International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 09, September-2015

Synthesis and Analysis of Microstrip Line Fed Trapezoidal Microstrip Patch Antenna at 800MHz

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***Abstract*— This paper proposes a simple, easy and cost-effective method to design a Broadband Microstrip Patch Antenna, which is capable of working in communication band region of microwave spectrum. Microstrip patch antenna with different patch geometry has been designed and simulated and also different feeding mechanism has been used to excite the radiator of the antenna system, so as to know about the best possible geometry and excitation technique. Produced results have been further utilized to obtain a "Broadband Microstrip Patch Antenna", which satisfies the objective of the research work.**

Keywords—Microstrip Patch Antenna, Trapezoidal Geometry, Microwave Spectrum, Broadband

I. INTRODUCTION

In the modern era of technology, MMIC has made Microstrip Patch Antenna (MPA) very popular. These antennas are very simple and can be easily fabricated and configured. MPA are low cost and low profile antennas. One of their limitations is that MPA provides less bandwidth. Modern communication systems as found in mobile systems, GPS, vehicular, WLAN, etc., uses MPA. Microstrip Patches are embedded on the substrate using PCB circuit technology. These patches are generally made up of metallic substances, are excited using different fed techniques such as coaxial probe fed, edge fed, Microstrip line fed and other techniques. These excited patches acts as the radiating element of the antenna.

This paper has five sections. Section I is introduction to MPA, design and implementation can be seen in section II, section III details the simulation work carried out in simulation software's and finally, the conclusion has been presented in section IV.

II. DESIGN IMPLEMENTATION

In this section; design, specification parameters of Microstrip Line Fed Trapezoidal Microstrip Patch Antenna (MLFT-MPA) at 800 MHz has been presented. Rogers RT Duroid 5880™ of dielectric constant 2.2 and height 1.575 mm has been used as substrate in MPA antenna design.

Table I shows the design specification of Microstrip Line Fed Trapezoidal Microstrip Patch Antenna. Antenna design and specification parameters have been shown in Figure 1. 3D View of simulated Microstrip Line Fed Trapezoidal MPA is shown in Figure 2. The antenna is fed with a waveguide port at the end of a microstrip line. Magnetic symmetry is used in the x-z plane to reduce simulation time.

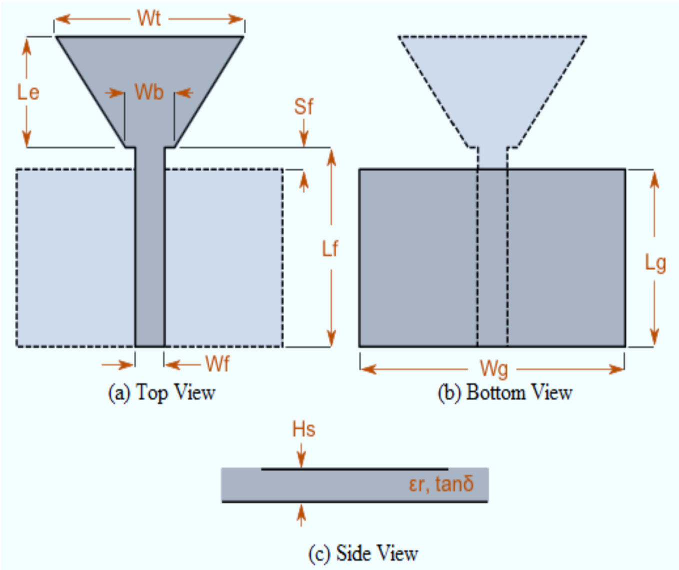

Figure 1 Deign & Specification Parameters of MLFT-MPA

Table 1 Antenna Design Specification of MLFT-MPA

S. No	Design Specification	Symbol	Value	Unit
1.	Center Frequency	fo	800	MHz
2.	Input Resistance	Rin	50	Ω
3.	Distance from Base	Le	39.90	mm
4.	Width of the Base	Wb	4.853	mm
5.	Width of the top	Wt	77.40	mm
5.	Feed Gap	Sf	2.330	mm
6.	Feed Line Length	Lf	42.23	mm
7.	Feed Line Width	Wf	4.853	mm
8.	Width of Ground Plane	Wg	154.8	mm
9.	Length of Ground Plane	Lg	79.81	mm
10.	Length of Antenna (X-axis)		122.0	mm
11.	Width of Antenna (Y-axis)		154.8	mm
12.	Height (Z-axis)		1.575	mm

