ISSN PRINT 2319 1775 Online 2320 7876

*Research paper*  UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021

# Assessment of Single Rejection Band Square Serrated Patch Antenna for Ultra-Wideband Applications

**P Saleem Akram, B T P Madhav, G. Jeevana Sravya, V. Sudhakar,**
**G. Lakshmi Sirisha, Ch. Mounika, M. Venkateswara Rao ,** Koneru Lakshmaiah Education Foundation (KLEF), Vaddeswaram 522302, Andhra Pradesh, India

## Abstract

This article delves into the design and analysis of a serrated patch antenna featuring a ground slot and microstrip line feed. The study involves a comparative analysis conducted on antennas with five and ten serrated patches positioned at both the top and side edges of the square patch. The entire design process for these iterations is executed using the commercially available HFSS 13 software. To enhance the bandwidth of these antennas, a ground slot has been incorporated into all iterations as a common feature. Subsequently, the return loss and gain characteristics are thoroughly examined and compared across all model variations. Ultimately, the proposed antenna configuration comprises ten serrations positioned along three edges of the square patch. This specific design operates in the ultra-wideband region and exhibits notably high gain compared to the other models. The applications for this antenna encompass WiMAX, WLAN 802.11, LTE 42/43 bands, and it operates within the ultra-wideband frequency range of 3.1GHz to 10.6GHz, with a notable rejection at 5-6GHz.

## Introduction

In today's era of rapid wireless technological advancements, the demand for compact antennas with wide bandwidth capabilities is ever-increasing. Among the multitude of options, microstrip patch antennas stand out due to their simple structure, consistent gain, low-profile design, and cost-effectiveness [1]. These antennas also offer the advantage of accommodating multiple frequency bands, making them suitable for dual or even triple frequency applications. This versatility extends to airborne and spacecraft systems, where a dielectric cover over the radiating element is essential for protection against heat, environmental factors, and physical damage [2]. Typically featuring a radiating patch on one side and a ground plane on the other, microstrip antennas are fed via microstrip lines. The choice of dielectric material with appropriate thickness and lower dielectric constant significantly influences antenna performance [3]. Despite their small size, microstrip patch antennas can achieve wideband characteristics through judicious parameter selection. Enhancements in frequency bandwidth and radiation properties are often achieved through the integration of monopole antennas [4]. Introducing a simple slot beneath the fed line on the ground plane serves as the foundation for maximizing bandwidth utilization and improving impedance matching for operation within the UWB range.

ISSN PRINT 2319 1775 Online 2320 7876

*Research paper*  UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021

## 2.1. 5 Serrations

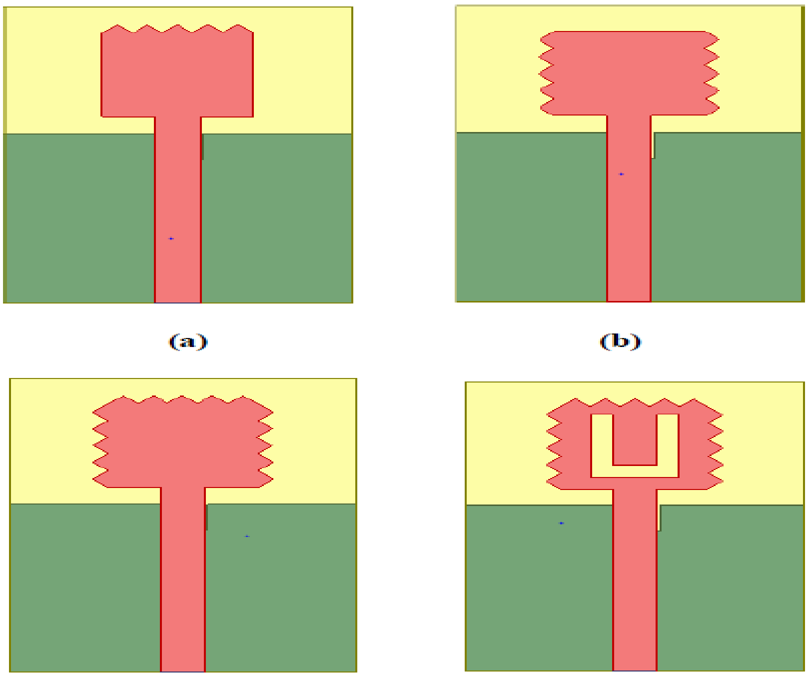


**Fig 1:** a) Top edge of square patch with 5 serrations. b) Opposite edges of square patch with 5 serrations. c) Three edges of square patch with 5 serrations d) Three edges of square patch with U-shape and 5 serrations on each edge.

