

Design & Simulation of Microstrip Trapezoidal Patch Antenna with H and V Shaped slot

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Abstract

This paper consists of two small Microstrip patch antenna. with H shaped and V shape slot. A trapezoidal patch is designed on a RT duroid substrate with relative permittivity of 2.2 and height of 6mm. A series of parametric study were carried out to show the dependence of the characteristics of the antenna on its various geometrical parameters Microstrip antenna is widely used in practical applications like wi-fi, wlan etc An Soft HFSS Vs 12 software which is based on finite element method , showed satisfactory performance with VSWR<2 for resonating frequencies

Keywords: V shaped slot, h shaped slot RT duroid /5880 WLAN, HFSS

INTRODUCTION

With the ever-increasing need for mobile communication and the emergence of many systems, it is important to design broadband antennas to cover a wide frequency range. WLANs are used worldwide. The 802.11 standard uses 5GHz band to support high speed WLAN. Various communication systems like WIMAX, GPS and radars requires dual frequency antenna with single feed. The design of an efficient wide band small size antenna, for recent wireless applications, is a major challenge. Microstrip patch antennas have found extensive application in wireless communication system owing to their advantages such as low-profile, conformability, low-cost fabrication and ease of integration with feed networks [1]. However, conventional Microstrip patch antenna suffers from very narrow Bandwidth. Broadband Microstrip Patch Antenna 175 bandwidth, typically about 5% bandwidth with respect to the center frequency

There are numerous and well-known methods to increase the bandwidth of antennas, including increase of the substrate thickness, the use of a low dielectric substrate, the use of various impedance matching and feeding techniques, the use of multiple resonators, and the use of slot antenna geometry[4]. However, the bandwidth and the size of an antenna are generally mutually conflicting properties, that is, improvement of one of the characteristics normally results in degradation of the other. Recently, several techniques have been proposed to enhance the bandwidth. There are numerous and well known methods to increase the bandwidth of antennas including increasing thickness of substrate, use of multiple resonators, and use of slot antenna geometry

This paper includes two microstrip trapezoidal patch antennas, one with H slot in center and other with V slot in the centre. We used HFSS simulator for designing and simulating these two proposed antennas. A study of return loss and VSWR is done here for both the slotted antenna. The results shows that both antennas have acceptable performance for $VSWR \leq 2$ with a 50 ohm line feed, at wide bandwidth and moderate gain and used for wireless communication

1. TRAPEZOIDAL PATCH WITH V SLOT

The basic structure of the proposed antenna, shown in Fig.1 consists of 3 layers. The lower layer, which constitutes the ground plane, covers the partial rectangular shaped substrate with a side of 60×60 mm. The middle substrate, which is made of RT Duroid /5880, has a relative dielectric constant $\epsilon_r = 2.2$ and height 6 mm. The upper layer, which is the trapezoidal patch, covers the surface. The design of antenna I shown in fig 1. Here the patch is trapezoidal with dimensions W_1, W_2, L_1, L_2 where L_1 is upper side length, L_2 is lower side length and W_1, W_2 are the height of trapezoidal patch. The V shaped Slot is printed inside the trapezoidal patch and patch is printed on a dielectric sheet of thickness h and dielectric constant ϵ_r .

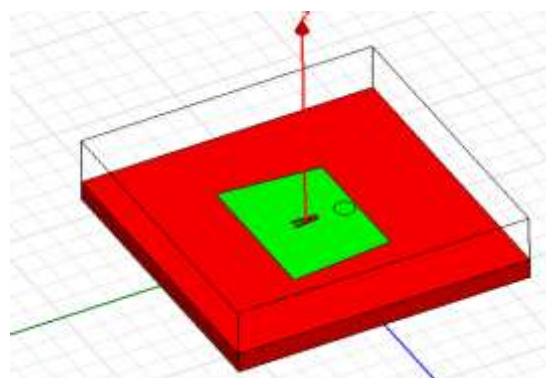


Fig 1. Design of Antenna 1

The feed point of antenna is located at the centre of substrate i.e (-8,0,0)

