Harmonic Rejection in Rectangular Microstrip Antenna

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ABSTRACT

This paper presents the effective harmonics rejection of dual band rectangular microstrip patch antenna. The dual frequency circular polarization achieved with proper pin shorting at the corner of RMPA. Pin shorting at the corner also process harmonic effect. Using effective corner truncation technique of the rectangular patch, undesired harmonics effect can be rejected completely. The simulation has been carried out using MOM based IE3D simulator.

Keywords

Shorting pin, dual band, harmonics rejection, corner truncation.

1. INTRODUCTION

Dual frequency operations are very popular in wireless communication[1]. Various kind of dual band production techniques are there, such as circular slots[2],π slots[3] etc. To keep the simple structure of the patch, the pin shorting procedure is efficient, which can produce the dual bands[4]. In rectangular patch antenna, the pin shorting at the corner produces dual frequency as well as undesired harmonics. The harmonics can be effectively suppressed by defective ground structure [5]. Different types of slots, such as T-shaped slots[6],U-type slots[7] are also introduced for harmonics rejection technique. Another type of popular method of harmonics rejection is PBG(Photonic Bandgap Technique)[8].This paper presents the corner truncation technique to reject unwanted harmonics from the frequency range of 4 to 10 GHz by selective truncation of different corners of the rectangular microstrip antenna while maintaining the required frequency bands unaltered.

2. ANTENNA DESIGN AND SIMULATION

A suitable dielectric substrate withε_r=2.6 (rexolite) is chosen at first. A rectangular patch of dimension 18.12mm x 24mm with thickness (h) 1.6mm, tanδ =0.001 is used. The coaxial feed is at (5,0), which shows the resonant frequency at 5.22GHz.

2.1 PIN SHORTING EFFECT

A single pin is shorted at the lower left corner of RMPA as shown in fig.1a. The simulation result is shown in fig.1b which shows dual frequency bands with harmonics.

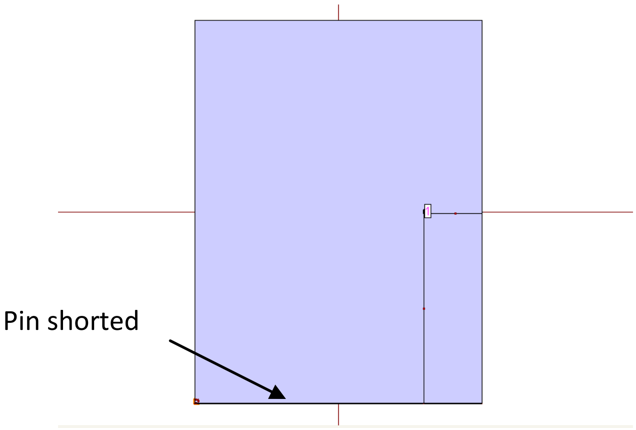

Fig.1a Structure of rectangular patch with shorted pin.

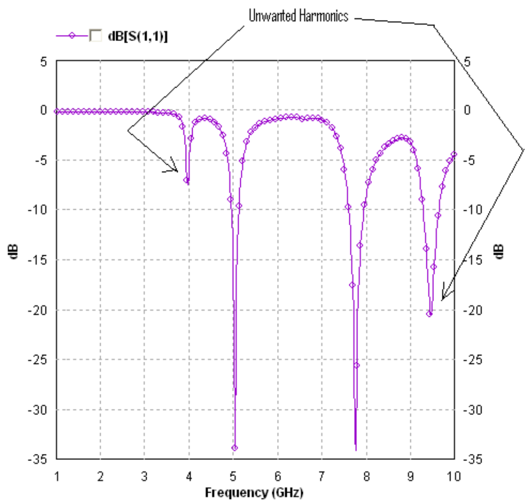

Fig.1b:Return Loss Performance

2.2 HARMONIC REJECTION BY CORNER TRUNCATION

Harmonics are reduced by truncating the upper left and right corners provided that pin shorting is done in the lower left corner of the patch. The surface area of the patch is reduced more from the upper left corner than the upper right corner.

