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# Improvement in Bandwidth of Micro-strip Patch Antenna

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**Abstract:** *This paper presents the improvement in various parameters of patch antenna. Here defected ground structure technique is used to improve the bandwidth. For the design of proposed antenna HFSS(High Frequency Structured Simulation) software is used. First designed a single patch as a reference antenna. In the simulation it operated at 2.34Ghz with gain of 2.01dBi, Bandwidth of 60 Mhz, & vswr of 1.34. So in order to improve the Bandwidth of single patch DGS technique is used & generated a defect of 1.5x1.5 mm below ground & in simulation in operate at 2.35Ghz with gain of 2.54dBi, bandwidth of 61Mhz & vswr of 1.24. Hence bandwidth is enhanced from 60 Mhz to 61 Mhz using DGS technique.*

**Keywords:** Patch, DGS, Bandwidth

## I. INTRODUCTION

Today wireless communication is become necessity in various applications. In many scenarios where the wired systems are impractical or almost impossible to be implement. Hence the micro-strip patch antennas are very helpful[1,5,6]. The micro-strip patch antenna have different advantages like small size, cheap cost, suitable for short and long distance communication etc[2,10], but while designing of patch antenna the potential challenges such as lower bandwidth, low gain, impedance matching may exist. DGS in newly introduced revolutionary technique in field of micro-strip patch antenna to enhance the Bandwidth[3]. The DGS structure is either etched periodic or non-periodic group configuration defect in ground plane can give increase in effective capacitance and inductance [7]. The bandwidth of the antenna without DGS is narrow and return loss is high while with DGS the antenna provides high bandwidth with less return loss [4].

The gain is very important parameter in wireless communication. The gain of an antenna can be improved by the array of patch[10]. In the antenna array few patches are arranged in a regular structure to form a single antenna in which radiation pattern can be support in particular direction. It increases overall gain and provides diversity reception [8].

In this Study, in order to improve the bandwidth and gain of micro-strip patch antenna we implemented DGS & Array technique respectively

## II. DESIGN CALCULATION

The dimensions of micro-strip patch antenna can be calculated by following formulas [2,9].

A. Calculation of width

$$W=\frac{1}{2fr\sqrt{\mu\epsilon}}\sqrt{\frac{2}{\epsilon r+1}}\text{mm}$$

B. Calculation of Effective Dielectric Constant

$$\varepsilon eff = \frac{(\varepsilon r+1)(\varepsilon r-1)}{2}\frac{1}{(1+12\frac{h}{w})}$$

C. Calculation of length extension

$$\Delta L = 0.412h(\frac{\varepsilon eff+0.3}{\varepsilon eff-0.258})^{\frac{\frac{w}{h}+0.264}{\frac{w}{h}+0.8}}$$

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D. Calculation for actual length of patch

