Journal of Science Engineering Technology and Management Science
Volume 02, Issue 06, June 2025 *ISSN: 3049-0952*
www.jsetms.com *DOI:10.63590/jsetms.2025.v02.i06.pp06-09*

New UHF RFID Tag Antennas: Architecture and Compactness

K. Mohan Kumar
Department of Electronic and Engineering, QIS college of Engineering, Nellore
Corresponding Author: mohankumar122@gmail.com

To Cite this Article
Robert Stewart and Samuel Jack, "New UHF RFID Tag Antennas: Architecture and Compactness", Journal of Science Engineering Technology and Management Science, Vol. 02, Issue 06, June 2025, pp:06-09, DOI: http://doi.org/10.63590/jsetms.2025.v02.i06.pp06-09

Submitted: 15-03-2025 *Accepted: 08-05-2025* *Published: 10-05-2025*

***Abstract**: The nature and properties of the antenna are the main topic of this article. The collective electrical signals obtained from RFID antennas necessitate sophisticated feeding, gain, and radiation pattern approaches. Following an overview of RFID technology (including its principles and the features of various RFID tags), the article provides several instances of how this technology is used in industry or daily life. The investigation of antenna properties stands essential for implementing radio frequency identification (RFID) systems and their wireless communications in various applications including road tolling systems and Bluetooth systems and wireless local area networks (WLAN) and military and personal communication systems and mobile phones and PDAs and animal traceability systems. The research proposes creating a new radio frequency identification printed antenna. The antenna achieves a bandwidth level much higher than standard printed antennas maintain in their planar configuration. The antenna shape for a printed dipole antenna displays significant reduction when operated in the same frequency band.*

***Keywords**: Miniaturization, RFID, Bandwidth, and RFID tags*

I. Introduction

Current years have seen computers become more expansive and widespread. New communication technology stands responsible for most of the vast growth seen in recent years. Mobile phones exist everywhere due to wireless connections that enable fresh possibilities. The implementation of WIFI extends throughout public spots including train stations and restaurants which gives individuals unlimited access to outside information[10]. New technology now enables the identification and tracking of objects as well as data transmission and exchange capabilities. The tracking system based on RFID (Radio Frequency Identification) tracks items which bear an RFID tag. This paper includes a brief RFID overview which is followed by several practical technology illustrations. This paper introduces a brand-new printed antenna which scientists proposed for radio frequency identification use [4].

II. The RFID Technology

Contactless technologies have taken a significant place in the common activities of people throughout the last few years. The category includes all appliances together with gadgets which operate through wireless communication methods. The data transfer of multimedia between mobile phones uses Bluetooth technology as its communication standard. The current technological advances enable both the identification of objects and their tracking alongside data transmission capabilities. Radio Frequency identifying technologies known as RFID represent an automatic identifying system [1].

The operation of RFID technology depends on three essential components including transmitter units and readers and player elements. RFID tags (Figure 1) consist of a radio wave-responsive antenna with a memory-equipped chip as their main components. Readers connect the tag data points to computers as their standard procedure [2]. The electronic component uses radio frequency alongside a reader for data transmission instead of relying on an optical system (such as bar code reading). The RFID tag delivers unique identification whereas the barcode labels an entire group of items. Users should acknowledge that RFID tags can be scanned remotely and mutually between one reader and numerous tags at once.

