International Journal of Electronics Communication and Computer Engineering
Volume 4, Issue 3, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209

# Square Shaped Ultra Wide Band Antenna for Wireless Application

**Ms. Jyoti Gupta, Dr. D.K. Srivastava**

***Abstract* - A new planer Ultra Wide Band (UWB) antenna fed by a 50-Ohm microstrip line for wireless application is presented. Ground plane of the antenna is designed such that it increases the directionality of the radiator so that antenna can also be successfully used for radar application. From the simulated and measured results it is stated that the designed antenna exhibits low return loss, high directivity in the band of interest between 4.51-7.21 GHz and bandwidth achieved is 47%. Since the designed antenna comes in C-band so it also can be used in WLAN application.**

***Keywords* - MSA, Square-Shaped, C-band, UWB.**

## I. Introduction

Microstrip antennas are very advantageous for their attractive features like low profile, light weight, low volume and low cost. However, the main disadvantage of patch antenna is narrow bandwidth. To overcome this problem, researchers have done many researches and many configurations have been designed with extended bandwidth. Use of parasitic patches is one of the conventional method to increase the bandwidth. In [1], a multiple resonator wide band antenna patch antenna having parasitic patches located on the same layer with the main patch is presented. In [2], an aperture coupled patch antenna having parasitic patches stacked on the top of main patch has been presented. But these methods are result in increased antenna size. With the increased development of wireless communication where the main focus is with the antenna size and its bandwidth ,single patch wide band antenna is presented [3]-[5]. In [6] E-shaped wide band patch antenna with 30 % bandwidth is presented. Several planer broadband monopole configurations for UWB applications have been presented [7]-[10]. But very few works has been done to increase the directionality of UWB antenna such as, in radar application.

Here, we have designed a new planner UWB antenna with square-shaped patch fed by a 50-Ohm microstrip line. Substrate used for antenna is FR4 with dielectric constant 4.4. The ground plane of the system is designed in such a way that it increases the directionality of the radiator so that it can be used for radar application.

## II. Methodologies Adapted

### *A. Selection of Dielectric Substrate*

Because of the trade-off between the dimensions of antenna and its performance, it is found suitable to select a thin dielectric substrate with low dielectric constant. Thin substrate is used to reduce the size and also spurious radiation and low dielectric constant is used for achieving the higher bandwidth, better efficiency and low power loss and vice versa here we have used FR4 substrate with dielectric constant 4.4.

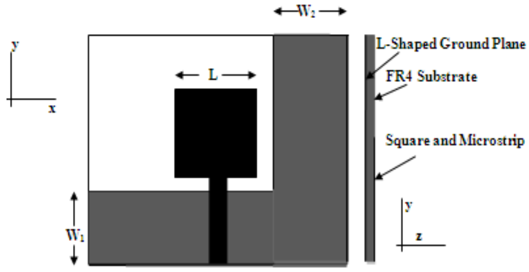


Fig.1.Schematic view of the printed square-shaped with L-shaped ground plane

### *B. Selection of Feeding Type*

Here antenna is fed by a 50-Ohm microstrip line. In this type of feed technique, a conducting strip is connected directly to the edge of the microstrip patch .The width of the conducting strip is made smaller as compared to the width of patch and the advantage of using such kind of feeding is that the feed can be etched on the same substrate to provide a planar structure.

### *C. Software Selection for Simulation*

Here we have used Zeland IE3D [version 12.0] software to model and simulates the Microstrip antenna [11]. IE3D is an integrated full-wave electromagnetic and simulation package based on the method of moments for the analysis and design of 3D (three dimensional) microstrip antenna, high frequency printed circuits and digital circuits such as MMICs and high speed printed circuit boards (PCBs). Several parameters as RL (Return Loss), VSWR (Voltage Standing Wave Ratio), Radiation pattern (Azimuth and Elevation), Smith chart and various other parameters can be easily calculated and plotted using the software.

## III. Description of the Antenna Structure

The designed antenna is fabricated on a low cost FR4 substrate with dielectric thickness and dielectric constant 1.6 mm and 4.4 respectively. Here Substrate is taken Square dielectric Fr4 board with dimension 5 cm x 5 cm. One side of the board is composed of a square with dimension L=18 mm (in the middle of the board) and 50-Ohm microstrip line feeding of width 4 mm. An L-Shaped ground plane is made on the other side of the substrate. The part of the conductor parallel to x-axis (width w1) forms the microstrip line, whereas the conductor strip parallel to y-axis (w2) acts as a reflector, and this is the key factor that is used to improve directionality as shown in fig 1.

