge of the patch antenna is truncated and slots are insearted. To match the impedance of the antenna to the transmission line, the feeding position is also optimized.

Keywords: circulary polarization slot patch antenna, RFID reader antenna, wideband patch antenna.

1. Introduction

In recent years, there has been growing interest in the development of Radio Frequency Identification (RFID) systems for tracking and identification of objects [1, 2]. Antennas are key components of microwave RFID systems. Some RFID systems operating at UHF band (910 MHz) use the microstrip patch antenna. UHF band RFID has been very popular in logistics, security systems, animal tracking, transportation and manufacturing process control [2]. ISO 18000 series introduces 860~960MHz, 2.45GHz and 5.8GHz bands RFID systems. RFID system consists of a reader, transponder (tag) and computer connected to the reader. The RFID reader antenna transmits modulated electromagnetic field, which powers up the tag and sends the data to the tag. The tag antenna reflects back a part of the energy received from the reader. A RFID reader antenna should have high gain and circular polarization to recognize signal from tag with any physical orientation.

An nverted F shape of UHF band RFID reader antenna is introduced [3], and 3 dimensional folded patch antenna is also introduced [4]. A dual-polarized C band (5.8GHz) RFID antenna also shown in [5]. Dual polarized high gain 2x2 arrays for 5.8GHz and 2.4GHz bands antennas are introduced. The two elements are Rx antennas and the other two are Tx antennas. Two Wilkinson power dividers are used for Tx and Rx [6]. A beam-scanning with low side-lobe pattern is also used as a RFID reader antenna as shown in [7]

Most RFID reader applications require wide-bandwidth, high gain, circulary polarization, omnidirection beam pattern and high front-to-back ratio. The optimal antenna for RFID application is that ensures the matching of the bandwidth of the transmitted and the received signal. Generally, microstrip antenna' s bandwidth is

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5% below. Simply using PCBs having thick substrate with low dielectric constant can bring wider bandwidth. The circular polarization characteristic of RFID reader antenna is very important as well as wideband characteristic since the antenna can recognize signal from tag with any physical orientation. In this paper, the goal is impedance bandwidth of about 10% and an average gain of about 7.5dBi. This single-patch with coax-fed provide low cost, easy fabrication, wide-band property, proper gain and circulary polarization property for RFID application.

2. Antenna configuration

A microstrip patch antenna was designed to operate with a center frequency of 910 MHz, with 10% impedance bandwidth, with configuration shown in Fig. 1. The antenna use substrates of RT/Duroid 5880 (Er = 2.2). To decide the feeding point and the geometry of the antenna, transmission line mode is used. In this paper, we use edge-truncated mathod to achieve the circular polarization [8]. The substrate thickness of 10mm and slots are used in order to overcome the narrow-bandwidth characteristics of microstrip patch antenna [9-10]. The designed circulary polarization microstrip antenna is shown in Fig. 1.

Circulary polarization microstrip antenna configuration shown in Fig. 1. The slot increase the bandwidth of the antenna. The location of the slots are carefully selected. They are symmetric.

