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Multilayer Stacked Microstrip Patch Antenna for 5G Applications Operating in Millimeter Wave Band.

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Abstract*: *The paper presents a multilayer stacked micro strip patch antenna specially for 5G applications[1]. It is a 2x2 patch array built in three layers with top layer comprising of four patches and bottom layer will be the ground plane whereas the middle layer is meant for achieving higher gain and wide bandwidth. The gain of the antenna array is found to be 11.66 dBi. The impedance bandwidth of the array antenna is found to be greater than 10%. The reflection coefficient of the array is calculated as -15.15 dB.

Keywords* : *Stacked Patch

I. INTRODUCTION

Millimeter wave is going to play a vital role in 5G application in the near future due to the demand in higher bandwidth along with lightning fast internet speed. In a country like India the government has introduced a new scheme named smart city scheme under which selected cities from across the country will be developed and equipped with latest technologies. In such circumstances the smart cities in India with its huge population require infrastructures to provide service with high quality. Millimeter wave communication can be the perfect choice for the requirement. Even though millimeter wave have certain limitations like small area coverage along with possibility of signal blockage from obstructions, it will fit into the smart city kind of ideas since the requirement is only high bandwidth and data rate and not about huge area coverage [2]. In this paper we propose an antenna which suits the above requirement along with its flexible and compact design.

II. PHYSICAL DESCRIPTION

The antenna design has been in such a way that the three layers are stacked one above the other. The middle layer is a single edge fed patch above the ground plane. And the four patches at the top layer is placed in such a way that it is symmetrical to the middle and with overlapping at all the four edges of the middle patch.

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Literature review shows research in millimeter wave communication has been done in printed antennas[3].Also few papers depicts MIMO antenna design in millimeter wave range[4]. Along with this research is active nowadays in sub-6 GHz range antenna design too which plays a major role in 5G technologies[5][6]. Future 5G applications may lead to wearable antennas operating in millimeter wave range or other 5G bands[7].

III.FEED METHOD

Here in this design a micro strip edge feed is used to feed the middle layer of the stack, which in turn will mutually couple with the top lay four patches which is actually parasitic. Along with this the proximity coupled 2x2 stacked patch will reduce the spurious radiation losses due to the normal corporate feed in other designs.

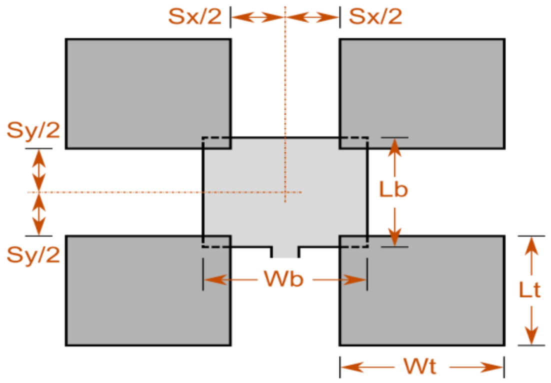
IV.OPERATION MECHANISM

Each and every patch can be looked into like a resonant cavity so that it will resonate in its designed resonant frequency. Here the top layer is always a parasitic one where it always depends on the middle layer with one patch located at the center which is also edge fed. The coupling between the top and middle layer will make the patches active. The coupling level will be based on the overlapping level of the edges so more the coupling more of overlapping required. The gain of the antenna can be increased by maintaining the low interspace between the layers or more overlapping area between the top and middle layers. Also the radiation of the middle patch is always out of phase with the top layer patches which in turn reduces the effective gain of the antenna. So to make the gain higher it is suggested to maintain the radiation from the middle layer as low as possible by some means.

V. ANTENNA ARRAY DESIGN

SKETCHES

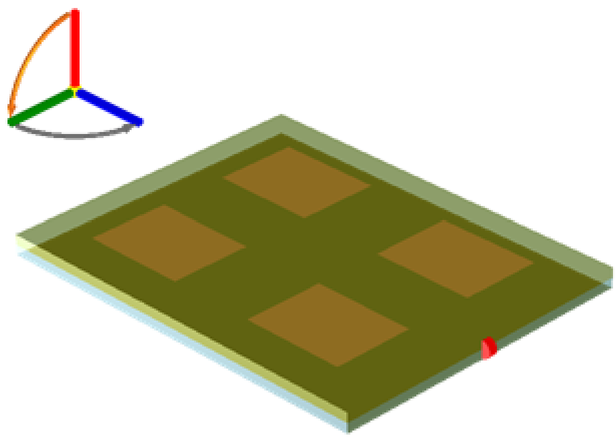
Top view



(a)

Side view

(b)



(c)

