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Designing and Analysis of Dual-Band Monopole Antenna for RFID Applications

Sarabjit Kaur, Mohammad Aquib Jameel Khan, Fahad Wali Khan, Mahtab Alam,Manish Singh

(Electronics and Communication Engineering, Noida Institute of Engineering and Technology, Greater Noida, India)

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ABSTRACT:-RFID stands for Radio Frequency Identification technology is widely used and has many applications such as logistics, security, and access control. The performance of RFID systems is heavily dependent on the design of the antenna. A dual-band monopole antenna for RFID applications is presented in this paper. The designed antenna can operate at two frequency bands: 915 MHz and 2.45 GHz, which are commonly used in RFID systems. The antenna design is optimized using simulation software, and the results are compared with measurement results. The results of simulation show that the proposed antenna has a return loss of less than -10 dB at both frequency bands, which is suitable for RFID applications. The measurements results show that the proposed antenna has a good agreement with the simulation results. The antenna has a compact size of 30mm x 30mm x 7mm, which is suitable for integration into RFID tags and readers. The results of this study indicates that the proposed dual-band monopole antenna is an adequate choice for RFID applications.

I. INTRODUCTION:

RFID which stands for Radio Frequency Identification technology, has various applications such as logistics, security, and access control. RFID systems consist of two components: 1. Reader and 2. Tag. The reader sends a radio frequency signal to the tag, which then responds with its identification information. The performance of RFID systems is heavily dependent on the design of the antenna. The antenna must have a suitable gain, polarization, and directivity to ensure reliable communication between the reader and tag. The most common type of antenna that is used for RFID applications is the monopole antenna. Monopole antennas have simple structure and hence easy to construct, easy to manufacture, and they also have a good impedance match with the transmission line. However, the bandwidth of monopole antennas is limited, which means that they may not be suitable for RFID systems that require a wide frequency range. To overcome this limitation, dual-band antennas have been proposed. Dual-band antennas can operate at two frequency bands, which makes them suitable for RFID systems that use multiple frequency bands.

In this paper, an F-shaped dual-band Monopole antenna for RFID applications is presented. This antenna is designed in such a way So that it can operate at two frequency bands: 915 MHz and 2.45 GHz, which are commonly used in RFID systems. The design of the antenna is optimized using simulation software (Ansys HFSS), and the results are compared with measurement results.

Antenna Design:-

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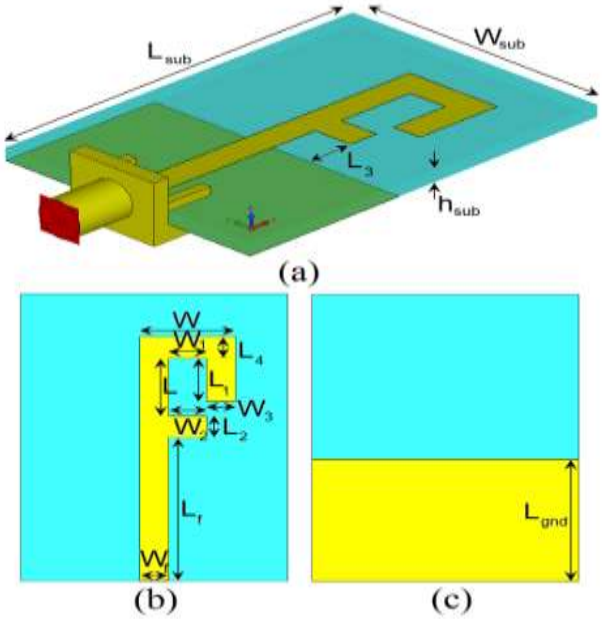

Figure 1. (A)Side view, (B)top view and (C)bottom view of the antenna

The proposed design of dual-band Monopole antenna (F-shaped) is shown in Figure 1. The antenna comprises of a metal rod, which serves as the radiating element, and a metal disk, which serves as the ground plane. The metal rod is shaped into an F-shape, which improves the impedance match and increases the bandwidth of the antenna. The antenna is fed by a microstrip transmission line, which is connected to the F-shaped metal rod.

In order to achieve dual-band operations, the metal rod is designed in F-shape to have two resonant frequencies. The first resonant frequency is located at 915 MHz, and the second resonant frequency is located at 2.45 GHz. The length and shape of the F-shaped metal rod are adjusted to achieve the desired resonant frequencies. The metal disk is designed to have a diameter of 30mm, which is suitable for integration into RFID tags and readers.

Figure 2(A) and Figure 2(B) are the primary designs for the antenna.