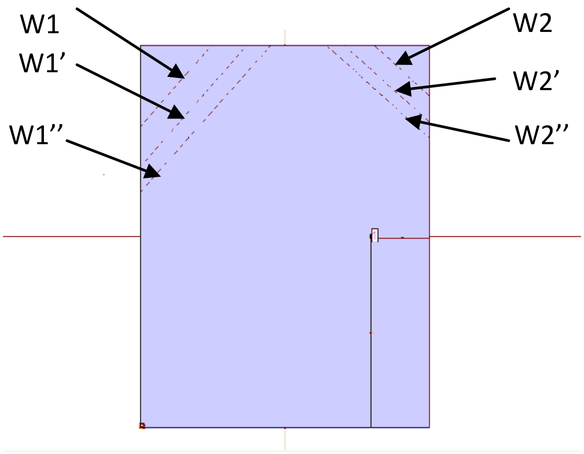

Fig.2a:Truncated structure of the rectangular patch with shorted pin

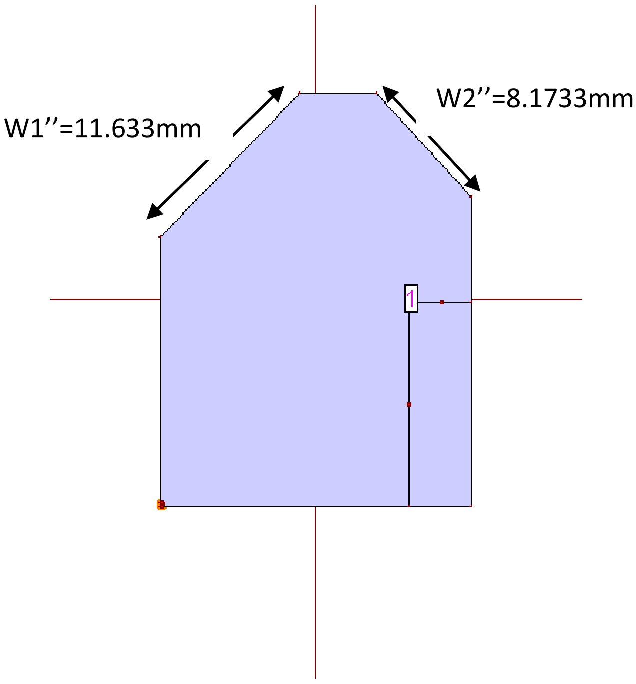

Fig.2b:Proposed patch after final Truncation with W1’’=11.633mm and W2’’=8.1733mm

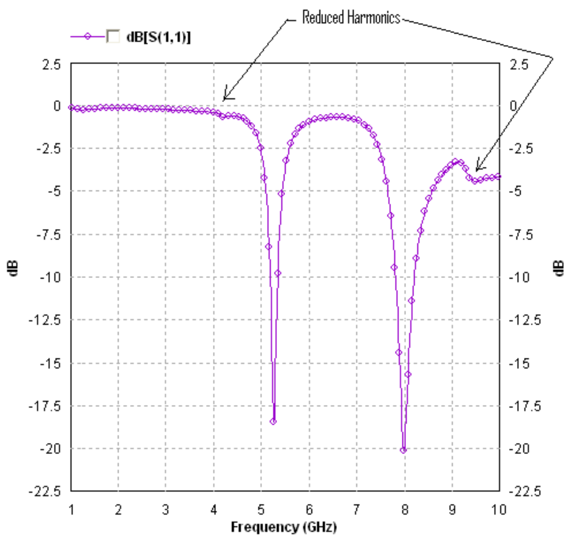

Fig.2c:Return loss performance after first truncation(cutting edge with W1 and W2)

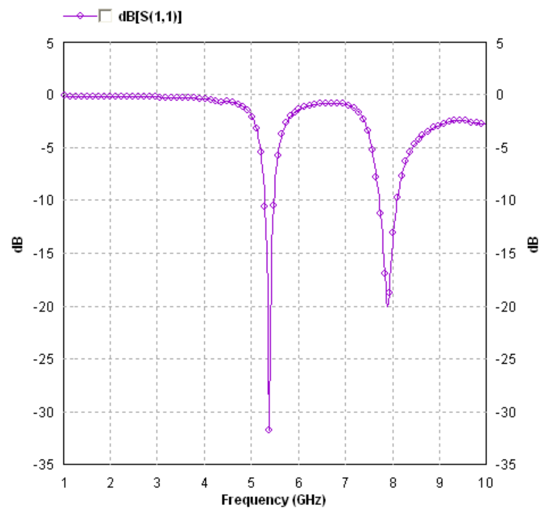

Fig.2d:Return Loss Performance after final truncation with rejected harmonics (cutting edge with W1’’=11.633mm and W2’’=8.1733mm)

From the return loss performance,it is clear that by increasing the truncation of the upper left corner reduces the harmonics more and more,and further increasing the truncation,it is observed that the harmonics are almost suppressed. But due to this truncation,the return loss is also reduced. This can be improved by proper truncation of the upper right corner further which increases the depth of the return loss.

