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Design of a Dual-Band Microstrip Patch Antenna for GPS,WiMAX and WLAN.

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Abstract : *The A multi band microstrip patch antenna has been designed for GPS,WiMAX and WLAN applications. The proposed antenna is designed by using substrate of RT duroid having permittivity of about 2.2 and loss tangent of 1.The substrate is having thickness of 6mm at which a trapezoidal patch antenna with V slot has been introduced in this paper. The designing results like S11 parameter return loss,VSWR and field pattern is plotted successfully. The obtained result is having a two band resonance with S11 less then -10dB and VSWR less than 2.*
So a dual band trapezoidal microstrip patch antenna has been designed and all results are plotted.Simmulating software used is IE3D.

Keywords - *V-shape slot, RT duroid, Dual band, WLAN, WiMAX,*

I. INTRODUCTION

Microstrip antenna is the ideal choice for wireless an such typed application due to low profile, light weight, conformal shaping, low cost ,simplicity of manufacturing and easy integration to circuit[1].however, conventional microstrip patch antenna suffers from very narrow bandwidth, typically about 5% bandwidth with respect to the central frequency. there are numerous and well-known method to increase the bandwidth of antennas, including increase of the substrate thickness, the use of a low dielectric substrate, the use of multiple resonators,and the use of slot antenna geometry[2],[3].

Wireless local area networks (WLAN) are widely used worldwide. The 802.11a standard uses the 5-GHz band which is cleaner to support high-speed WLAN. However, the segment of frequency band used varies from one region of the world to another[6][7]. Dual frequency microstrip antennas with a single feed are required in various radar and communication systems, such as global positioning system (GPS), WiMAX,WLAN etc[1].

These communication system applications include fixed broadband local multipoint communication services, small mobile units, laptops and remote-sensing devices [2]. Also, bandwidth should be further enhanced in order to increase the information transfer rate, without sacrificing the performance[4]. There are lots of communication schemes that make use of the large operational bandwidth[8][9]. For example, the Orthogonal frequency-division multiplexing (OFDM) scheme transmit and receive signals with a number of frequency components [3]-[5]. Another example is the transmission of broadband pulse.
radiating edge.

In this paper, we design a trapezoidal patch with V-shaped antenna which works as a dual frequency. First resonance frequency f1 centered at 3.5 GHz frequency is due to its patch itself. Second resonant frequency f2 is due to V-shape slot, which is centered at 5.0 GHz.

II. ANTENNA STRUCTURE

The configuration of proposed antenna is shown in figure 1. The antenna consist of a trapezoidal microstrip patch with V-shaped slot, support on a grounded dielectric sheet of thickness h and dielectric constant ε_r. The trapezoidal patch has an upper side of length L1, base of trapezoidal patch of length L2 and height of trapezoidal patch of length W1, W2. V-shape slot has a length of L3, L4 and a width of W3, W4 which is loaded on trapezoidal patch. The feed point is located at the central line of the patch, with a distance of $d_f(x.y)$ from the bottom edge of trapezoidal patch.The dimension of trapezoidal patch with V-shape slot are tabulated in table 1.

