A Circular Shaped Microstrip patch Antenna for Wi-Fi/UWB/X-band Applications

This project report is submitted to

Yeshwantrao Chavan College of Engineering

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In partial fulfillment of the requirement

For the award of the degree

Of

Bachelor of Engineering in Electronic and Telecommunication Engineering

By

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(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

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CERTIFICATE OF APPROVAL

Certified that the project report entitled **"A Circular Shaped Microstrip patch Antenna for Wi-Fi/UWB/X-band Applications"** has been successfully completed by **Sarthak Hedaoo and Anurag Arvelliwar** under the guidance of **Dr. S.S. Khade** in recognition to the partial fulfilment for the award of the degree of Bachelor of Engineering in Electronics and Telecommunication Engineering, **Yeshwantrao Chavan College of Engineering** ***(An Autonomous Institution Affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)***

Dr. S. S. Khade

Name and Sign of Guide

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➢ INTRODUCTION

UWB antennas have extreme concentration in both academic and industrial areas for use in wireless systems. Federal Communication Commission (FCC) approves the UWB in 2002 for unapproved actions in the 3.1 to 10.6 GHz range for the use of various wireless transmission systems .

Two main points are to be considered while constructing printed monopole UWB antennas. First point is that, the antenna should operate with other narrow band transmission systems along with the **UWB antenna range**. As an instance, for interchanging the data from the fixed and mobile appliances, over the short length narrow bands of 2.4 to 2.485 GHz and 2.4 GHz to 5.8 GHz bands are used for Bluetooth and Wi-Fi applications.

Bluetooth technology builds a PAN (Personal Area Network). **Wi-Fi technology** builds a LAN (Local Area Network). Bluetooth and Wi-Fi involves many commodities, like telephones, tablets, speakers, media players, handheld, robotics systems, laptops, headsets, watches, modems and console gaming materials. Moreover, **X band** contains the frequency range from 8 to 12 GHz. X band is used in applications for radar, wireless computer networks and satellite communications.

The other point is constructing band notched properties in some specific bands for rejecting these frequencies in order to overcome interference between UWB transmission systems and other narrowband systems.

UWB antennas can be used in different applications like Communications (WPAN (Wireless Personal Area Network), Military Communications), Radar (Ground Penetrating Radar, Through Wall Radar, Wall Imaging Radar), Intelligent sensors, Location Finding and in Medical Applications.

Different sizes and shapes are to be considered for monopole antennas such as such as circular, semicircular, square, crescent shape, pentagonal, elliptical, rectangular and hexagonal. These antenna designs involve high entire bandwidths, small sizes, simple antenna structures, fabrication ease and amiable antenna radiation properties.

In this proposed mini-project, **A Circular Shaped Microstrip patch Antenna is used for Wi-Fi, UWB and X-band applications** by using defected ground plane.

➢ LITERATURE REVIEW

We studied many IEEE papers for patch antenna design. Our focus was on getting good results from our proposed design and also on the applications provided by the designed antenna. After proper survey of few papers we came to know about various new concepts and methods.

We studied about adding defects in the design which affect the impedance bandwidth and also about compact sizes of antenna. We came to know about various application of antenna at various bands.

IEEE papers and our subject teacher where our guide in making of this mini-project. We learned more about patch antenna, gain of the antenna, various bands having various applications, defects in the design, optimizing the results, avoiding interference between the bands, application of UWB and X band antennas in various fields and much more.

IEEE papers and documents that we referred are:

2018 International Conference on Power Energy, Environment and Intelligent Control (PEEIC) G. L. Bajaj Inst. of Technology and Management Greater Noida, U. P., India, Apr 13-14, 2018 – "A Circular Shaped Microstrip patch Antenna".

Mewara, H. S., Mayank Sharma, M. M. Sharma, and Ajay Dadhich. "A novel ultra-wide band antenna design using notches and stairs", 2014 International Conference on Signal Propagation and Computer Technology (ICSPCT 2014), 2014.

Rajan Mishra and Vijay Shanker Tripathi, "A Compact Circular Disc Monopole Antenna For UWB applications International Journal of Applied Engineering Research, Vol. 12,2017; pp.3049-3053.

User's Manual, vol. 4, CST-Microwave Studio, 2002.

