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Design of Microstrip Patch Antenna with triangle,rectangle Slits

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Abstract: In this paper we had designed a dual band microstrip antenna with the dimensions of 24x20x1.5 mm^3 fabricated on FR4 Substrate. the operating bands of the antenna were 5.9 GHz to 6.2 GHz and 8.9 GHz to 10 GHz. These two bands are useful for the enabling gigabit Wi-Fi speeds and, gaming and file streaming.
Key words: Dual Band, Wi-Fi, Microstrip Antenna, FR4 Substrate

IndexTerms **- Component,formatting,style,styling,insert.**

I. INTRODUCTION

In the last decade of wireless communication field have abrupt changes. for compact size wireless devices demand has been arise due to ease of fabrication of multiple IC within smaller space. Today we also introduced the 5G wireless communication system that operated higher bandwidth spectrum. on account of this, designers are paying more concentration on compact broadband antenna, microstrip patch antenna has attracted the designer's matter of its compact size, low profile, low cost and high reliability. However major disadvantage of microstrip patch antenna is narrow bandwidth, low gain and directivity. Metamaterials and meta surface are contemplated by researchers due to some uncommon electromagnetic properties those are extremely hard to discover in nature. in the metamaterial region, the phase velocity is greater than the antenna substrate. Therefore, the radiated beam of the basic antenna will be more directive with narrow beamwidth, when EM wave propagates in the metamaterial region. In this way the proposed metamaterial behaves like a beam focusing lens. To fetch the advantages provided by the meta material and meta surface we are trying modify the radiation patch to make the antenna should operate at 5G band with low return loss and high directive gain.

II. RELATED WORK

A dual-polarized and high gain, four-element based compact multiple-input-multiple-output (MIMO) antenna operating at 5.2 GHz. This design has a low profile and single layer planar structure of area 65 mm × 65 mm, a hammer-shaped antenna has been designed with a gain of 5.3 Db i.e., impedance bandwidth of 400 MHz, and broadside radiation [1], A 4-port MIMO (Multiple-Input Multiple-Output) antenna operating at 28 GHz in the Milli meter wave band for future 5G communications. Due to its capacity to offer high data rates and low latency, 5G technology has received a great deal of attention in today's era [2], A compact size and high isolation with 2 × 2 MIMO, double flare horns shaped antenna for K and Ka bands of mm-wave applications. The overall size of the MIMO antenna 0.19λ×0.19λ×0.01λ mm3 at a lower frequency has been designed, the antenna covers 18.61–20.01 GHz in the K- band (18–26.5 GHz) and 21.52–33.91 GHz in the Ka-band (26.5–40 GHz) with impedance bandwidths of 7.2% and 44.5% respectively at port-1 and port-2 [3], the design of an ultra-wideband MIMO antenna with low mutual coupling and dual-band elimination characteristics. The proposed structure consists of a microstrip-fed monopole antenna with a stub to enhance the isolation for ultra-wideband applications, the isolation enhancement of |S21| > 20 dB is achieved over the impedance band width by adding two counter-facing F-pattern stubs to the ground. The impedance bandwidth of 9 GHz (2.65–11.65 GHz) for VSWR < 2.13 with the notch bands of 3.6–4.2 GHz and 5.15–5.87 GHz is obtained [4], The MIMO antenna configuration includes two radiators integrated with an array of Frequency Selective Surfaces (FSSs). These antenna components are implemented on an FR-4 substrate and encompassed by FSS units that are optimized for X-band frequencies. The proposed MIMO antenna possesses dimensions of 65 mm (width) × 45 mm (length) × 1.6 mm (height). The FSS unit cells exhibit excellent stability across various polarization incidence angles and operate within the frequency range of 7 to 9 GHz. The FSS loaded antenna offers a bandwidth ranging from 8.0 to 8.55 GHz, with a peak gain of 6.5 dB and isolation exceeding −20 dB among the MIMO elements [5], A new design of a highly isolated tri-band antenna for 5G and future 6Gapplications is proposed. The overall dimensions of the proposed antenna are just 56.4 × 36.6 mm2, the proposed antenna system is designed and tested to reach the 5G dual bands of 3.38 GHz–3.61 GHz, 4.51 GHz–4.96 GHz, and the future 6G band of 6.06 GHz–7.51 GHz [6] reconfigurable polarization MIMO (Multi-Input Multi-Output) dielectric resonator antenna at a milli meter-wave frequency band, the designed antenna operates at 4.35 GHz for polarization diversity applications of the modern wireless MIMO systems. The proposed antenna covers a bandwidth of 11.26% at the central frequency and provides circular and linear polarizations with a high gain of around 6.4 dB [7] in our proposed work we had designed a antenna by modifying the surface of the patch, that will operate at 5.95 GHz to 6.26GHz and 8.95GHz to 10 GHz

