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Novel Antennas for UHF RFID Tags: Design and Miniaturization

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ABSTRACT

This article focuses of study the nature and characteristics of the antenna, The collective electrical signals acquired from RFID antennas require advanced techniques for feeding, gains and radiation patterns. After an introduction to RFID technology itself (principle and characteristics of different RFID tags), the article offers some examples of applications of this technology in everyday life or in the industry. In order to use radio frequency identification (RFID) antenna for wireless communication and real world applications military and personal communication systems, mobile phones, personal digital assistant (PDA), blue-tooth systems, wireless local area networks (WLAN), road tolling systems, animal traceability etc, studying the nature and characteristics of the antenna is an important use. A novel printed antenna is proposed for Radio Frequency Identification. The antenna has a much wider bandwidth than known printed antenna, mostly planar antennas. The antenna geometry is much smaller than a printed dipole antenna at the same frequency band.

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1. INTRODUCTION

Computer wants recent years highly scalable and present in everyday life. New communication technologies have greatly contributed to the massive spread. Wireless communications have enabled new applications and made the presence of mobile phones.

WIFI for example, is widely installed in public places (stations, restaurants, etc.) Making external information available to anyone at any time.

Beyond the communication or data exchange, the latest technology has allowed the identification or object tracking. This is the case of RFID (Radio Frequency Identification), which allows traceability of objects to which is attached an RFID tag.

We propose in this paper an overview of RFID and some examples of applications technology. We then present a novel printed antenna is proposed for Radio Frequency Identification [4].

2. THE RFID TECHNOLOGY

Contactless technologies have emerged in recent years in our daily lives. They correspond to all appliances and other devices that can communicate without any physical connection. For example, the exchange of multimedia data from a mobile phone to another uses Bluetooth technology.

Beyond the exchange of data, the latest technologies have also led to the identification and tracking of objects. This is the case of Radio Frequency identification more commonly known as RFID, which falls into the category of automatic identification technologies [1].

2.1. Principles

RFID technology works on the principle of a reader player and a transmitter. The RFID Tags (Figure 1) are composed of a chip may contain a memory, connected to an antenna responsive to radio waves. They are read by a reader most often connected to a computer [2].

The communication between the electronic component and the reader is established by radio frequency and not optical reader (eg for reading bar code).

The barcode identifies a family of products while the RFID tag allows the unique identification of an object with a tag. Also note that RFID tags can be read at a distance and parallel multiple tags can be read the same time on a single reader.

Regarding the RFID tags, there are various types. Indeed, RFID tags can be either passive or active.

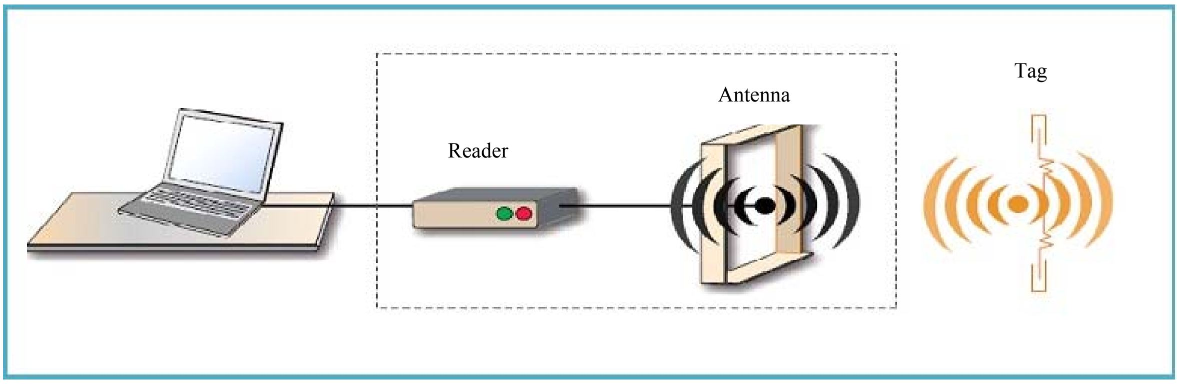

Figure 1. Principle of operation of RFID

Passive tags operate in the read-only, they use the energy of the radio signal propagated the reader for transmitting short turn their unique identification code. These tags have a memory capacity of up to several hundred bits. Generally purchased blank, they can be programmed with data that can not be changed. When using the label on an object, the user can write the information which would be useful. This information can be read but can not be amended or supplemented.These tags represent the most economical solution, they are small (a few millimeters to centimeters) and have a virtually unlimited life in passive form (because they do not include the battery) is the transmitter receiver that provides energy.