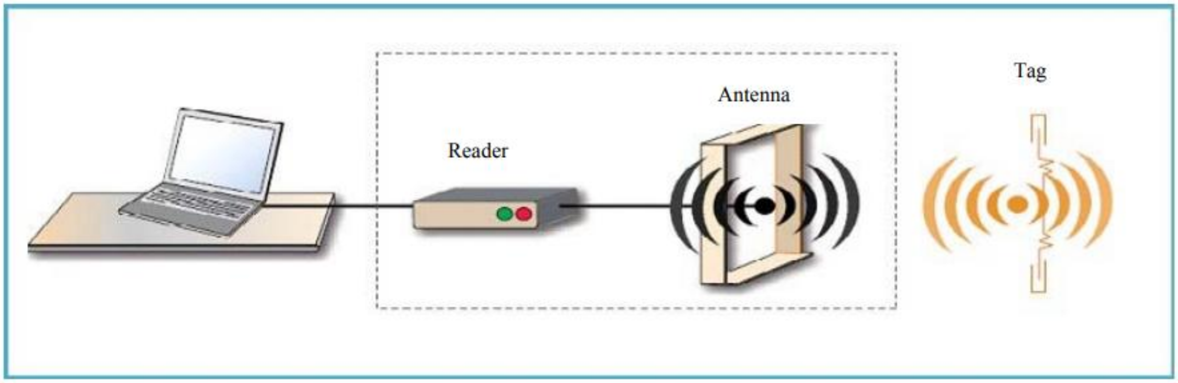

Fig 1: Principle of operation of RFID

The operating mode of passive tags sends brief identifying codes through received radio signal energy directly to the reader. Such wireless identification tags store information up to several hundred pieces of data. The majority of passive tags start their life blank and programming them with permanent data before release. Users can add relevant information to the label through a writing process at the time of application. An audience can read the stored information within passive tags yet the tags remain non-editable. These transmitter-receivers known as tags operate as the power supply and represent the most economical choice in the market. These tags measure only a few millimeters to centimeters and function without end because they do not contain power cells. UHF systems provide better communication range distance thus they are commonly used instead of HF/LF systems in such situations [3], [4]. RFID technology features long-range operations as a system that keeps transponders and readers beyond one meter from each other. UHF frequencies in different regions function at 1090 MHz in Germany, 820 MHz in the UK and 960 MHz in Asia. Communication systems require antennas to function as their basic operational elements [5].

Quality control of RFID tags depends on two fundamental elements: a microchip along with an antenna that fit inside a tiny casing. A specific structure of packaging permits RFID tag application for monitoring purposes. Packaging of RFID devices includes an adaptive circuit that enables antenna and microchip matching [6]. A computerized scanner generates signals toward the antenna connected to the radio-frequency identification devices and this signal is sent backward from the antenna[10]. Active or semi-active tags need a built-in flat internal battery to operate independently during reading or writing operations. Such devices support data access for both reading and writing purposes. These tags possess a longer detection capability than what passive tags achieve. The communication process for semi-active tags does not involve the consumption of power from the device.

III. Applications

This technology has recently emerged but now draws use in various applications despite the brief existence of both RFID applications and consumer adoption. RFID tags equipped with encryption now include a protection mechanism that can only be unlocked with authentication keys to access stored data. This technology enables quick urban transit access and saves time for passengers because transportation systems do not require individual tickets each time. The broader implementation of RFID technology supports tracking operational clothing through laundry services together with system management in resource libraries as well as supply chain storage and retail distribution processes in major retail venues. Another application involves monitoring objects for product authentication. Decreasing tag prices fail to promote RFID adoption beyond bar codes because tags act as an inhibition to tag-wide implementation. The widespread adoption of this technology seems possible for future application years [1] [2].

IV. Proposed Antenna

Basic RFID system fundamentals are covered in the introduction. The primary features of the suggested RFID tag antenna will be covered in the second section. In the third section, a simulation antenna using CST is introduced. Additionally, Part Four lists certain benefits of the suggested RFID tag that satisfy the goals of affordability and compactness [7]. The suggested antenna is suitable for usage as a tag in the 868MHz–965MHz UHF frequency range. The length of a dipole antenna [4] operating in the same frequency band is 147 mm. The suggested antenna model's geometry is significantly smaller than a printed dipole antenna made for the same frequency range, which is 60 mm long[10]. This type can be used as a tag for RFID applications and printed on smart cards [8]. Figure 2 depicts the geometry of the suggested printed antenna. This antenna's structure is straightforward, consisting of a single dielectric layer.