ISSN: 2278-0181
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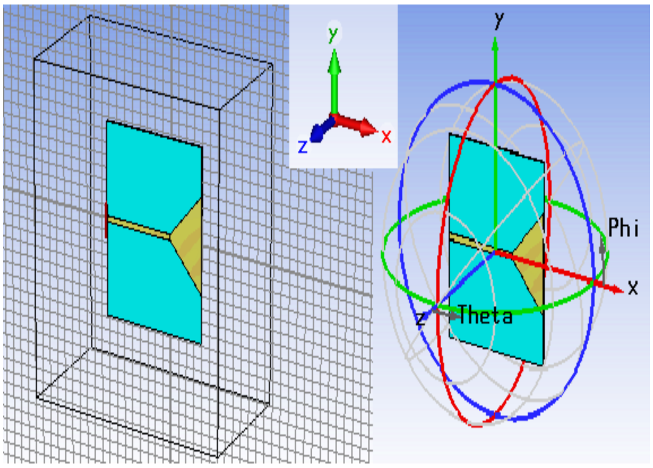

Figure 2 3D View of Simulated MLFT-MPA

III. SIMULATION

In this section, analysis of designed antenna has been performed. Different antenna characteristics has been analyzed in detail to find the suitability of the antenna in wireless communication.

A. Antenna Input Impedance

Input Impedance Vs Operating Frequency of the antenna has been shown in Figure 3. It is observed that, at resonating frequency only real value for input impedance exists for synthesized Microstrip Line Fed Trapezoidal MPA. It has been found that the real value of impedances is 74.76 Ω at the resonating frequency, therefore antenna is well matched at the resonating frequency.

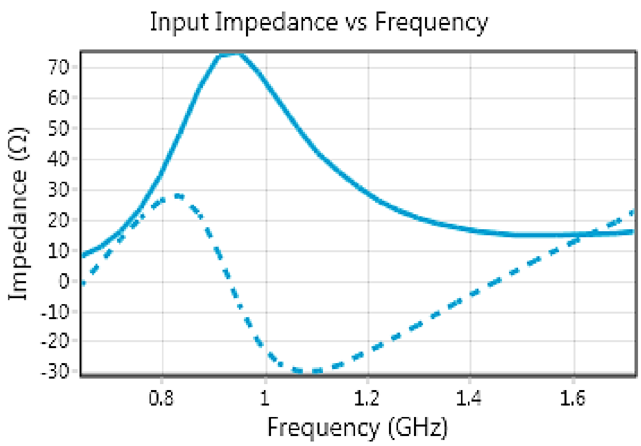

Figure 3 Input Impedance Vs Frequency Plot of MLFT-MPA

B. Antenna Reflection Coefficient

The power reflected from the antenna is given by the parameter 'S' which is also known as the reflection coefficient or the return loss. Figure 4 presents the Return loss curve of the designed Microstrip Line Fed Trapezoidal MPA. It implies that the MPA radiates best between 809.5 MHz to 1.100 GHz, providing a bandwidth of 290.5 MHz, where S11 is -10 dB or less. Further, at the resonating frequency of 910.3 MHz, return loss obtained is about -22.00 dB.

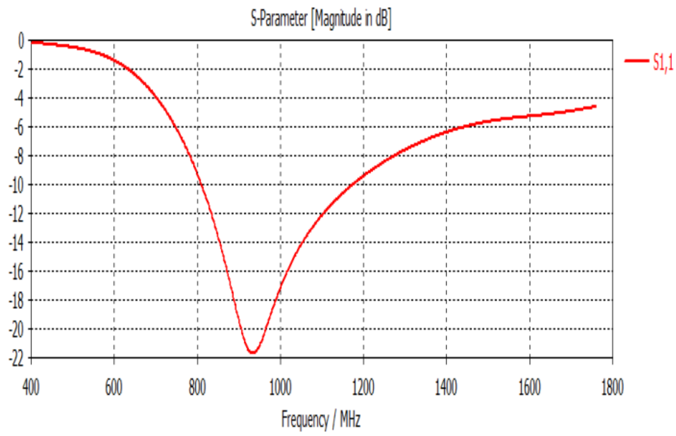

Figure 4 Return Loss Curve of MLFT-MPA

C. Gain

Power transmitted in the direction of the peak radiation by the synthesized antenna to that of an isotropic antenna source is termed as gain of the synthesized antenna. Antenna gain considers the actual losses occurred in the antenna system. Figure 5 presents the normalized gain of MPA as the radiation pattern. The peak gain of antenna is found to be 2.248 dBi at resonating frequency.

