Modified T&U Shape Triangular Microstrip Patch Antenna Array for Communication

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Abstract— Modern communication system requires high gain, large bandwidth and less size antennas which shows excellent performance over a wide range of frequency spectrum. Proposed system uses FR4 as a dielectric substrate(€r=4.4).Proposed Triangular Miscrostrip Patch antenna is designed with additional T & U shape ,simulated by using high frequency simulation software HFSS & finally tested with the help of vector network analyzer (VNA -N9923A) . Various antenna parameters like Return Loss, Gain and VSWR etc. are calculated using HFSS. The antenna has been designed to operate on the range of 5.5GHz. This paper report the simulation result using equilateral triangular patch antenna with Microstrip line feed.

Key words: Microstrip Patch Antenna Array, Radiation, Directivity, Gain, T-Junction, RMSA &TMSA etc.

I. INTRODUCTION

Compact microstrip antennas have recently received much attention due to the increasing demand of small antennas for personal as well as commercial communication equipment. It has been demonstrated that equilateral triangular microstrip patch can effectively reduce the required patch size for a given operating frequency [3].

Now days communication plays an important role in the worldwide society and the communication systems are rapidly switching from "wired to wireless". Wireless technology gives a flexible way for communication and less expensive alternative compared to wired . Antenna is one of the important elements of the wireless communications systems. Thus, antenna design has become one of the most active fields in the communication studies.

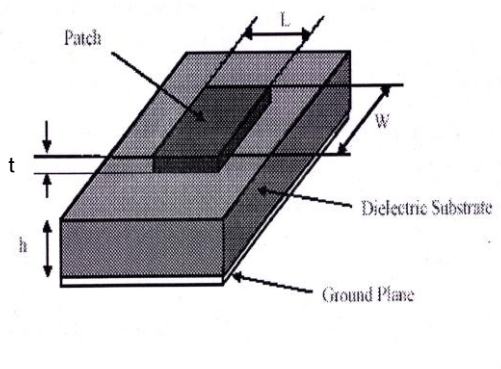


Fig. 1: Microstrip Rectangular Patch Antenna Structure

In mobile communication system such as satellite, RADAR, Global Position System (GPS) often require extremely small size, light weight. The 'C' bands of frequency are used for the satellite communication and terrestrial application. This paper report the simulation result using equilateral triangular patch antenna with Microstrip line feed using HFSS (high frequency structure stimulator) which is commercially available in the market and it depend on the FEM(finite element method) analysis.

Microstrip patch antennas are the most common form of printed antennas. They are popular for their low profile, geometry and low cost. A microstrip device in its simplest form is a layered structure with two parallel conductors separated by a thin dielectric substrate. The lower conductor acts as a ground plane. The device becomes a radiating microstrip antenna when the upper conductor is a patch with a length that is an appreciable fraction of a wavelength (λ), approximately half a wavelength (λ/2).The patch antenna plays a very important role in today's world of wireless communication systems. The planar patch antenna is preferred because of their various advantages such as light weight, low volume, low cost and ease for fabrication. Although the microstrip patch antenna has various disadvantages such as low gain, narrow bandwidth and low efficiency .These disadvantages can be overcome by constructing many patch antennas in array configuration.[2]

A. Motivation of Project

The microstrip patch antenna has been considered as the most common and significant types of antennas due to their significant advantages of light weight, low cost, low profile, and planar configuration, high reliability, suitable for arrays, easy fabrication techniques, and easy integration with microwave monolithic integrate circuits (MMICs). Microstrip patch antennas have extensively used in commercial and military applications also. However, the traditional microstrip antennas using Rectangular Patch with T -Junction does not meet the requirements of various wireless applications because antenna has only few percent of impedance bandwidth and radiation pattern with omni direction. So the proposed system introduces better modification into antennas with the help of triangular shape & insertion of T & U shape.

B. Scope of the Project

Patch antenna can be designed by using antenna simulation software such as HFSS Software, Computer Simulation Tool microwave environment software or any other software. For substrate different materials can be chosen (for proposed work FR4 substrate having dielectric constant as 4.4 s selected) .They have been widely used for commercial and military applications such as television, broadcast radio, mobile systems, GPS, radio-frequency identification (RFID), multiple-input multiple-output (MIMO) systems, vehicle collision avoidance system, satellite communications, surveillance systems, direction founding, radar systems, remote sensing, biological imaging, missile guidance, radar and so on .As the gain of the rectangular microstrip antenna is more as compared to

Traingular antenna, But the Bandwidth can be enhanced by use of Equi-lateral Triangular Microstrip antenna & insertion of T&U Shape .The proposed system achieves increment in the electrical length without increasing physical distance. Also adding more array elements gain can be improved easily.

