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# A Circularly Polarized Stacked Patch Antenna using Polyflon Substrate for Wireless Applications

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## ABSTRACT
**A probe-fed circularly polarized stacked patch antenna is presented and simulated by using Commercial Ansoft High Frequency Structure Simulator. The design consists of two patches and two substrates. The bottom patch is square-shaped where as the top patch is of triangular-shaped. T-shaped slots parallel to the edges of the patches are inserted so that bandwidth can be improved. Enhancement of the gain is observed by varying the substrate material for the proposed antenna. Return loss, gain, axial ratio and radiation patterns are simulated and analyzed. This antenna is best suitable for wireless communication applications like WiMax, WLAN and Radar applications.**
*Keywords*: **Circular polarization, Stacked patch antennas, WiMax, WLAN.**

## I. INTRODUCTION
In high performance applications such as aircraft, spacecraft, satellite, and mobile applications, where size, weight, cost, performance and ease of installation are required. Usually, microstrip patch antenna meets all those requirements such as simple structure, low cost, low profile, small size and high polarization [1]. Wireless communications have progressed very rapidly in recent years, many mobile units are becoming smaller and smaller. At the same time the applications which require circular polarization also increased day by day. Microstrip patch antennas suffer with a drawback of narrow bandwidth which can be overcome by using thick substrates, cutting slots. Several dual frequency and wide band antennas have been reported using stacked structures [1-4].

The majority of current and future commercial and military applications typically use a circularly polarized antenna. A single-feed circularly polarized microstrip antenna allows a reduction in the complexity, weight, and has the additional advantage of small size and produce a completely planar antenna [7-8]. Single-feed circularly polarized microstrip antennas are currently receiving much attention.

The designs of conventional single-feed circular polarized microstrip antenna are available either of a square or circular patch on single planar. In this paper, multi-band circularly polarized stacked patch antenna is presented. The multi-band is achieved by the slotted patches, which represents the square and triangle. The whole system is fed by a coaxial probe into the substrate, with an input impedance of 50 Ω.

## II. ANTENNA DESIGN
Figure 1 shows the geometry of the proposed antenna. The bottom patch is of square-shaped and its dimensions are 44 × 44 $mm^2$. The slots in the bottom patch are of 0.5 mm width and 32 mm length. The top patch is of triangular-shaped, with a base of 41.4 mm and a height of 41.4 mm. the slots in the top patch are of 0.5 mm width and 28 mm length. The location of the feed is (8, 8). Coaxial probe is used for good excitation of antenna over entire range.

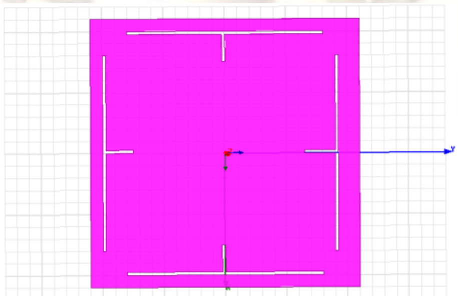
Fig 1 (a): Geometry of the Bottom patch

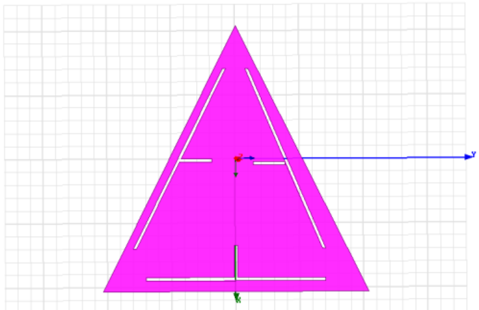
Fig 1 (b): Geometry of the Top patch

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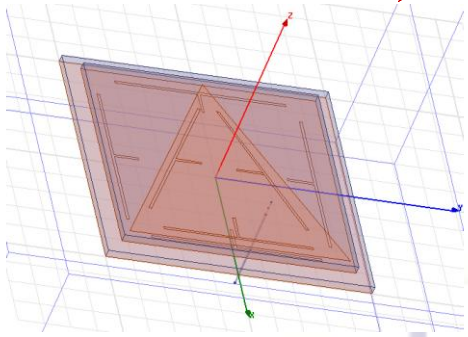


Fig 1(c): Proposed antenna model

The proposed antenna uses Polyflon Norclad substrate which has a dielectric constant $\varepsilon_r$ = 2.55 and a height of 1.5 mm. Circular polarization can be achieved using a single probe feed along the direction $45^0$ to the centerlines of the patch. With this antenna, broad bandwidth and relative gain improvement has been achieved. If both the patches are of square-shaped, it has more bandwidth but with low gain where as if both the patches are of triangular-shaped, the size become compact but it resonates at relatively less number of frequencies with poor gain.

## III. RESULTS

From Figure 2, the return losses of the proposed antenna which uses FR4 substrate at 1.40 GHz, 2.17 GHz, 2.35 GHz, 3.80 GHz, 7.10 GHz, 7.73 GHZ and 8.77 GHz are -10.87 dB, -13.99 dB, -15.68 dB, -12.13 dB, -31.55 dB, -13.93 dB and -17.82 dB respectively. When the proposed antenna uses Polyflon Norclad substrate, the return losses at 4.48 GHz, 7.64 GHz are -11.80 dB and -11.88 dB.