In such a context, Ultra-High-Frequency (UHF) systems,are generally preferred to the more consolidate High-Frequency (HF) and Low-Frequency (LF) ones, because they considerably guarantee longer communication distances [3] [4].

Radio Frequency Identification (RFID) systems in which the gap between reader and transponder is greater than 1m is called long-range-systems.

These systems are operated at UHF frequencies of 868MHz (Europe), 915MHz (USA) and 965MHz (Asia). Antennas are fundamental elements in communication systems [5]. An RFID tag consists of a microchip combined with an antenna in a compact package; the packaging is structured to allow the RFID tag to be attached to an object to be tracked. The microchip package can contain an adaptative circuit for matching the RFID puce with the antenna [6].

The tag's antenna picks up signals from an RFID reader or scanner and then returns the signal.

Active or semi-active tags have for their feeding their own (one extra flat internal battery). They allow both reading than writing data. They allow detection distances greater than the passive tag. Note, however, that the semi-active tags do not use their power to make communication signals. Their diet allows, for example, to record traceability data during moving an object.

2.2. Les Applications

Although this technology is relatively new as well as in the industry of consumer side, it is possible to find more and more applications that use it.

Recently the biometric passport contains a tag RFID, data contained in it is encrypted and only the readers with the authentication key can read the contents.

Transport also use this technology and easy access to the various urban transport but also save time by avoiding taking a ticket for each trip. More generally speaking, RFID is present in applications such as logistics with instant renewal parts or merchandise for the big chains, the management of any loan libraries or tracing clothes for laundry.

Another use is the track of objects that allows a product. However, the cost of tags even if declining, is still an obstacle to the full propagation RFID or replacement, for example, bar codes that are still widely used. However, we can consider a common use of this technology in the coming years [1] [2].

3. PROPOSED ANTENNA

The introduction includes basic concepts of RFID systems. The second part will address the main characteristics of the proposed RFID tag antenna. The third part introduces a and simulations antenna with CST. And in Part Four some advantages of the proposed RFID tag that meets the objectives of low-cost and size reduction [7].

The proposed antenna can be used as a tag at the UHF frequency band (from 868MHz to 965MHz). A dipole antenna [4] used at the same range of frequency has length of 147mm. The geometry of the proposed antenna model is much smaller than 60mm of the length of a printed dipole antenna designed for the same frequency band. This model can be printed on smart cards and can be used as a tag for RFID applications [8] [9] [10].

The geometry of the proposed printed antenna is shown in Figure 2. This antenna has a simple structure with only one layer of dielectric [12] [13] [14].