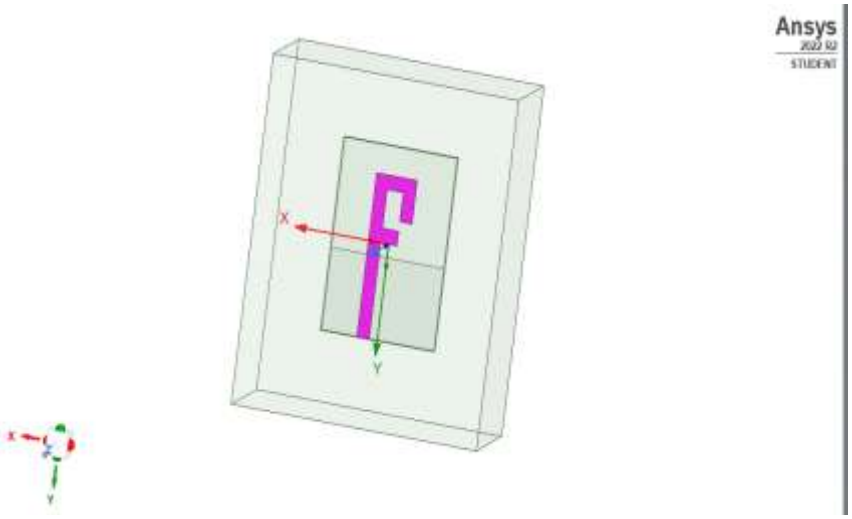

Figure 2(A)

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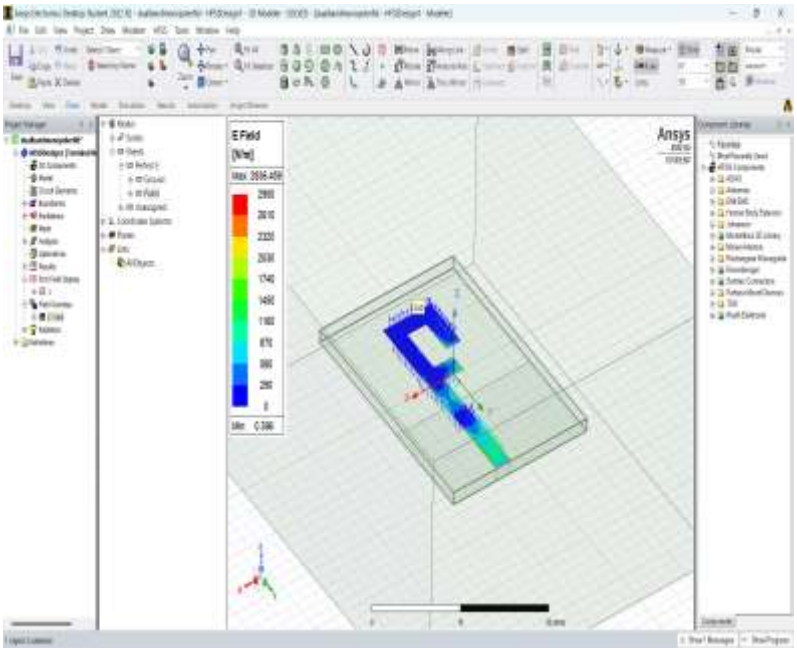

Figure 2(B)

Table 1:-Representsthe parameters of the F-shaped Dual-band Monopole antenna

Parameter of Antenna	Dimensions in mm
Length of Substrate	28
Width of Substrate	40
Height of Substrate	1.6
Length of Box	60.5
Width of Box	72.5
Height of Box	34.1
Length of Port	3
Width of Port	0

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Height of Port	1.6
Length of Ground	28
Width of Ground	17
Height of Ground	0

