Multiband Microstrip Patch Antenna For 5G Applications using DGS Technique

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Abstract— In this paper, multiband microstrip antenna fed by microstrip feedline is proposed with total area of 30x24x1.6 mm^3[1]. The planned antenna is stamped on a substrate FR4 epoxy having relative permittivity of 4.4[2]. The multiband characteristic is created by different shapes slots employed on the ground plane. This antenna covers two frequency bands from 24.0GHz to 24.53GHz for K band applications and from 26.7GHz to 27.6GHz for Ka band applications[3][4]. Prototype of the anticipated antenna is premeditated and measured. The simulated results by means of Ansys HFSS software are in acceptable agreement with the measurements.

Keywords - X-band, Microstrip Antenna, K-band, Ka band, HFSS.

I. INTRODUCTION

Microstrip patch antennas will take numerous benefits such as light heaviness, low outline, low price, easy production.

However, it will agonize from truncated efficiency and fine bandwidth. In recent times wireless communication systems antennas with multiband had been played a vital role for wireless service standard requirement. The interest and research on multiband antenna are growing, particularly to diminish the number of antennas implanted in uniting numerous applications on an only antenna. To achieve its Characteristics many efforts had been made by the researchers in the recent years. The methods like slots technique, DGS technique etc are used to design multiband antennas. By utilizing various types of methods and techniques in the geometry MSP antenna and proper selection of feeding technique helps to achieve the properties in a easy way[5]. A various number of techniques and shapes were used to design MMSPA for 5G[6][7].In the esteemed paper, microstrip patch antenna with low outline for 5G wireless communications using DGS technique is projected and discussed.[8]

In the following contribution, microstrip patch antennae is planned for 5G wireless communications. The projected antennae take dimensions of 30x24x1.6 mm^3 and resonates at a frequency of 24.22GHz and 27.20 GHz respectively for K and Ka bands.

In segment 2, the projected antennae design is explained and deliberated with its sizes are obtained. In section 3 the overview of effect of with and without dgs technique is briefly explained. Segment 4 comprises of replicated outcomes like return loss(s11) plot,3D gain plot,2D radiation pattern plot. Then finally, conclusion is explained in segment 5.

II. ANTENNA DESIGN

The representation diagram of the designed antenna is illustrated in following figure. The design parameters and dimensions are recorded in following tables. Here the antennae are printed on the substrate FR4 epoxy with relative permittivity of 4.4. [2][9]

A. Ground Plane Design And Dimensions

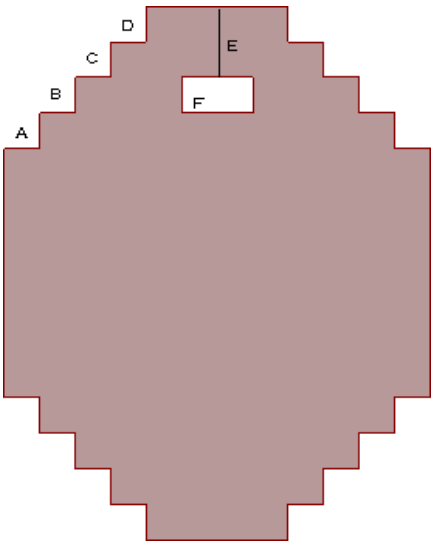


Fig. 1.Ground Design

The ground plane with slots and defected is as above and dimensions are mentioned in the below table.

NAME	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
GROUND	30	24	0
A	8	2	0
B	6	2	0
C	4	2	0
D	2	2	0
F	4	2	0

E = 4mm

B. Substrate Design And Dimensions

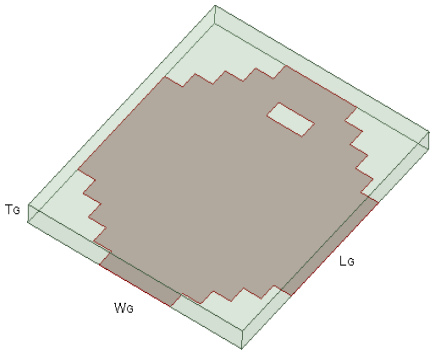


Fig. 2.Substrate Design

The substrate used is FR4 Epoxy of permittivity 4.4 and dimensions mentioned below.

NAME	Lg	Wg	Tg
SUBSTRATE	30	24	1.6

C. Patch And Feed Line Design And Dimensions

Patch and Feed line with multiple rectangular slots are used in the design with the dimensions mentioned in the below table.