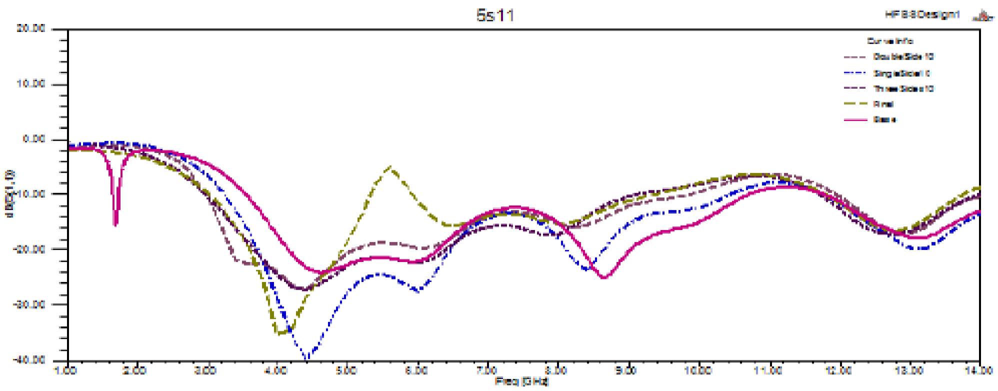



**Fig 2:** Return loss of 5 Serrated Patch Antenna

ISSN PRINT 2319 1775 Online 2320 7876

*Research paper*  UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021

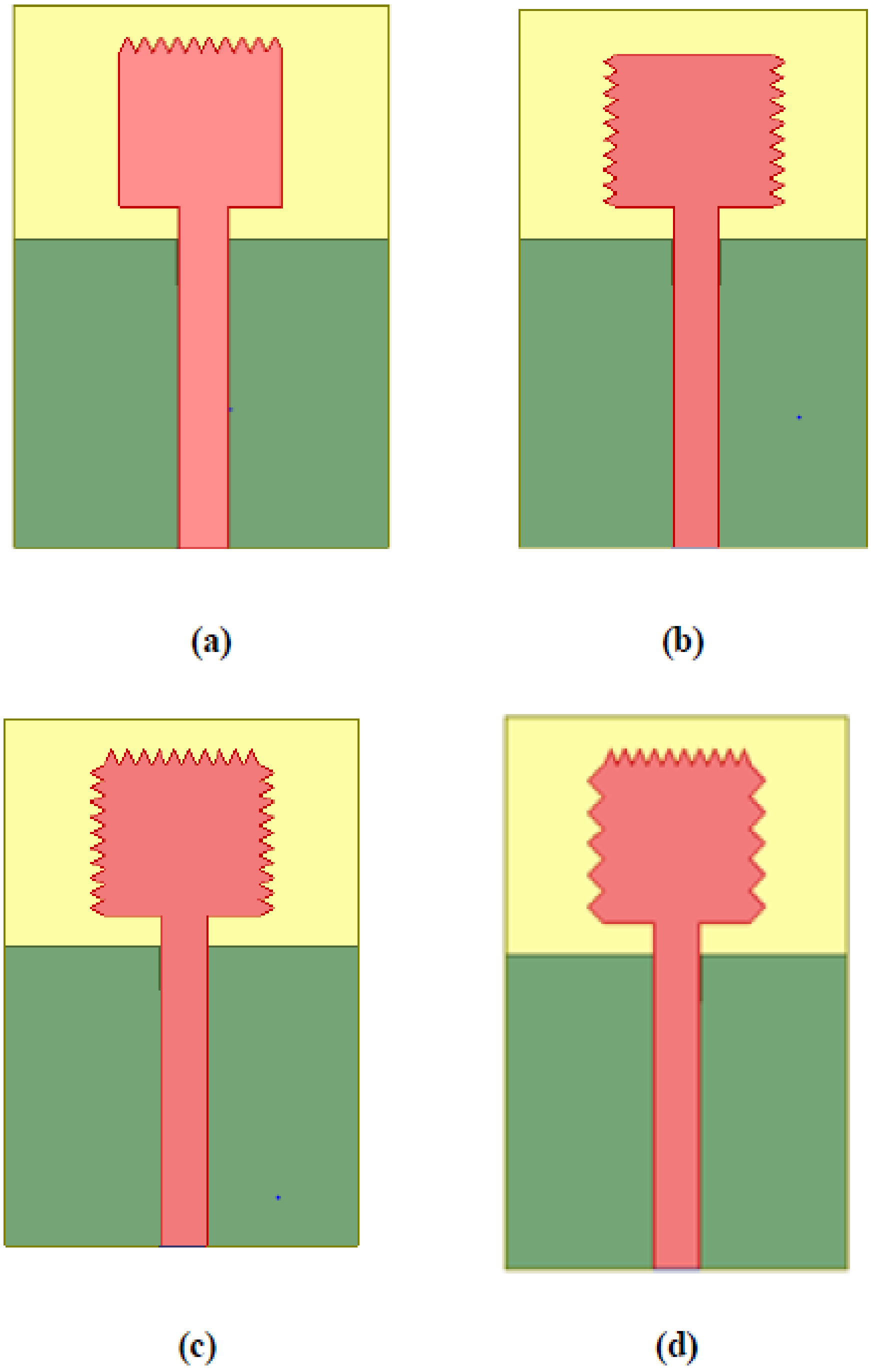



**Fig 4:** a) Top edge of square patch with 10 serrations. b) Opposite edges of square patch with 10 serrations on each edge.c) Three edges of square patch with 10 serrations on each edged) Opposite edges of square patch with 5 serrations on each edge and remaining edge with 10 serrations

ISSN PRINT 2319 1775 Online 2320 7876

*Research paper* © 2012 IJFANS. All Rights Reserved, UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021

