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A Novel Triple Band Microstrip Patch Antenna

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Abstract

In this paper the design of a multi resonant patch antenna is presented. The conventional antenna is modified by removing small triangular slots from its patch. This attempt is continued in order to make the antenna radiate at WIMAX, Public and Private Bands with adequate gain and Bandwidth. The proposed antenna has an omnidirectional pattern with radiating efficiency greater than 85% in all the three bands of resonances.

Keywords: *Microstrip Patch Antenna, Linear Polarization, Wireless Applications, WiMax, Public, Private Bands*

INTRODUCTION

Of all the feeding mechanisms, Coaxial feed is the simplest method to feed a microstrip patch antenna (MPA) except that the soldering effects may some times slightly shift its resonant frequency [1]. The printed antenna is found to be one of the most prefered wireless application antenna due to many of its remarkable features.

Bandwidth enhancement is done traditionally by lowering the quality factor, by providing good impedance match and also by creating slots in patch as well as in grounds. Many literatures were found addressing bandwidth enhancement approaches [2–6]. The magical properties of metamaterials whose unit cell size is less than quarter of wavelength having negative permeability, permitivity supporting backward waves are utilised in such antenna design most recently.

Slightly different unit cells are seen in patch leading to a wideband miniaturized antenna [7, 8]. CSRR structures are utilised to create three different variants for three different applications [9]. An Elliptical patch with CSRR slots in its ground plane is seen in [9]. Differntial loads of CSRR leading to multi resonance is seen in [10]. Spiral resonators are also noted in [11]. Fusion concept of fractal with metamterial are also noted nowadays.

In this paper by etching simple geometry of traingle in the patch multi resonances are created.

DESIGN OF PROPOSED PATCH

A conventional patch is designed using NELTEC NY9220 substrate with a thickness of 62 mils. Coaxial feeding is done. The patch is optimised using an FEM based simulator.

The conventinal patch is intially etched along all the four sides with a simple triangle pointing towards centre of the patch. Further, four more traingles are etched from centre of patch. Again 16 small traingles are etched along sides of the patch to develop this novel patch design to resonate at triple bands with improved bandwidth.

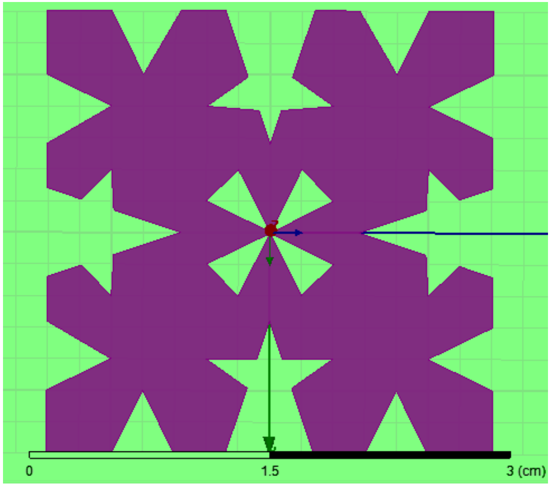

Fig. 1: *Top View of the Proposed Antenna.*

ANALYSIS OF THE PROPOSED ANTENNA

The coaxial fed antenna is modelled and optimized for inducing resonances at three frequencies they are 2.61, 6.46, 8.21 GHz and its return loss characteristics values of -21.09, -25.56,-15.9 dB's are shown in Figure 2.

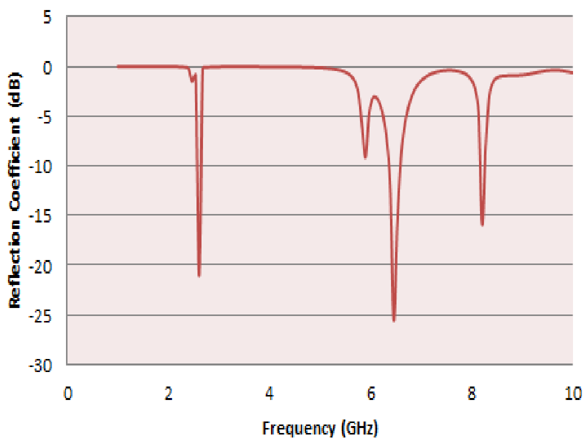

Fig. 2: *Reflection Coefficient of the Proposed Antenna.*

The optimized Ludwig Gain Radiation Pattern as well as its polar plot at the three resonant frequencies is presented in Figures 3–8. The directivity as well as VSWR is shown in Figures 9 and 10. The summative antenna parameter is given in Tables 1–3.