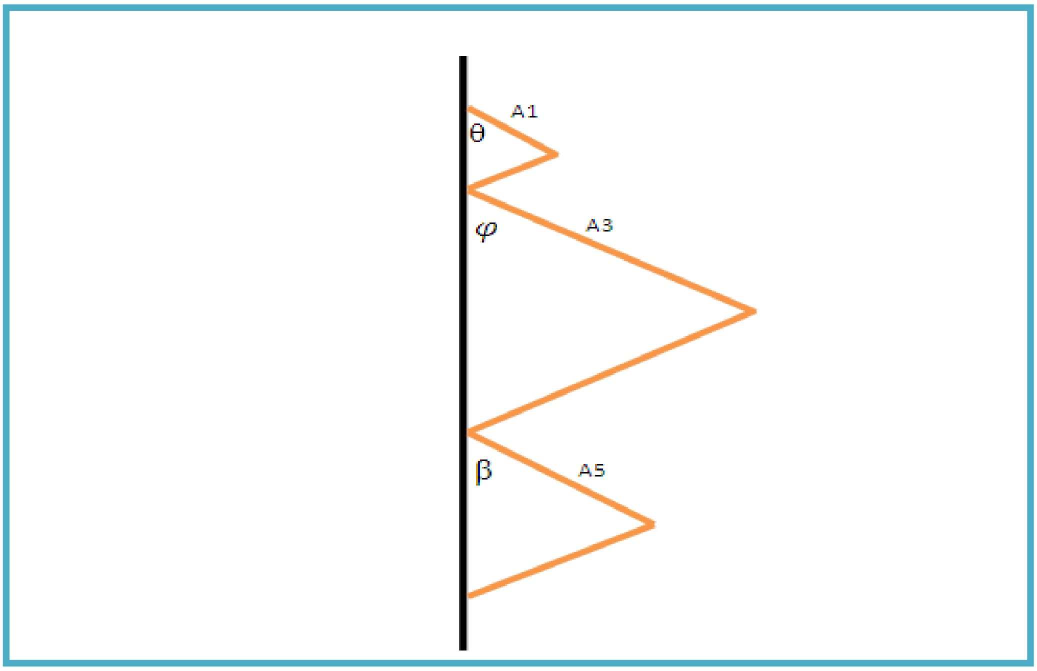

Figure 2. Geometry of the proposed antenna

A 900MHz prototype antenna is implemented with the substrate size L x W = 60 mm × 40 mm (substrate FR-4), with dielectric constant ε_r= 4, 3, loss tangent tan δ= 0,02 and thickness h = 1,6 mm.

The design parameters as shown in Figure 2 are: A1 = 16,67 mm, A3 = 35mm, A5 = 12mm width = 6mm, $\theta = \pi/3$, $\beta = \pi/3$ et $\varphi = \pi/3$.

This miniature and uniplanar design can find many applications like RFID tags printed on smart cards and other wireless handheld devices [15] [16].

4. RESULTS AND ANALYSIS

A very good result is found with CST Microwave Studio, a 3D electromagnetic solver.

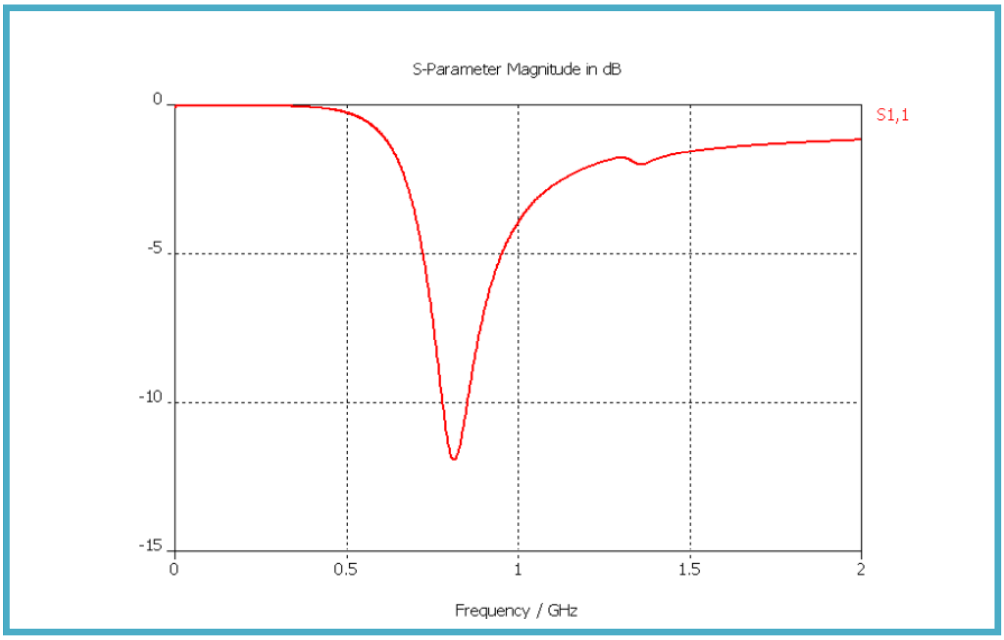

Figure 3. Simulation with CST (5dB/div)

While the simulated bandwidth is 75MHz (0.83–0.905 GHz). The simulated results are in good agreement. The E and H-plane radiation patterns calculated at 900 MHz are shown in Figures 4.a and 4.b, respectively. The radiation patterns are broadside and bidirectional in the E-plane and almost [10].