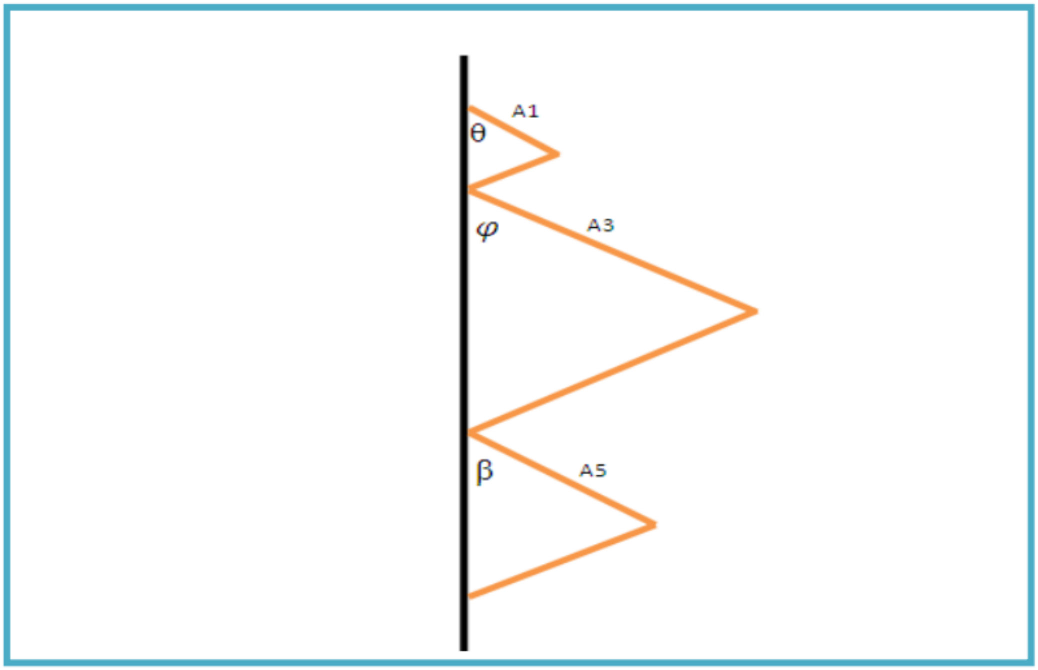

Fig 2: Geometry of the proposed antenna

V. Results and Analysis

CST Microwave Studio, a 3D electromagnetic solver, yields excellent results.

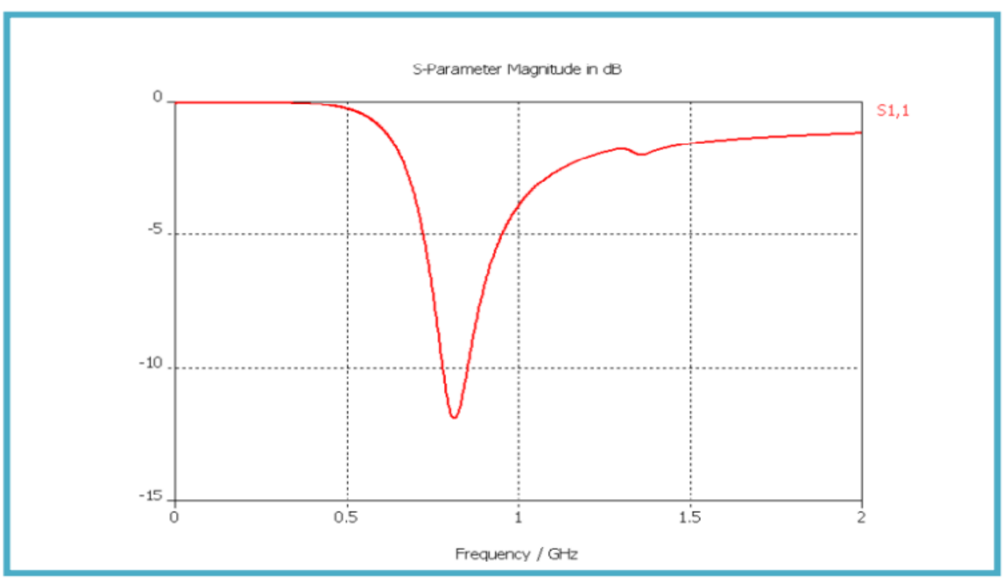

Fig 3: Simulation with CST (5dB/div)

