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Design of Circular Polarized Transmitter for RFID Tag

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***Abstract*: RFID stands for "radio-frequency identification". It refers to the technology by which the digital data encoded in RFID tags or smart labels are captured by a reader via radio waves. RFID is uniform to barcoding in that data from a tag or label are captured by a device that stores the data in a database. However, RFID has many over systems which use barcode asset tracking software. The most notable is the RFID tag data that can be read outside the line-of-sight, whereas barcodes must be aligned with an optical scanner. RFID methods utilize radio waves to achieve this. At a basic stage, the RFID system is divided into three components: an RFID tag or smart label, an RFID reader, and an antenna. RFID tags consist of an integrated circuit and an antenna, used to send data the RFID reader. After this, the reader transforms radio waves into a more usable data. Then, the data acquired from tags is transmitted via communication interface to the host pc, where the information gets accumulated in a database and later examined.**

***Keywords*: Barcodes, RFID tag,**

1. Introduction

The importance of radio frequency identification is that it allows computers to automatically capture information about what is going on in the real world, as well as alert managers when something is not going according to plan. Unfortunately, I don't think there is a CEO at any major technology company anywhere in the world that understands how profoundly important this is. The computer allowed human beings to do complex calculations far faster than was ever possible before. The personal computer put that power in the hands of every worker. And the Internet connected these machines, enabling another leap in productivity. The next great leap in computing is the ability for computers to understand what is happening in the real world without the need for human involvement. Devices using Wi-Fi, ZigBee and Bluetooth will play a part, but when you talk about connecting trillions of ordinary items to the Internet, RFID is the only technology I see that is viable. In short, RFID will be as important as the Internet is today, because it will link the digital and real worlds. And just as no one envisioned the many innovations unleashed by the Internet, I don't think anyone has begun to understand the changes that ubiquitous RFID will bring and the innovations that it will enable.

2. Literature survey

A circularly-polarized printed dipole-like antenna employing asymmetrical arms and an orthogonal slit in the ground plane is presented in [1]. It is fed by a stepped microstrip line which connects to the shorter arm. By utilizing surface currents on the asymmetrical arms and the orthogonal feedline structure, circular polarization is realized. Experimental and numerical data are in agreement and the measured results show a fractional impedance bandwidth of 41.3% (1.77 GHz to 2.69 GHz) and a wide axial-ratio bandwidth of 38.4 % (1.81 GHz to 2.67 GHz). The concept, design, and measurement of a multi-band circularly polarized printed slot antenna with a single microstrip feed line is presented in [2]. The antenna design for circular polarization (CP) at 1.5 GHz for GPS, 2.4 GHz for Bluetooth, and 3.75 GHz for WiMax application is given. The proposed antenna also provides a fourth linear polarized band over 5.2 to 6 GHz covering the WLAN band. The design is such that all three CP bands can be tuned for any other desired frequencies. Three configurations of the proposed antenna with different design parameters for different circularly polarized bands are reported in the paper. A prototype of the proposed antenna is fabricated, and measured results are compared with those of the simulations.

A compact design of a hexagonal single feed circularly polarized microstrip antenna for RFID applications is proposed in [3]. This structure fabricated on FR4 substrate offers compactness, good axial ratio bandwidth with a broadside radiation characteristic in the entire band, better gain, good impedance bandwidth at a resonant frequency of 2.45 GHz. The structure is suitable for RFID reader antenna applications. A novel design of a single feed circularly polarized hexagonal patch antenna has been designed, simulated and experimentally investigated. The elliptical and circular slots perturbation method yields better circular polarization characteristics. The experimental results confirm that it is suitable for RFID applications in the 2.45 GHz band.

3. Scope of project

Impedance matching concepts in RFID tags is analyzed, in which both antenna and chip have complex impedances. The impedance match can be characterized by the power transmission coefficient. The behavior of the power transmission coefficient and the effect it has on tag performance has been analyzed. A specific RFID tag example is presented and showed that the tag resonance is determined by the peak in the power transmission coefficient. The experimentally measured read range agreed well with the theoretical model. As an example, a specific RFID transponder design is considered, an Intellitag ID card with embedded folded meander antenna operating in 915 MHz band. Both measurement data and simulation results are in good agreement

4. Designing method

Requirement of RFID transmitter is as follows but depending on the need it can be modified.