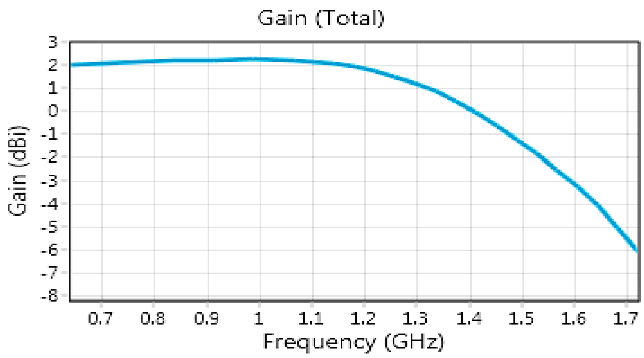

Figure 5 Normalized Gain of MLFT-MPA

D. VSWR

VSWR Vs Operating Frequency of the antenna has been shown in Figure 6. It is found from the figure that Antenna has VSWR value of 1.506 at the resonating frequency.

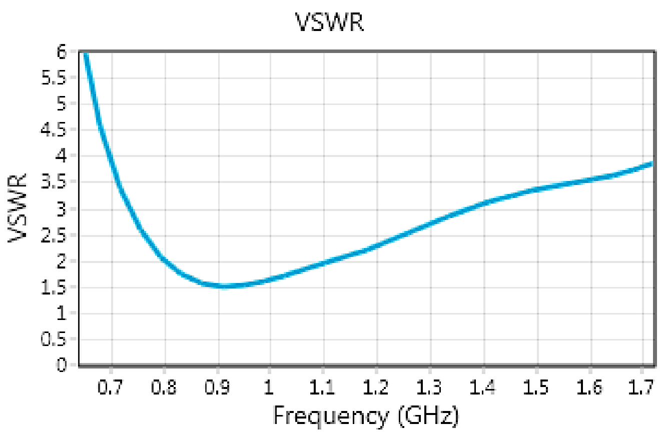

Figure 6 VSWR Vs Frequency of MLFT-MPA

E. Antenna Directivity

Figure 7 shows the directivity of Microstrip Line Fed Trapezoidal MPA. Absolute value of directivity is found to be 2.654 dBi at the resonating frequency.

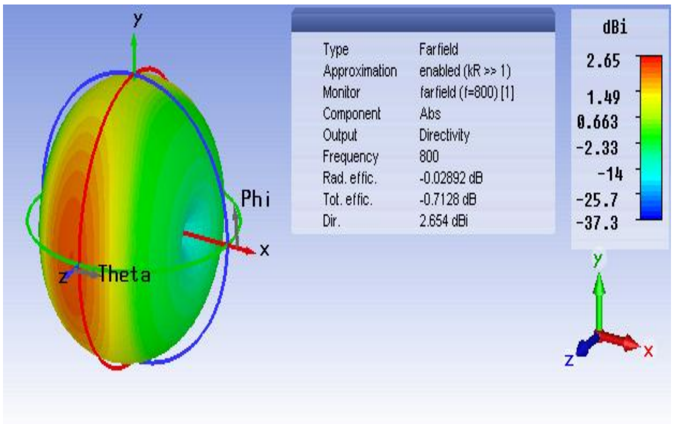

Figure 7 Directivity of MLFT-MPA

F. Axial Ratio

For pure elliptical polarization the axial ratio is 0 dB and for linear polarization the axial ratio is ∞. From the 3D result shown in Figure 8, observation is made about the polarization of MPA. It is found that the axial ratio is high in this case with the help of color coding. So, it is found that antenna will propagate properly in pure elliptical polarization.