➢ WORK DONE

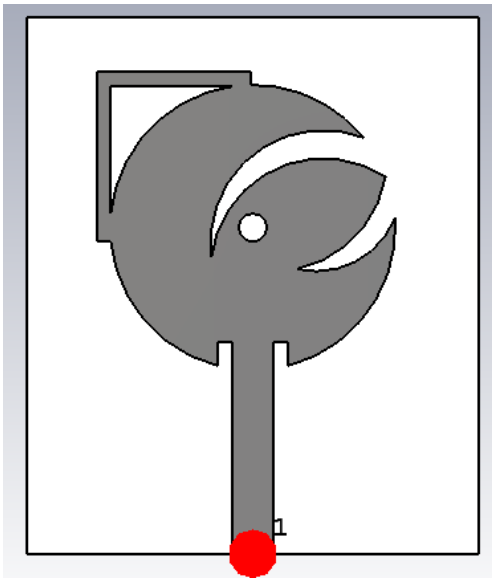
- Proposed microstrip patch antenna is printed by using FR4 (lossy) substrate. Substrate has permittivity of 4.3 and height of 1.6 mm.
- The proposed antenna is of compact size 32mm × 36mm × 1.6mm.
- Firstly, for perfect match of load impedance of microstrip feedline to the radiation patch, a circular microstrip patch antenna was designed with inset line feed.
- Then the ground plane is defected by inserting two I shaped slots and truncated it at its top corners.
- After that, patch is modified by inserting two crescent shaped slot, one circular slot and one L slot into it.
- In the antenna configuration W and L are the width and length of the scheduled antenna.
- Ws and Ls are the width and length of the microstrip feedline. LGND is the length of ground surface.
- R and C are the radius of the radiation patch and the diameter of the circular slot.

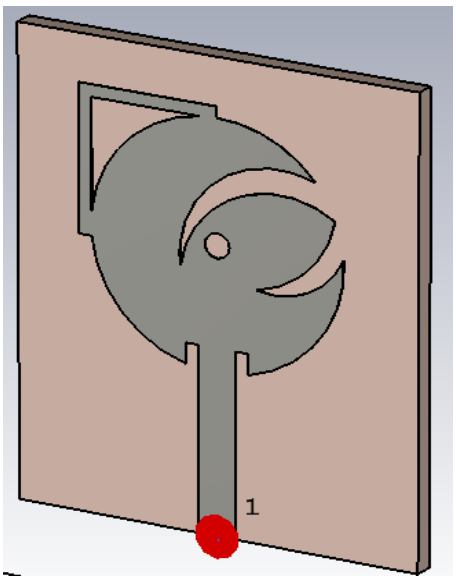
TABLE.I. Dimensions of the proposed antenna

Parameter	Value (mm)	Parameter	Value (mm)
L	36	R	10.1
W	32	A,B	12
Ls	15	H,C1	2
Ws	3	R1, R2	8
LGND	15	O	2
c	0.5	b	10
d	14	e	5
g, a	1	G	5

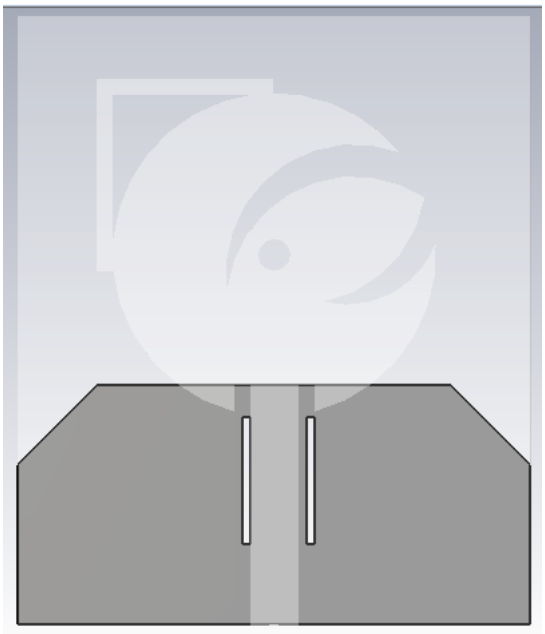
❖ ANTENNA DESIGN

➢ Front View:





➢ Ground View:



❖ RESULTS AND DISCUSSIONS

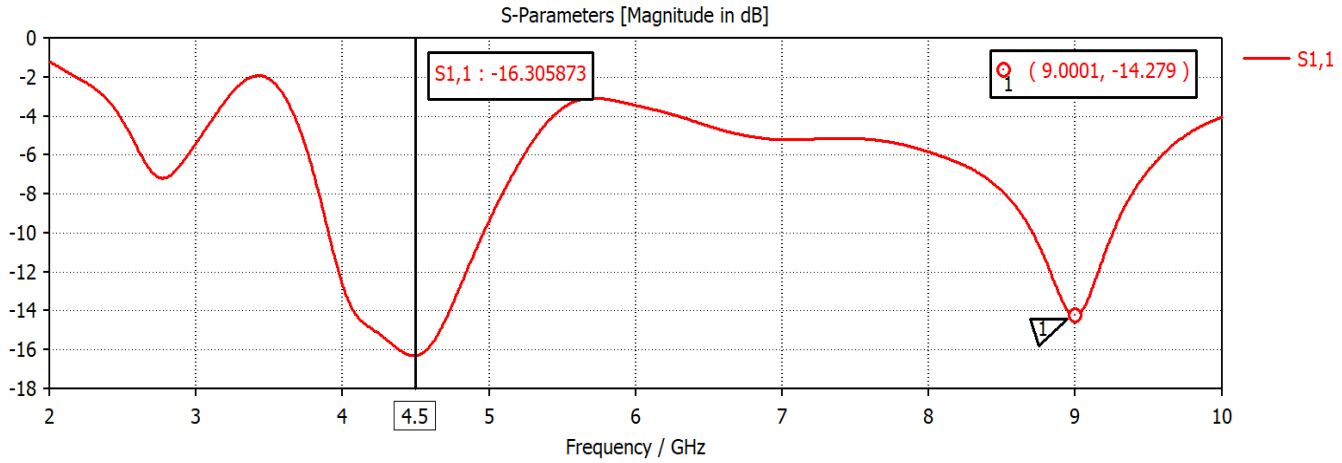
A circular shaped Microstrip patch antenna with single band notch characteristics is investigated in this paper by using relevant standards of various principles.

A software tool named CST is used to construct this proposed design. Truncated ground plane, two I slots, one circular slot and two crescent shaped slot are used to improve the impedance bandwidth of the scheduled antenna.

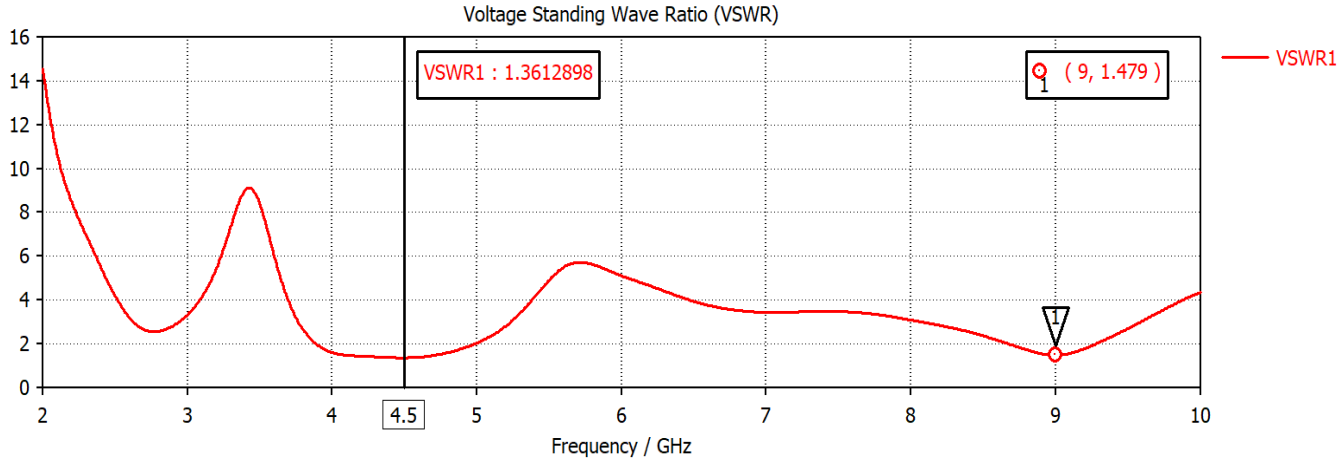
A particular band is rejected by using one L slot into the radiation patch. L slot has different values of its parameters for the exceptional rejection of specified WIMAX band.