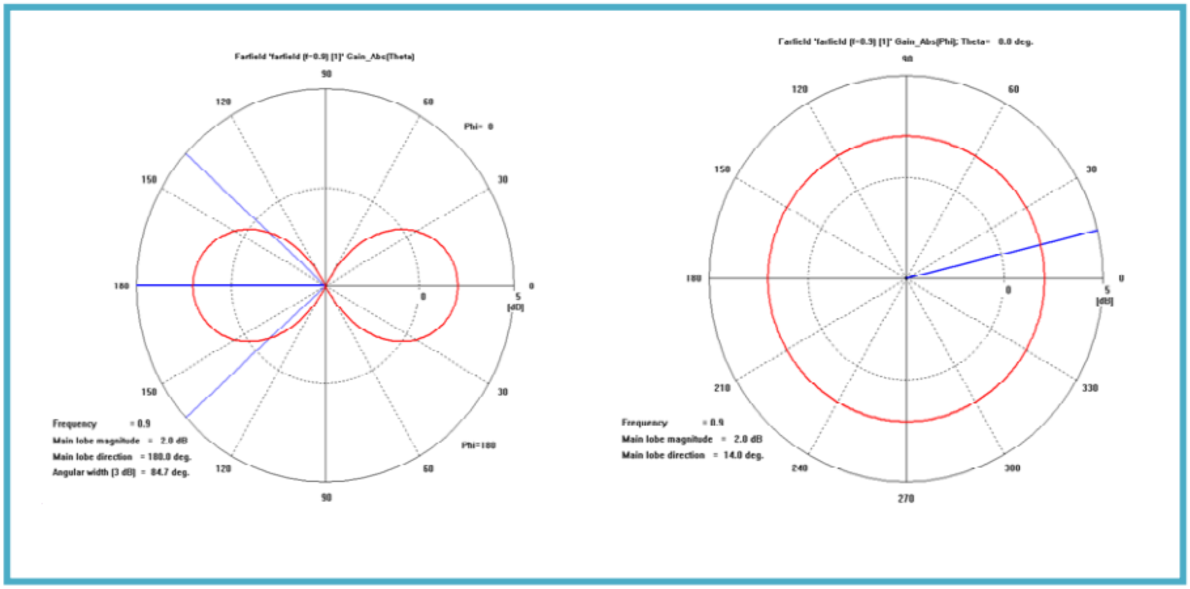

Fig 4: Radiation patterns of prototype antenna measured at 700 MHz

The length of our suggested model is approximately 55% longer at the same frequency range than that of a typical printed dipole antenna. However, compared to the bandwidth predicted for a planar antenna at the same frequency, the bandwidth achieved using the suggested model is significantly higher. It's crucial to note that this antenna model's dimensions match those of smart cards. As a function of resonance frequency and S11, the fluctuation of the various parameters (A1, A3, and A5) in Figure 1 was examined.

VI. Conclusion

An innovative printable antenna for RFID tags that can operate at 700MHz has been introduced. The tiny prototype's bandwidth and antenna gain are 65MHz and 4dBi, respectively, according to its design and implementation. In the H-plane, the radiation pattern measured at resonance is nearly omnidirectional. Additionally, the current antenna is simple to design and build and has a strong mechanical foundation. Although this design is based on RFID requirements, it can also be used in other wireless application domains. Lastly, it's crucial to note that, with minor adjustments, this suggested model can function at both the 800MHz (UK) and 760MHz (Asia) UHF frequencies.

References

[1] D Paret. "RFID and Contactless Smart Card Applications". Wiley. 2005.

[2] R Want. "An introduction to RFID technology". IEEE Pervasive Computing. 2006; 5: 25-33.

[3] CA Balanis. Antenna theory: analysis and design. 3rd ed. ed. Hoboken, N.J.: [Great Britain]: Wiley-Interscience. 2005.

[4] Tiang JJ, MT Islam, N Misran, and JS Mandeep. "Circular microstrip slot antenna for dual-frequency RFID application". Progress In Electromagnetics Research. 2011; 120: 499–512.

[5] A Ghiotto. "Conception d'Antennes de Tags RFID UHF, Application à la Réalisation par Jet de Matière". PHD thesis, Grenoble Institute of Technology, France. 2008.

[6] Taeik Kim, Uisheon Kim, and Jaehoon Choi. "Design of a Compact UHF RPID Tag Antenna Using an Inductively Coupled Parasitic Element". Microwave and Optical Technology Letters. (Submitted Apr. 24. 2010).

[7] MB Eunni. "A Novel Planar Microstrip Antenna Design for UHF RFID". M.S. thesis, Madras University, India. 2004.

[8] Y Choi, U Kim, J Kim, and J Choi. "Design of modified folded dipole antenna for uhf rfid tag". Electronics Letters. 2009; 45(8): 387 –389.

[9] Budak Erhan, Catay Bulent, Tekin Ibrahim. "Microstrip Patch Antenna for RFID Applications". RFID Eurasia. 2007 1st Annual5-6 Sept. 2007 Page(s): 1–3, IEEE CNF 2007.

[10] C, Wang Chie. "An LC Filter and IGBT-Based High Regulated Low Ripple DC Supply." Journal of Science Engineering Technology and Management Sciences, vol. 2, no. 5, Apr. 2025, pp. 20–25. Crossref, https://doi.org/10.63590/jsetms.2025.v02.i05.pp20-25.

[11] HW Son and CS Pyo. "Design of RFID tag antennas using an inductively coupled feed". Electron Lett. 2005; 41(18): 994–996.