International Journal of Scientific Research in Science, Engineering and Technology

Print ISSN - 2395-1990
Online ISSN : 2394-4099

OPEN ACCESS

Available Online at : www.ijsrset.com
doi : https://doi.org/10.32628/IJSRSET241126

Design and Implementation of Integrated Square - Shaped Microstrip Patch Antenna with Slots for Wireless Applications

G. Shankara Bhaskara Rao[1*], G. Hema Latha[2], G.S.G.V. Subbaraju[3], Ch. Dindu Karthi[4], A. Jnaneswari[5]

[1]Associate Professor, Department of Electronics and Communication Engineering, Sri Vasavi Engineering College (Autonomous), Tadepalligudem, Andhra Pradesh, India

[2, 3, 4, 5]U.G Students, Department of Electronics and Communication Engineering, Sri Vasavi Engineering College (Autonomous), Tadepalligudem, Andhra Pradesh, India

ARTICLEINFO

Article History:

Accepted: 25 March 2024
Published: 10 April 2024

Publication Issue :
Volume 11, Issue 2
March-April-2024
Page Number :
199-203

ABSTRACT

In this project we designed a square shaped microstrip patch antenna. The design offers desired and enhanced performance characteristics suitable for various wireless communication systems. The design consists of slots and DGS (Defective Ground Structure). The integration of slots within the square patch structure allows for improved radiation characteristics. The designed antenna operates in two different bands. The antenna designed in 5 iterations.

The S11 parameter (Return Loss) of proposed antenna is -24.9dB, gain of the proposed antenna is 3.7dB and the VSWR of the proposed antenna is 1.19. The S11 parameters, gain plots and VSWR plots of the proposed antenna is provided in the paper.

Keywords :- FR4 Substrate, Microstrip Patch Antenna, HFSS.

I. INTRODUCTION

Antenna is defined as which is usually a metallic device which is used for radiating or receiving radio waves. Generally, the different types of antennas are:

- Wire antennas,
- Aperture antennas,
- Microstrip antennas,
- Reflector antennas

Among all of them microstrip patch antennas become very much popular, particularly for ultra-wideband applications. Microstrip patch consists of a dielectric substrate with a ground conducting plane on the other side. The desirable advantages of microstrip patch antennas makes them useful in many wireless communications applications. They have low profile, light weight, low volume, low profile planer configuration, easy fabrication with low cost, supports both linear and circular polarization, easily integrated with microwave integrated circuits, capable of dual frequency operations like c and x bands, mechanically robust. These antennas are well suited for wireless communication systems, radar systems and satellite communication systems etc. Here we are designed a

square-shaped microstrip patch antenna by using HFSS simulation tool. The design consists of square-shaped microstrip patch, which is used as the main radiator. Here we are used microstrip line feeding.

II. METHODOLOGY

In this proposed antenna the size of patch is 10x10mm.The main design of the proposed antenna as shown in figure1.

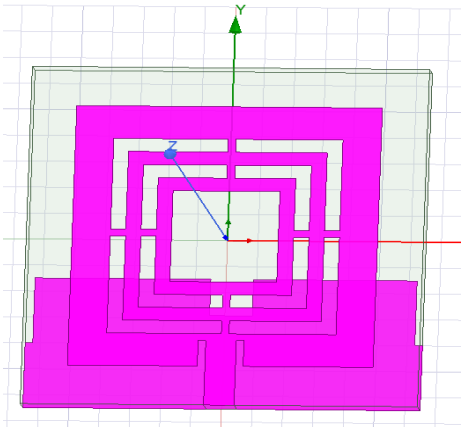


Fig 1. Proposed Antenna with Slots and DGS.

Table 1: Dimensions of the proposed antenna

S. No	Name of the parameter	Unit(mm)
1	Length of the substrate	26 mm
2	Width of the substrate	26 mm
3	Height of the substrate	1.6 mm
4	Length of the patch	20 mm
5	Width of the patch	20 mm

DESIGN STAGES OF PROPOSED ANTENNA:

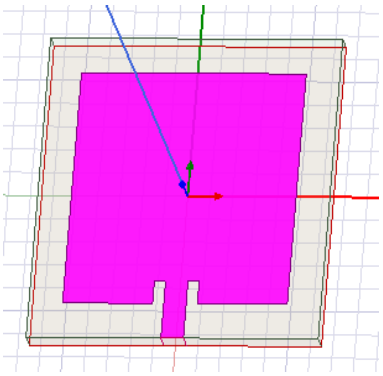


Fig 2: 1st iteration of proposed antenna

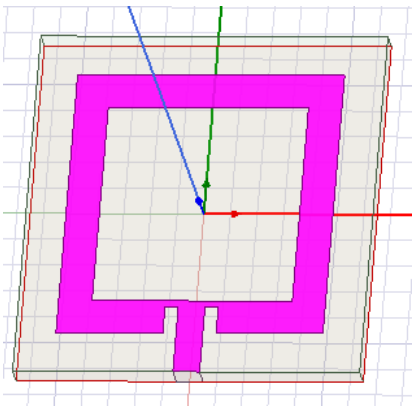


Fig 3: 2nd iteration of proposed antenna

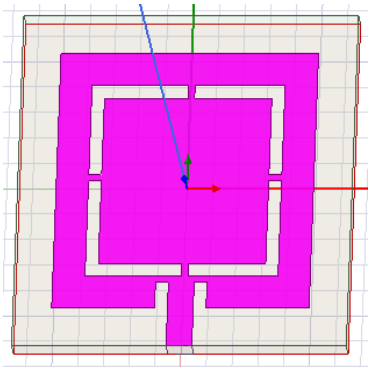


Fig 4: 3rd iteration of proposed antenna

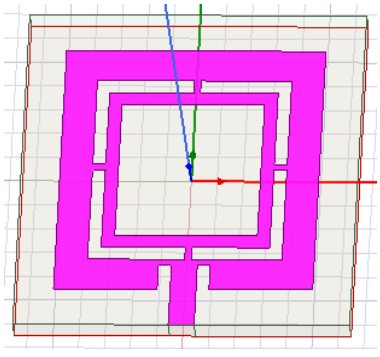


Fig 5: 4th iteration of proposed antenna

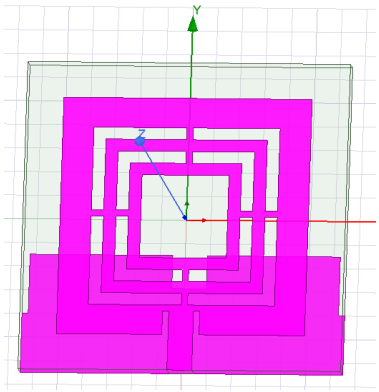


Fig 6: 5th iteration of proposed antenna with DGS

III. RESULTS

The proposed antenna is designed with the resonant frequency 2.4GHz using FR4 as a dielectric substrate.

Return Loss or S11

(S-Parameters):

An antenna's Return Loss is a figure that indicates the proportion of radio waves arriving at the antenna input that are rejected as a ratio against those that are accepted.

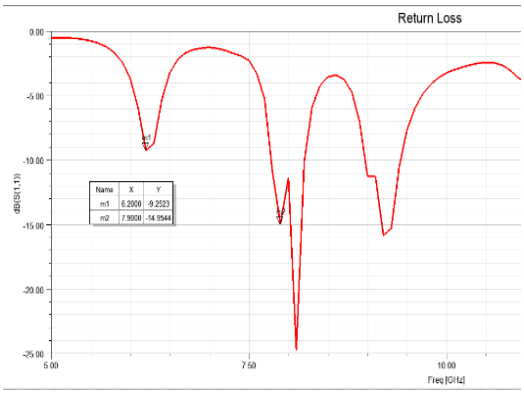


Fig 6: S-Parameter without DGS

The figure 6 shows the S-parameters of the proposed antenna without DGS.

It shows the S11 parameter of the proposed antenna is -9.25 dB.

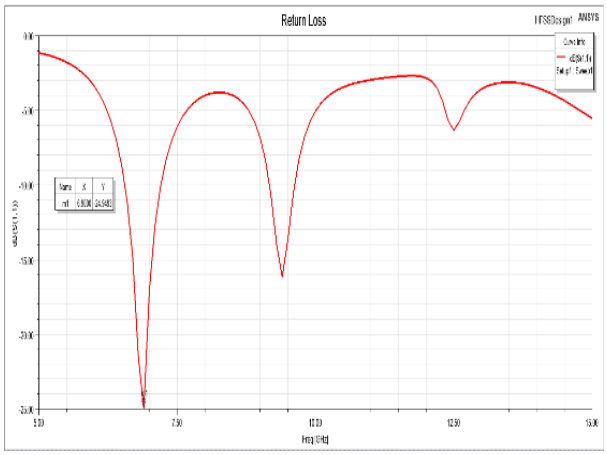


Fig 7: S-Parameter with DGS

The figure 7 shows the S-parameter of the proposed antenna with DGS is -24.9 dB.