Table 1

Simulation:-

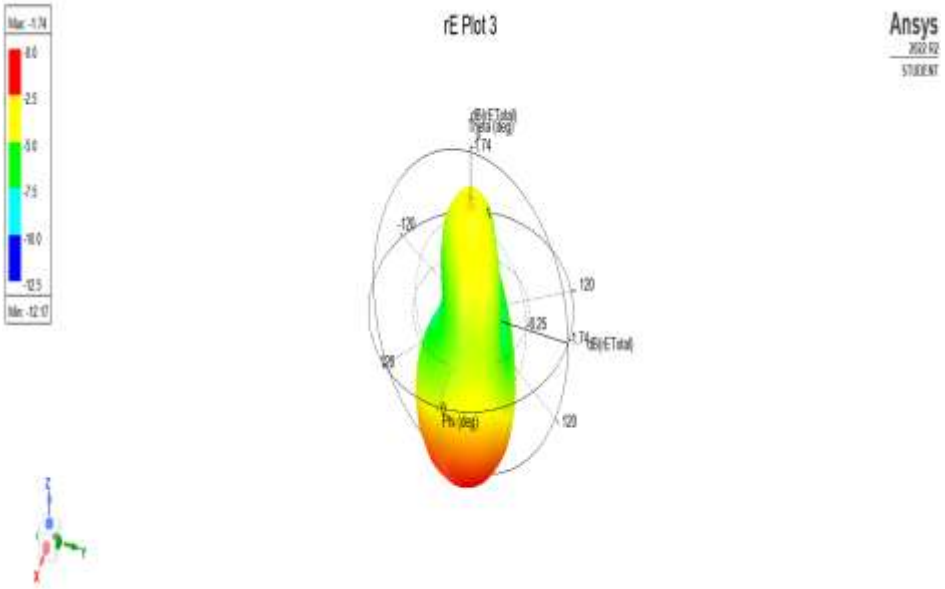

Figure 3. Far Field 3-d Polar plot

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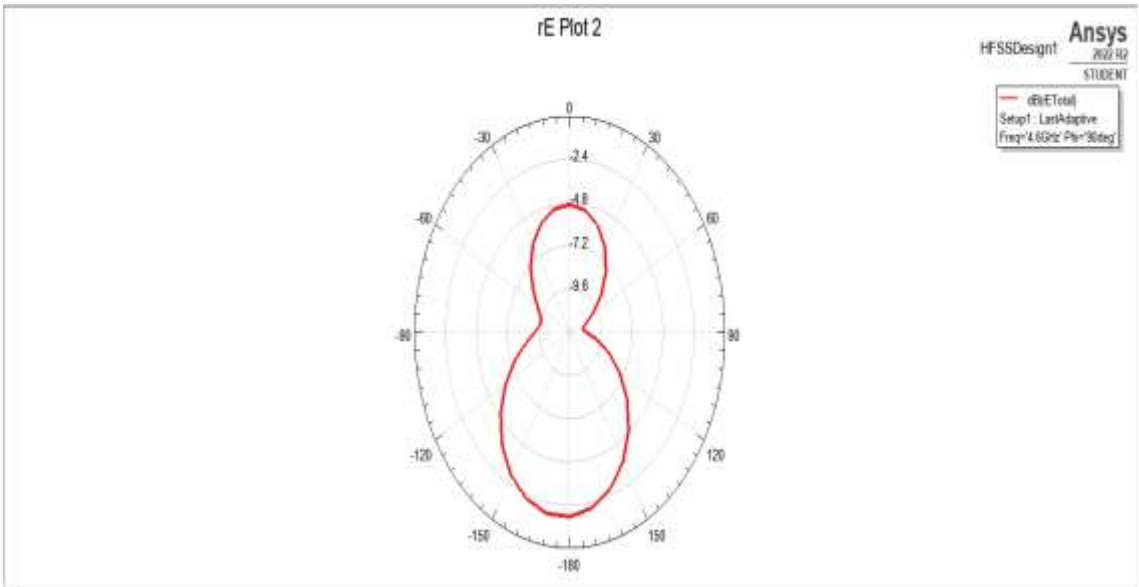