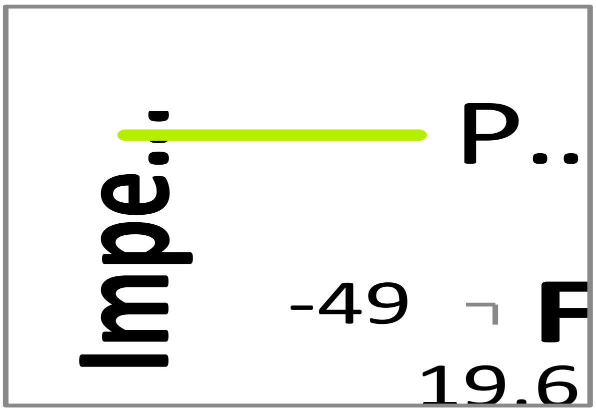
Fig.1

VI. DESIGN OBJECTIVES

Name	Value
f₀	28 GHz
Wb	2.534 mm
Lb	3.167 mm
Wt	2.407 mm
Lt	3.009 mm
Sx	2.027 mm
Sy	2.534 mm
Hb	288.7 µm
εb	2.2
Ht	288.7 µm
εt	2.2
X	6.840 mm
Y	8.551 mm
Z	577.5 µm

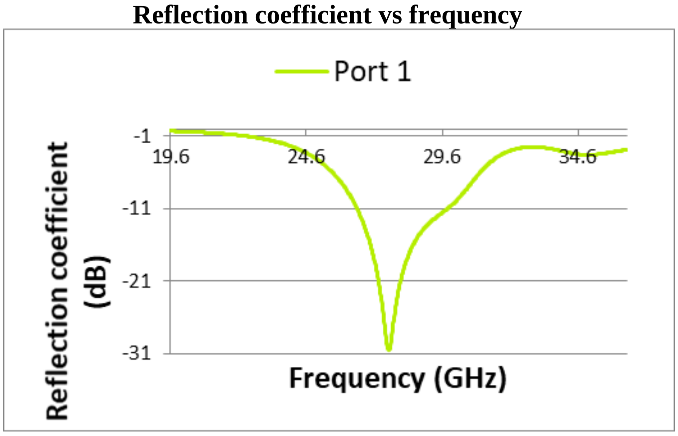
Fig.1 a, b and c shows the top view , side view and the simulation representation of the stacked array antenna.

Input Impedance vs Frequency

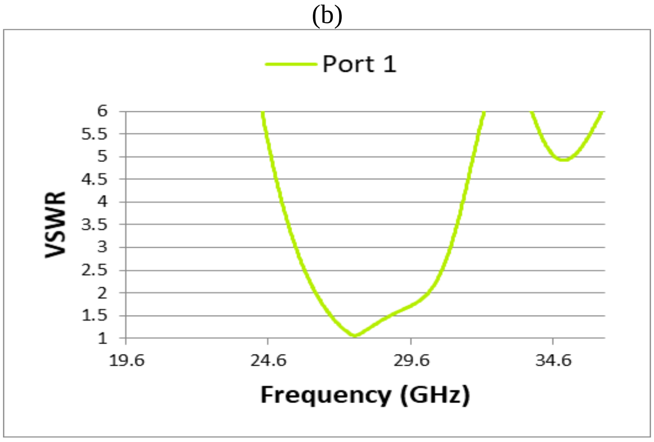


(a)

Reflection coefficient vs frequency



(b)



(c)

Input Impedance (Smith)