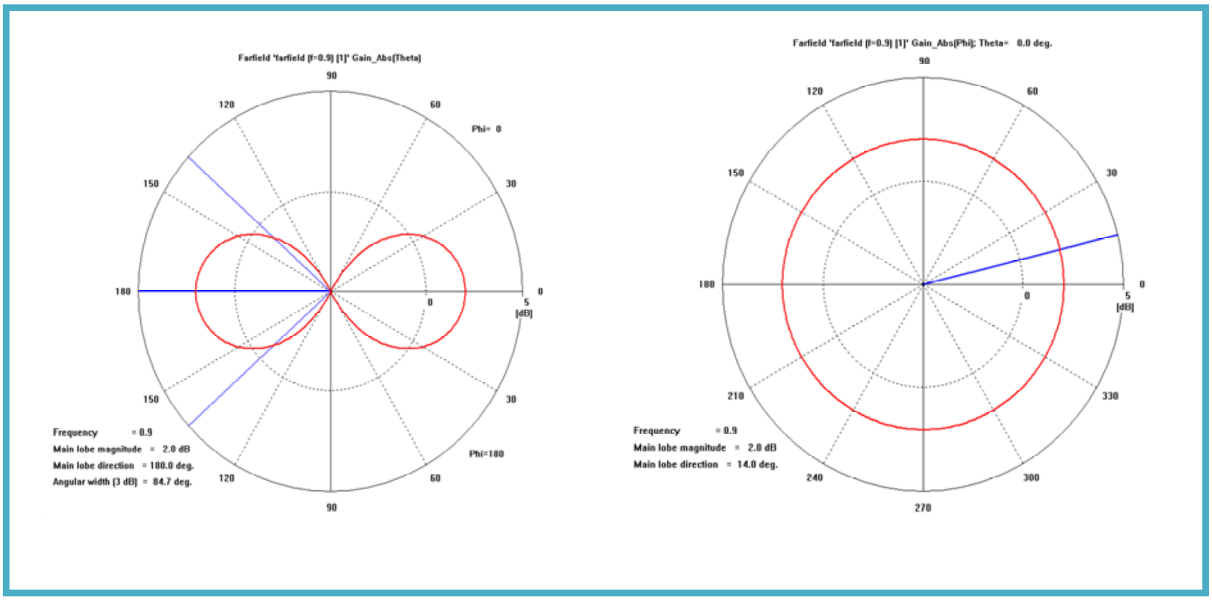

Figure 4. Radiation patterns of prototype antenna measured at 900 MHz
a: E-plane pattern b: H-plane pattern

By comparing the length of a normal printed dipole antenna with our proposed model, we gain about 55% of length at the same frequency band. However, the bandwidth obtained with the proposed model is much larger than the bandwidth calculated of a planar antenna at the same frequency. It is important to remark that the dimension of this antenna model is the same as smart cards.

The variation of the different parameters shown in Figure 1 (such as: A1, A3 and A5) was studied in function of the resonance frequency and S11.

by increasing the length of the "A1", the return loss factor "S11"and the resonance frequency will decrease. By increasing the length of "A3" as shown in Figure 2, the resonance frequency will also decrease.

By increasing the length of "A5", shown in Figure 2, both the resonance frequency and the return loss factor "S11"will decrease.

5. CONCLUSION

A novel RFID tag printed antenna suitable for use at 900MHz has been presented.

The miniature prototype has been designed and implemented to have the bandwidth and antenna gain of 75MHz and 2dBi, respectively. The radiation pattern measured at resonance is almost omnidirectional in the H-plane.

Moreover, the present antenna is mechanically robust and easy to fabricate and design. This design is based on the RFID needs but is also applicable to other fields of wireless applications. Finally, it is important to remark that this proposed model can operate at both UHF frequencies of 868MHz (Europe) and 915MHz (USA) with slight modifications.

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