$$L = \frac{1}{2fr\sqrt{\varepsilon eff}\sqrt{\mu\varepsilon}} - 2\Delta L$$

E. Calculation of Ground plane dimension

$$Lg = 6h + L$$
$$Wg = 6h + W$$

**Single Patch Design**

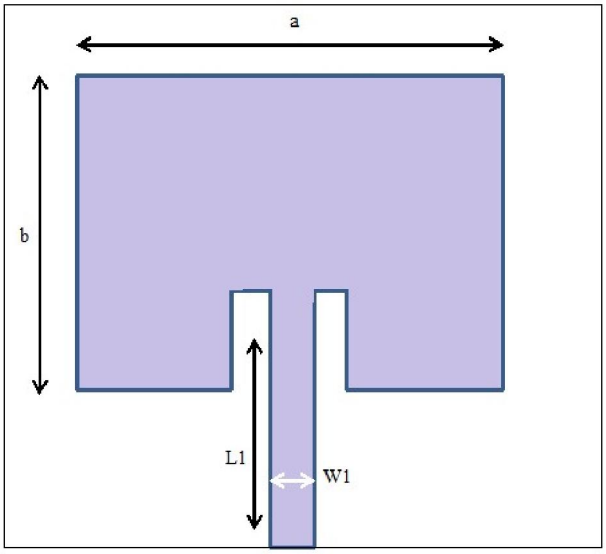


Fig : Single Patch

**Single Patch With DGS Design**

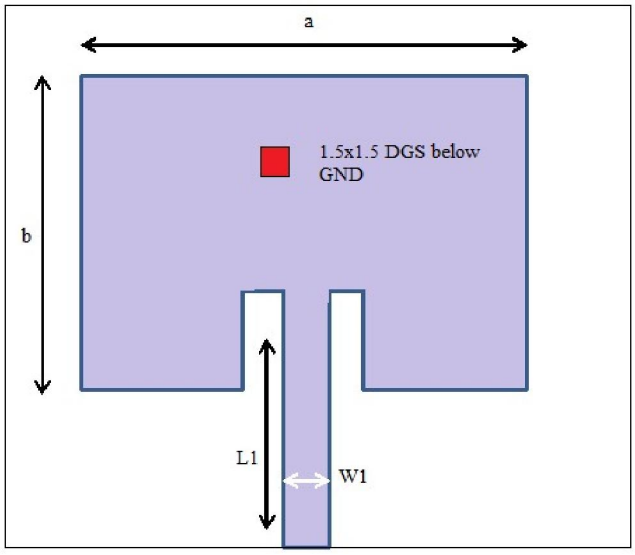


Fig: Single Patch With DGS

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**Dimensions of Designs**

| Sr.No | Parameter | Dimensions (mm) |
|---|---|---|
| 1 | a | 38 |
| 2 | b | 29.82 |
| 3 | W1 | 3 |

Table 1 : Dimensions of Design

## III. RESULTS AND DISCUSSION

This study designs and simulates a single patch and Single patch with DGS. The bandwidth of the patch is enhanced by using DGS technique from 60 Mhz to 61.2 Mhz.. The proposed designs maintain the benefits like cheap cost, high gain, light weight, etc

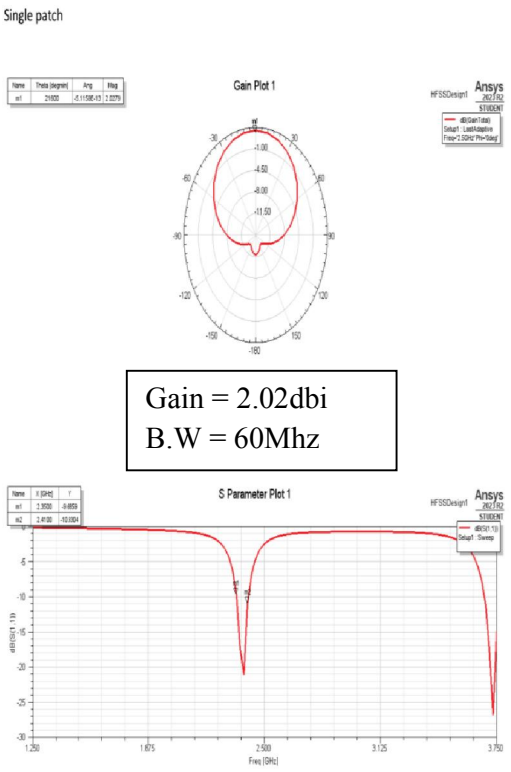


Fig : Simulation Result for Gain & Bandwidth of Single patch Without DGS

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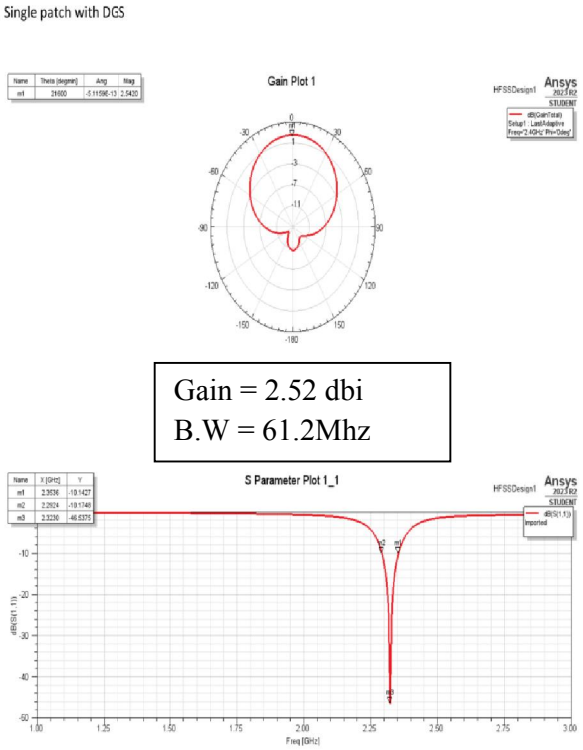