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## IV. ANTENNA DESIGN AND CHARACTERIZATION

The goal of the work is to design a planner antenna with high bandwidth, low return loss and high directionality. Here we have done numeric simulation through IE3D software (version 12.0) which uses the method of moments techniques for electromagnetic computation. In order to obtain good results we have varied the dimension of the square patch and the width of the two strips that compose the ground plane and we have achieved optimum set of geometric parameters with L=W= 18 mm, W1= 15 mm, W2=14 mm.

Antenna with same optimum geometric parameters has been designed. In Fig 2 we have shown the photograph of two antennas. On the left it is possible to see the side of the board with the L-shaped ground plane, whereas on the right we can see the other side with square patch and the microstrip line. Simulated results of fabricated antenna have been verified through measurement by network analyser. In the fig.3 and fig.4 we have shown its return losss obtained through simulation and measurement.

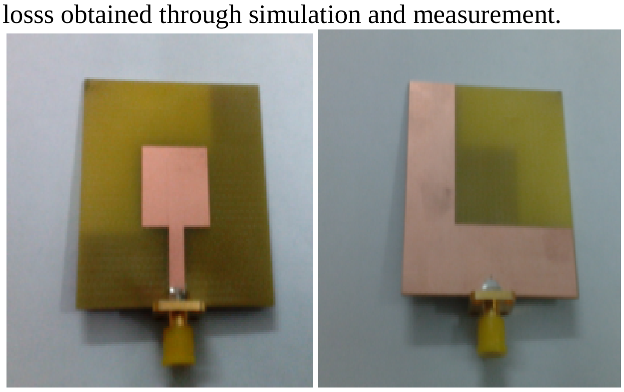

Fig.2. Photograph of the fabricated antennas with identical geometric parameters. Side of the board with L-shaped ground plane (left side). Side of the board with the square and the microstrip (right side)

## V. RESULT

### *A. Return loss*

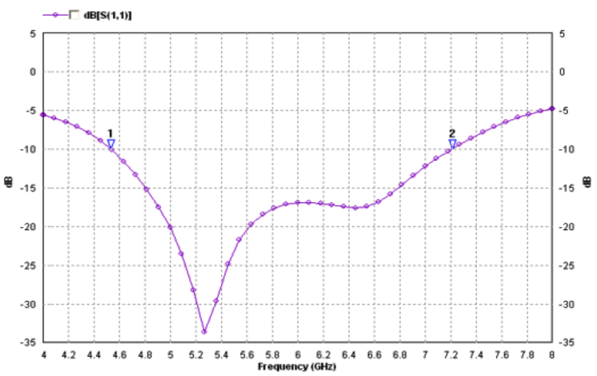


Fig.3. Simulated return loss through IE3D software showing 10 dB bandwidth from 4.51 – 7.21 GHz with center frequency 5.28GHz having -33 dB return loss Percentage bandwidth achieved is 47 %

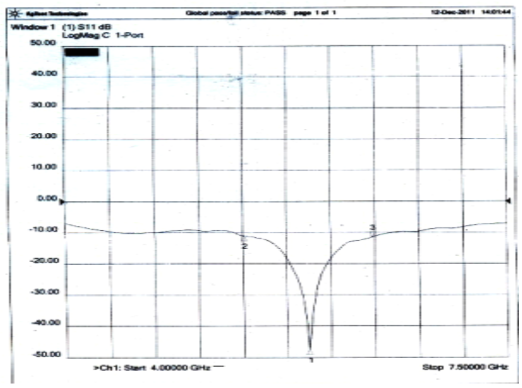

Fig.4. measured result through network analyser showing 10 dB bandwidth from 4 GHz to 7.5 GHz (approx) with center frequency 5.9 GHz having -48 dB return loss. Percentage bandwidth achieved is 40.3 %

### *B.VSWR vs Frequency*

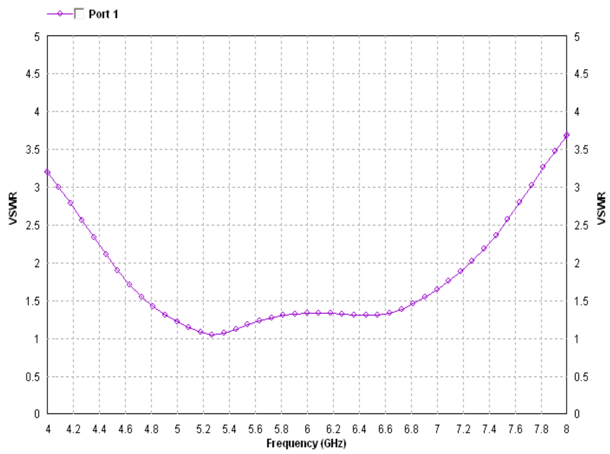


Fig.5. VSWR vs Frequency

VSWR obtained from 4.51-7.21 GHz is well within the limit of 2.

