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Bandwidth improvement of Microstrip Patch Antenna using Stacked Patch Antenna configuration

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Abstract — *In recent year due to increase in applications large Bandwidth upon large spectrum is require Thus, all the subsystem are required to operate over wide bandwidth, the demand for wideband antenna increase as well. Thus, low-profile, high-bandwidth and wideband antenna are often desired. Use of conventional M, is limited because of their poor gain, low bandwidth and polarization purity. Stacked antenna are use to overcome this limitation. So the Stacked antenna is very popular nowadays for various applications due to its low profile and operation at microwave frequencies. The proposed antenna is a Staked antenna intended to work at frequencies of Ku-band applications. In simulation results, main parameter in focus is Bandwidth at desired frequencies. Some other parameters like antenna gain, axial ratio, return loss etc. are also taken into account and optimized. This simulation work has been done using CST.*

Keywords*-bandwidth, wideband, stacked antenna, Ku-Band, gain, return loss*

I. INTRODUCTION

With the rapid growth of the wireless mobile communication technology, the great demand in future technologies are very small size wide band antennas. For this microstrip patch antenna is the better part. Microstrip patch antenna becomes very popular nowadays because of its ease of analysis and Fabrication, low cost, light weight, easy to feed and their attractive radiation characteristics. Although microstrip patch antenna has numerous advantages, it has inherent limitation of narrow bandwidth low gain. To overcome its inherent limitation of narrow impedance bandwidth and low gain, many techniques have been suggested and investigated for MSA. We can mention Multilayer structures [2], broad folded flat dipoles [3], curved line and spiral antennas [4], impedance matched resonator antennas [5], resonator antennas with capacitive coupled parasitic patch element [6], log periodic structures [7, 8], modified shaped patch antenna (H-shaped [9]).In the present paper stacked patches along main patch type microstrip patch antenna analyzed and compared with rectangular patch antenna.

II. MSA WITH SINGLE PATCH

A microstrip patch antenna in its basic form consists of a metallic radiating patch on one side of dielectric substrate, which has a ground plane on other side. The radiating elements and feed lines are usually photo etched on the dielectric substrate [1].

The pertinent design parameters are given together with their relevant equations to allow basic 'hand' calculations before simulation is attempted. By using this flow of design, simple microstrip patch antenna can implemented. A single element of rectangular patch antenna, as shown in figure 1, can be designed for the Ku-band(step 1, 2, 3).

In the typical design procedure of the microstrip patch antenna, the desired resonant frequency, thickness and dielectric constant of the substrate are known or selected initially. In this design of rectangular microstrip antenna, Teflon dielectric material is selected as the substarte with 0.88mm height. Then, a patch antenna that operates at the specified resonant frequency (14 GHz) can be designed by the using transmission line model equations [1].

As shown in figure 2, coaxial probe type feeding mechanism used. The rectangular microstrip patch antenna parameters are:

Resonatinf frequency fr =14GHz
Patch width w = 8.6 mm
Patch length L = 7.0 mm
Substrate height h = 0.8 mm
Dielectric constant of substrate material εr =2.1
Feed loction (Xf,Yf) = (1.3,0)
Feed diameter = 1.2 mm