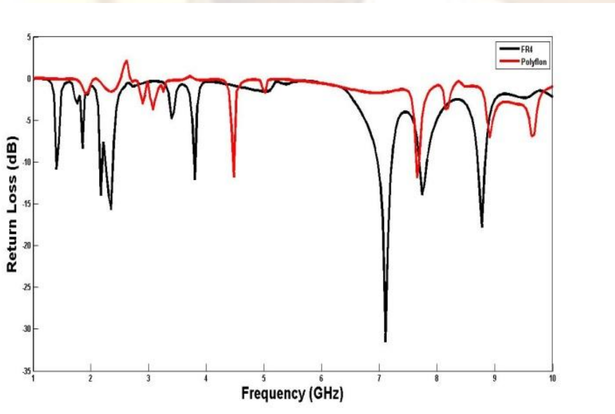


Fig 2: Return losses

At all operating frequencies, the value of VSWR is less than 2. Practically, the antennas which have relative high gain are considered. For the current design, when Polyflon Norclad substrate is used, high gain is achieved when compared to the antenna which uses FR4 substrate. Figure 3 and Figure 4 shows the gain of the antenna in 2D and 3D patterns. The gain of the proposed antenna is 6.1872 dB.

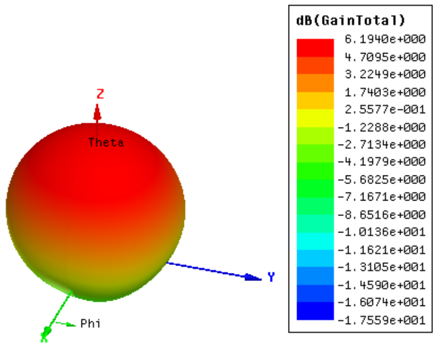


Fig 3: 3D- Gain Total

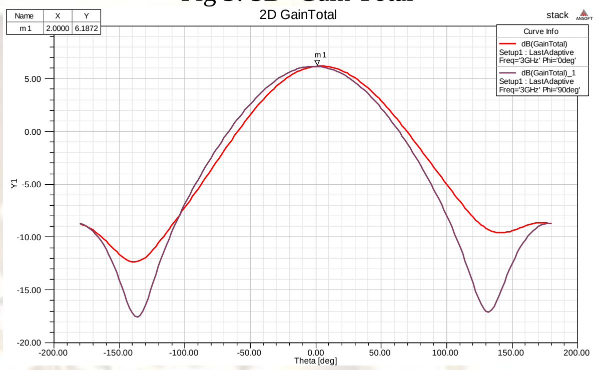


Fig 4: 2D- Gain Total

The radiation patterns are as shown in the Figures 5. The radiation pattern describes the relative strength of the radiated field in various directions from the antenna, at a constant distance. The proposed antenna exhibits directional pattern.

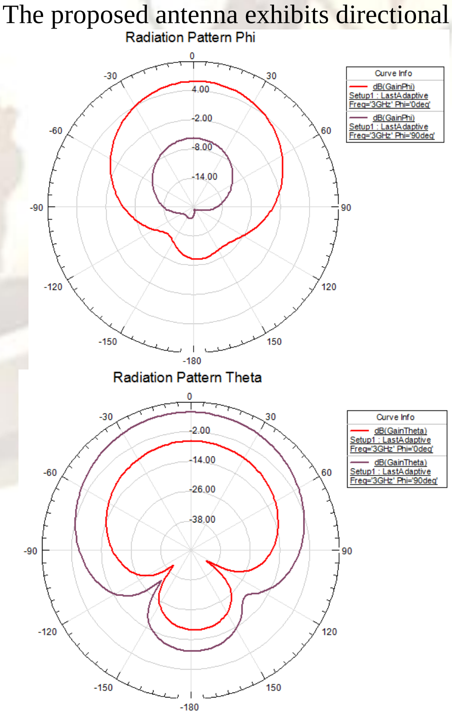


Fig 5: Radiation Pattern E-plane and H-Plane

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A circularly polarized wave has equal amplitude components in two orthogonal directions, therefore the received power is constant for a rotated linearly polarized antenna. The received power is the same whether the antenna is left hand (LHCP) or right hand (RHCP). The LHCP/RHCP radiation is generated by simultaneously exciting two orthogonal modes with equal magnitude and a ±90$^0$ phase difference.

