# SLOT BASED MICROSTRIP ANTENNA FOR WLAN AND WI-MAX APPLICATIONS

*[1]SANDIP GAJERA, [2] NARESH PATEL, [3]HITESH DHOLAKIYA*

**[1]M.E. Student, Department of Electronics and Communication Engineering, SCET, Surat, Gujarat**
**[2] Asst. Professor, Department of Electronics and Communication Engineering, SCET, Surat, Gujarat**
**[3] Asst. Professor, Department of Electronics and Communication Engineering, SSASIT, Surat, Gujarat**

***Sandipgajera1010@gmail.com , Naresh.patel@scet.ac.in , Hitesh123dholakiya@gmail.com***

***ABSTRACT:*** *A compact triple-band slot based microstrip antenna is proposed in this paper. The antenna is printed on a 35×30 $mm^2$ FR-4 substrate with thickness of 1.6mm and relative permittivity of 4.4.The proposed antenna design has a simpler structure than other antennas for realizing triple-band characteristics. Then, to prove the validation of the design, a prototype is simulated in HFSS 12.0. The simulated result shows that the antenna can provide three impedance bandwidths of 380 MHz centered at 2.65 GHz, 550 MHz centered at 3.5 GHz, and 1390 MHz centered at 5.8 GHz and also suggests that the proposed antenna is suitable for the WLAN and Wi-Max applications. In addition, the radiation patterns of the proposed antenna are figure-eight in E-plane and omni-directional in H-plane at 2.65/3.5/5.8 GHz, and with very low cross polarization level with stable antenna gain across the three operating bands.*



***KEYWORDS: - Microstrip Antenna, WLAN, Wi-MAX, Slot based Multiband antenna, HFSS 12.0***

## I: INTRODUCTION

In recent year, multiband antenna with simple structure, compact size, low cost, and easily integration with the circuit has been playing a very important role for wireless communication system. Wireless local area network (WLAN) and Worldwide Inter-operability for Microwave Access (Wi-MAX) have been widely used in mobile devices such as handheld computers and intelligent phones. These two techniques have been widely recognized as a viable, cost-effective, and high-speed data connectivity solution, enabling user mobility. In practice, IEEE802.11 WLAN standards consist of 2.4-GHz (2.4–2.484 GHz), 5.2-GHz (5.15–5.35 GHz), and 5.8-GHz (5.725–5.875 GHz) frequency bands. Wi-MAX standards consist of 2.5-GHz (2.5-2.7 GHz), 3.5-GHz (3.3–3.6 GHz) and 5.5-GHz (5.25–5.85 GHz) frequency bands [1], [2].

With the rapid development of the modern wireless communication system, recent research in antenna design has turned to focus on wide multiband antenna with simple structures that can be easy to fabricate on printed circuit board (PCB). To adapt, the complicated and diverse, WLAN and Wi-MAX environments, several promising dual and multiband antenna designs have already been proposed in [3]–[7]. In [3], a compact CPW feed L shaped slot antenna for quad band is proposed but the CPW feed is complicated, in design, as compare to the microstrip line feed. In [4], the proposed monopole antennas have good return loss characteristics for both WLAN and Wi-MAX applications, but they are complicated in structures and large in size so the fabrication cost has been increased. In [5], a compact trapezoid slot based triple band antenna has been proposed for WLAN and Wi-Max application. In [6], a compact and low-profile patch antenna with a simple structure has been presented for the WLAN and WAVE applications but it operates only in dual band operations. In [7], a printed planar inverted-F antennas (PIFAs) with a direct feed, which offers small size and easy multiband operations by inserting the slot and slit on the radiator is proposed. However, the PIFA has a narrow bandwidth or requires a large ground plane.

In this paper, a compact triple-band microstrip slot antenna is proposed for WLAN and Wi-MAX applications. The antenna consists of a microstrip feed line, a substrate, and a ground plane on which some simple slots are etched. The rectangular and trapezoid slots are able to achieve dual frequencies and also provide a broadband operation at high frequency. The additional resonant mode is excited with the use of a pair of symmetrical horizontal strips embedded in the trapezoidal slot. And also, the additional square slot is applied to adjust the WLAN frequency at 5.8 GHz. Compared to the antennas in [3]–[7], the proposed slot based multiband antenna is not only achieves triple bands characteristics, but it has a simple structure and compact in size so that easy to fabricate on PCB. Meanwhile, the simulated results represent that the antenna shows a good multiband characteristic to satisfy the requirement of WLAN in the 5.8-GHz bands and Wi-MAX in the 2.5/3.5 GHz bands. In section II the structure of proposed antenna is discussed. Section III shows the results obtained from HFSS 12.0