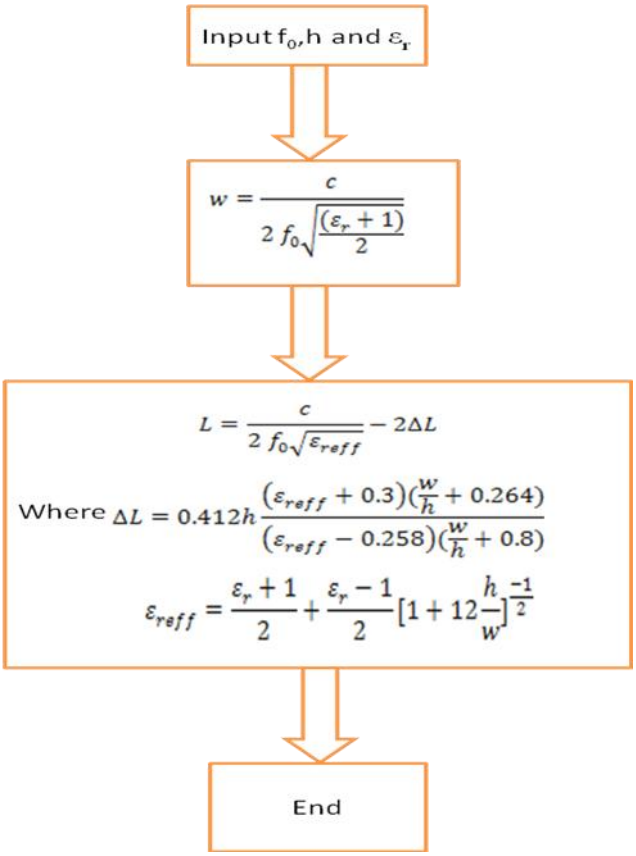

Figure 1.Design Flow Steps

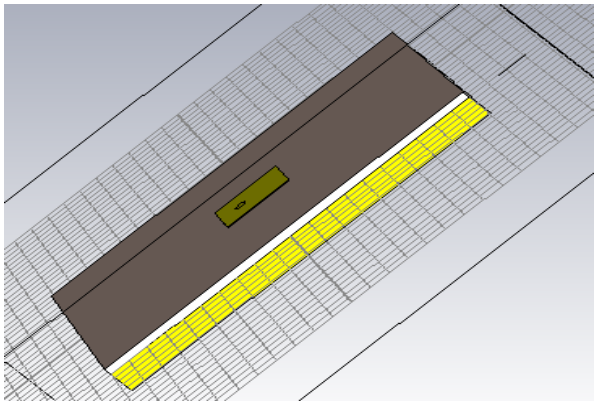

Figure 2.MSA antenna with single patch

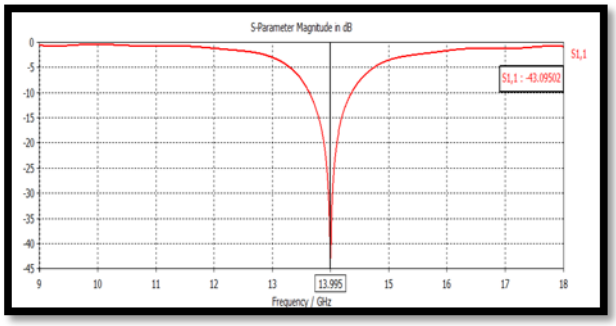

Figure 3.Return loss of MSA with single patch antenna

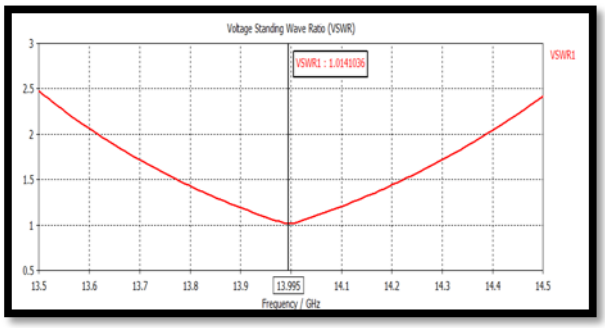

Figure 4.VSWR of MSA with single patch antenna

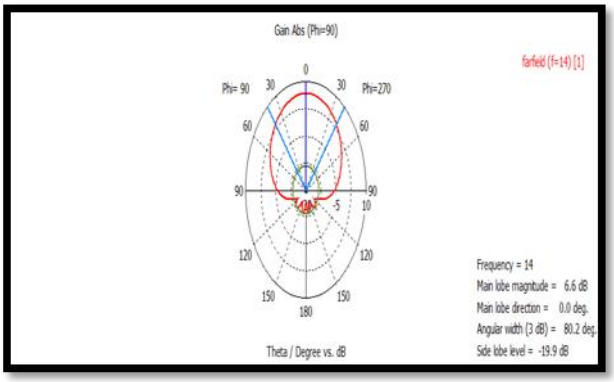

Figure 5.Gain of MSA with single patch

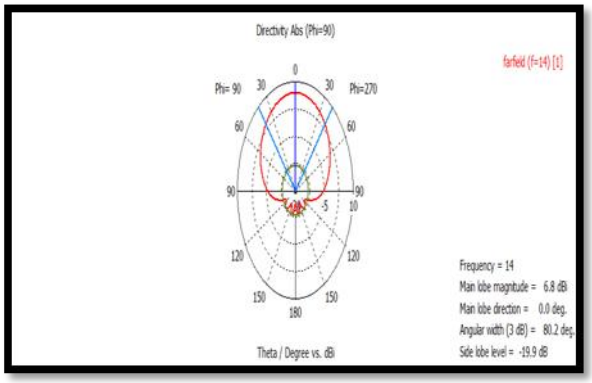

Figure 6.directivity of MSA with single patch

III. WHY WE USED STACKED ANTENNA

In each antenna type, a design according to the bandwidth .Bandwidth can be increased by increasing the height of the antenna. However, there are some limitations on how high the antenna volume to be small. Therefore, increasing the height of the antenna may not satisfy the size specification for the required bandwidth. However, performance can be degraded when the height is increased.