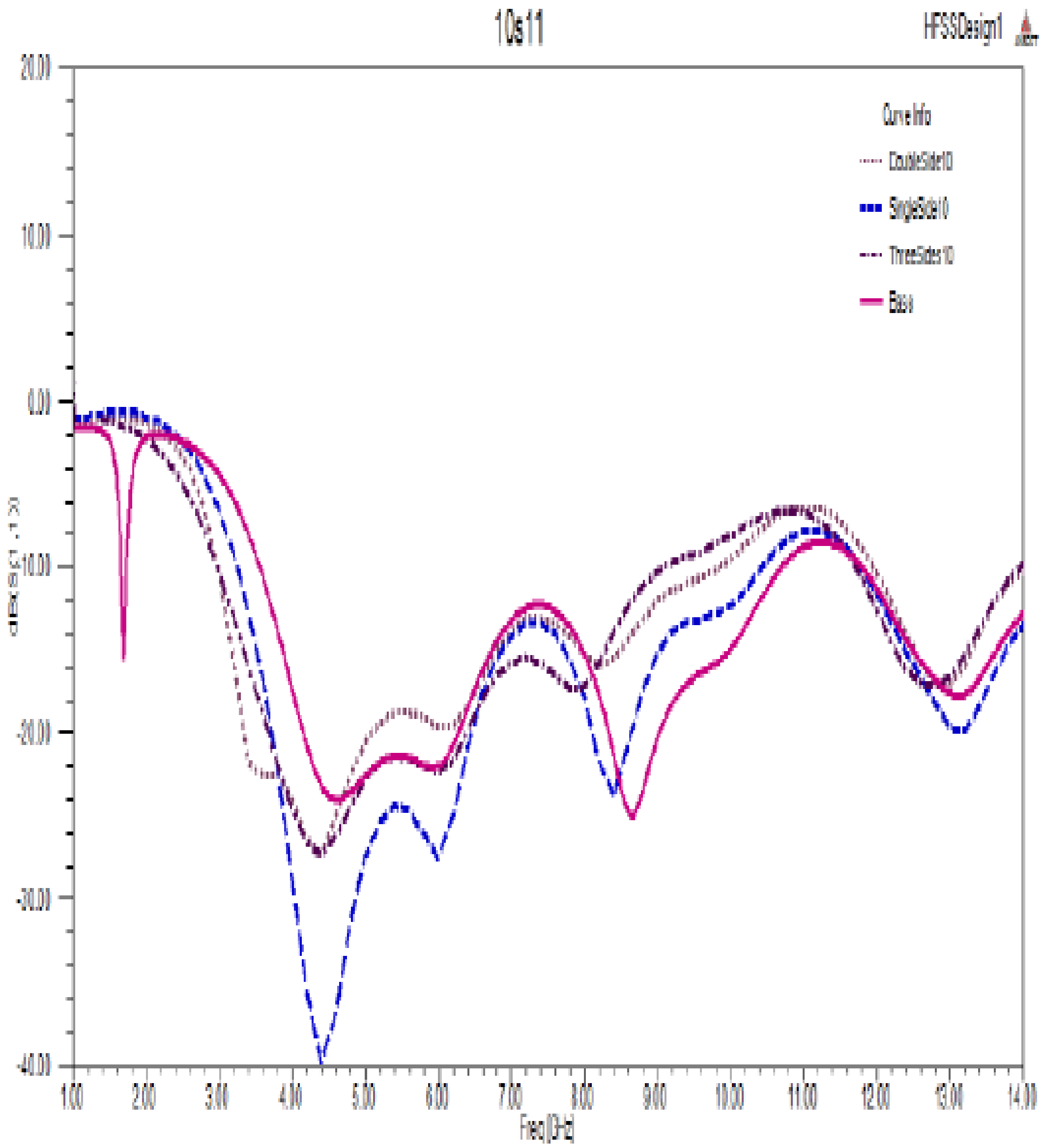



Fig 5: Return loss of 10 Serrated Patch Antenna

ISSN PRINT 2319 1775 Online 2320 7876