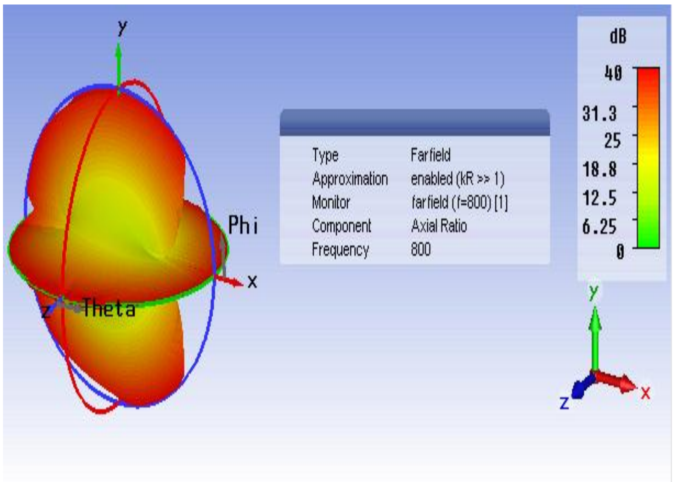

Figure 8 Axial Ratio of MLFT-MPA

G. Radiation Pattern

Radiation patterns have been presented in elevation angle (θ-degree) and azimuth angle (φ-angle). Figure 9 is the elevation pattern, which represents the plot of the radiation pattern as a function of the angle measured off the z-axis (for a fixed azimuth angle).

Observing Figure 9, it is deduced that the radiation pattern is minimum at 0 and 180 degrees and becomes maximum broadside to the antenna (90 degrees off the z-axis). Figure 10 shows the Radiation Pattern of Microstrip Line Fed Trapezoidal MPA at Elevation Angle Phase.

The radiation pattern shown in Figure 11 is the azimuthal plot. It is a function of the azimuthal angle for a fixed polar angle (90 degrees off the z-axis in this case). Figure 11 shows the Radiation Pattern of Microstrip Line Fed Trapezoidal MPA at Azimuth Angle Phase.