Microstrip antenna, compared with the ordinary antennas, represent excellent properties such as small volume, low productivity cost, plane structure, reliability, easy of fabrication and easy to confirm with the carrier. However some imperfections such as narrow bandwidth, low gain and low power handling capability restrict its wider application. In the current scenario of satellite and wireless communication, where number of users are increasing day by day and demand of dual/multi broadband antenna is growing in leaps and bound. So, in this problem with the help of stacked patch antennas we can increase the bandwidth.

Stacked patch antenna is kind of Microstrip which consists of two printed antenna. The lower patch is called driven patch and another patch is parasitically coupled to driven patch. To produce broadband responses the selection of the substrate of the first layer is very important.

IV. TWO LAYER OF PATCH STACKED ANTENNA

Using single patch, bandwidth enhance up to very low percentage. With the two layer of substrate, surface wave of the antenna is decrease and we can improve the bandwidth with good result compare to single patch. Here we assigned perfect E boundary for patch and ground plane.

In the both design we used the same dielectric material for the substrate. In both design, dimension of patch, ground and substrate 1 is same .height of substrate 2 is 1.6 mm and feed diameter is 1.2 mm. The position of probe is changed because of impedance matching. Result of this design is best one compared to single patch.

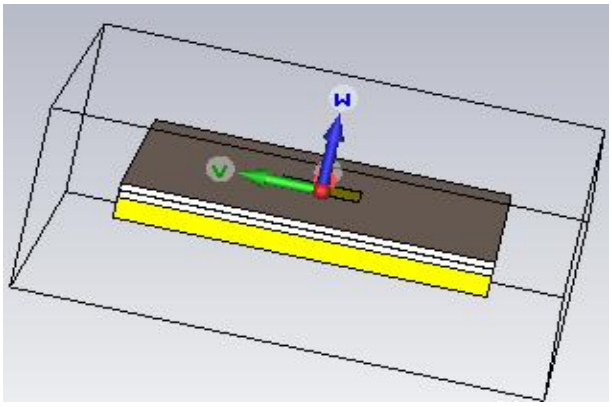

Figure 7.stacked antenna

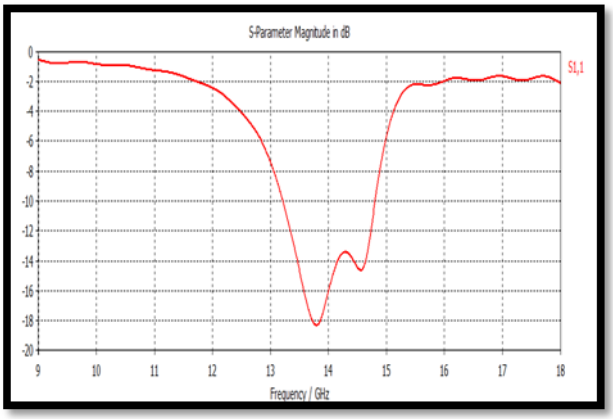

Figure 8.Return loss of stacked antenna

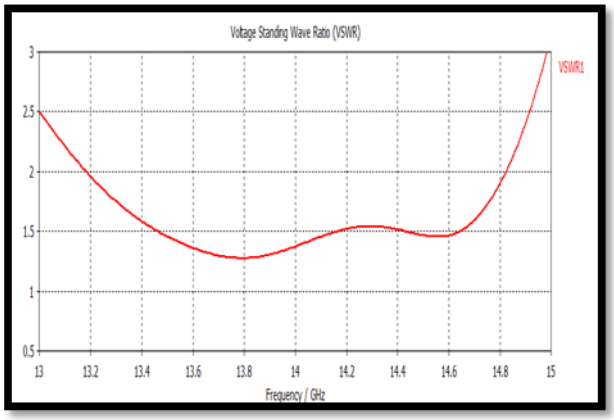

Figure 9.VSWR of stacked antenna

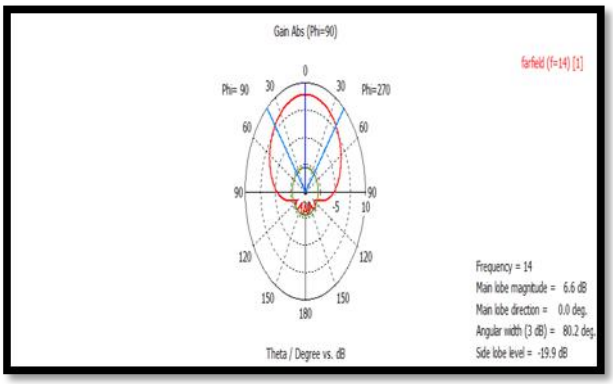

Figure 10.Gain of stacked antenna

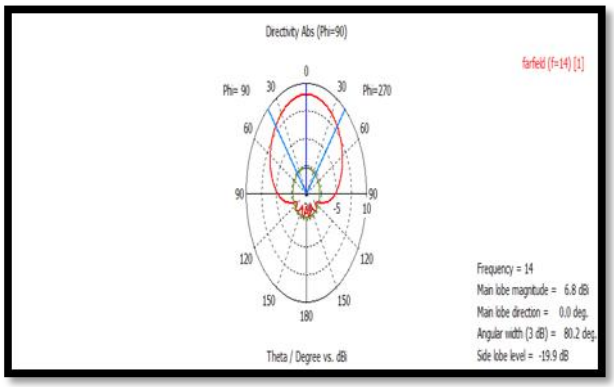

Figure 11. Directivity of stacked antenna

V. RESULTS

The simulated results of S11 scattering parameter of single element rectangular Microstrip antenna is presented in figure 7.from the antenna has almost 14 GHz resonant frequency and it has 727MHz bandwidth at 10dB.in percentage ,the bandwidth of antenna is 5.2%.

In two layer substrate stacked antenna, the simulated result of S11 scattering parameter is presented in figure 8. From the figure 8, the antenna has almost 13.788 GHz resonant frequency and it has 1.587GHz bandwidth at 10dB. In percentage the bandwidth of the antenna is 11.3%.

VI. CONCLUSION