*Research paper*  UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021

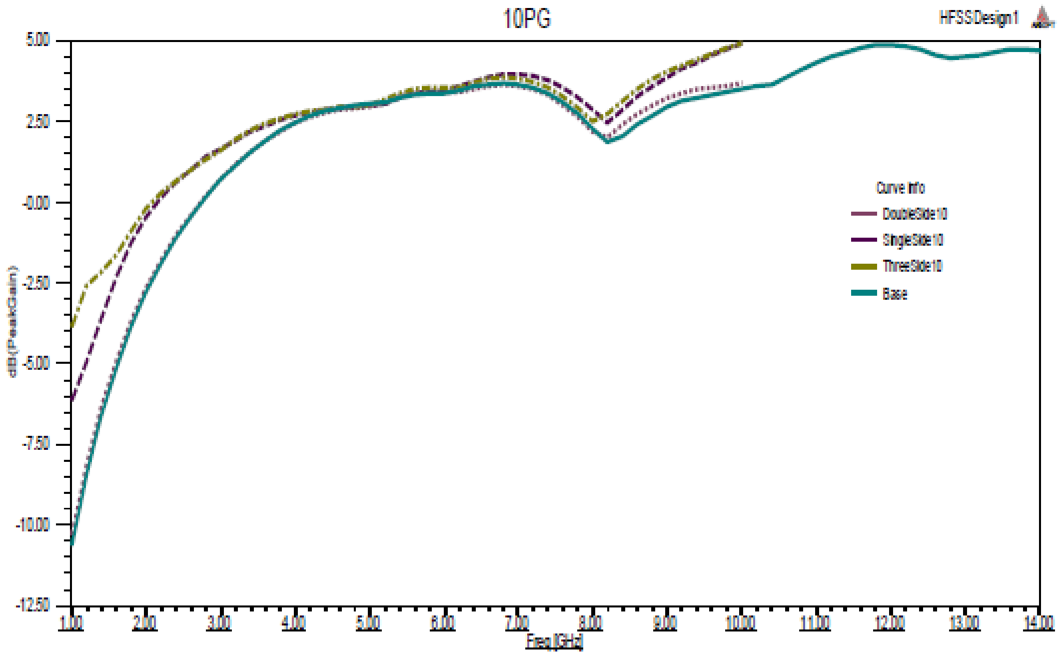
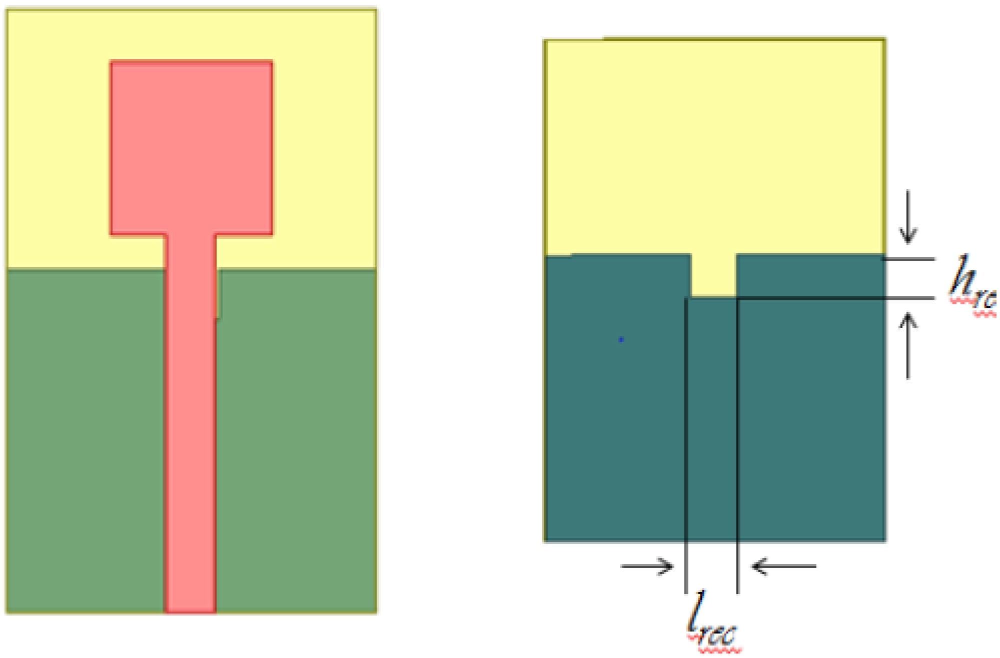