III. ANTENNA MODELLING

Fig .1 shows the basic patch antenna and the parametric dimensions of the proposed antenna was mentioned in the table .1

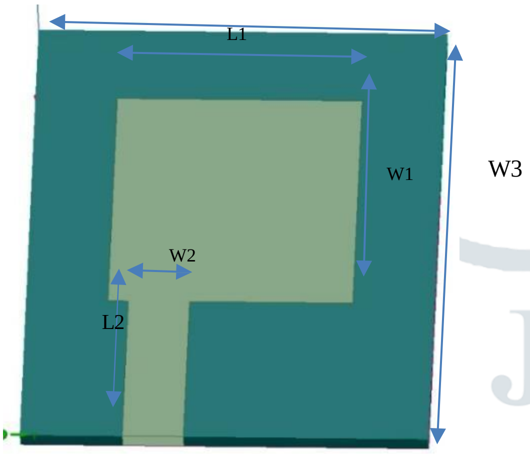

Fig. 1

Table 1

Parameter	Value(mm)
L1	12
L2	8
L3	20
W1	12
W2	3
W3	24

S11 parameter of the antenna mentioned in fig.1 was shown in the fig.2

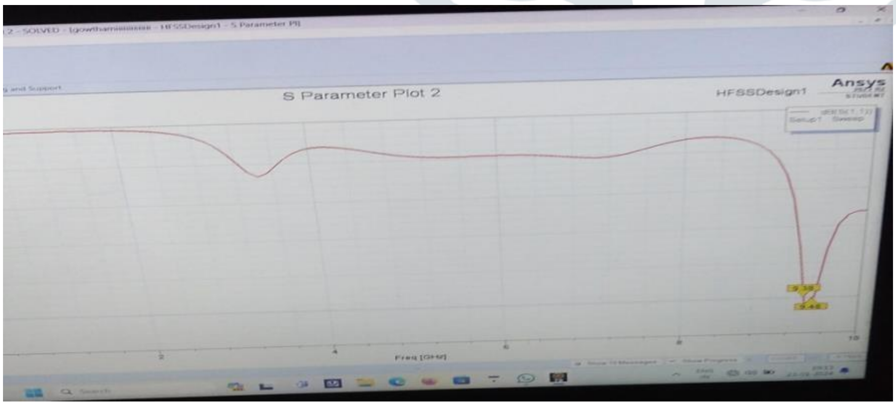

Fig. 2

To enhance the bandwidth of the antenna, we had tried to modify the antenna surface as mentioned below.

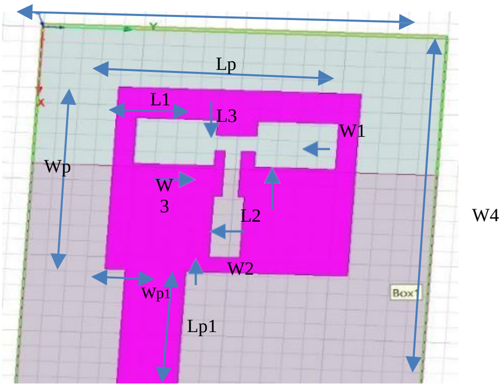

Fig.3

Table 2 represents the dimensions of the antenna shown in fig 3.