II. DESIGN METHODOLOGY FOR TMSA

Fundamental Resonant Freq Calculation

$$fr = 2C/3W\sqrt{\varepsilon r}$$

Substatate Caculations for Triangular MSA

Lambda=c/f=54mm ,Where c –velocity of light=3x10^8m/s^2 ,F=5.5Ghz ,Er=4.4

D=lambada/4*sqrt(er)=6.7mm

Or gnd plane should be Lambda/2

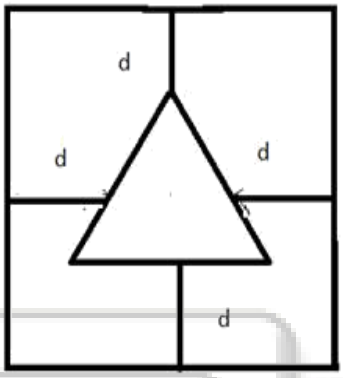


Fig. 2: Design geometry of TMSA

III. PATCH GEOMETRY

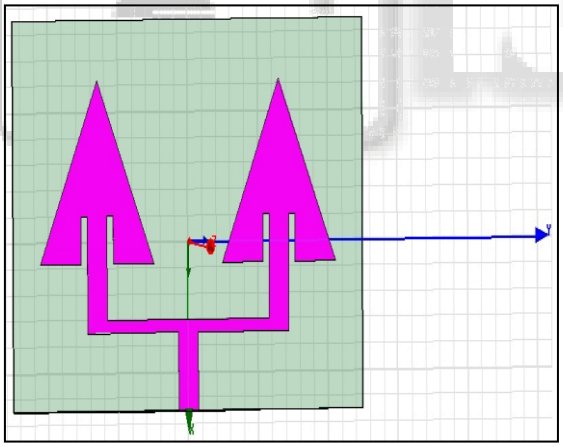


Fig. 3: Simulated view of 2X1 TMSA

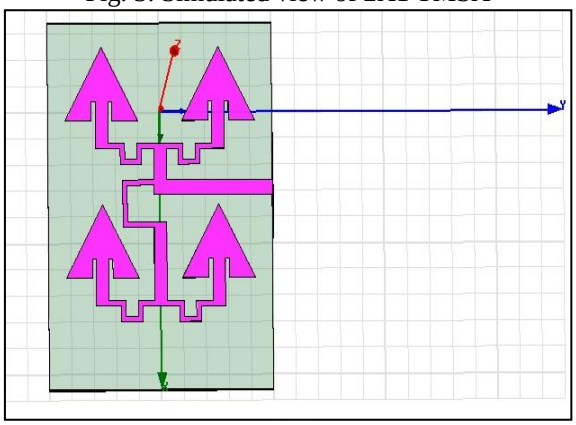


Fig. 4: Simulated view of 2X2 TMSA

IV. SIMULATION RESULTS

A. *Directivity*

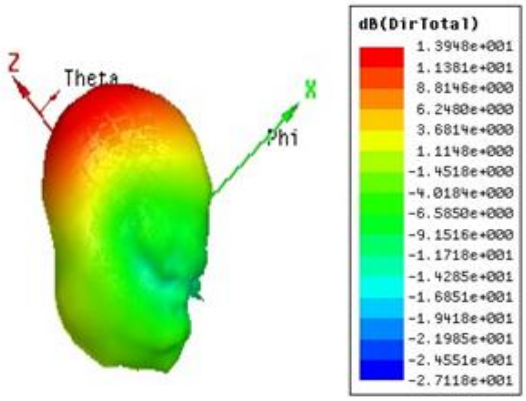
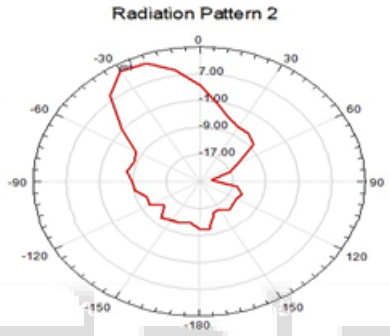