**Fig 6:** Peak gain of 10 Serrated Patch Antenna.

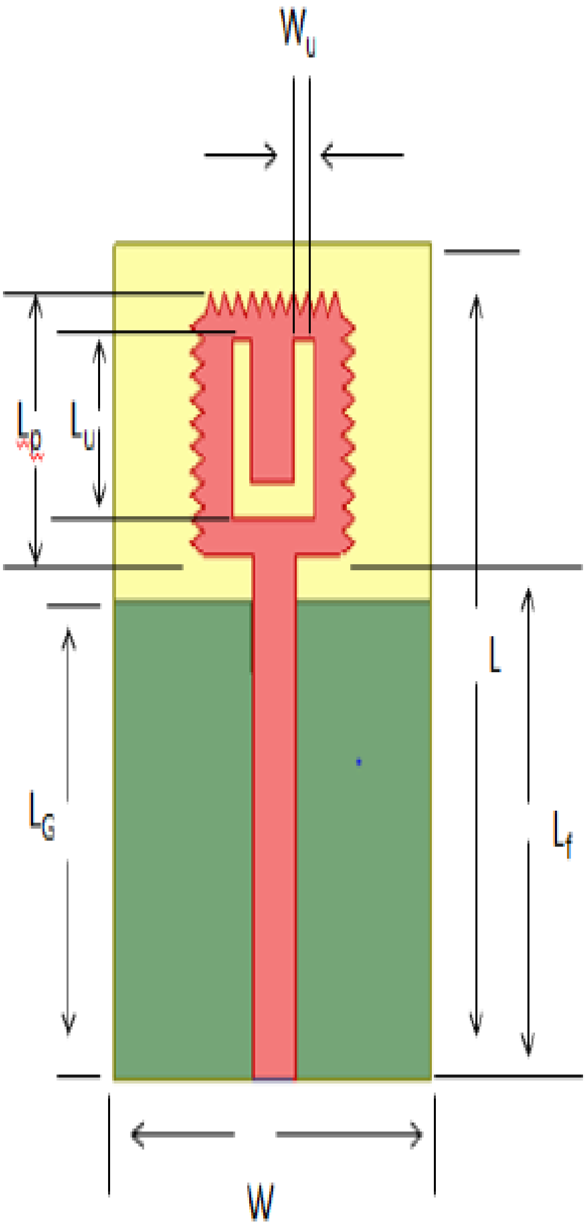
## 2.3. Base antenna and Proposed antenna




(a) (b)

ISSN PRINT 2319 1775 Online 2320 7876

*Research paper* © 2012 IJFANS. All Rights Reserved, UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021




(c)

**Fig 7:** a) Base antenna with a ground slot's) Back view of proposed antenna's) Front view of proposed antenna.

ISSN PRINT 2319 1775 Online 2320 7876

*Research paper* © 2012 IJFANS. All Rights Reserved, UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021