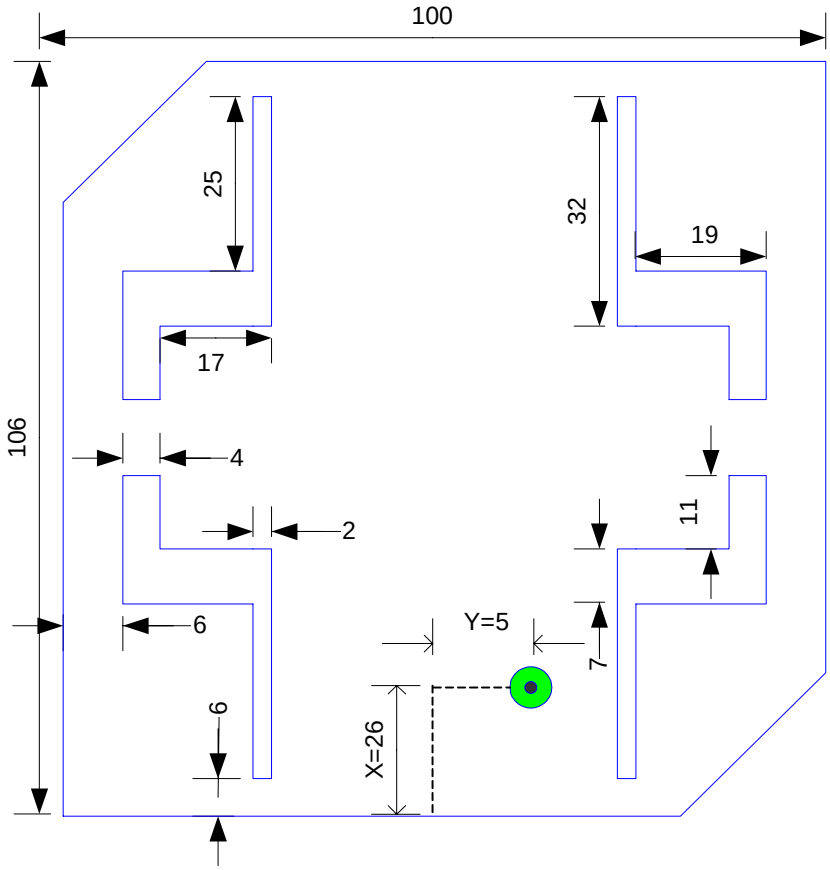

Figure 1. Circulary Polarized Wideband RFID Reader Antenna

3. Simulation result

Fig. 2 represents the simulated reflection coefficient and radiation pattern of the microstrip patch antenna. As shown in figure 2, the antenna has bewlow 10dB from 840 to 950 MHz. The achieved bandwidth is broader than that of a conventional microstrip patch antenna. Figure 3 shows Smith chart with the circle at VSWR=2. Figure 4 shows the pattern and 7.9dB gain. Figure 5 shows the axial ratio of the antenna. In figure 5, from 840MHz to 945MHz, the axial ratio is below 3dB. It is about 115MHz.

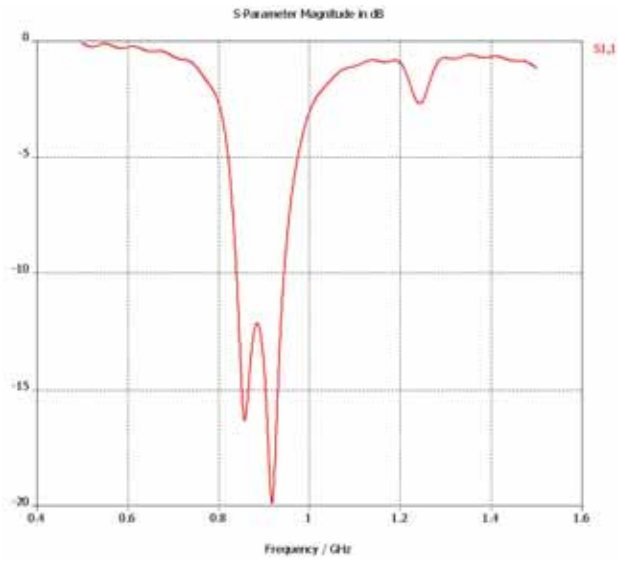

Figure 2. S11 of the antenna

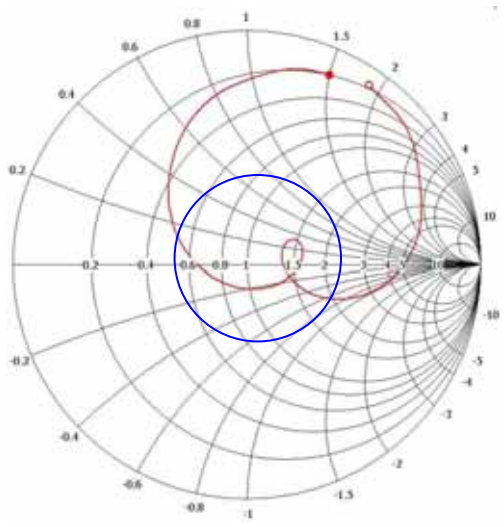

Figure 3. Smith chart with the circle of VSWR=2

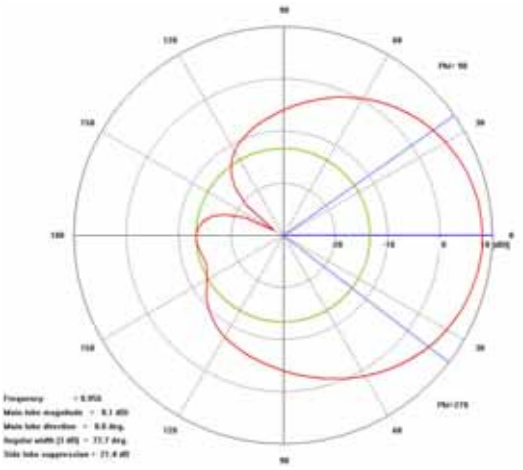

Fig 4. S11 and radiation patterns

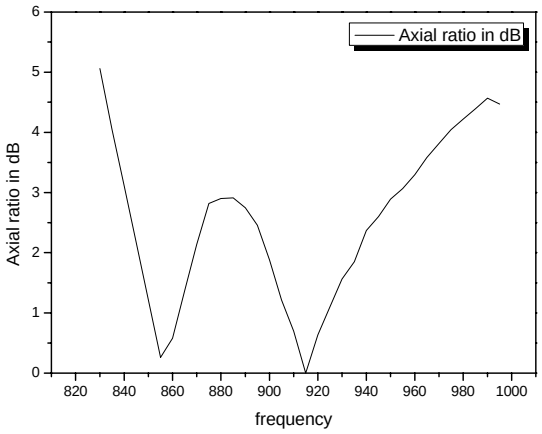

Figure 5. Axial Ratio

Conclusion

A conventional microstrip patch antenna is modified so that it may have broader bandwidth and circulary polarization in the UHF RFID band, 860~960MHz. It has the required characteristics of RFID reader antenna in a simple structure. the

antenna has enough bandwidth and circulary polarization, using edge-truncate method. The simulation shows the main lobe gain is 7.9 dB, and side lobe supression is 21.4dB.

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