## II: PROPOSED ANTENNA GEOMETRY

As shown in Fig.1, the configuration of the triple-band slot antenna is designed on a FR4 substrate with relative permittivity of 4.4 and a loss tangent of 0.02.The entire size of the antenna is only 35*30*1.6 $mm^3$ .A 50-Ω microstrip feed line with a width of 3 mm is adopted for centrally feeding the antenna at one side of the substrate. Some simple slots are etched on the ground plane to provide all the work bands. The symmetrical trapezoid slot, which has a resistance gradual changing structure, provides the highest resonance and makes impedance matching in a wideband range. The symmetrical trapezoid slot can achieve the lowest resonant frequency at 2.5 GHz. The symmetrical rectangular strips embedded in the trapezoid slot are used for feeding and providing the middle work band at 3.5 GHz and 5.5 GHz. The square slots are applied into the ground plane which adjusts the frequency band at 5.8 GHz. The rectangular strips generates current flow path at the middle resonant frequency, which can be assumed as

$$f = \frac{c}{2L\sqrt{\varepsilon_{re}}} \quad \text{...1}$$

Where c is the speed of light in the air, $\varepsilon_{re}$ is the effective relative permittivity and L is the length of the square slot. The proposed antenna is fed by 50 Ω microstrip line which is printed on opposite side of the substrate.

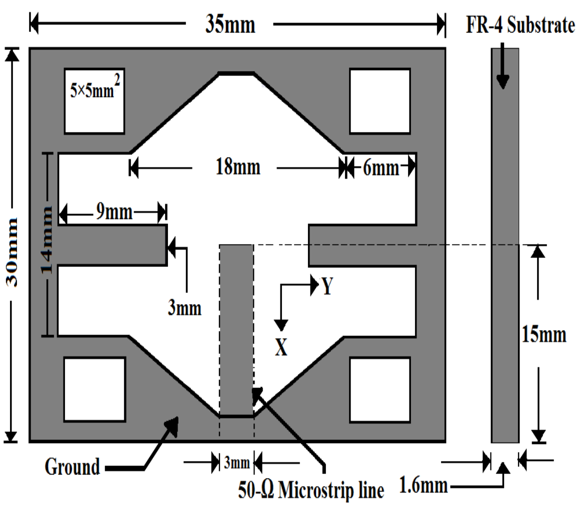



Fig. 1 Proposed antenna geometry

By fixing optimum parameters of the proposed antenna, good impedance matching, throughout the operating bands for the WLAN and Wi-MAX applications, can be achieved.

## III: RESULTS AND DISCUSSION

The simulated return-loss characteristics of the proposed antenna obtained by using HFSS 12.0.As Shown in Fig. 2, the simulated return losses are measured for three different geometries at -10dB and get impedance bandwidths range from 2.46–2.84, 3.17–3.72, and 5.08–6.47 GHz with the relative fractional bandwidth 14.33%, 15.96%, and 24.06% respectively. As shown in Table 1, shows the centre frequency for three different antenna geometries with its frequency range. Fig. 3 presents the peak gains in the maximum directions of each required frequency point. The antenna gain has a peak value of 2.76 dBi at 2.65 GHz, 2.47 dBi at 3.5 GHz, and 4.75 dBi at 5.8 GHz, respectively.

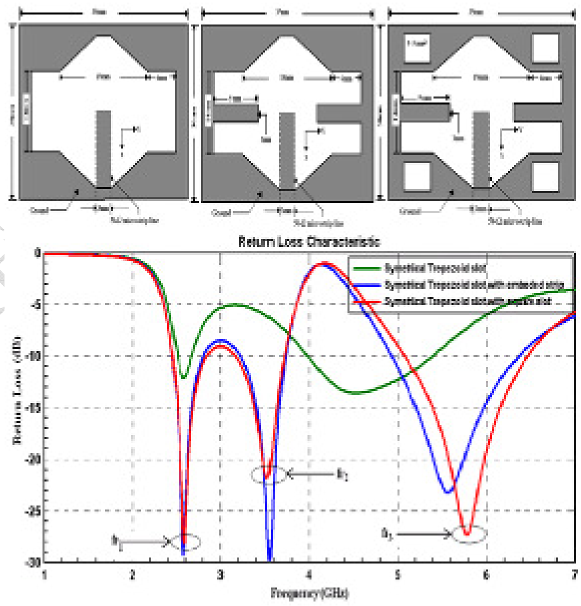



Fig. 2 Simulated return loss performance of proposed antenna design

Table 1 Centre frequency for three different antenna geometries

| Antenna Type | Frequency Range (GHz) | | |
|---|---|---|---|
| | $fr_1$ | $fr_2$ | $fr_3$ |
| STS* | 2.59 | - | - |
| STS with embedded strips | 2.63 (2.46-2.81) | 3.56 (3.22-3.73) | 5.57 (4.93-6.35) |
| STS with embedded strips and etched square slot on ground | 2.65 (2.46-2.84) | 3.5 (3.17-3.72) | 5.8 (5.08-6.47) |