Figure below show various results after simulation,

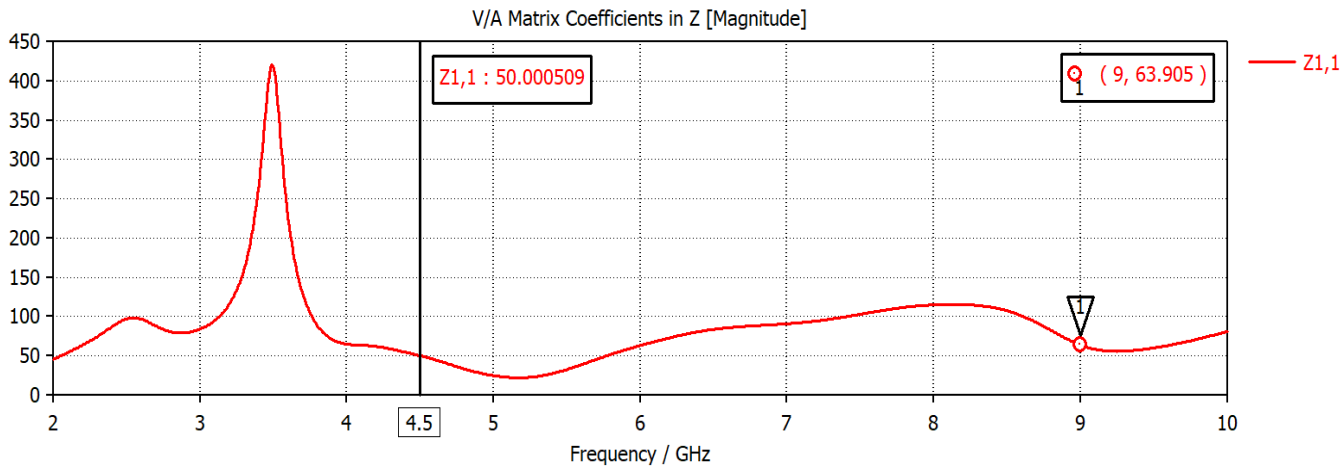
➢ S1,1



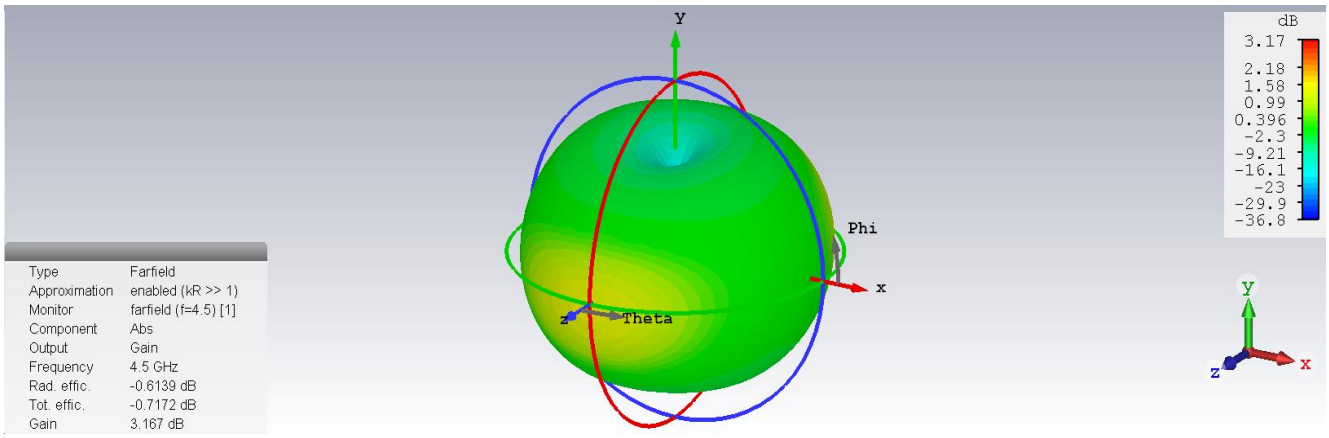
➢ VSWR