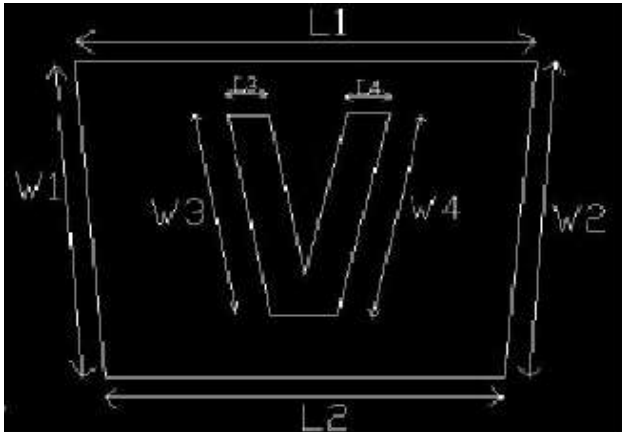


Fig 2. Structure of trapezoidal Patch with V slot

The dimensions of trapezoidal Patch with V slot are given in the table

Sr. No	Parameter	Explanation	Value (mm)
1.	L_1	Upper side of trapezoidal Patch	30
2.	L_2	Base of the trapezoidal Patch	26
3.	W_1, W_2	Height of the trapezoidal Patch	21.04
4.	L_3, L_4	Length of the V-shape slot	5
5.	W_3, W_4	Width of the V-shape slot	5
6.	ϵ_r	Dielectric Constant	2.2
7.	h	Height of Dielectric Constant	6

Table 1: Dimensions of Antenna 1

2. RESULTS OF V SLOT ANTENNA

Here we will discuss the simulated results of Antenna 1. We will discuss two parameters here Return loss and VSWR. The results are obtained from HFSS simulator after validation check of all the design setup, excitations, boundaries and all required parameters

(a) **Return Loss**- The Simulated scattering parameter is shown in fig 3. The S_{11} parameters (return loss) for the proposed antenna resonates at 3.9 GHz having value of -21.4 dB. The bandwidth of the antenna can be said to be those range of frequencies over which the return loss is greater than -10 dB (corresponds to a VSWR of 2).

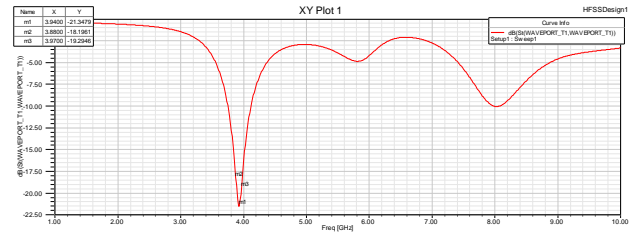


Fig 3 Return loss

(b) **VSWR** –The simulated results of VSWR for V slot antenna is shown in figure 4. This depicts good impedance matching between probe feed microstrip transmission line and trapezoidal radiating element. Minimum VSWR obtained is 1.24

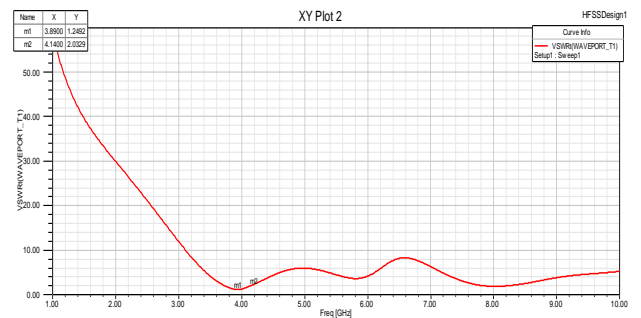


Fig 4 VSWR

3. TRAPEZOIDAL PATCH WITH H SLOT

The basic structure of the proposed antenna, shown in Fig. 1, consists of 3 layers. The lower layer, which constitutes the ground plane, covers the partial rectangular shaped substrate with a side of 60×60 mm. The middle substrate, which is made of RT Duroid/5880, has a relative dielectric constant $\epsilon_r=2.2$ and height 6 mm. The upper layer, which is the trapezoidal patch, covers the surface. The design of antenna 2 shown in fig 5. Here the patch is trapezoidal with dimensions W_1, W_2, L_1, L_2 where L_1 is upper side length, L_2 is lower side length and W_1, W_2 are the height of trapezoidal patch. The H shaped Slot is printed inside the trapezoidal patch and patch is printed on a dielectric sheet of thickness h and dielectric constant ϵ_r .

