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# Design and Analysis of a Rhombus shaped Microstrip Antenna for Modern Wireless Communication Systems

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**Abstract**

In this paper an analysis is done on a compact rhombus shaped microstrip antenna by calculating different parameters. This paper shows an elementary work on performance analysis of a Rhombus shaped micro strip antenna whose resonant frequency is 5.208 GHz. The radiating structure has a shape of rhombus type to reduce the overall dimensions. The proposed antenna energized with coaxial feed. This antenna looks much directive in shape and provides some extra advantages like area reduction, uniform distribution of radiation pattern and comparatively less weight.

The proposed antenna has achieved compactness with a gain of 2.589 dBi which provides robust wireless applications. This antenna finds applications in Wi-Max, Radar Communication and some fixed satellite services applications covering 5.208 GHz Frequency.

**Keywords:** Micro strip Patch Antennas, Gain, IE3D, Return loss, Voltage Standing Wave Ratio (VSWR)

## Introduction

An antenna is treated as a region of transition between a transmission line and space. Antennas generally radiate electromagnetic energy in the desired direction. Antenna is a key component in designing any communication system. Antenna provides connecting links between the transmitter and free space or free space and the receiver. Thus antennas play very important role to set up the link or wireless communication link in the system Patch Antennas are assigned different namessuch as printed antennas, microstrip patch antenna or simply microstrip antennas (MSA).

Microstrip Antennas are often used where thickness and conformability to the host surfaces are key requiremen. Since patch antennas can be directly printed onto a circuit board, these are becoming increasingly popular with the mobile phone market.A microstrip antenna in its simplest form is alayered structure with two parallel condu ctors separated by a thin dielectric substrate.

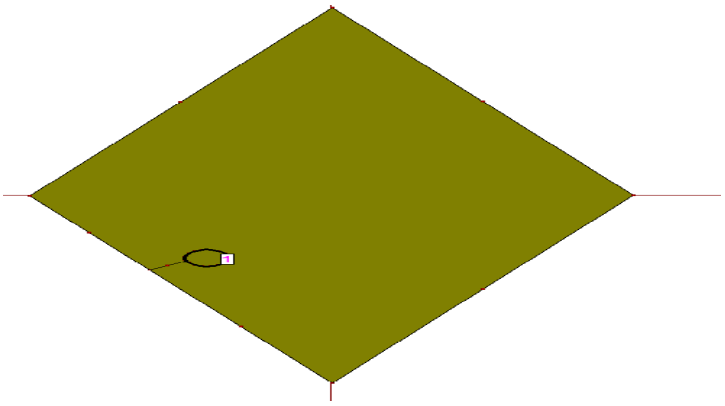

Figure 1 : A Rhombus shaped microstrip antenna with feed point as marked in a circle

**Selection of the substrate and software**

The antenna is designed on FR4 substrate of thickness 2.5 mm with dielectric constant, εr = 4.4. For the simul ation and fabrication of Rhombus shaped antenna IE3D software is used.

**Antenna design**

A Rhombus shaped antenna is used to reduce the size of the antenna and to increase the performance of the p roposed antenna. The overall size of the antenna is 7mm x 27mm x 2.5mm. The gap between the ground and patch is 0.2mm.

The structure of the proposed microstrip antenna is illustrated in Figure . The antenna with the proposed geometry is analyzed with the IE3D simulator.

To energize the patch a single coaxial SMA female connector with radius 0.62mm at an optimized feed locatio n ($X_0$=-3.5mm, $Y_0$=-4.5mm) is used. The mashed structure of the proposed antenna with the feed location is shown in figure 2.

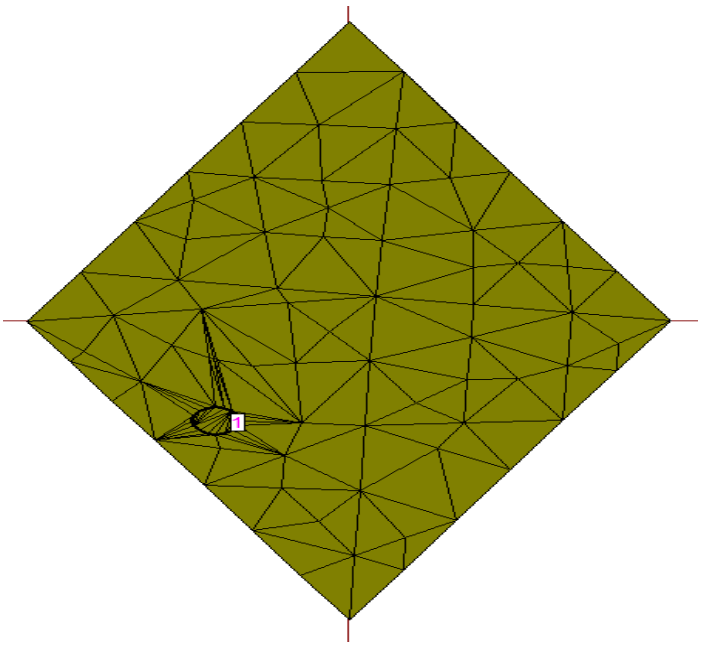


Figure 2: Mashed structure with feed point of proposed microstrip antenna

**Results and discussions**

A coaxial feed Rhombus shaped microstrip antenna is simulated and it exhibited a resonant frequency at 5.2 08 GHz which can be used for modern wireless communication.