NAME	LENGTH	WIDTH	HEIGHT
PATCH	14	10	1.6
FEEDLINE	15	3	1.6
PATCH SLOTS	2.5	0.5	1.6
FEED SLOTS	2	0.5	1.6

P1 = P2 = 5mm

P3 = P4 = 2.5mm

P5 = 2mm

P6(Radius) = 1mm

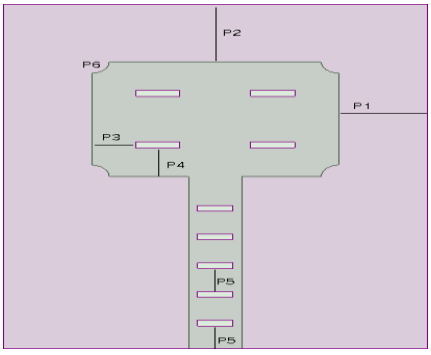


Fig.3 Patch and Feedline

D. Final Proposed Design

Top view and Dimetric view of projected antennae design are shown below:

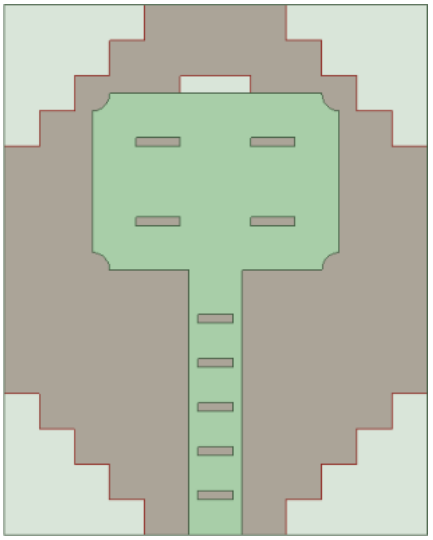


Fig.4.Top view

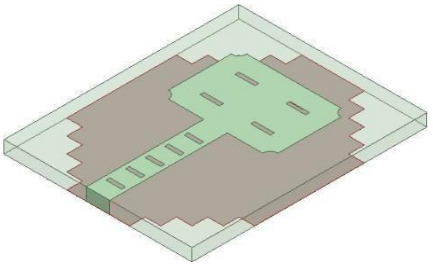


Fig.5. Diametric View

Simulation and Designing of the anticipated patch antennae are achieved by means of an accessible simulation tool. The used tool is HFSS (High frequency Structure Simulator). The antennae are particularly intended for consideration of its future 5G applications in one of the frequency band. In the next segment we will discuss about various simulation results.[10][1]

III. EFFECT OF DEFECTEDGROUND STRUCTURE ON PROPOSED DESIGN

The gain of the projected antenna remains same before and after dgs but S11 vs freq plot has a huge effect without adding slots to ground (dgs).The below shown plot is without dgs. [12]

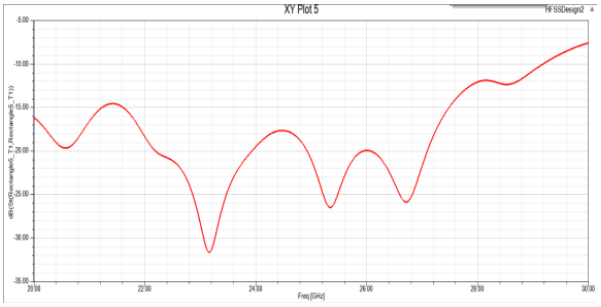


Fig.6.without dgs

Obtained plot is not good and with lot of fluctuations, so

dgs is used to reduce this effect.

IV. SIMULATED RESULTS

A. *Return loss plot*

Using port configurations, we can obtain S11 parameters which remain as Return loss.-10db is measured as virtuous value for mobile communication, so it is referred as base value [13].]. Any value below this is considered as a best case to use. The antennae function at projected 5G Frequency bands. The patch antennae have return loss of -42.56 dB, resonating at 24.22 GHz and bandwidth of 2.13 GHz. Also resonates at 27.20 GHz having a return loss of -dB and width of band 2.57 GHz.

Below plot shows the return loss plot of the antennae.

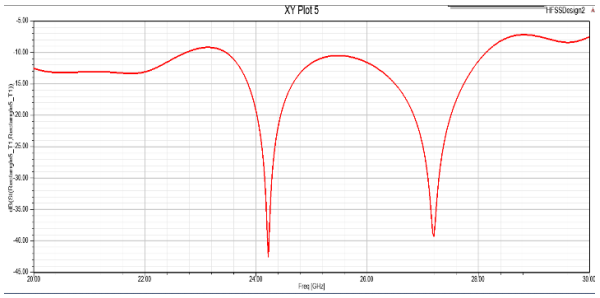


Fig.7 Return Loss plot

B. *3D polar plot*

The antennae efficiency is determined by 3D polar plot. The projected antenna design attained a gain of 10.00 dB which is measured as an admirable in terms of solid antennae proposal. The 3D gain plot of projected antennae is shown below[14].