### *C. Smith Chart*

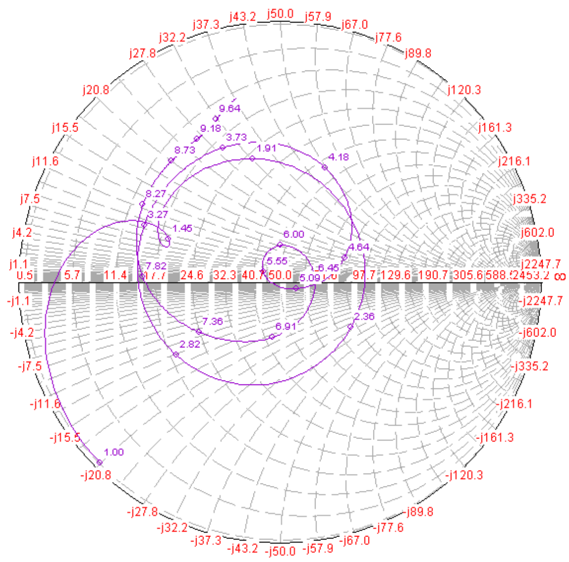

Fig.6. Smith Chart

### *D. Radiation Pattern*

From the figure 7, we can see that the radiation pattern obtained is highly directive in nature. This is because of the L-shaped ground plane. Because of its highly directive pattern the antenna can be used for radar application.

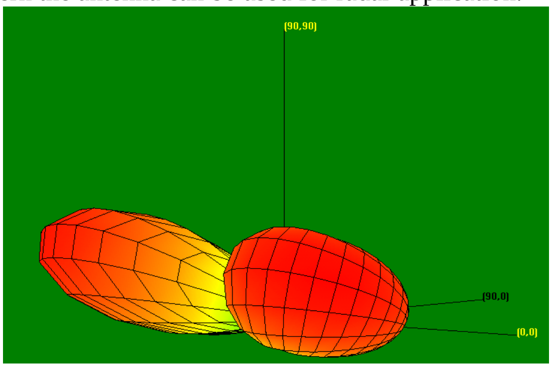


Fig.7. Radiation Pattern

## VI. Conclusion

The microstrip patch with dielectric constant 4.4 (FR4 substrate) has been designed with the help of the formulae presented in the work. The simulations are carried out using IE3D software (version 12.0).The Ultra wide band square Shaped microstrip antenna has been fabricated and demonstrated theoretically and experimentally. From the simulated and experimental results we conclude that, microstrip line feed square shaped patch antenna with L-shaped ground plane gives the best performance .The antenna is working in single band from 4.5 -7.2GHz. The impedance bandwidth of this antenna is 2.7GHz (47%).This antenna is simple to design, compact and easy to fabricate with low cost. The performance of optimized square -shaped microstrip antenna is far better in comparison to that of a conventional rectangular antenna. The antenna designed comes in C-Band and it can be used for WLAN. The antenna length and width has been optimized so that it works in wireless device band. Radiation pattern of the antenna is highly directive so it is a good to use for radar application also.

The final measured results show satisfactory performance and good agreement with the simulated result.

## Acknowledgement

The authors would like to express their sincere thank to management, faculty and colleagues at Electronics and Communication Engineering Department of Bundelkhand Institute of Engineering and Technology, Jhansi, Uttar Pradesh, India for providing all necessary help, support, motivation and cooperation to carry out this study and work.

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## Author's Profile

**Jyoti Gupta**
received his bachelor's degree in Electronics and Communication Engineering from the Uttar Pradesh Technical University, Lucknow, India, in 2008 and Masters' degree in Digital Communications from Uttar Pradesh Technical University, Lucknow India, in 2011. She is currently working as a Associate Professor in the Department of Electronics and Communication, Anand Engineering, Agra, India. She has many publications in National/International Conference proceedings and International Journals.

**Dr. D. K. Srivastava**
is a Reader in the Department of Electronics and Communication Engineering, Bundelkhand Institute of Engineering and Technology Jhansi, India. He has more than 14 years of experience in teaching, research and administrative work. He is Ex Member IEEE. His current area of research includes Microwaves and Optical communication. He has published around fifteen papers in referred international journals. He has also presented more than thirty research articles in national and international conferences.