The measured and computed variation of return loss for the proposed antenna with frequency shown in figure 3.

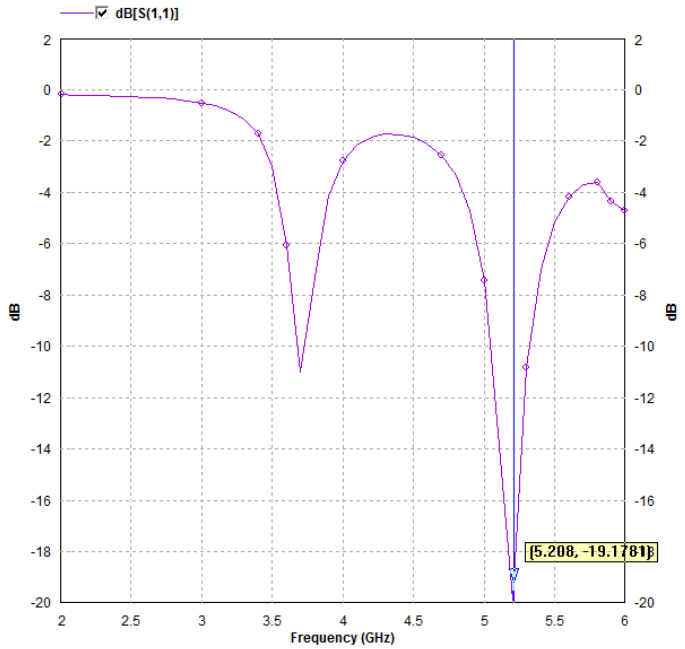


Figure 3: Measured variation of return loss for the proposed antenna with frequency

The proposed microstrip antenna is tested for it VSWR .The measured VSWR of this antenna for the resonant frequency 5.208 GHz is close

to unity as shown in fig.4. This result confirms excellent matching of this antenna geometry

with the feed network.

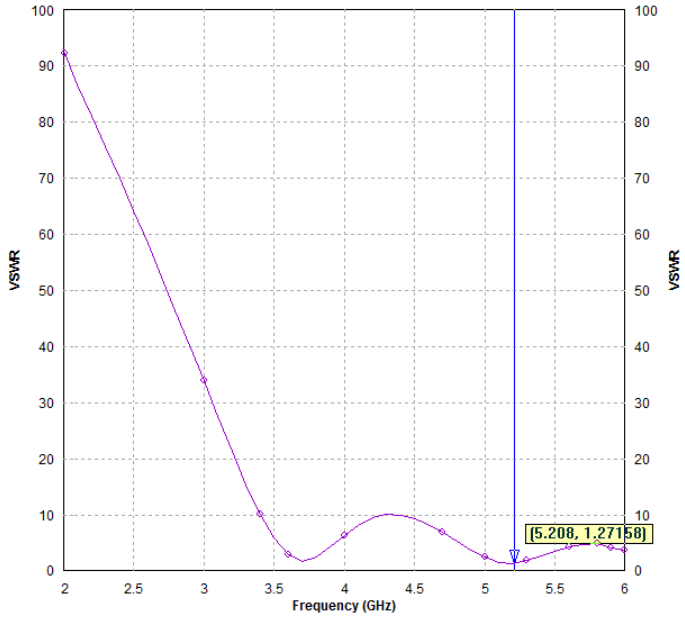


Figure 4: Measured variation of VSWR for the proposed antenna with frequency

The measured variation in input impedance ofantenna with frequency is shown in figure 4. The input impedane at the resonant frequency isclose to 50 ohm and reactive parts are also close to desired values.

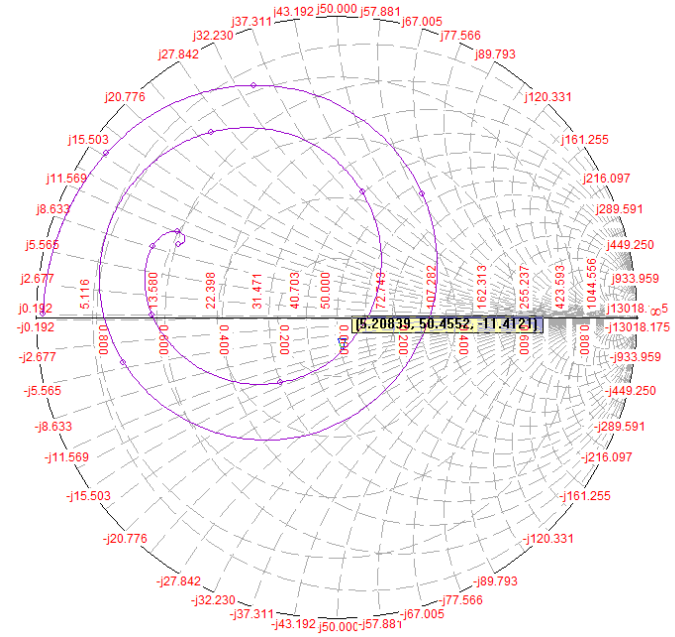


Figure 5: Measured variation of input impedance for the proposed antenna with frequency