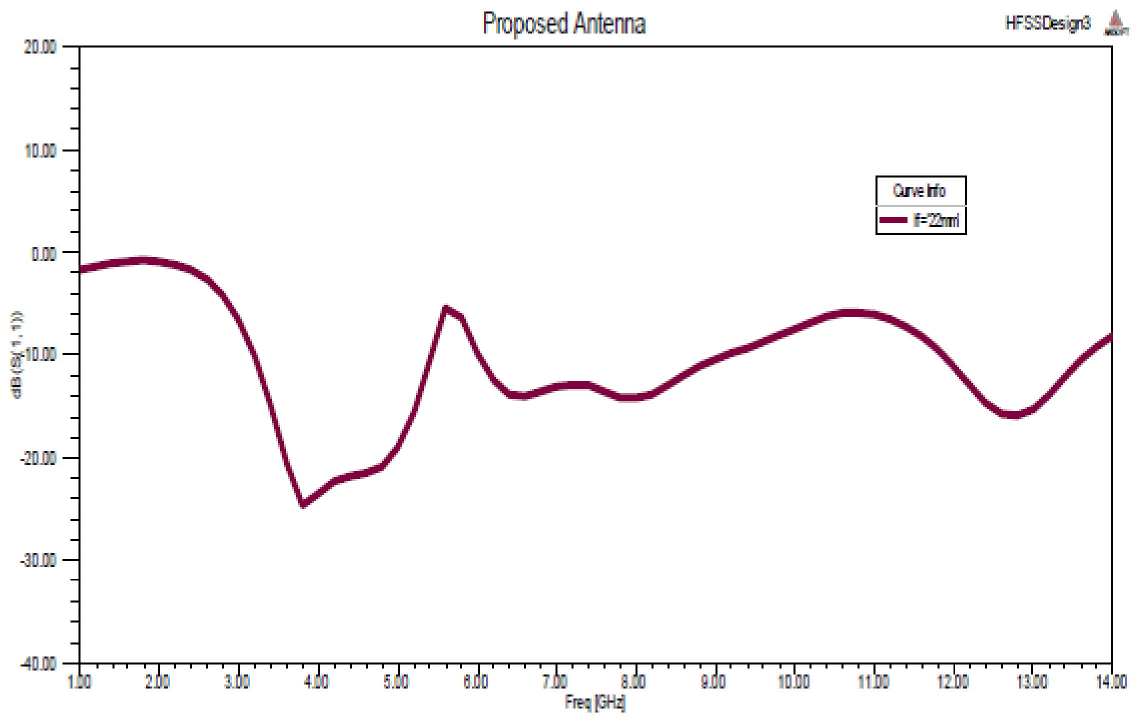



**Fig 8:** Proposed antenna return loss

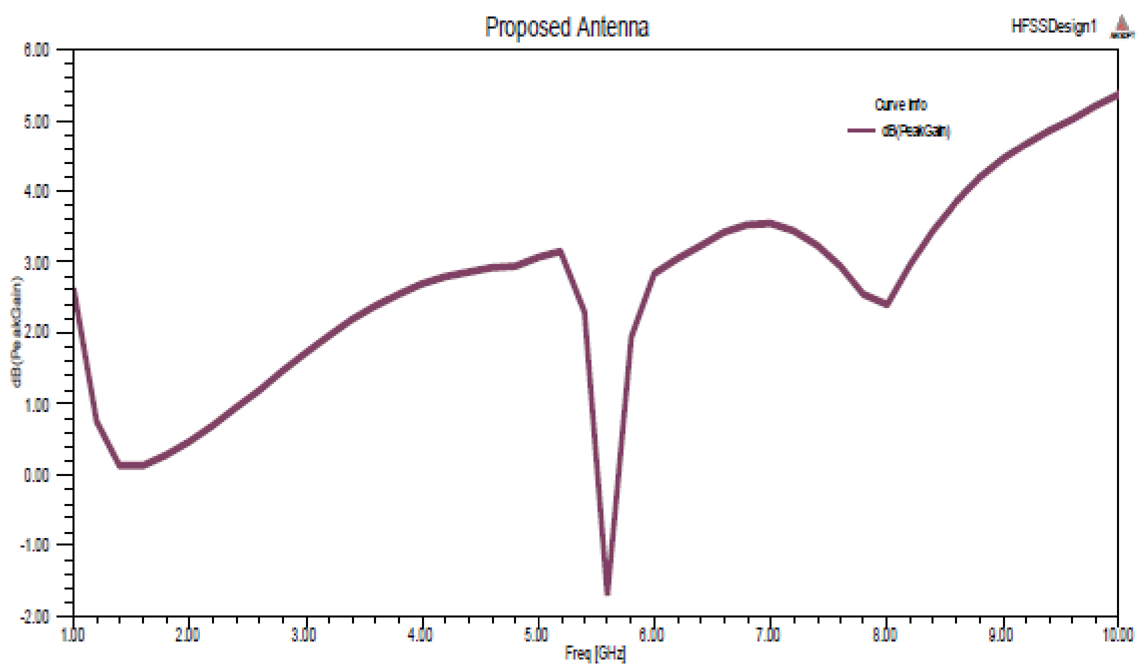
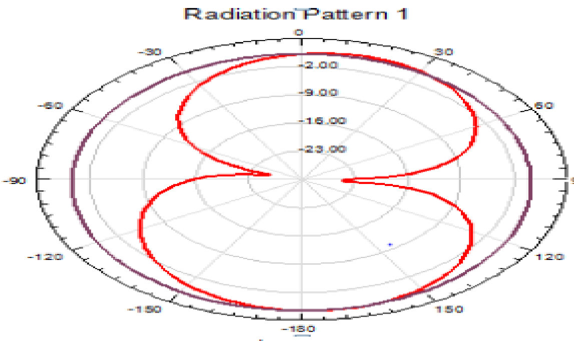


