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Corner Truncated Microstrip Fed Wide Band Patch Antenna

Suneel Kumar
Department of Electronics & Communication Engineering
Sri Satya Sai Institute of Science & Technology-
Sehore, India

Prof. Mukesh Tiwari, Prof. Jai Karan Singh
Department of Electronics & Communication Engineering
Sri Satya Sai Institute of Science & Technology-
Sehore, India

***Abstract*- Microstrip feed rectangular patch antenna was designed with partial ground plane. Partial ground plane acted as impedance matching element that reduced the quality factor of antenna and inductive nature of antenna. Partial ground also improved the impedance bandwidth of the antenna further impedance bandwidth of antenna was enhanced by two and four corner truncation method. Parametric study was also carried out. The antenna was designed on FR substrate with permittivity of 4.3. The antenna was simulated using CST.**

Keywords—Rectangular Microstrip Patch Antenna (RMPA); Truncated corner.

I. INTRODUCTION

Microstrip patch antenna offers several advantages like low profile, low cost, planar structure and easy integration with printed circuit board. These features make the microstrip antenna very attractive for use in high-speed vehicles, such as missiles, rockets and satellites. But it has some draw back like low gain, low impedance bandwidth and less power handling capability [1-2]. The geometry of a microstrip antenna contains conducting patch on the top of a substrate, which is backed by a ground plane. The shape of patch can be arbitrary. But in practice, regular shapes like rectangular, circular and the annular ring are used for easier analysis. In Ref. [3-7], a slot changes the resonance frequency of modes and also alters the current distribution of the patch. Wide band star shape patch antenna with posts in side of the patch provides the impedance band width of 81% [8]. In this paper wide band antenna is designed in three stages. In first stage reference antenna is designed with partial ground. Further in second stage two corner of patch are truncated and at last stage all the corner are truncated.

II. ANTENNA CONFIGURATION

The geometry of reference (rectangular patch microstrip feed) antenna is shown in Fig. 1. This geometry is designed is designed on FR4 substrate with permittivity of 4.3, loss tangent=0.02 and thickness 1.6mm. The rectangular radiating element has a length of L and a width of W that is excited by 50Ω microstrip line has a width MW=3mm and a length ML=16mm. In this design, the dimensions of rectangular patch are chosen to be L =29.5 mm, W = 38mm for resonant frequency 2.4 GHz. the dimension of partial ground plane are GL=14mm and GW=47.6mm and physical dimension of the substrate are Lsub=50.25mm and Wsub=47.6mm.

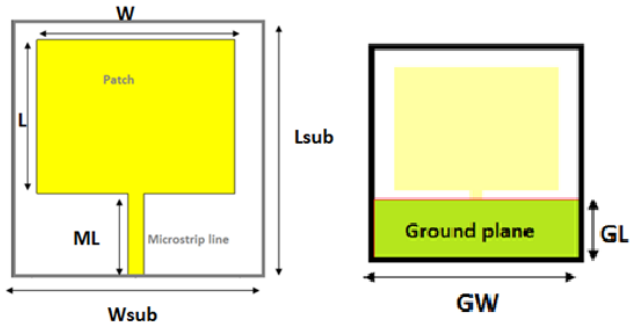

Fig.1.Geometry of reference antenna

III. RESULT ANALYSIS

(A). Reference antenna

Figure 2 shows the return loss characteristic of the reference antenna. Benefit of the partial ground is it reduces the inductive effect of antenna also reduces the quality factor. By figure 2, antenna is resonating at one frequency 2.5GHz. Near 2.5GHz impedance bandwidth is wider as compare to conventional antenna i.e. partial ground improves the impedance bandwidth of the antenna.

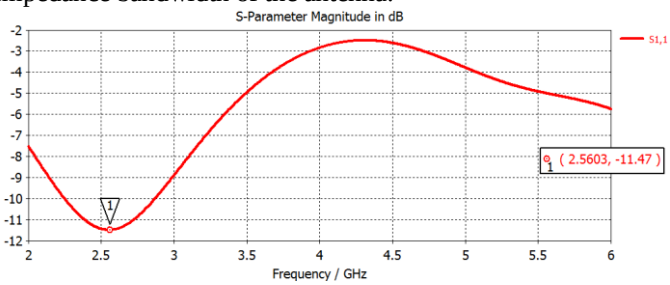

Fig.2. Return loss for reference antenna.