Figure 4. Far Field radiation pattern

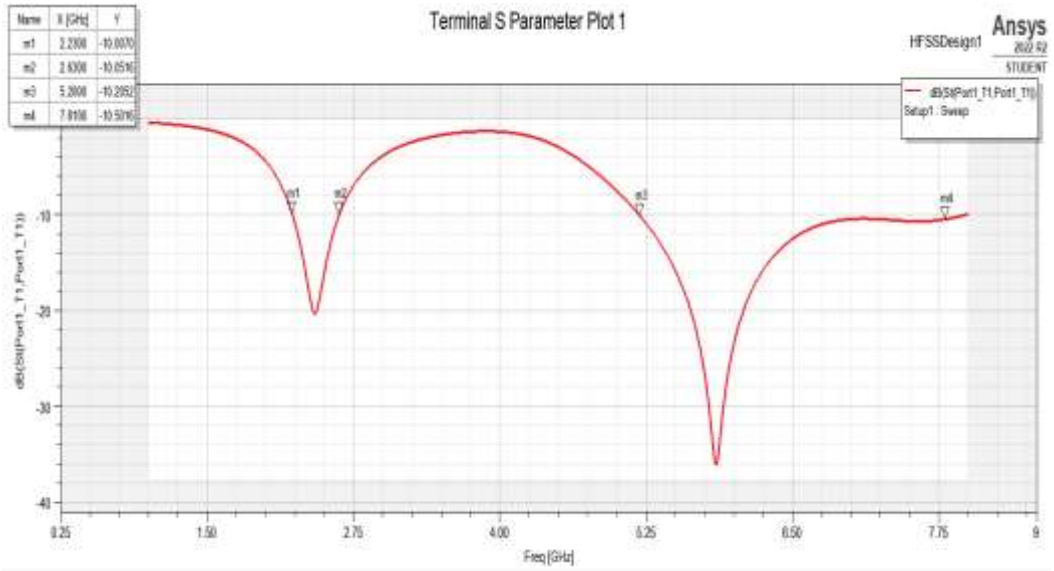

Figure 5. Rectangular Plot

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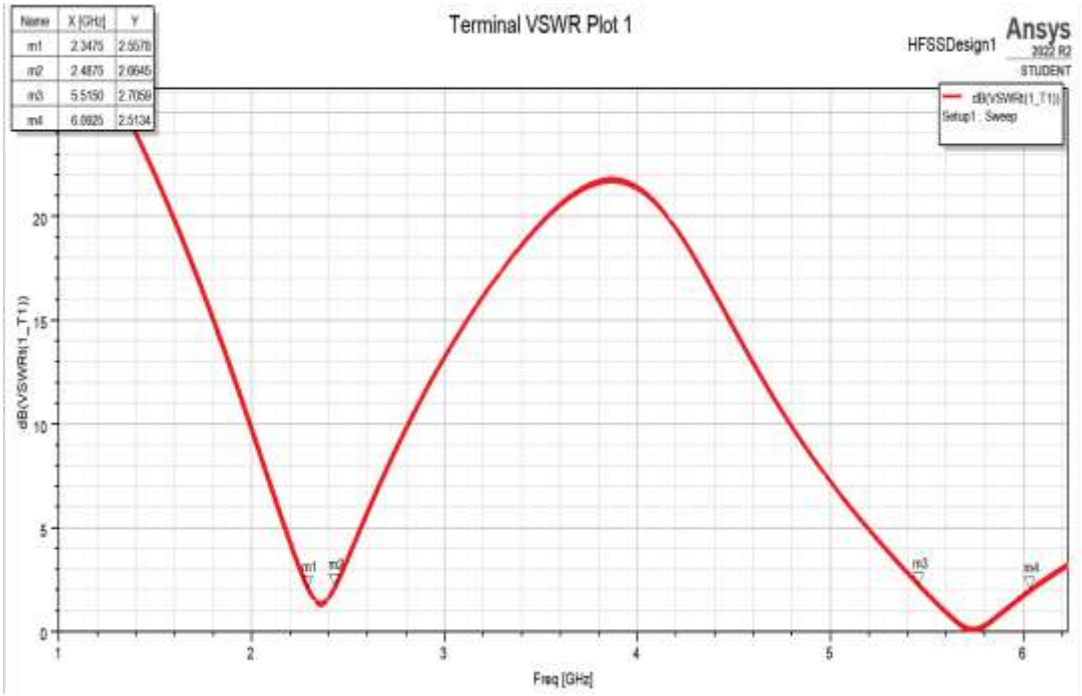

Figure 6. Terminal VSWR Plot 1

II. RESULTS:

The operational effectiveness of the proposed dual-band F-shaped monopole antenna was analysed using simulation software (Ansys HFSS). The results of the simulation are displayed inFigure 3, Figure 4, Figure 5 and Figure 6.The return loss of the antenna came out to be less than -10 dB at both frequency bands,The gain of the antenna is about 2 dB at both frequency bands,The directivity of the antenna is about 4 dB at both frequency bands,All of which are suitable for RFID applications.

III. CONCLUSION:-

A new antenna design has been created specifically for RFID applications that has the capability to work in two frequency bands - 2.4 GHz and 5.8 GHz. This design features the proposed monopole antenna which has a radiation patch in the shape of an "F". The impedance-bandwidth of the antenna has a wide range of frequencies it can cover, from 2.2 to 2.6 GHz and 5.3 to 6.8 GHz, which offers both good radiation properties and broad bandwidth. The antenna has an omnidirectional radiation pattern and delivers adequate gain values in both frequency bands it operates in. This design is straightforward and can be an adequate option for use in RFID systems.

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