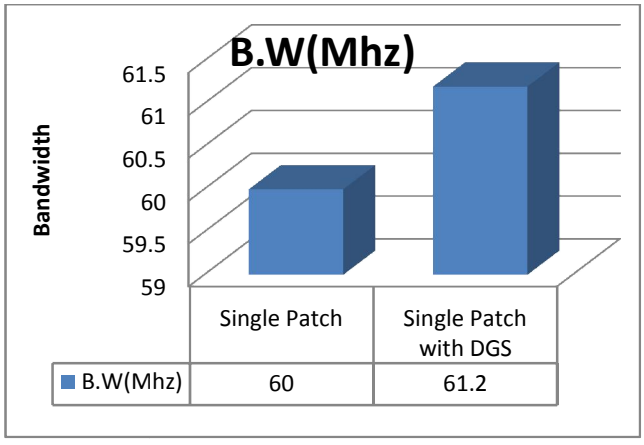

Fig : Simulation Result for Gain & Bandwidth of Single patch With DGS

**Comparison Table of Simulated Result**

| Design | Operating Frequency (Ghz) | Gain (dBi) | Bandwidth (Mhz) | VSWR |
|---|---|---|---|---|
| Single patch | 2.34 | 2.02 | 60 | 1.34 |
| Single patch with DGS | 2.35 | 2.54 | 61.01 | 1.24 |

Table 2 : Comparison of results

**Bandwidth Enhancement**




## IV. CONCLUSION

From the above simulation result, the bandwidth of patch antenna can be enhanced by using the DGS technique.

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## REFERENCES

**[1].** Sailee Palekar, "Performance analysis of micro-strip patch antenna & its array for 2.4ghz application," in International Research Journal of Engineering and Technology(Feb 2023). Goa, India.

**[2].** Ms.Anjali Majale, Mr.S.R.Mahadik,"Rectangular Micro-strip patch antenna for 2.45Ghz wireless applications," in International Journal for Scientific Research & Development( Issue 08 2015 F). kolhapur, India.

**[3].** Amar B Kachare, Mahesh S. Mathapati, "Effect of DGS on Characteristics of Rectangular Micro-Strip Patch Antenna" in International Research Journal of Research in Engineering and Technology(Issue 05 2015). Pandharpur, India.

**[4].** Rajeshwar Lal Dua, Himanshu Singh, Neha Gambhir "2.45 GHz Microstrip Patch antenna with Defected Ground Structure for Bluetooth" in International Journal of Soft Computing & Engineering(Jan 2012). India

**[5].** Waheed khan, Sanjay Gulhane "Related review on micro strip patch antenna," in International Journal of Industrial Electronics & Electrical Engineering (Jan 2015). Yavatmal, India.

**[6].** Sakshi Soundhiya, Sunil kumar Singh, "Study & analysis of microstrip patch antenna using metamaterial structure," in ECB. Jabalpur , India.

**[7].** Navya Nanda, Monika Agarwal, "Analysis & Design of Microstrip Patch Antenna with Defected Ground Structure" in IRJERT (Jun 2014). Sanrur, India.

**[8].** Vasujadevi Midasala, Dr.P.Siddaiah "Micro-Strip Patch Antenna Array Design to Improve better Gains" in ICCMS ( 2016). Guntur, India.

**[9].** Madhukant Patel, Piyush Kuchhal, Kanhiya Lal, Ranjan Mishra, "Design & analysis of micro-strip patch antenna array Using different substrates for X- Band Applications." in International journal of Applied Engineering Research(Nov 2017).India.

**[10].** Dr. Vaishali M. Dhede, Vaishali V. Thorat "Array Antenna for Wireless Applications" in InternationalJournal of Scientific Research in Computer Science, Engineering and Information Technology(Feb 2023). Maharashtra, India