(B). Antenna with two truncated corner

The geometry of two corner truncated antenna is shown in figure 3. Two new parameter a and b are chosen 11.4mm and 9.1mm respectively. Other dimensions of the antenna are same as reference antenna. It is found truncation from the corner increases the impedance bandwidth of the antenna. Figure 4

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shoes the return loss curve antenna. The impedance bandwidth of the antenna is 54.19%. Parameter a and b affect the impedance bandwidth of the antenna. Figure 5 shows the return loss variation if we vary parameter (a) with constant parameter (b). By graph it can be observed by reducing parameter (a) the bandwidth of antenna is reduced. Maximum bandwidth is obtained when a=11.4mm and b= 9.1. Figure 6 shows the variation of return loss if we vary the parameter b and keep the parameter a constant. Maximum bandwidth is achieved when a=11.4mm and b=5.1mm

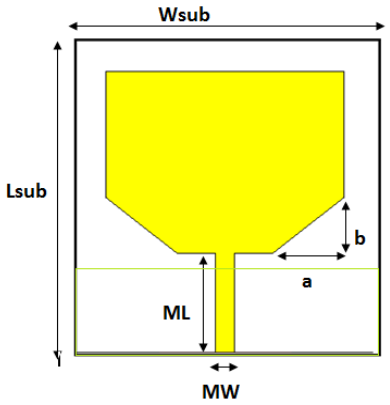

Fig.3.Geometry of two corner truncated antenna.

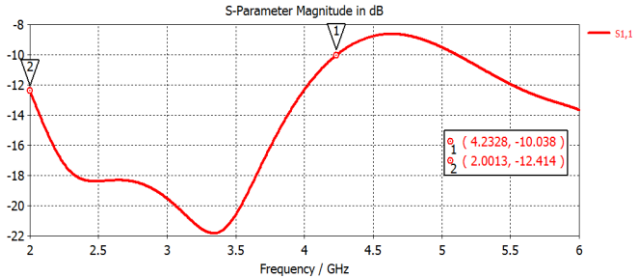

Fig.4. Return loss for two corner truncated antenna.

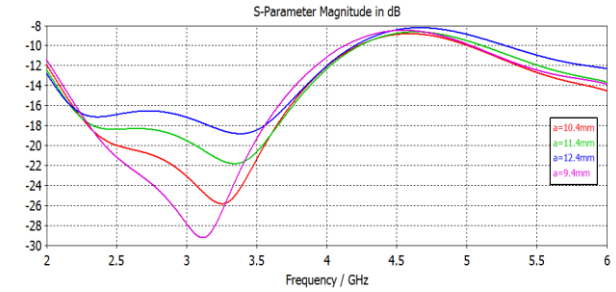

Fig 5. Effect of parameter (a) on return loss

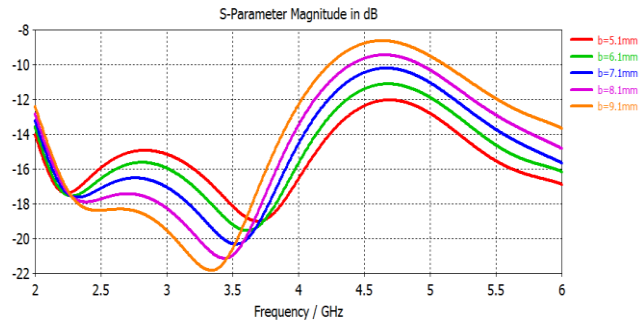

Fig 6. Effect of parameter (b) on return loss

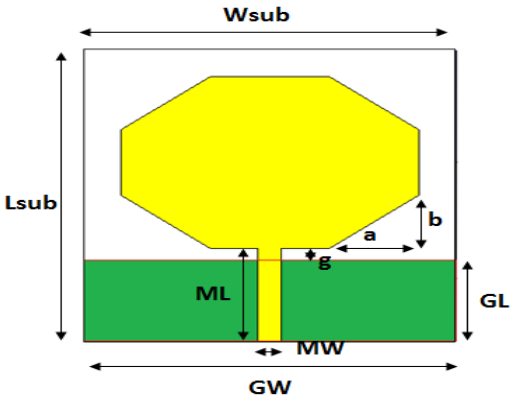

Fig.7.Geometry of four corner truncated antenna.