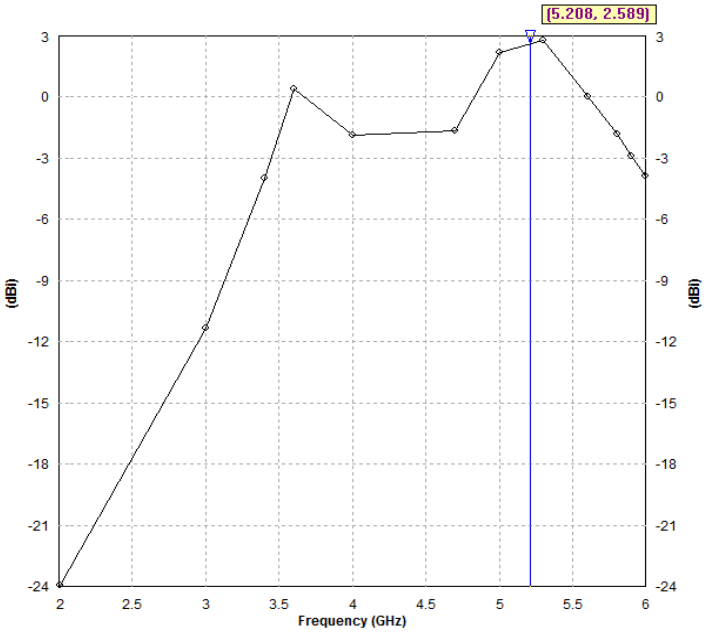


Figure 6: Gain of the proposed antenna

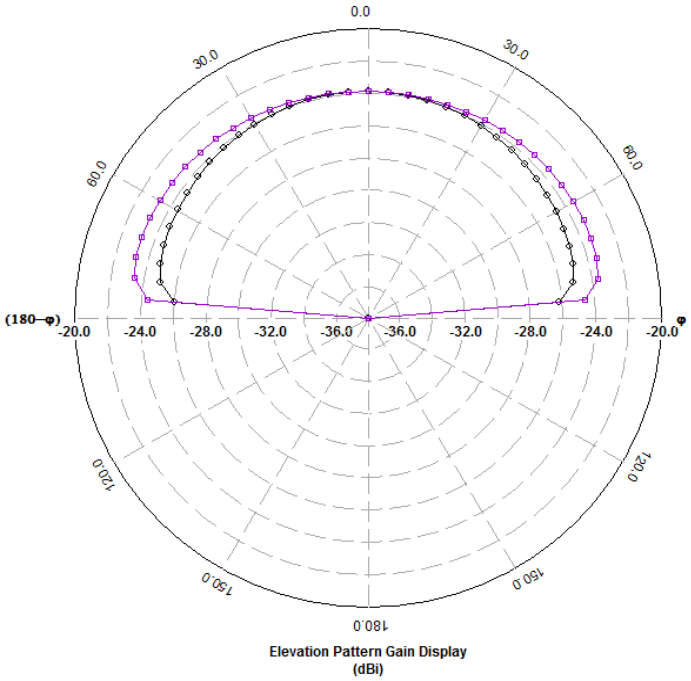


Figure 7: Radiation pattern at phi= 0 degree and phi= 90 degree

The radiation pattern is observed and displayed in figure 7. It represents the radiation pattern in Eplane for phi = 0 degree and phi= 90 degree.

It is clearly depicted in the figure that radiation is uniformly distributed and it is a desired parameter for any s uccessful antenna. Table represents the output parameters of the antenna like Return loss, VSWR etc.

| Sr. No. | Parameter | Value at 5.208 GHz |
|---|---|---|
| | Return loss | - 9. 7 dBi |
| 2 | VSWR | .2 |
| 3 | Impedence | 50.45 ohm |
| 4 | Gain | 2.589 dBi |

Table 1: Antenna output parameters

**Conclusion**

A Rhombus shaped patch antenna is proposed for wireless communication systems at 5.208 GHz. The size of t he antenna is compact and prototype on FR4 substrate of thickness 2.5mm.

The proposed patch antenna is a rugged, low cost, moderate gain antenna solution for Radar and Space applicat ions. The fundamental parameter Return Loss is 9. 7 dB and VSWR is less than 2. A satisfactory gain of 2.58 9 dBi is achieved. The radiation pattern of the antenna is uniformly distributed.

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