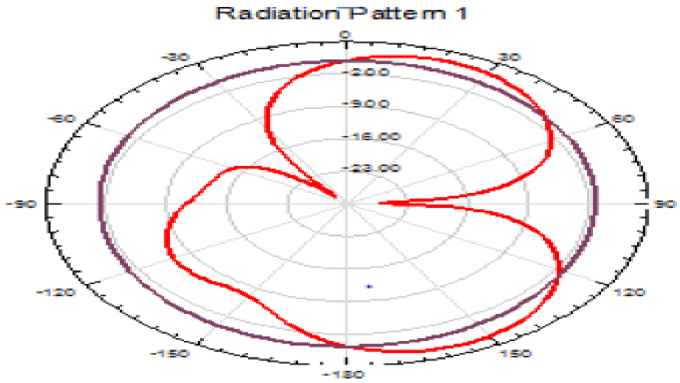

**Fig 9:** Proposed antenna peak gain vs frequency

ISSN PRINT 2319 1775 Online 2320 7876

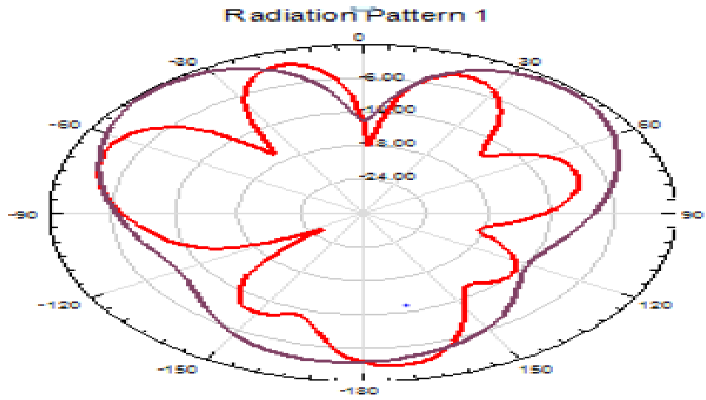
*Research paper*  **UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021**