The geometry of four corner truncated antenna is shown in figure 7. The physical dimension of the antenna is same as reference antenna except two parameter a and b. for given proposed antenna value of a= 10.4mm and value of b=12.1mm. Theses dimensions are optimized. Figure 8 shows the return loss variation of proposed antenna that covers the band of frequency from 2.09 GHz to 7.9623 GHz. The calculated impedance bandwidth of proposed antenna is 116.31%. Figure 9 shows the VSWR curve for proposed antenna and it is clear from the figure 9 VSWR is below 2 from 2.09 GHz to 7.96GHz. Figure 10 shows the impedance variation of the proposed antenna. Real part of the impedance is fluctuating between 30 ohm to 75ohm in the frequency band of 2.095 GHz to 7.96 GHz.

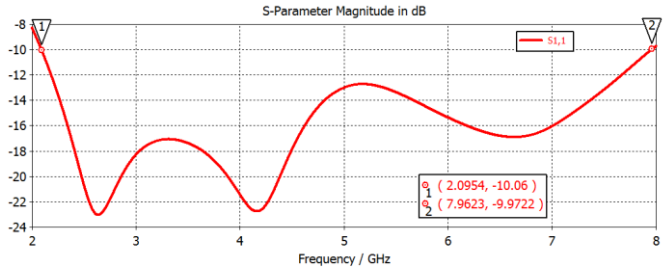

Fig.8. Return loss for four corner truncated antenna.

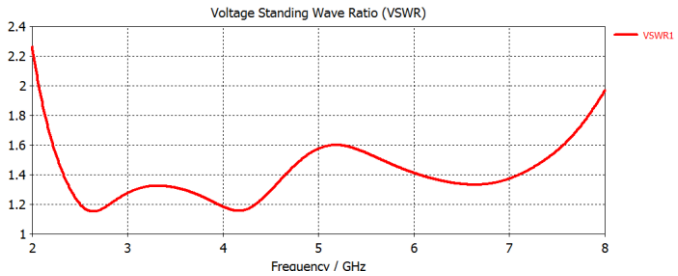

Fig.9. VSWR for four corner truncated antenna.

The simulated current distributions of proposed antenna at different frequencies are depicted in Figure 11. It can be observed from the current distribution pattern that majority of the electric currents is concentrated around the edge of the radiating patch and the ground plane while the currents at the

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centre of the patch and ground plane are very weak. It is also seen that the current is coupled from the top and bottom edge of the ground plane to the patch through microstrip feed line and radiates to the free space.

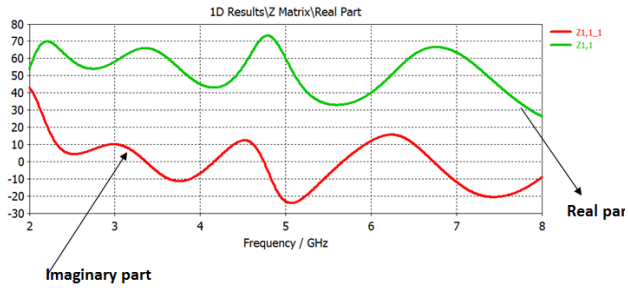

Fig.10. Impedance variation for four corner truncated antenna.