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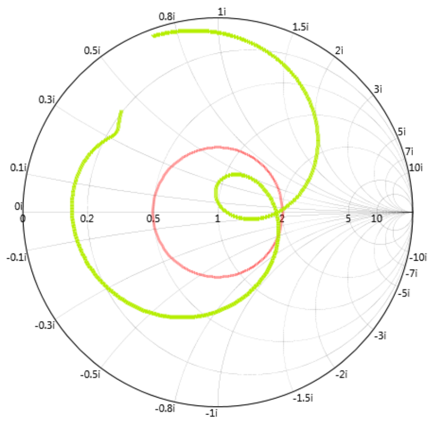
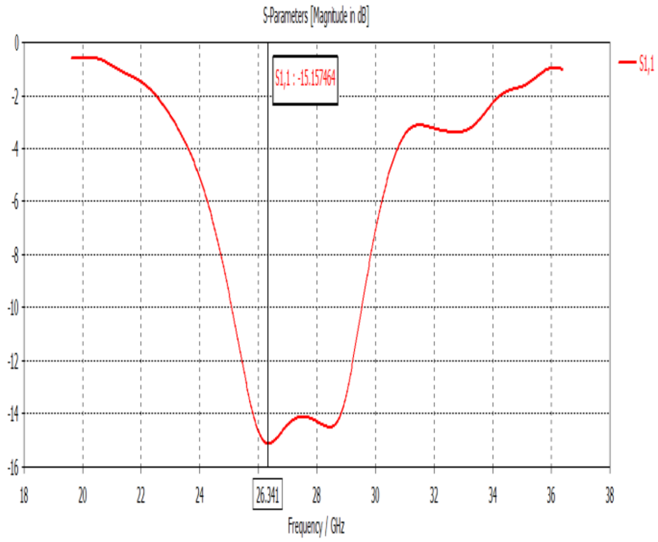
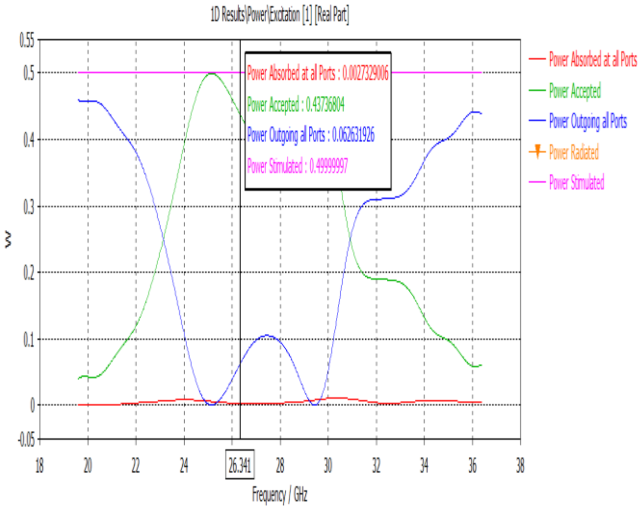


(d)

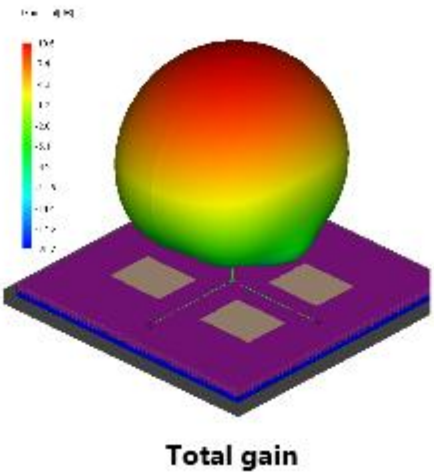
Fig.2



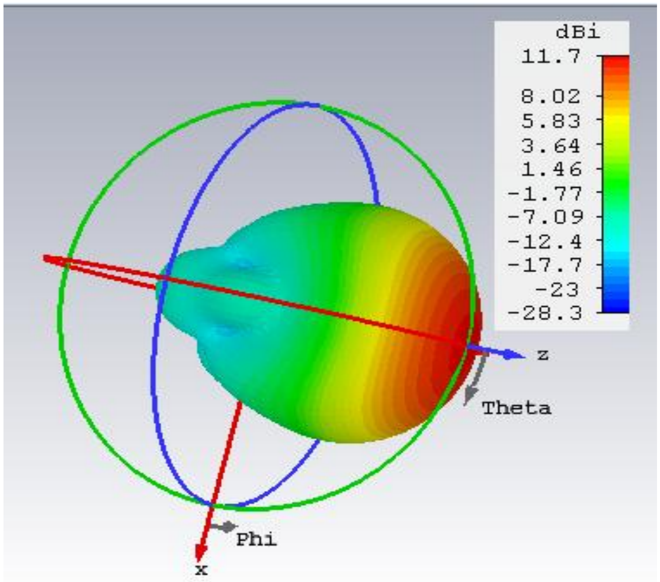
(a)



(b)



(c)



(d)

FIG.3

Fig.2 and Fig.3 shows the simulation results of the antenna array in terms of reflection coefficient, VSWR and gain metrics.

VII. RESULTS AND DISCUSSION

The results obtained shows that the array gain of 11.66 dBi, whereas the reflection coefficient has been found as -15.15 dB. Also the bandwidth of the array is quite good with more than 45%. Also the power absorbed has been very less of the order of 0.4W. Which shows that the array antenna is energy efficient along with its compact size and efficiency.

VIII. CONCLUSION

The paper presents a stacked array antenna comprising of three layers with advantages over other designs. The operating frequency of the antenna is in millimeter wave band especially for 5G application meant for smart city requirement. Results and discussion shows that the antenna is having a wide operating frequency band with very good gain in its resonant frequency.

Finally the antenna design is of compact size which is energy efficient and can be flexible in terms of instalation with the existing available infrastructure.

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