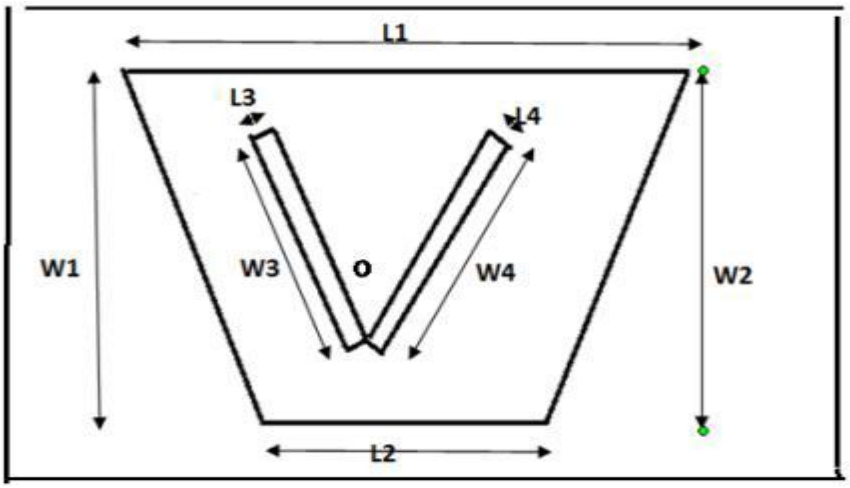

Fig.1: Geometry of proposed antenna

Table 1. Dimension of proposed antenna

S.no	Parameter	Value(mm)
1	L1	30
2	L2	26
3	W1,W2	21.04
4	L3,L4	0.5
5	W3,W4	1.5
6	ε r	2.2
7	h	6

The proposed antenna is designed and simulated by using IE3D software. All the proposed design parameters are calculated by using conventional formula for patch antenna design process.

III. DESIGN RESULTS

In this section, the simulated results of various parameters like VSWR, Return loss, input impedance and radiation characteristics of proposed antenna are presented and discussed. The simulated results are obtained using IE3D Simulator.

A. *S11 PARAMETER and VSWR*

The simulated result for the return loss less than -10dB is shown in figure 2. From simulated result we get dual band. Based on a -10 dB return loss, 4% impedance bandwidth is obtained at first resonant frequencies f1 in the frequency range (3.41-3.57) GHz and 15.6 % impedance bandwidth is obtained at second resonance frequencies in the frequency range of 4.75-5.53 GHz.

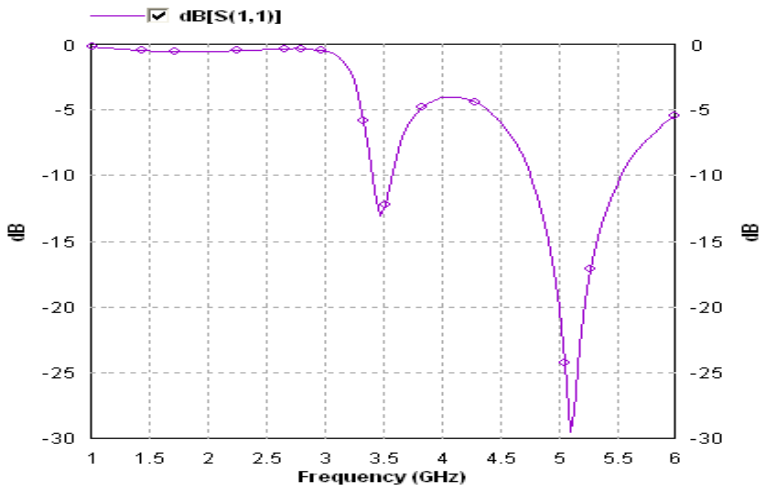

Fig. 2: Return loss

VSWR plot shows that the VSWR occur at first resonant frequency is 1.66 and second resonant frequency is 1.07. This depict that there is good impedance matching between probe-fed microstrip transmission line and the trapezoidal radiating element.

B. *Input impedance*

The simulated result for the antenna input impedance is plotted in figure 4. It is shown that the real part of the input impedance at first resonant frequency f1 oscillates around 74.83Ω with frequency while the imaginary part of the input impedance at resonant frequency oscillates around 0Ω with frequency.
At second resonant frequency f2, the real part of the input impedance at resonant frequency oscillates around 50Ω with frequency while the imaginary part of the input impedance at resonant frequency oscillates around 0Ω with frequency. Hence, from the graph it is clear that there is proper matching occur at both resonant frequencies