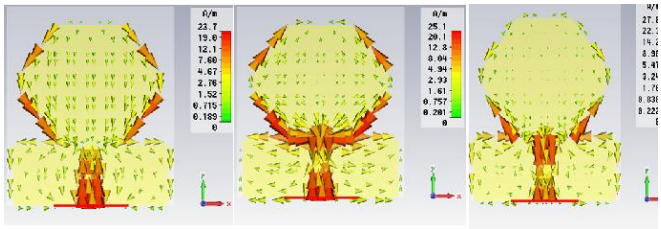

Fig.11. Current distribution at 2.62GHz, 4.1GHz and 6.69 GHz

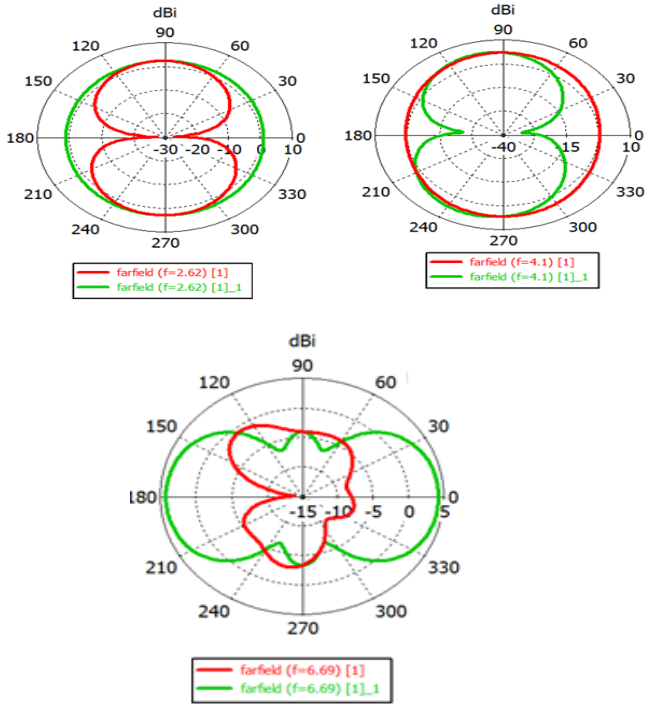

Fig.12. Radiation pattern at 2.62GHz, 4.1GHz and 6.69 GHz

Figure shows effect of parameter (a) on return loss. It is clear from the figure 13 bandwidth is depends upon the parameter (a). Maximum bandwidth is found when a=10.4mm and b=9.1mm. It is found that antenna parameters affect the impedance bandwidth.

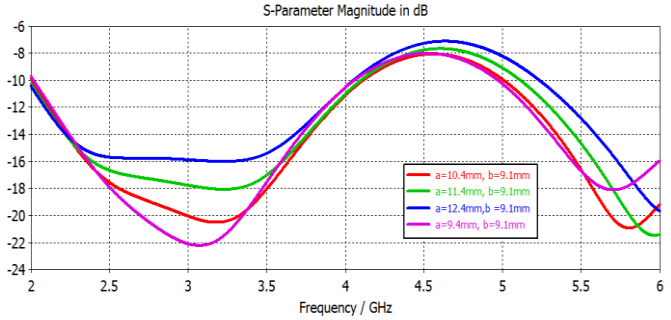

Fig 13 Effect of parameter (a) on return loss for four corner truncated antenna

It is clear from the figure 14 the parameter (b) affect the impedance bandwidth of the antenna. This is one of the main parameter that controls the impedance matching between patch and microstrip line. From figure 14 as the value of parameter (b) increases the impedance bandwidth of the antenna also increases. Maximum bandwidth is observed for b=12.1mm and a=11.4mm.

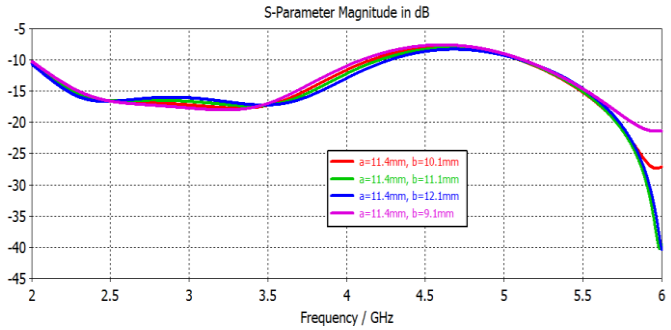

Fig 14 Effect of parameter (b) on return loss for four corner truncated antenna

Figure 15 gives the impact of parameter GW on the impedance bandwidth of antenna. This parameter slightly affects the impedance bandwidth of antenna. It lowers the return loss of the antenna. Maximum impedance bandwidth is obtained for GW=43.5mm.

