<u>www.ijser.in</u>

ISSN (Online): 2347-3878, Impact Factor (2014): 3.05

Optimizing Microstrip Patch Antenna Using Array

Anil Kumar Dubey

Ph.D. Research Scholar, Dr. K. N. Modi University, India

Abstract: In this paper wideband E shape Microstrip Patch Antenna operating at frequency of 5.8 GHz is designed and its performance is optimized using array concept. Two antenna array is proposed of E-shape patch 1×2 and 2×2 array – these antennas are designed and its performance is analyzed by return loss, VSWR, current distribution and smith chart. Aim is to enhance bandwidth so that disadvantage of narrow bandwidth of patch antenna can be overcome and patch antenna will be used worldwide for electronic communications applications.

Keywords: Array, Microstrip Patch Antenna, Return loss, Smith Chart, VSWR

1.Introduction

A microstrip antenna consists of conducting patch on a ground plane separated by dielectric substrate. This concept was undeveloped until the revolution in electronic circuit miniaturization and large-scale integration in 1970. G.A Deschamps [1] conceived first microstrip antenna in 1953, in USA. H. Gutton and G. Baissinot [2] in 1955 patented a flat aerial that can be used in the UHF region in France. L. Levin [3] in 1960 studied the radiation from the discontinuities in strip-lines. E.V Byron [4] in the early 1970's conceived the first practical microstrip radiator. The basic rectangular and circular patch antennas were designed by J.Q Howell [5]. Recently, development and analysis of broadband microstrip antennas have become an interesting area in personal communication systems due to the need of high speed data transmission. The bandwidth of microstrip antennas can be increased by increasing the substrate thickness, decreasing the dielectric constant, and many more as investigated by different researchers [8-9]. Here Array concept is used for enhancing the bandwidth on E shape patch antenna.

2. Proposed Antenna Design

Our requirement is to design patch antenna which can operate ISM band frequency 5.8 GHz. This band is available worldwide for all users. Patch antenna at this frequency have very narrow bandwidth, which limits its applications. So Patch antenna is modified into new shape that looks like English alphabet "E" for a better result [6-7]. For optimization of antenna and enhancement of bandwidth array of antenna is designed. Here 1×2 array and 2×2 array using strip-line feeding is proposed. Basic design specification are - RT/DUROID Thickness (h) = 1.580mm, Loss Tangent = 0.001 and Dielectric Constant =2.2

Proposed Antenna design 1: Patch Antenna of alphabet E-shape geometry: Feed Point is calculated by analyzing their return losses at different coordinate on E shape Patch. We found that return loss of -23.3010 dB is found of 140 MHz bandwidth.



Figure 1: E-Shape Patch Antenna

Proposed Antenna design 2: 2×1Array of E shape Patch Antenna: Transmission line feeding is designed by using transmission line equations [8]



Figure 2: 2×1 Array of E-Shape Patch Antenna

Proposed Antenna design 3: 2x2 Array of E shape Patch Antenna: Further transmission line feeding is designed by using transmission line equations with coaxial feeding.

International Journal of Scientific Engineering and Research (IJSER)





Figure 3: 2x2 Array of E-Shape Patch Antenna

3. Result

On designing of patch antennas on electromagnetic simulator IE3D using above parameters return loss smith chart, VSWR and current distribution is obtained. Output is shown below:

3.1 Antenna Design 1

Return Loss:

Frequency: 5.8 GHz Return Loss: -23.3053dB Bandwidth: 140 MHz





Figure 5: Smith Chart of E-Shape Patch Antenna

VSWR: Voltage standing wave ratio ≈ 1







Figure 7: Current Distribution of E-Shape Patch Antenna

International Journal of Scientific Engineering and Research (IJSER) www.ijser.in

ISSN (Online): 2347-3878, Impact Factor (2014): 3.05

3.2 Antenna Design 2

Return Loss:

Frequency: 5.8 GHz Return Loss:-25.8449dB Bandwidth: 186MHz



Figure 8: Return Loss of 2×1 Array of E-Shape Patch Antenna

Smith Chart:



Figure 9: Smith Chart of 2×1E-Shape Patch Antenna

VSWR: Voltage standing wave ratio ≈ 1



Current Distribution:



Figure 11: Current Distribution of 2×1E-Shape Patch Antenna

3.3 Antenna Design 3

Return Loss:

Frequency: 5.8 GHz Return Loss:-36.0901dB Bandwidth: 530 MHz



ISSN (Online): 2347-3878, Impact Factor (2014): 3.05

Smith Chart:



Figure 13: Smith Chart of 2×2 E-Shape Patch Antenna



VSWR: Voltage standing wave ratio = 1

Figure 14: VSWR of 2×2 E-Shape Patch Antenna

Current Distribution:



Figure 15: Current Distribution of 2×2E-Shape Patch Antenna

*****Current Distribution Scale:



4. Conclusion

A compact E shape Microstrip Patch Antenna operating at ISM band frequency 5.8 GHz is designed and its performance is optimized by modifying its geometry by using transmission line and array of E shape antenna. On simulating bandwidth of 530 MHz for 2×2 E shape array antenna is obtained in comparison to 140 MHz of E-shaped patch antenna, which shows bandwidth enhancement of 390 MHz. So proposed antenna design overcomes the disadvantage of narrow bandwidth of patch antenna upto a satisfactory level. Also VSWR of 1 is achieved for 2×2 E-shaped patch antenna. The result is good enough to satisfy our requirements to fabricate it on hardware which can be used wherever needed. The investigated results can be used to design the microstrip patch antenna to be used in the applications such as Wi-Fi, Bluetooth, Amateur Radio, Earth Station, Microwave links & Radar. For future work this design can further optimize by the help of Artificial Neural Network.

Acknowledgment

The author acknowledges Dr P K Singhal Head and Professor Department of Electronics Engineering, Madhav Institute of Technology and Science, Gwalior, India for supporting this research work.

References

- [1] G.A Deschamps, "Microstrip Microwave Antennas", 3rd USAF Symposium on Antennas, 1953.
- [2] H. Gutton and G. Baissinot, "Flat Aerial for Ultra High Frequencies", French Patent No. 703113, 1955.
- [3] L. Levin, "Radiation from Discontinuities in Strip Lines", Proc. IEE, vil.107, pp 163-170, 1960.
- [4] E.V Byron, "A new Flush Mounted Antenna Element for Phased Array Applications", Proc. Phased Array Antenna Symposium, pp.187-192, 1970.
- [5] J.Q Howell, "Microstrip Antennas", IEEE Trans. Antennas Propagation, vol.AP-23, pp.90-93, 1975.
- [6] A. R. Mallahzadeh, S. Es'haghi, and A. Alipour, "Design of an E-shaped MIMO Antenna using IWO algorithm for wireless applications at 5.8 GHz", Progress In Electromagnetic Research, PIER 90, 187-203, 2009
- [7] B.-K. Ang and B.-K. Chung, "A wideband E-shaped microstrip patch antenna for 5–6 GHz wireless communications", Progress In Electromagnetic Research, PIER 75, 397–407, 2007
- [8] C.A. Balanis, Antenna Theory, John Wiley & Sons, Pg. 722-784, Inc., 1997

[9] Kin-Lu Wong, Compact and Broadband Microstrip Antennas, John Wiley & Sons, pg. 22-26, Inc.2002

Author Profile



Anil Kumar Dubey received M. Tech. degree in Electronics & Communication Engineering with specialization in Telecom Technology from RGPV, Bhopal in 2008. He worked as Assistant Professor and teaches wireless communication, Microwave Engineering,

Mobile & Satellite Communication to undergraduate students of Maharishi Dyanand University, Haryana. He is Ph D research scholar of Dr K N Modi University, Rajasthan under the esteemed guidance of Dr P K Singhal Department of Electronics Engineering, MITS, Gwalior. His research field is Microstrip Patch Antenna.