*STS= Symmetrical Trapezoid slot

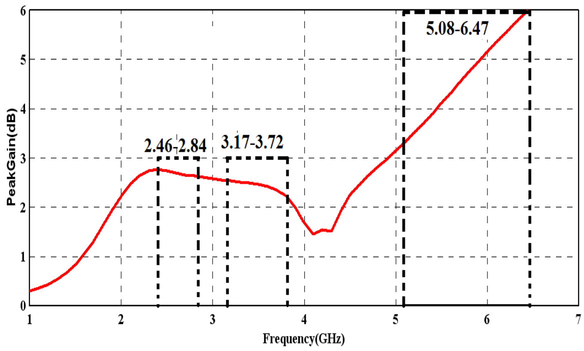
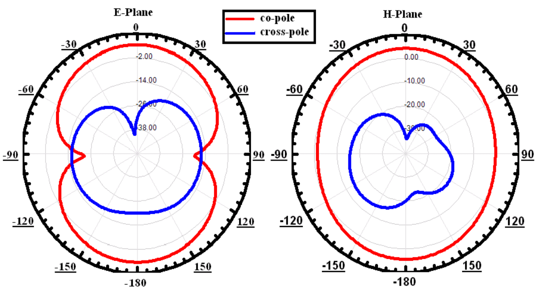
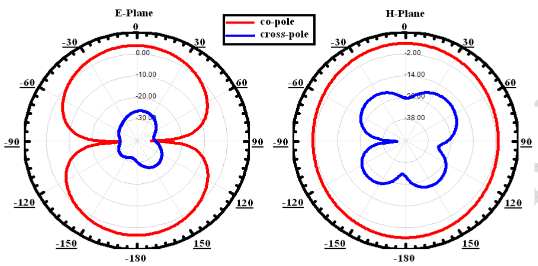


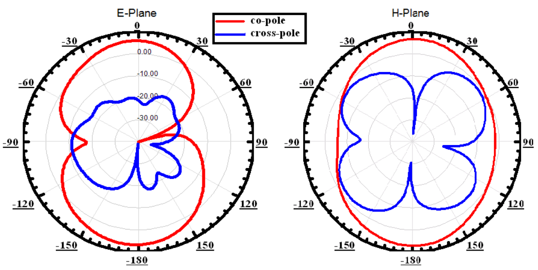

Fig. 3 Simulated gain performance of proposed antenna design.




(a)




(b)




(c)

Fig. 4 Radiation patterns of the proposed antenna. (a) 2.65 GHz. (b) 3.5 GHz. (c) 5.8 GHz

**IV: CONCLUSION**

In this paper, a compact triple-band slot antenna for WLAN/Wi-MAX application has been presented. Compared to many antennas proposed in recent papers [3]–[7], this antenna is designed based on a rather simple structure and suitable for frequency bands of WLAN and Wi-MAX applications simultaneously. The proposed antenna can be considered to achieve multiband just through etching slots on the ground plane, so it can be much easier to fabricate. The simulated return losses are measured for three different geometries at -10dB and get impedance bandwidths range from 2.46–2.84, 3.17–3.72, and 5.08–6.47 GHz with the relative fractional bandwidth of 14.33%, 15.96%, and 24.06% respectively, good enough for WLAN and Wi-MAX applications. Additionally, the radiation patterns of the proposed antenna are figure-eight in *E*-plane and omni-directional in *H*-plane at 2.65/3.5/5.8 GHz with very low cross polarization level. The antenna gains at 2.65/3.5/5.8 GHz are 2.76 dBi, 2.46 dBi, and 4.75 dBi, respectively so it can emerge as an excellent candidate for multiband generation of wireless.

## REFRENCES

[1] R. Garg, Microstrip Antenna Design Handbook, Artech House Boston, 2001

[2] C. A. Balanis, Antenna Theory, Willey Inter Science, 3rd Edition, 2003.

[3] Xin Sun, Gang Zeng, Hong-Chun Yang, "A Compact Quad band CPW-Fed Slot Antenna for M-Wi-MAX/WLAN Applications", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 11, 2012

[4] Aidin Mehdipour, Abdel-Razik Sebak, Christopher W. Trueman, and Tayeb A. Denidni, "Compact Multiband Planar Antenna for 2.4/3.5/5.2/5.8-GHz Wireless Applications", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 11, 2012.

[5] Lin Dang, Zhen Ya Lei, Yong Jun Xie, GAO Li Ning, and Jun Fan, "A Compact Microstrip Slot Triple-Band Antenna for WLAN/Wi-MAX Applications", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 9, 2010

[6] Wen-Chung Liu, Chao-Ming Wu, Nien-Chang Chub, "A compact low-profile dual-band antenna for WLAN and WAVE applications", Int. J. Electron. Comm. (AEÜ-2012) 467– 471, science direct.

[7] YANG Jun, LI Xiao-lin2, ZHAO Wei-liang, "Triple broadband compact planar inverted *F antenna* for WLAN and Wi-MAX", sciencedirect/science/journal/10058885 February 2010, 17(1): 32–36.