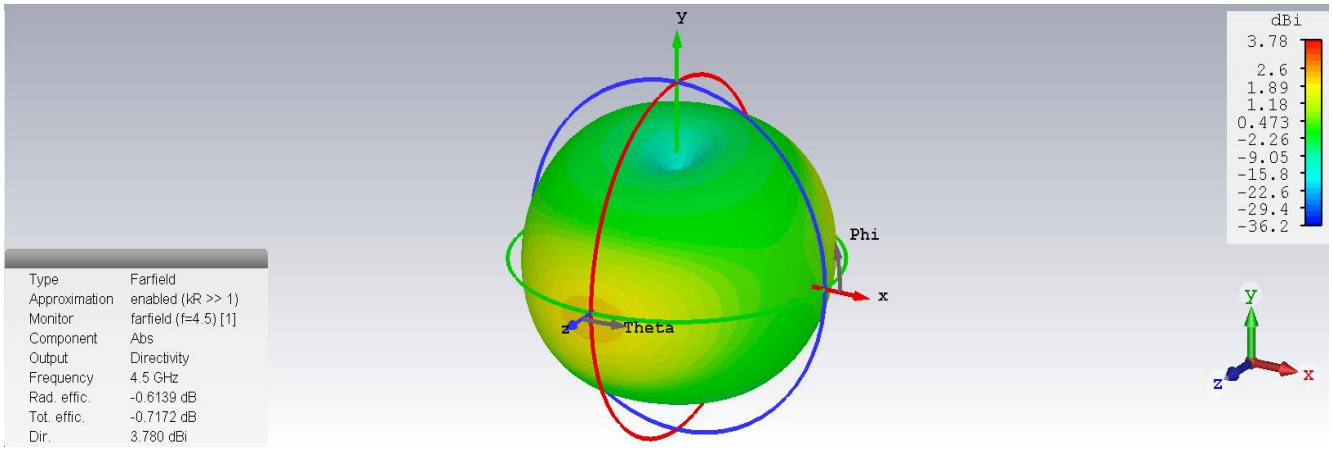
➢ IMPEDANCE



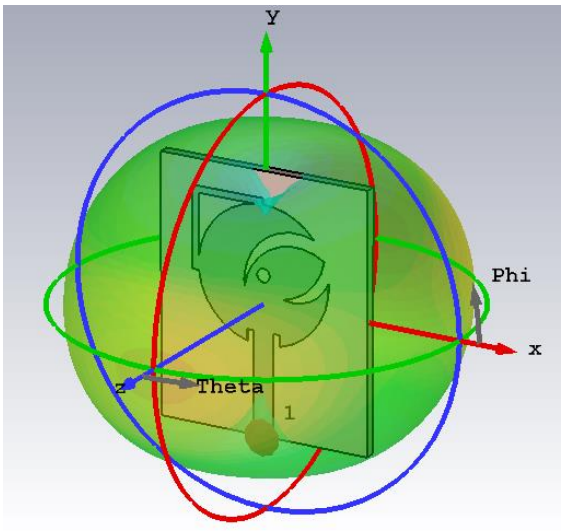
➢ Gain (3D)



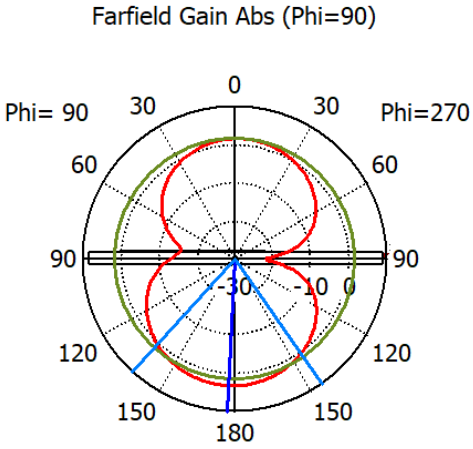
➢ Directivity (3D)