Table 2

Parameter	Value (mm)	Parameter	Value (mm)
Lp	12	Wp	12
Lp1	8	Wp1	3
L1	4	W1	3
L2	4	W2	1
L3	3	W3	1
L4	20	W4	24
L5	1	W5	3

The reflection coefficient results of the antenna were

Fig. 4

As per the above results we don't have any satisfied operating bands, so to improve the performance of the antenna had modified the surface area of the basic antenna as like in the fig .5

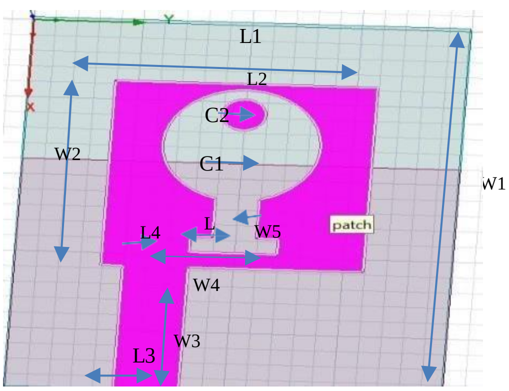

Fig.5

Table 3 represents the dimensions of the antenna shown in fig.5

Table 3

Parameter	Value (mm)	Parameter	Value (mm)
L1	20	W1	24
L2	12	W2	12
L3	8	W3	3
L4	1	W4	5
L5	2	W5	2
C1(rad)	3.60	C2(rad)	1.00

The s11 parameter for the modified antenna was shown in figure 6.

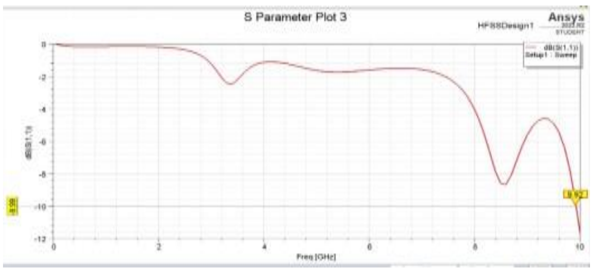

Fig.6

IV. RESULTS

We had further modified the surface area of the antenna as like in the mentioned figure 7, parametric dimensions are available in the table

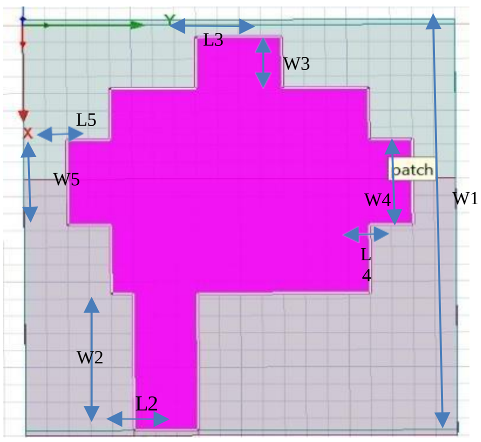

Fig.7

Table 4

Parameter	Value (mm)	Parameter	Value (mm)
L1	24	W1	20
L2	16	W2	5
L3	6	W3	4
L4	6	W4	4
L5	6	W4	4

The s11 parameter of the mentioned antenna in fig 7 was

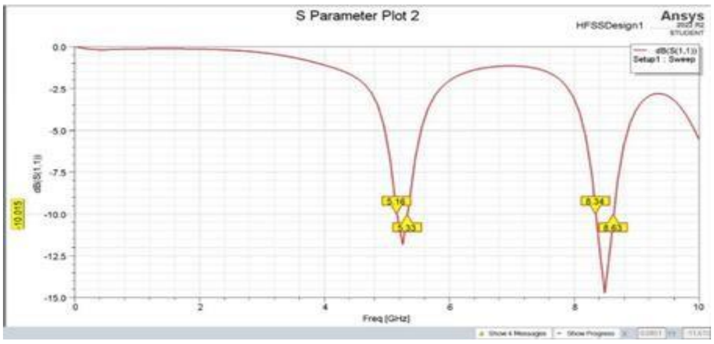

Fig.8

From the above antenna, we had observed one operating bandwidth i.e. 5.16GHz to 5.33GHz and 8.34 to 8.63 to enhance the bandwidth we had modified the antenna shown below.