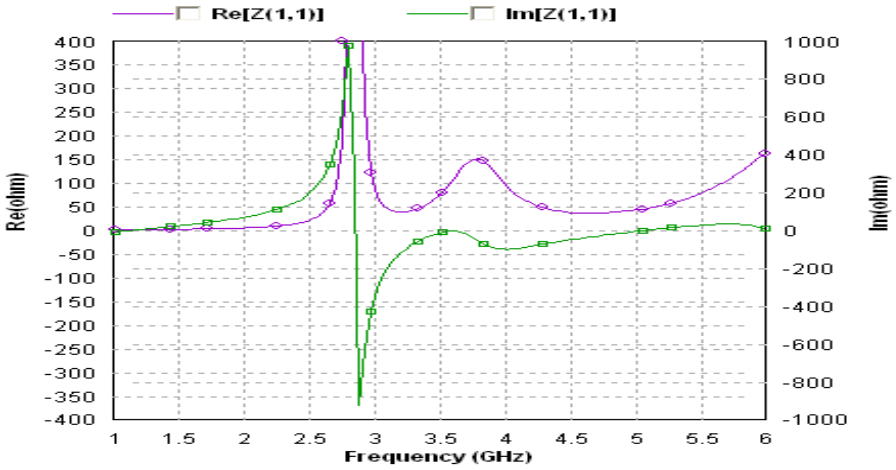

Fig. 4: Real part and imaginery part of input impedance

C. *Radiation pattern*

From figure below Shows the measured radiation pattern at first resonant frequency 3.5 GHz. it can be observed that in the ϕ=0 plane, the cross polarization is -13 db below the co polarization above the ground plane. In the ϕ=90 plane, the cross polarization is -19.3 dB below the co polarization level.

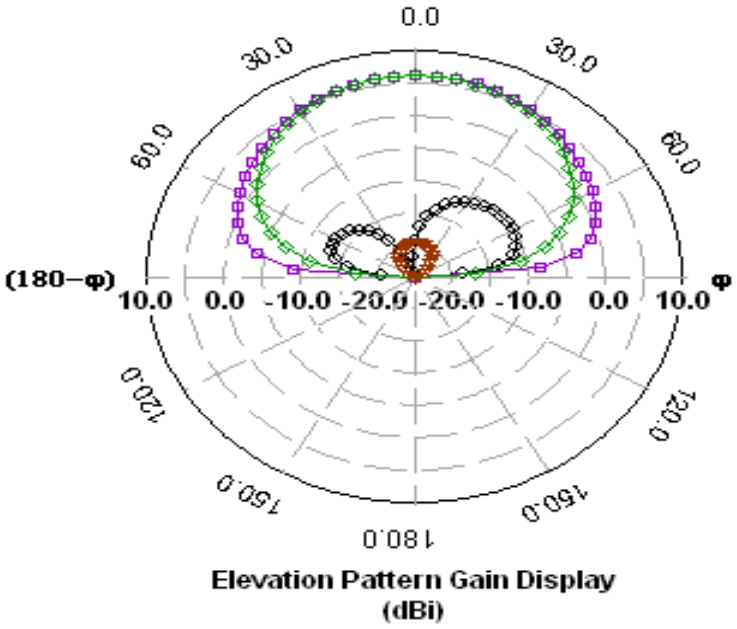

Fig. 5: Radiation pattern at 3.5 GHz

Table 2. Simulated data

Resonant frequency	F1	F2
Centre frequency	3.5 GHz	5 GHz
bandwidth	4.95	15.6%
Frequency range	(3.41-3.57)GHz	(4.75-5.53)GHz
Return loss	-12.8 dB	-29.37 dB
VSWR	1.66	1.07

IV. CONCLUSION

The dual frequency and wide-band operation of a trapezoidal patch with V-shaped slot have been studies and simulated. The proposed antenna is compact, occupies small volume and has simple structure compared to other antenna design. The antenna offer a 2:1 VSWR bandwidth of 4% from frequency range (3.41-3.57)GHz at first resonant frequency which cover 3.5 GHz band WiMAX applications. second resonant frequency cover the WLAN(5.15-5.35) band application with impedance bandwidth 0f 15.6%.the simulated return loss, VSWR, radiation pattern and gain showed well performance.

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