In this paper, 7×8.6 mm Rectangular Microstrip patch antenna fed with contacting method using coaxial feeding technique. The rectangular MSA with single patch got return loss bandwidth 5.2%.in two layer of substrate of stacked antenna got 11.3% bandwidth. Main reason of bandwidth improvement is effective aperture area is increased and the surface wave is decreased. So by using two layer substrate MSA instead of rectangular MSA we can get bandwidth improvement.

TABLE1. Comparison between rectangular and stacked MSA

Design	Resonant frequency	Return loss	Bandwidth	Directivity	Efficiency	Gain
Single patch	14GHz	-43.09dB	727MHz	6.8dBi	97.051%	6.6dB
Double layer	13.78GHZ	-18.31dB	1.587GHz	6.8dBi	97.05%	6.6dB

REFERENCE

[1] Constantine A. Balanis: “Antenna Theory, Analysis and design” (JohnWiley & Sons)
[2] Hall, P. S. Wood, C and Garrett, C, _“Wide bandwidth Microstrip antennas for circuit integratio”, Electron. Lett. , 15, pp. 458-460, 1979.
[3] Dubost, G., Nicolas, M. and Havot, H. _“Theory an applications of broadband microstrip antenna”, Proceedings of the 6th European Microwave Conference, Rome, pp. 21S—219, 1976.

[4] Wood, C,_ "Curved microstrip lines as compact wideband circularly polarised antenna", IEE J. Microwaves, Opt. & Acoust, 3, pp. 5-13, 1979.
[5] Van De Capelle, A., De Bruyne J., Verstraete, M., Pues, H. and Vandensande J. _"Microstrip spiral antenna", Proceedings of the International IEEE Symposium on Antennas and Propagation, Seattle, pp.383-386, 1979.
[6] Pues H. F. and Van De Capelle A. R. _"Impedance-matching of microstrip resonator antennas", Proceedings of the North American Radio Science Meeting, Quebec, p. 189, 1980.
[7] H. Pues, Ir., J. Bogaers, Ir., R. Pieck, Ir. and A. Van de Capelle, Dr. Ir."Wideband quasi-log-periodic microstrip antenna", IEE PROC, Vol.128, Pt. H, No. 3, , pp. 159-163, June 1981.
[8] V. B. Romodin, V. I. Oznobikhin and V. V. Kopylov, _"Log Periodic Microstrip Array", IEEE - Russia Conference, Mia-Mep9, 1999.
[9] Ravi Kant and D.C.Dhubkarya, _"Design & Analysis of H-Shape Microstrip Patch Antenna", publication in the _Global Journal of Research in Engineering, Vol. 10 Issue 6 (Ver 1.0), pp. 26-29, Nov. 2010.
[10] Sandeep Kumar, Suresh Sahni, Ugra Mohan Kumar, Devendra Singh, "Design of circularly polarized Microstrip square patch antenna for improved bandwidth and directive gain with low loss." International Journal of Electronics and Communication Engineering & Technology (IJECET), Vol 4, Issue 2, pp. 324-331, March-April 2013.
[11] Bilgic, M., and K. Yegin. "Wideband Offset Slot Coupled Patch Antenna Array for X/Ku Band Multimode Radars." (2014): 1-1.
[12] GARG R., BHARTIA P., BAHL I., ITTIPIBOON A., "Microstrip antenna design handbook" ARTECH HOUSE, INC., Boston, London 2001, ISBN 0-89006-513-6