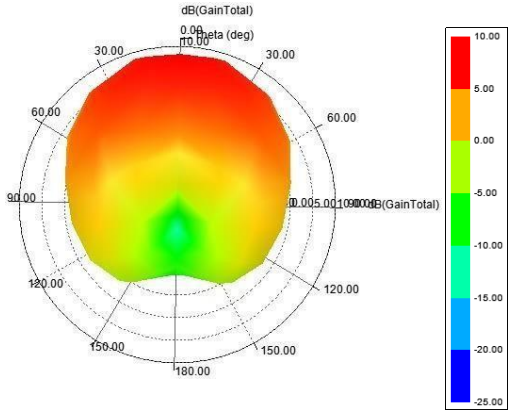


Fig.8 Polar plot

C. *Radiation pattern*

The 2D radiation pattern of the projected patch antennae is exposed below. A directional shape obligated by the antennae which is anticipated for 5G communications.

The antennae demonstrate a decent radiation pattern with good expansion value which can be used for 5G wireless communication. 5G wireless standard has come into presence more in current times. It can be used for high haste broadcast links. In the forthcoming we may see numerous progresses for 5G standard.[15]

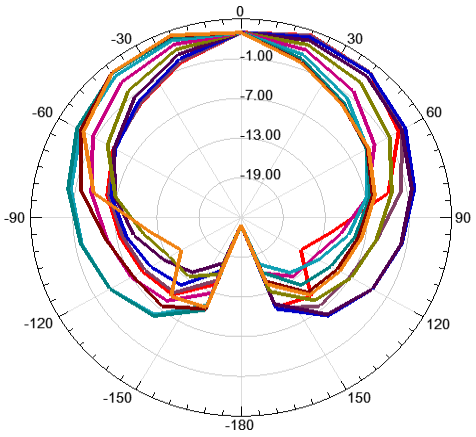
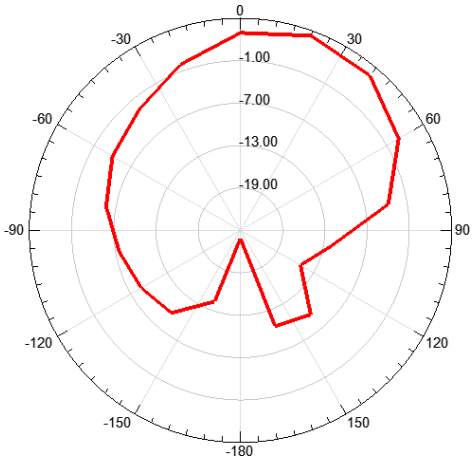


Fig.9 Radiation pattern



Radiation pattern at phi=0 degrees

Fig.9a. Radiation pattern 2

D. *Smith chart*

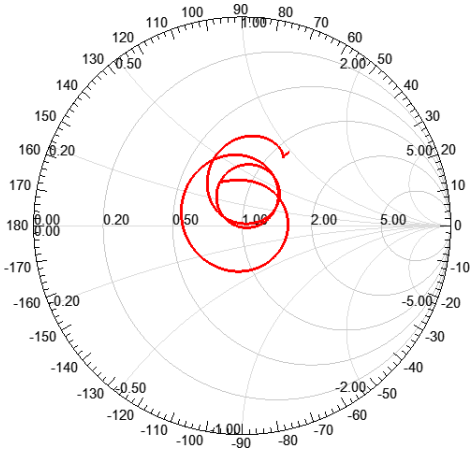


Fig.10.Smith chart

V. CONCLUSION

In this projected paper, multiband slotted microstrip antenna with DGS used for 5G wireless application is presented. The proposed antennae of below parameters can be used for 5G wireless applications**.**

RESONATES (GHz)	RETURN LOSS(dB)	BANDWIDTH (GHz)
24.22	-42.56	2.13
27.20	-39.33	2.57

The projected antennae display a virtuous radiation shape and good gain of 10 db. The projected antennae is simple construction, less cost and small dimensions. The outline of the projected antenna is very low i.e,30 mm x 24 mm x 1.6 mm and can be effortlessly unified in devices.

VI. REFERENCES

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