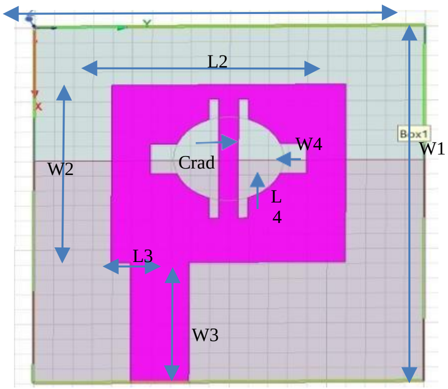

Fig.9

The parametric dimensions of the antenna shown fig 9 was

Table 5

Parameter	Value (mm)	Parameter	Value (mm)
L1	20	W1	21
L2	12	W2	12
L3	8	W3	3
L4	2	W4	2
Crad	2.82		

The s11 parameter of the above designed antenna was

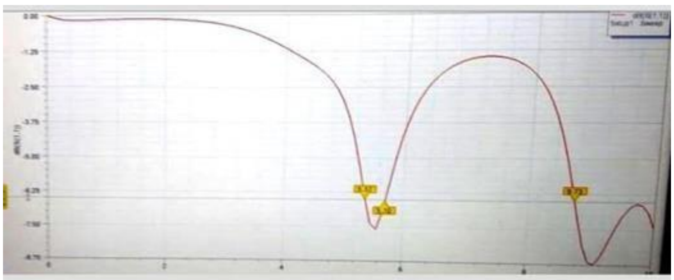

Fig.10

To get ultra-wide band and decrease reflected energy we had modified further the patch as shown in the figure

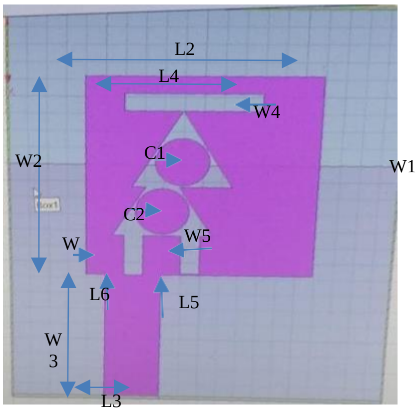

Fig.11

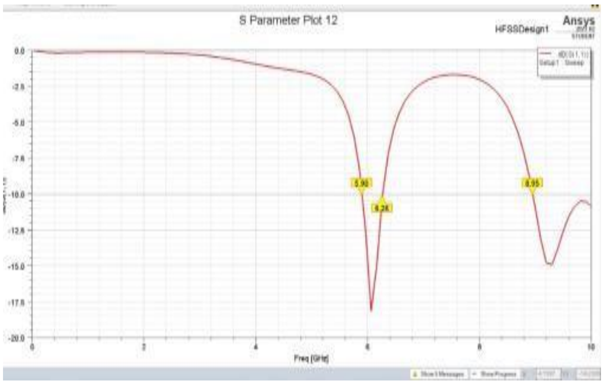

Fig.12

The parametric dimensions of antenna shown in fig. 11 was

Table 6

Parameter	Value (mm)	Parameter	Value (mm)
L1	20	W1	21
L2	12	W2	12
L3	16	W3	4
L4	7	W4	1
L5	1	W5	3
L6	1	W6	3
C1(rad)	3.60	C2(rad)	3.60

we can observe the operating bands of the proposed antenna shown in figure 11 was 6.29GHz to 5.91GHz and 8.92GHz to 10 GHz this bands have the applications of enabling gigabit Wi-Fi speeds and allow operations free from legacy Wi-Fi interference, gaming and file streaming.

V. CONCLUSION

A rectangular patch antenna with triangular and rectangular slots for dual band operation was described in this paper. the proposed designed antenna operates with a band width of 400MHz (5.9GHz to 6.2GHz) and 1 GHz (8.9GHz to 10 GHz).

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