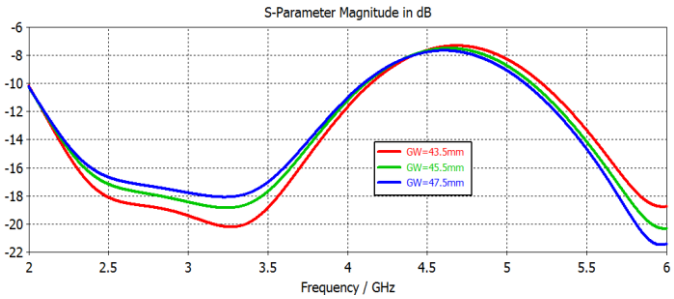

Fig 15 Effect of parameter (GW) on return loss for four corner truncated antenna

Impedance bandwidth is mainly affected by parameter g. Figure 16 shows the impact on parameter g on impedance bandwidth. The gap g is between the ground and radiating patch. For g=1mm return loss is lower. For other value of g

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the impedance bandwidth is high. Maximum impedance bandwidth is obtained for g=.75mm

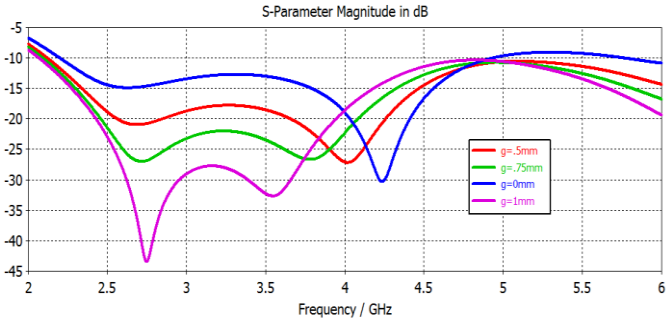

Fig 16 Effect of parameter (g) on return loss for four corner truncated antenna

IV. Conclusion

Rectangular microstrip patch antenna with partial ground plane has been simulated with other two configurations (two truncated corner and four truncated corner). The parametric study has been carried out, it is observed truncation of the corner highly affect the impedance bandwidth of the patch antenna.

References

[1] J. A. Ansari and R. B. Ram , "Analysis of broad band U slot microstrip patch antenna," Microwave and optical technology letters, Vol.50, No. 4, April 2008.

[2] A. MoradiKordalivand and T.A. Rahman, "Broadband modified rectangular microstrip patch antenna using stepped cut at four corners method," PIER, Vol.137, 599-619, 2013.

[3] Amit A. Deshmukh, Tejal Tirodkar and Sudesh Agrawal, "Analysis of Multi-band stub loaded and two Half U-slot cut Rectangular Microstrip Antenna," International Journal of Computer Applications, 0975 – 8887, ICCT, 2015.

[4] Amit A. Deshmukh, et.al, "Analysis of Double U-slot Cut Rectangular Microstrip Antenna," International Journal of Computer Applications, 0975 – 8887, Volume 94 – No 4, May 2014.

[5] Amit A. Deshmukh, et.al, "Analysis of Multi-band Rectangular Microstrip Antennas," IJMOT, Vol.8, no. 3, May 2013.

[6] Amit A. Deshmukh, et.al, "Formulation of Resonance Frequency for Multi-Band Circular Microstrip Antennas," IJMOT, Vol.5, no. 5, September 2010.

[7] Amit A. Deshmukh, Tejal Tirodkar, "Formulation of Resonant Length for Triple Band Slot Cut Stub Loaded Rectangular Microstrip Antenna," International Journal of Computer Applications, 0975 – 8887, ICCT, 2015.

[8] P. C. Ooi and K. T. Selvan, "Wideband star-shaped microstrip patch antenna," Progress In Electromagnetics Research Letters, Vol. 1, 61-68, 2008.

[9] CST MICROWAVE STUDIO 2010.

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