Table 1
Required RFID antenna parameters

Parameter	Parameter value
Resonant Frequency	866 MHz
Gain	5-7 dB

The antenna can be either circular or rectangular one. A rectangular antenna is chosen here as RFID transmitter.

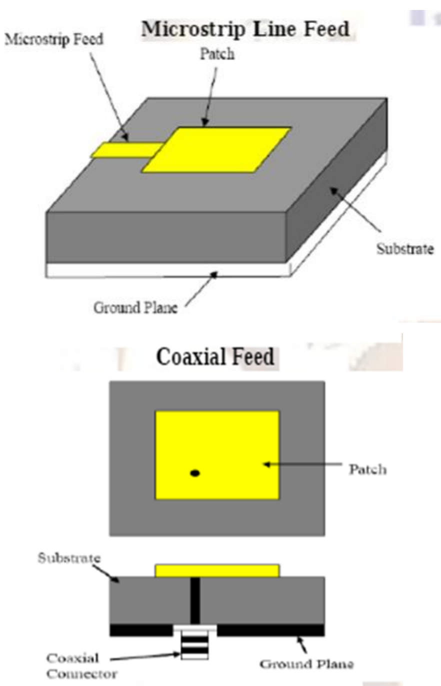

Fig. 1. Rectangular antenna with different feeding techniques

It shows the different feeding technique to excite the rectangular microstrip antenna. In order to design the microstrip antenna it is important to understand the parameters involved in the design of antenna. Table 1 shows the various parameters need to design the antenna

The dimension of the patch is taken 67.6 mm x 67.6 mm after multiple simulations and the structure with feed location. It is observed that the feed location plays very important role in bringing the antenna impedance favorable to reference impedance of 50 Ω. It can be observed in figure 6 that the location of the feed is at (u,v) = (0, 20) and w varies from 0 to 0.835 since the feed must be connected to ground plane at 0 mm and patch at 0.835 mm. Fig. 2. shows the reflection coefficient of the antenna. It can be observed that the antenna is tuned at 0.864 GHz and the band of the antenna ranges from 0.8639 GHz to 0.869 GHz. Therefore, the obtained band also covers 0.866 MHz frequency.

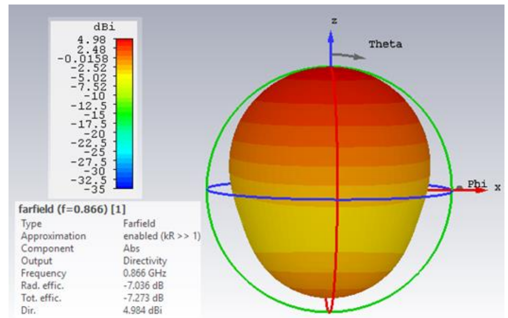

Fig. 2. Reflection coefficient of the antenna

5. Result and discussion

It shows that the required result is achieved by the antenna modeled.

Comparison between linear and circular polarized patch antenna.

Table 2
Comparison between linear and circular polarized patch antenna

Parameter	Simulated Result Linear Polarized Antenna	Simulated Result Linear Polarized Antenna
Resonant Frequency	866 MHz	870 MHz
Gain	4.98 dBi	5.75 dBi
Reflection coefficient	-15.25 dB	-14.8 dBi

Table 3
Two antennas based on dimensions

L x W mm^2 (Ground plane)	L x W mm^2 (patch)	Feed locations (u,v) mm
120 x 120	67.6 x 67.6	0, 20
120 x 120	52 x 52	0, 11.3

It shows the comparison between the two antennas based on dimensions.

It can be observed that the patch antenna with slits not only gives circular polarized wave but also reduces antenna size. It shows that the patch size is reduced by 40%.

6. Conclusion

A patch antenna of dimension 52 x 52 mm^2 resonates at 870 MHz and the gain of the antenna is 5.75 dB with return loss of -14.8 dBi. Polarization of the antenna achieved is circular after inclusion of slits and antenna resonates at 870 MHz. It is also observed that the slit technique can be explored for dual band property of patch and it also ensures size reduction in the patch antenna.

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