GAIN:

It states that the ratio of output power radiated in a particular direction to the total input power given to the antenna.

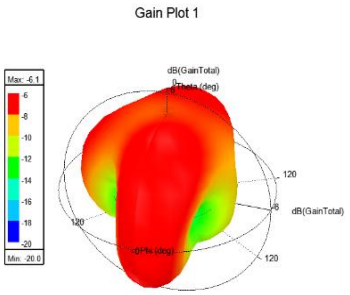


Fig 8: Gain of proposed antenna without DGS

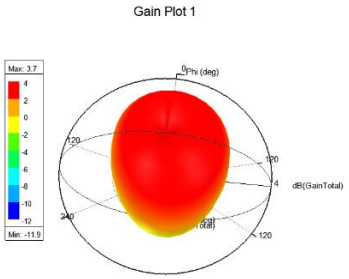


Fig 9: Gain of proposed antenna with DGS

The figure 8 shows the gain of proposed antenna without DGS as -6.1 dB and figure 9 shows the gain of proposed antenna with DGS as 3.7 dB.

VSWR:

VSWR stands for Voltage Standing Wave Ratio. It states that the power reflected from the antenna. The

range of VSWR varies between 1 to infinity. VSWR value under 2 is most suitable for Ultra-wide band applications.

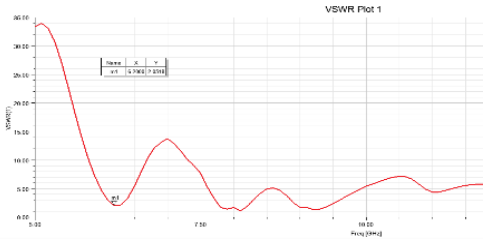


Fig 10: VSWR of proposed antenna without DGS

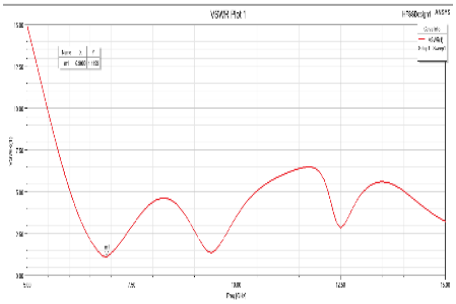


Fig 11: VSWR of proposed antenna with DGS

The figure 10 shows the VSWR of proposed antenna without DGS as 2.05 and figure 11 shows the VSWR of proposed antenna with DGS as 1.19.

DIRECTIVITY:

It indicates that the device can transmit or receive signals in a particular direction.

Fig 12: Directivity of proposed antenna without DGS

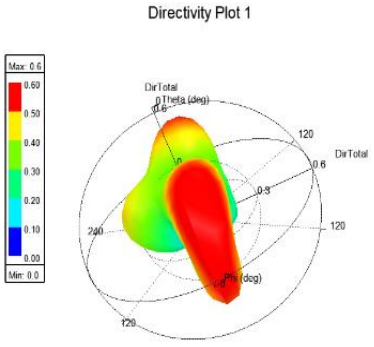
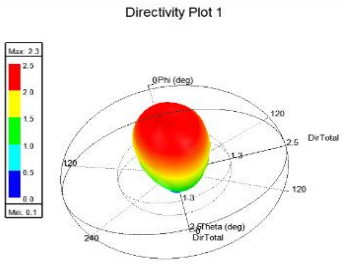


Fig 13: Directivity of proposed antenna with DGS



The figure 12 shows the directivity of proposed antenna without DGS as 0.6 dB and figure 13 shows the directivity of proposed antenna with DGS as 2.3 dB.

COMPARISON TABLE:

Antenna Parameters	Proposed antenna without DGS	Proposed antenna with DGS
Frequency (GHz)	6.2	6.9
S11(dB)	-9.25	-24.9
Gain(dB)	-6.1	3.7
VSWR	2.05	1.19
Directivity (dB)	0.6	2.3

Table 2 : Comparison table

The above table shows the comparison between the square shaped patch antenna without DGS and with DGS respectively. We notice that the enhanced values of S11 parameter, gain, VSWR and directivity as shown in above table.

IV. CONCLUSION

The main aim of this paper is to enhance the parameters like gain, S11 parameter and directivity. It was observed that the S11 parameter, gain, VSWR, directivity increased compared to proposed antenna without DGS. The observed S11 parameter is -24.9 dB, gain is 3.7 dB, VSWR is 1.19 and directivity is 2.3 dB.

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