Table 1. Before Truncation

f1 (GHz)	f2 (GHz)	R/L of f1 (dB)	R/L of f2 (dB)	Gain of f1 (dBi)	Gain of f2 (dBi)
5.03	7.75	-31.53	-33.46	6	4.9

Table 2. After Truncation

f1 (GHz)	f2 (GHz)	R/L of f1 (dB)	R/L of f2 (dB)	Gain of f1 (dBi)	Gain of f2 (dBi)
5.38	7.88	-30.64	-19.24	6	4.9

3. RADIATION PATTERN AND GAIN

3.1 RADIATION PATTERN

Radiation pattern of the E-field in the φ=0˚ and φ=90˚ planes for the proposed antenna at different resonant frequencies. Wide variation of the radiation pattern are obtained.

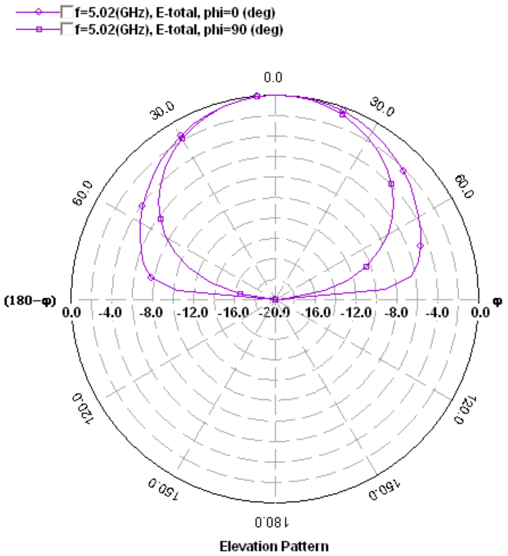

Fig.3.1.a: Radiation pattern at 5.02GHz with only pin shorting

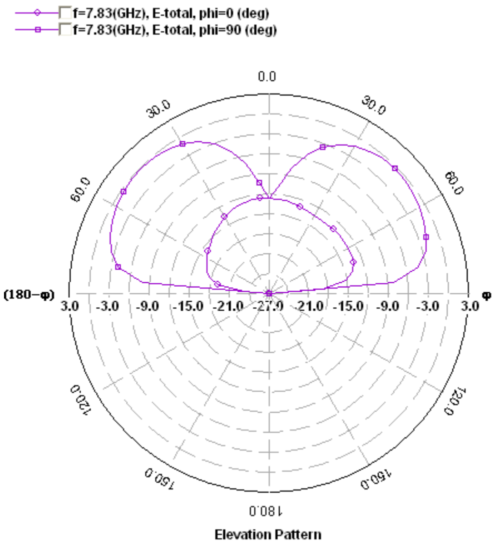

Fig.3.1.b: Radiation pattern at 7.83GHz with only pin shorting

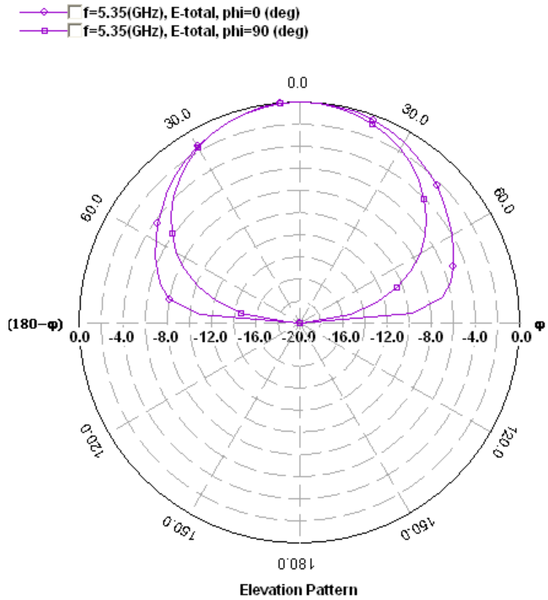

Fig.3.1.c: Radiation pattern at 5.35GHz in proposed antenna

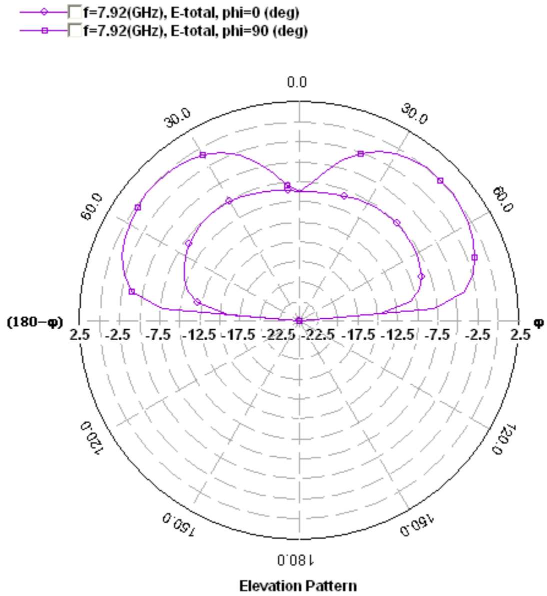

Fig.3.1.d: Radiation pattern at 7.92GHz in proposed antenna

3.2 GAIN