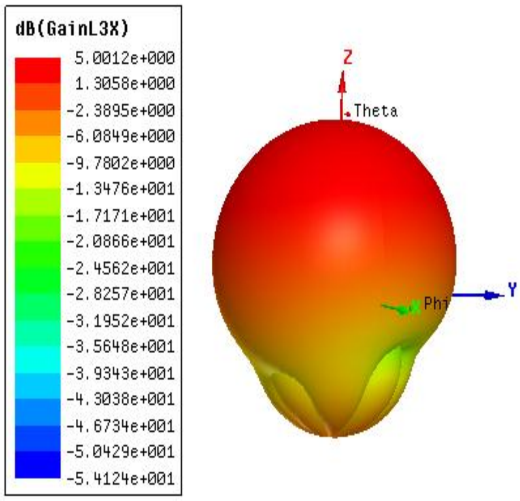

Fig. 3: *Polar Plot (Gain) of the Proposed Antenna.*

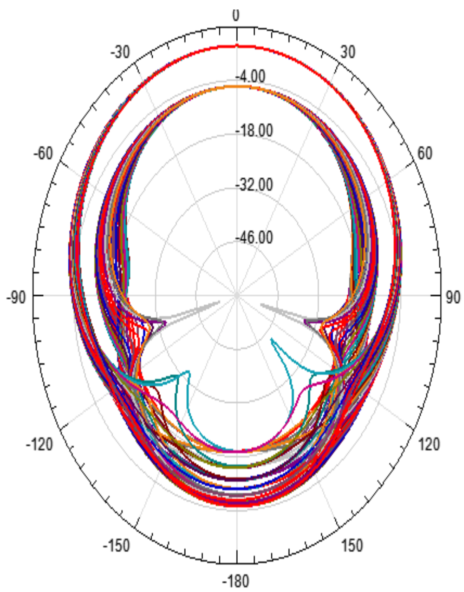

Fig. 4: *Gain Pattern of the Proposed Antenna.*

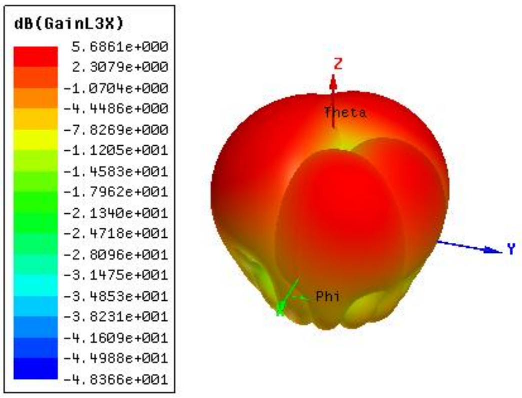

Fig. 5: *Polar Plot (Gain) of the Proposed Antenna.*

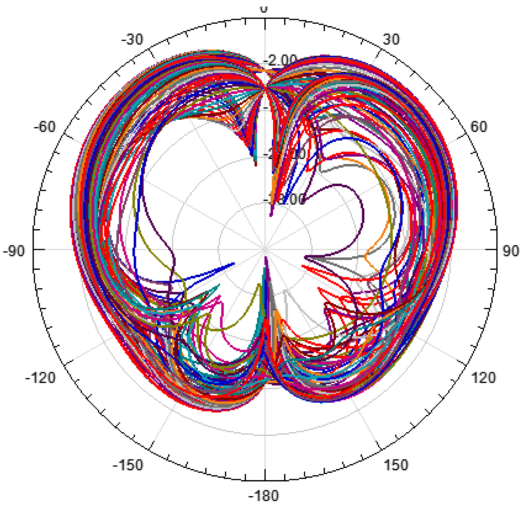

Fig. 6: *Gain Pattern of the Proposed Antenna.*

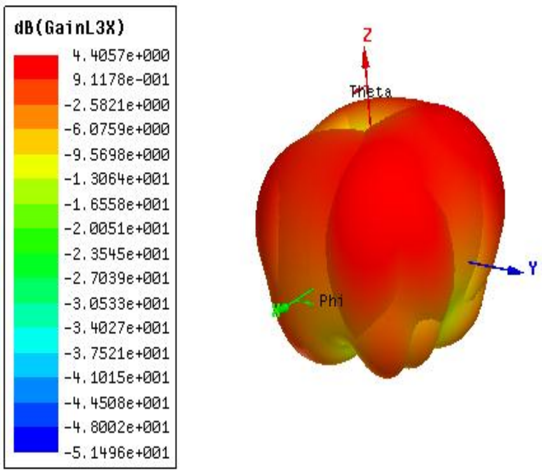

Fig. 7: *Polar Plot of the Proposed Antenna.*

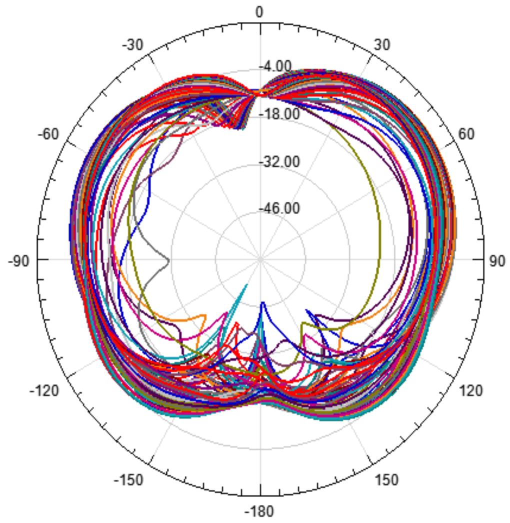

Fig. 8: *Gain Pattern of the Proposed Antenna.*

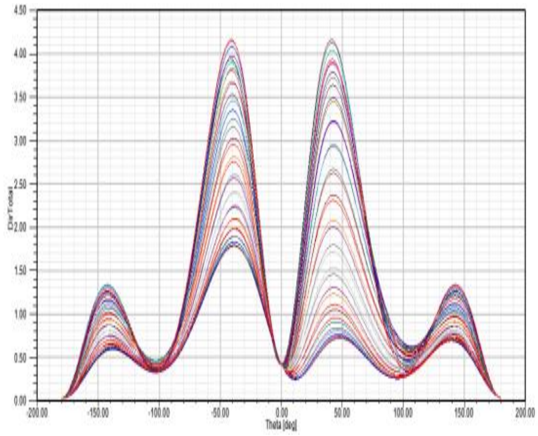

Fig. 9: *Directivity of the Proposed Antenna.*

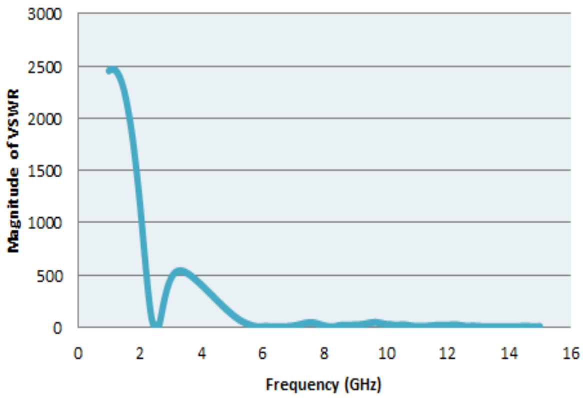

Fig. 10: *VSWR Characteristics of the Proposed Antenna.*

Table 1: *Antenna Parameters at 2.61GHz.*

Quantity	Value
Directivity	3.93
Gain (dB)	3.44
Efficiency	87.4
VSWR	1.19

Table 2: *Antenna Parameters at 6.46 GHz.*

Quantity	Value
Directivity	4.06
Gain (dB)	3.83
Efficiency	94.33
VSWR	111

Table 3: *Antenna Parameters at 8.21GHz.*

Quantity	Value
Directivity	4.74
Gain (dB)	4.42
Efficiency	93.3
VSWR	1.37

CONCLUSION

A compact printed antenna resonating at WiMax and Public bands is designed with adequate gains of 3.44,3.83,4.42 dB. The band width is found to be 74, 220, 86 MHz respectively overcoming the narrow band problem in conventional patch. Also the antenna is lost effective due to choice of cheaper substrate in its design. The antenna has adequate difference between co and cross polarization levels in its pattern with a non compromising directivity confirming uniform radiation.

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