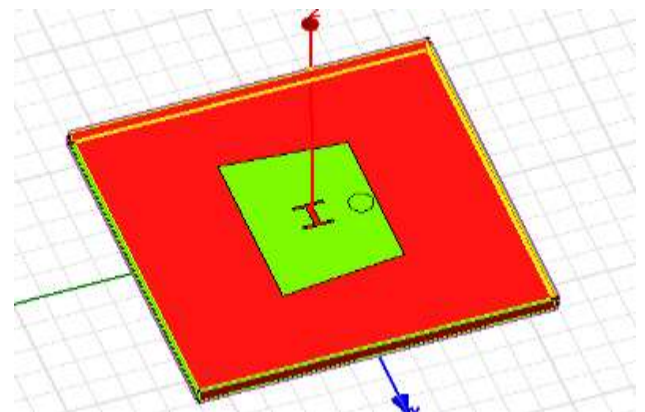


Fig 5 Design of antenna 2

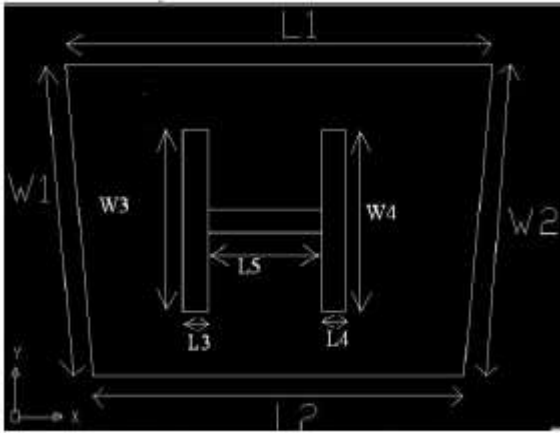


Fig 6 Structure of trapezoidal Patch with V slot

In this case also the feed point of antenna is located at the centre of substrate i.e, (-8,0,0). The layout of H slot is shown in figure 6. The H slot is designed in the middle of substrate for a symmetrical configuration.

S.no.	Parameter	Explanation	value(mm)
1	L1	Upper side of trapezoidal patch	30
2	L2	base of trapezoidal patch	26
3	W1,W2	height of trapezoidal patch	24,24
4	w3,w4	length of H slot	5
5	L3,L4	width of H slot	0.5
6	L5	distance between two sticks of H	0.5

Table 2 Dimensions of Antenna 2

4. RESULTS OF V SLOT ANTENNA

Here we will discuss the simulated results of Antenna 1. We will discuss two parameters here Return loss and VSWR. The results are obtained from HFSS simulator after validation check of all the design setup, excitations, boundaries and all required parameters

(a) Return Loss-

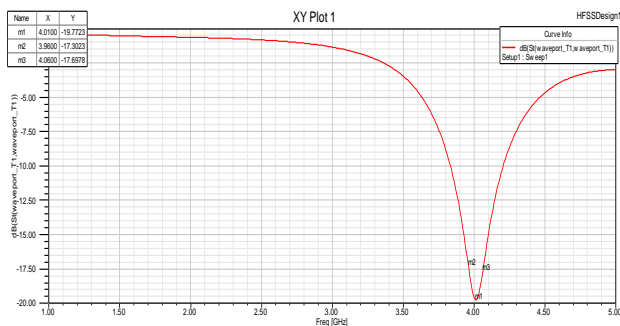


Fig 7 Return loss

The Simulated scattering parameter is shown in fig 7. It can be seen that input reflection coefficient at each input is less

than -10 db over the frequency range. Maximum Return loss obtained is -19.7 db

(b) VSWR –The simulated results of VSWR for V slot antenna is shown in fig 8.

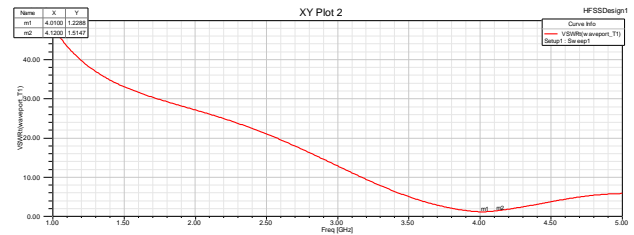


Figure 8 VSWR

This depicts good impedance matching between probe feed microstrip transmission line and trapezoidal radiating element. Minimum VSWR obtained is 1.22

5. CONCLUSION

Two aspects of microstrip antenna has been studied. H slot and V slot microstrip trapezoidal patch antenna. These antennas are suitable for WLAN applications, Wimax, RADAR.

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