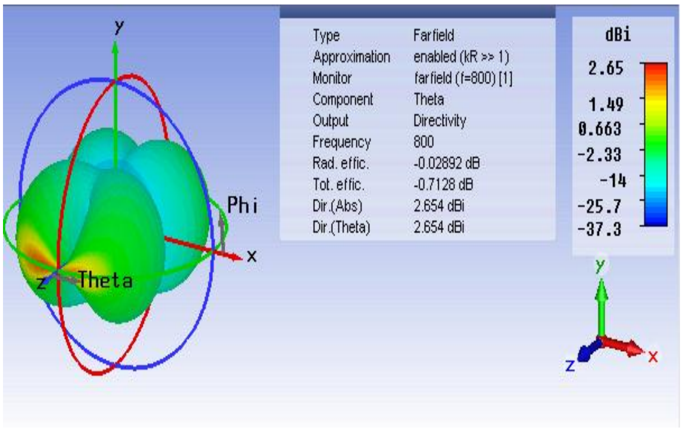

Figure 8 Radiation Pattern of MLFT-MPA at Elevation Angle

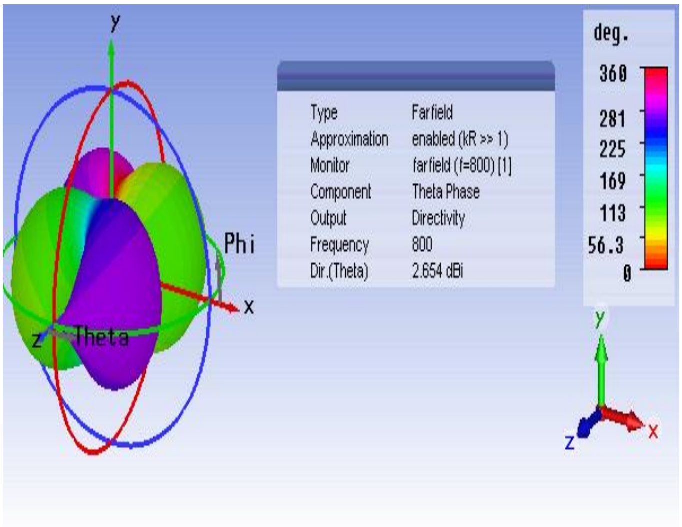

Figure 9 Radiation Pattern of MLFT-MPA at Elevation Angle Phase

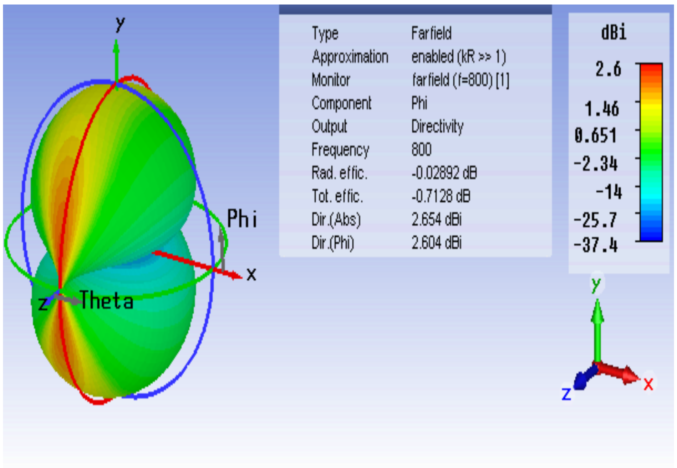

Figure 10 Radiation Pattern of MLFT-MPA at Azimuth Angle

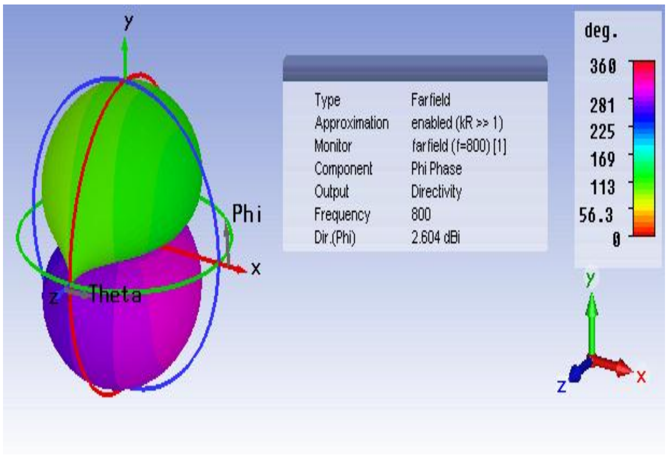

Figure 11 Radiation Pattern of MLFT-MPA at Azimuth Angle Phase

IV. CONCLUSION

Synthesis and analysis of Microstrip line fed Trapezoidal Microstrip Patch Antenna has been achieved. During the analysis, it is found that antenna MPA radiates best in pure elliptical polarization between 809.5 MHz to 1.100 GHz, providing a bandwidth of 290.5 MHz, where S11 is -10 dB or less. Further, at the resonating frequency of 910.3 MHz, return loss obtained is about -22.00 dB. The peak gain of antenna is 2.248 dBi at resonating frequency and has VSWR value of 1.506. Thus, the designed antenna is a suitable candidate for wireless communication at 800 MHz.

ACKNOWLEDGMENT

Author thanks members and technical staff at Department of Physics, C. M. Science College, Darbhanga, Bihar, India for providing essential requirements and assistance in completing this research work in time.

REFERENCES

[1] A. Kaya, “Meandered Slot And Slit Loaded Compact Microstrip Antenna With Integrated Impedance Tuning Network,” Progress In Electromagnetics Research B, Vol. 1, 219–235, 2008.

[2] Yoonjae Lee and Yang Hao, “Characterization of microstrip patch antennas on meta-material Substrates loaded with complementary split-ring Resonators”, Wiley Periodicals, Inc. Microwave Opt Technol. Lett. 50, pp. 2131–2135, 2008.

[3] Q. Lu, X. Xu, and M. He, “Application of Conformal FDTD Algorithm to Analysis of Conically Conformal Microstrip Antenna”, IEEE International Conference on Microwave and Millimeter Wave Technology, ICMMT. , April 2008. p p. 527 – 530, 2008.

[4] Abumazwed,A.,Sebak,A.R., “Compact dielectric resonator antenna for broadband applications (5.2/5.8GHz)‖, European Conference on Antennas and Propagation”, EuCAP 2009, Proceedings , art. no. 5067658, pp. 433-436, 2009.

[5] A. Elrashidi, K. Elleithy, and Hassan Bajwa, “The Fringing Field and Resonance Frequency of Cylindrical Microstrip Printed Antenna as a Function of Curvature,” International Journal of Wireless Communications and Networking (IJWCN), Jul.-Dec., 2011.

[6] B. Jyothi, B.T.P Madhav, V.V.S. Murthy, P. Syam Sundar VGKM Pisipati, “Comparative Analysis of Micro-strip Co-axial Fed, Inset Fed and Edge Fed Antenna operating at fixed frequency”, International journal of scientific and research publications, Vol. 2, Issue 2, February 2012.