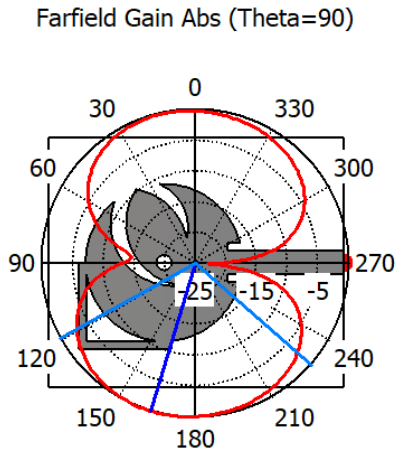
➢ Directivity (With structure)



➢ Gain (2D)

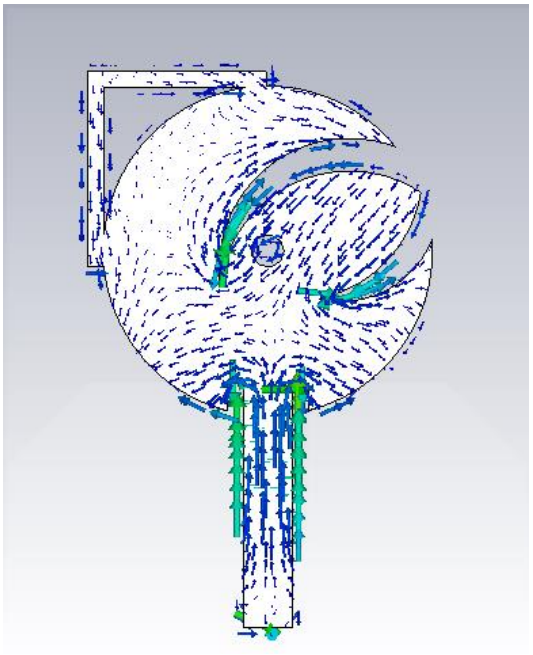


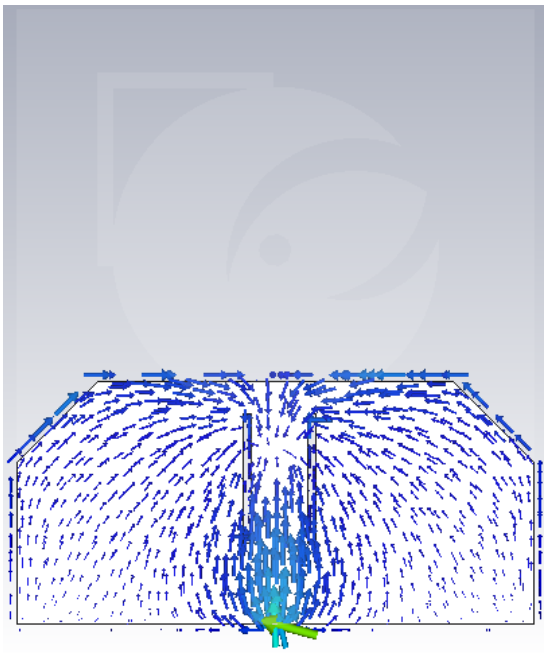
Frequency = 4.5 GHz
Main lobe magnitude = 3.17 dB
Main lobe direction = 177.0 deg.
Angular width (3 dB) = 77.0 deg.
Side lobe level = -1.6 dB



Frequency = 4.5 GHz
Main lobe magnitude = -0.0407 dB
Main lobe direction = 163.0 deg.
Angular width (3 dB) = 109.8 deg.

➢ SURFACE CURRENT





❖ SUMMARY AND CONCLUSIONS

A circular shaped Microstrip patch antenna is investigated in this paper with single band notch characteristics for use in applications in Wi-Fi (2.4 to 5.8 GHz), ultra wideband (UWB) (3.1 to 10.6 GHz) and X band (8 to 12 GHz) respectively.

WIMAX band is rejected in this antenna into the specific frequency spectrum range from 3.4 to 3.69 GHz. Interference can be reduced with the rejection of WIMAX band.

Truncated ground plane, two I slots, one circular slot and two crescent shaped slot are used to improve the impedance bandwidth of the scheduled antenna.

A particular band is rejected by using one L slot into the radiation patch.

The proposed antenna is of compact size 32mm × 36mm × 1.6mm, which is tolerable range for distinct wireless systems. Thus, this proposed antenna is a agreeable applicant for relevant Wi-Fi, UWB and X-band operations.

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