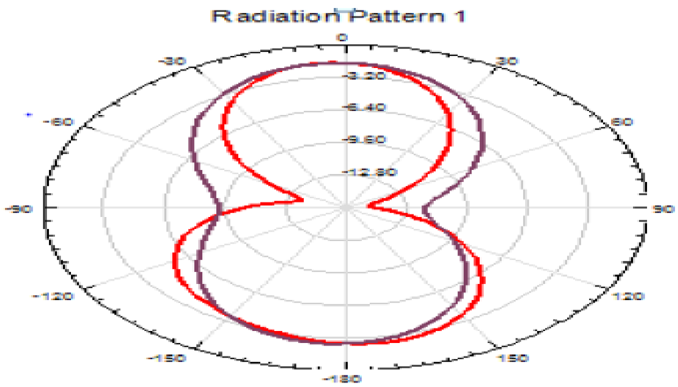

a) At 4.2




b) At 6.4




c) At 12.8




d) At 5.6

**Fig 10:** Proposed antenna peak gain vs frequency

ISSN PRINT 2319 1775 Online 2320 7876

*Research paper*  **UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021**

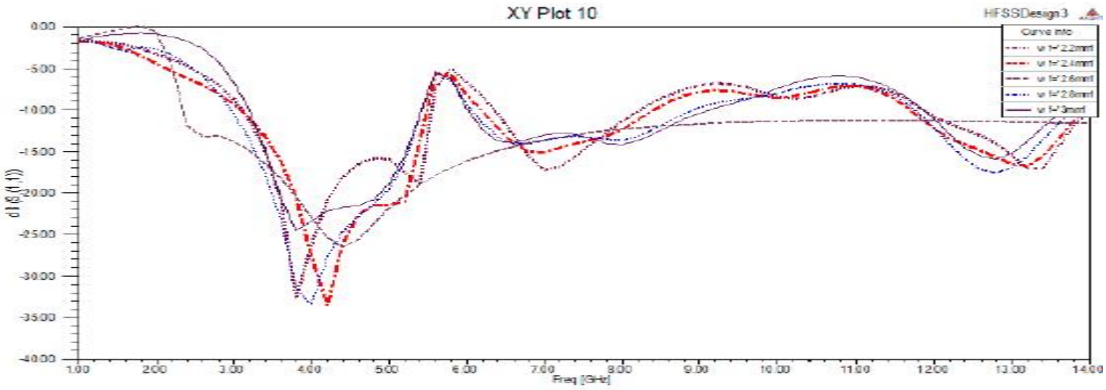



**Fig 11:** Proposed antenna peak gain vs frequency

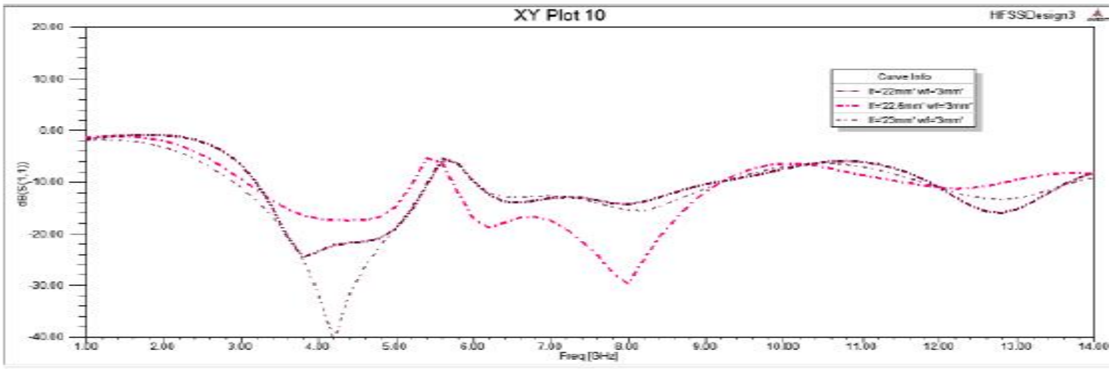



**Fig 12:** Parametric analysis by changing width of the feed

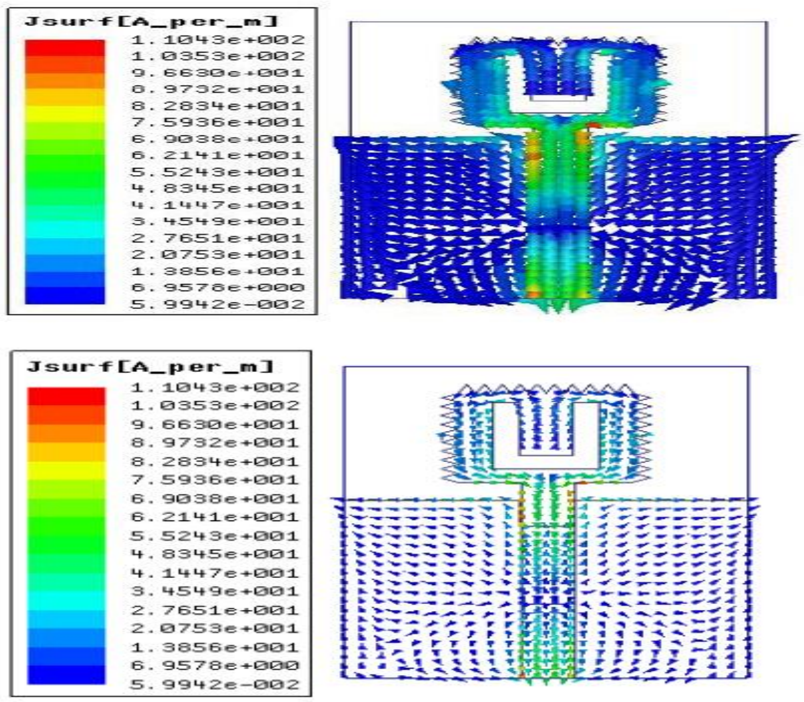



**Fig 13:** current distributions at 4.3GHz and 12.8GHz

ISSN PRINT 2319 1775 Online 2320 7876

*Research paper*  UGC CARE Listed ( Group -I) Journal Volume 10, Spl Iss 1, 2021

## Conclusion

The entire study is conducted using HFSS software, with a noteworthy outcome being the remarkable gain achieved by the proposed antenna, surpassing comparable models with an impressive 5 dB gain. This exceptional performance sets it apart as a standout performer in the realm of antenna configurations.

Operating within the ultra-wideband region, this antenna proves itself as an excellent choice for a wide range of applications that require versatile and high-performance wireless communication solutions. By incorporating serrations along the patch edges and introducing a U-shaped slot, this research significantly contributes to expanding the possibilities of UWB antenna design. The integration of these distinctive elements into the antenna's design enhances its band-notching capabilities, a critical feature for managing interference and optimizing communication efficiency.

## References

[1] Liu, L., Cheung, S. W., & Yuk, T. I. (2011). Bandwidth improvements using ground slots for compact UWB microstrip-fed antennas. In *Progress in Electromagnetics Research Symposium*. Electromagnetics Academy. The Journal's web site is located at http://www. piers. org/piers proceedings/.

[2] Babu, M. R., Sarat, K. K., & Madhav, B. T. P. (2016). Compact serrated notch band MIMO antenna for UWB applications. *ARPN Journal of Engineering and Applied Sciences*, *11*, 4358-4369.

[3] Azim, R., Islam, M. T., Misran, N., Cheung, S. W., & Yamada, Y. (2011). Planar UWB antenna with multi-slotted ground plane. *Microwave and Optical Technology Letters*, *53*(5), 966-968.

[4] Bhavani, K. V. L., Khan, H., Rao, D. S., Madhav, B. T. P., Reddy, V. R., Monika, M., & Chand, Y. D. (2016). DUAL BAND NOTCHED PLANAR PRINTED ANTENNA WITH SERRATED DEFECTED GROUND STRUCTURE. *Journal of Theoretical & Applied Information Technology*, *88*(1).