The peak gain of dual band has been shown in Fig.3a and Fig.3b. Fig.3a shows the gain(dbi) for pin shorted antenna only. Fig.3b is the gain plot of proposed antenna where the maximum gain of 6 dbi and 4.9 dbi is achieved only for dual resonance frequencies at 5.35GHz and 7.92GHz.

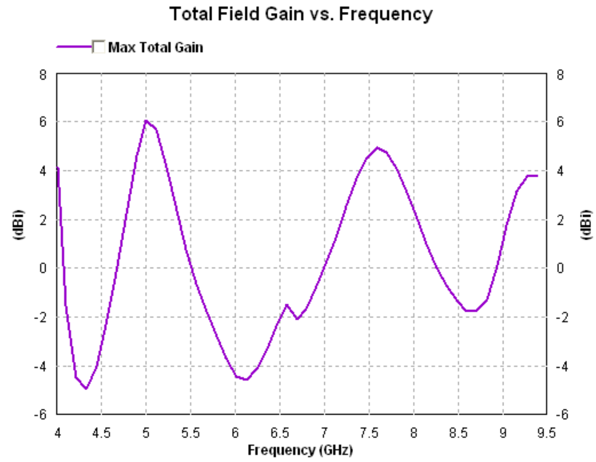

Fig.4a:Frequency vs gain graph with only pin shorting

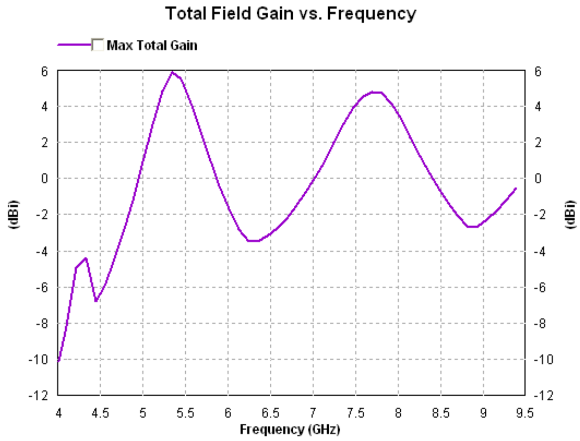

Fig.4b:Frequency vs gain graph in proposed antenna

4. CONCLUSION

A pin shorted rectangular patch antenna with dual truncated corner is proposed. The proper truncation on two corners completely eliminates harmonics effect. Gain and directivity of dual band with stable radiation pattern ensure that this antenna gives good result for the given resonance frequencies of 5.35 GHz and 7.92GHz. In proposed antenna, the surface area of the patch is also reduced. This dual band antenna is applicable in C band wireless application.

5. REFERENCES

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