Fig. 5: Directivity of Simulated 2x2 TMSA

B. *Radiation Pattern*



Name	Theta	Ang	Mag
m1	330.0000	-30.0000	12.8894

Fig. 6: Radiation of Simulated 2x2 TMSA

C. *Return Loss*

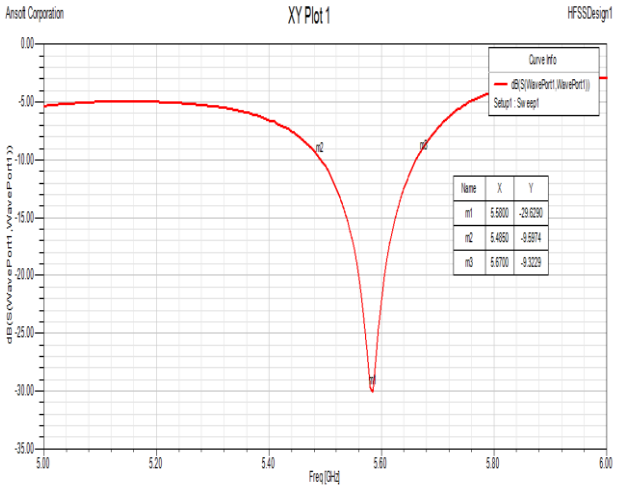


Fig. 7: Return Loss of Simulated 2x2TMSA

D. VSWR

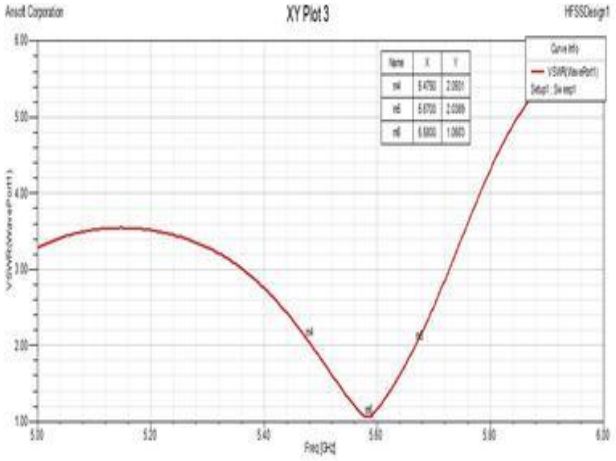


Fig. 8: VSWR of Simulated 2x2 TMSA

V. FABRICATED ANTENNA

Fig. 9: Fabricated 2x2 TMSA

VI. EXPERIMENTAL SETUP

Fig. 10: Experimental setup of fabricated 2x2 TMSA

The proposed fabricated Triangular Microstrip Patch antenna is designed at freq. of 5.5 GHz. & tested with the help of vector network analyzer (VNA -N9923A) operated at maximum Freq of 6 GHz

VII. FABRICATION RESULTS

A. Return Loss.

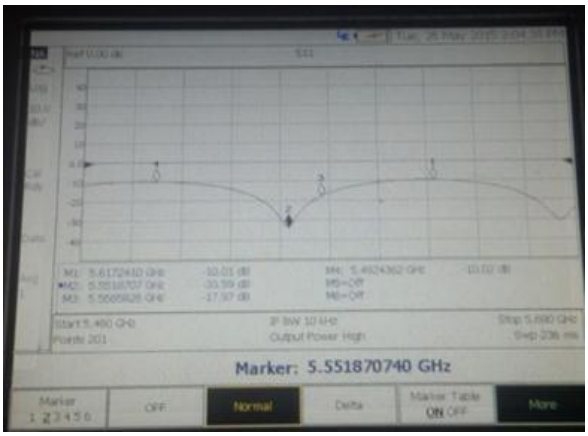


Fig. 11: Return Loss of fabricated 2x2 TMSA

B. VSWR

Fig. 12: VSWR of fabricated 2x2 TMSA

VIII. COMPARATIVE STUDY

Sr No.	Type of MSA	Freq (GHz)	Retun loss(DB)	VSWR	BW(MHz)	Gain (dB)
1.	Single patch	5.57	-45.07	1.01	190	6.31
2.	2x1 TMSA	5.55	-27.61	1.08	210	7.80
3.	2x2 TMSA	5.58	-29.62	1.06	195	14.0

Table 1: Comparison of TMSA (Simulated)

SrNo	Results	Freq (Ghz)	Return Loss(dB)	VSWR	BW (Mhz)	Zo (ohm)
1.	Simulated Results	5.58	-29.62	1.06	195	50.92
2.	Measured Results	5.56	-32.87	1.04	140	45.0

Table 2: Comparison of TMSA (Measured)

IX. CONCLUSION

This study compared Triangular Microstrip antenna array of 2X1 & 2X2 elements with insertion of T & U shape at freq. of 5.5 GHz using HFSS software. The size of array reduced because of utilization of Triangular patch .So fabrication

cost of antenna will be less. By insertion of Triangular patch gain will be improved for 2X2 TMSA to 14 db, Bandwidth equals to 195 MHz & VSWR value is of 1.06. Earlier the gain value was of 7.8 db, Bandwidth equals to 210 MHz & VSWR 1.08 for 2X1 TMSA. Whereas the fabricated antenna shows the VSWR equals to 1.04 & bandwidth equals to 140 MHZ.

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