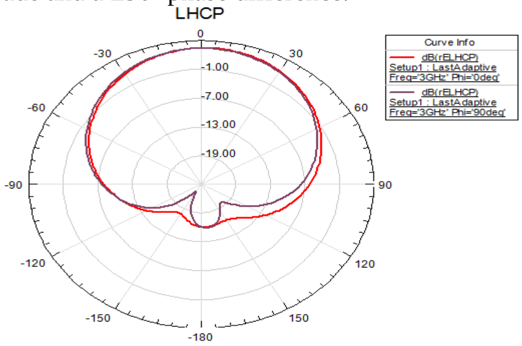


Fig 6: Left-handed Circular Polarization

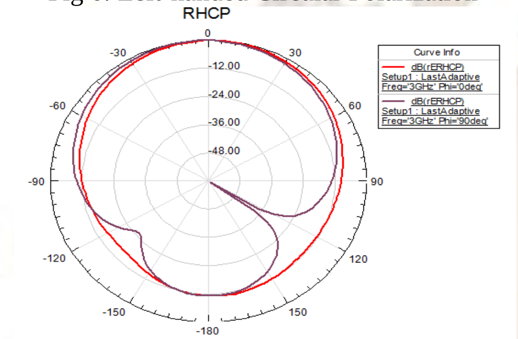


Fig 7: Right-handed Circular Polarization

Axial ratio is the ratio of orthogonal components of an E-field. A circularly polarized field is made up of two orthogonal E-field components of equal amplitude (and 90$^0$ out of phase). Because the components are equal magnitude, the axial ratio is 1 (or 0 dB). Axial ratios are often quoted for antennas in which the desired polarization is circular. The ideal value of the axial ratio for CP fields is 0 dB. In addition, the axial ratio tends to degrade away from the main beam of an antenna. From Figure 8, the axial ratio is finite and very low.

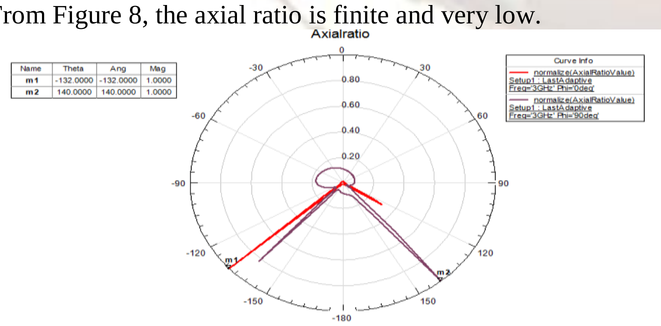


Fig 8: Axial Ratio

## IV. CONCLUSION

A single-feed multi-band CP stacked microstrip antenna is proposed. From the simulated results, it is proved that high gain is achieved when Polyflon Norclad ($\varepsilon_r$ = 2.55) is used rather than using FR4 ($\varepsilon_r$ = 4.4) substrate. The CP radiations are achieved by inserting two pairs of T-shaped narrow slots parallel to the edges of the patches. Also this is only achievable when both the patches are of different shapes rather than being same. Good CP performances are achieved in all bands.

## V. ACKNOWLEDGMENT

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## VI. REFERENCES

[1] F. Zhao, T. T. Liu and Z. P. Qian, "A Circularly polarized aperture stacked patch microstrip antenna for L band", *Progress In Electromagnetics Research C*, vol. 20, 95-109, 2011.

[2] Richard H. Chen and Yi- Cheng Lin, "Miniaturized Design of Microstrip-Fed Slot Antennas Loaded with C-Shaped Rings", *IEEE Antennas and Wireless Propagation Letters*, vol. 10, 2011.

[3] Wen Liao, Qing-Xin Chu and Shu Du, "Tri-band Circularly Polarized Stacked Microstrip Antenna for GPS and CNSS Applications", *IEEE* 2010.

[4] H. F. AbuTarboush, H. S. Al-Raweshidy and R. Nilavalan, "Bandwidth Enhancement for Microstrip Patch Antenna Using Stacked Patch and Slot", *IEEE* 2009.

[5] Mohammod Ali, Abu T. M. Sayem and Vijay K. Kunda, "A Reconfigurable Stacked Microstrip Patch Antenna for Satellite and Terrestrial Links", *IEEE*, vol. 56, No. 2, March 2007.

[6] J. A. Ansari, P. Singh and S. K. Dubey, R. U. Khan and B. R. Vishvakarma, "H-Shaped Stacked patch antenna for Dual band operation", *Progress In Electromagnetics Research B*, vol. 5, 291-302, 2008.

[7] D. K. Srivastava, J. P. Saini and D. S. Chauhan, "Broadband Stacked H-Shaped Patch Antenna", *International Journal of Recent Trends in Engineering*, vol.2, No. 5, November 2009.

[8] Y. C. Lee and J. S. Sun, "Compact Printed slot antennas for wireless dual- and multi-band operations", *Progress In Electromagnetics Research*, PIER 88, 289-305, 2008.

[9] Kwok L. Chung, "Effect of perturbation on the parasitic patch of singly-fed circularly polarized stacked patch antennas", *Proceedings of ISAP* 2005.

[10] Cuthbert M. Allen, Atef Z. Elsherbeni and Charles E. Smith, Chun-Wen P. Huang and Kai-Fong Lee, "Tapered Meander slot antenna for Dual band personal wireless communication systems", *Microwave and Optical Technology Letters*, vol. 36, No. 5, March 2003.