ANTIPODAL VIVALDI ANTENNA UWB ANTENNA WITH 5.5GHz BAND-NOTCH

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Abstract—**This paper presents a compact antipodal Vivaldi antenna for UWB allocation with band dispersion characteristics. The main purpose of this design is the reduction of three parameter such as transient distortion, reflection co-efficient & surface wave loss. The proposed antenna has the capability to operate over the bandwidth 3-11GHz at return loss< -10 dB, except the bandwidth of 5-6GHz for WLAN .By cutting Ω- shaped slot in the radiating patch frequency band notch created. The antenna is successfully designed and simulated, it showing broadband matched impedance, stable gain and radiation pattern over a operating bandwidth.**

Keywords: antipodal Vivaldi antenna (AVA), Ω-shaped slot band- notch, wideband antenna.

INTRODUCTION

In recent years, there has been a great demand for commercial and military mobile wireless systems. Since the Federal Communications Commission (FCC) first approved rules for the commercial use of ultra wide band(UWB) range from 3.1 to 10.6 GHz in 2002 , the feasible design and implementation of UWB system has become a highly competitive topic in both academy and industry communities of telecommunications. Over the designated bandwidth of UWB system, there are some other existing narrowband services that already occupy frequencies in the UWB band, such as wireless local-area network (WLAN) IEEE802.11a and HIPERLAN/2 WLAN operating in the 5–6 GHz band. These UWB antennas with filtering property at the 5–6 GHz band have been proposed not only to mitigate the potential interferences but also to remove the requirement of an extra band stop filter in the system.

Vivaldi antennas are widely used in wireless and radar applications due to their broad bandwidth. The Vivaldi antenna, proposed by Gibson in 1979 [1], is a planar, travelling wave antenna which radiates with a symmetric end fire beam and may be impedance matched over a broader bandwidth. A balun is required to allow feeding from a coaxial port. Gazit [2] introduced the antipodal Vivaldi antenna in order to eliminate the need for a balun. Here a tapered slot line is placed on opposite sides of the substrate, therefore allowing micro strip to be used to feed the antenna. Jolani [3] details the design of a miniaturized Vivaldi antenna that has dimensions of 32x 35x1.6 mm^3 and has an impedance bandwidth which covers all of the 3.1-10.6 GHz. However, owing to the antenna's small size the gain is very low across of the band, varying from -2.6 to 6 dB across the bandwidth.

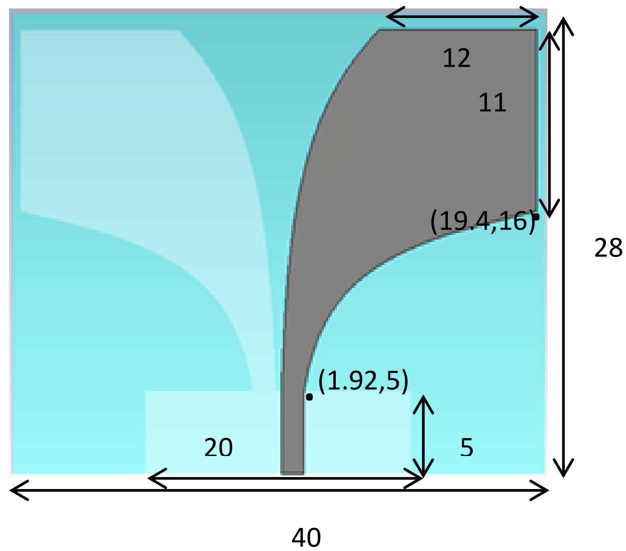

Fig.1.Geometry of the antenna(all dimensions are in mm)

Based on the background of the researches above, this paper is based on antipodal Vivaldi antenna with less dimensions compared to previous researches is proposed that is useful for UWB applications and improvement in gain .The band-notched operation is achieved by etching Ω- shaped slots, and the notch frequency depends on the length of the slots. This band notch useful for IEEE802.11a and HIPERLAN/2 WLAN systems. The stable radiation patterns and constant gain are also obtained. In this paper, a UWB antenna area of 40 x 28mm^2 is first proposed and after by etching, single band-notched characteristic from 5 to6 GHz can be easily obtained. Details of the antenna design and simulation are presented and the measured results are given in order to demonstrate the performance of the proposed antennas.

UWB ANTENNA DESIGN AND RESULTS

Fig. 1 shows the geometry and configuration of a UWB antenna. The antenna (referred to as antenna 1 in this paper) was fabricated on an FR4 substrate with ε_r = 4.4 and loss tangent tan δ = 0.002 and with height h=1.6mm .As shown in the figure, the inner and outer edge tapers of the antennas are defined as

$$X_i=C_s * \exp(k_s*y) \quad (1)$$

$$X_o=C_w* \exp(k_w*y^{sf}) \quad (2)$$

Where X_i and X_o shows the distances from the slot centerline to the inner and outer edges, and C_s , C_w , k_s, k_w,, sf are the constants for FR4 substrate and their values are 0.1mm ,1.5mm ,0.16, 0.001, 2 are respectively.It is found that the input impedance of the fabricated antenna is well matched as the bandwidth covers the entire UWB band (3.1–10.6 GHz).

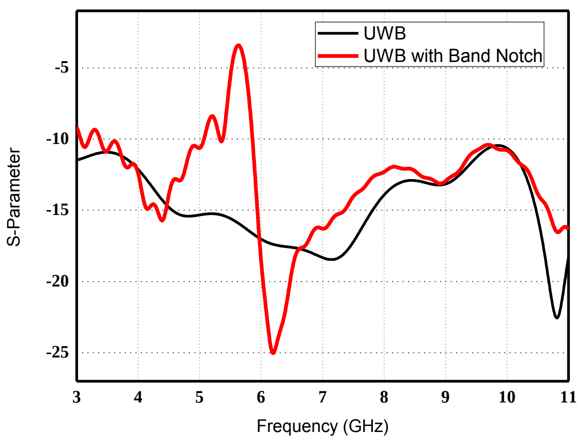

Fig..2. Return loss VS frequency

SINGLE BAND-NOTCHED UWB ANTENNA DESIGN AND RESULTS:

To reduce the interferences from the IEEE802.11a and HIPERLAN/2 WLAN systems, the band-notched function is desirable in the UWB system. Fig. 4 shows the geometry and dimensions of the UWB antenna with filtering property operating in the 5–6 GHz band. By etching Ω- shaped slots in the rectangular radiating patch of antenna 1, a frequency band notch is created. Note that when the band-notched design applied to antenna 1, there is no retuning work required for the previously determined dimensions. fig.2 shows the return loss versus frequency characteristics of both antennas. Return loss provides an estimate of an antenna's fitness; therefore, it is important that the return loss be below -10dB across the entire UWB (3.1-10.6) band. If you observe the return loss it shows that return loss is less -5dB from 5-6 GHz, and notch at 5.6GHz . Performance of the measured and simulated VSWR of both antennas is shown in Fig. 3. it is indicating that in the frequency range 3.1 – 10.6 GHz antenna 1 has VSWR is less than 2 and the other antenna has VSWR < 2 in the entire range except 5 – 6GHz which is desirable for band notch application Fig.3. From the figure 4, it is evident that the desired filtering property is introduced by the Ω- shaped slot as expected. Compared to antenna 1 design, the single band notched UWB antenna successfully blocks out the 5–6 GHz band and still performs good impedance-matching at other frequencies in the UWB band.

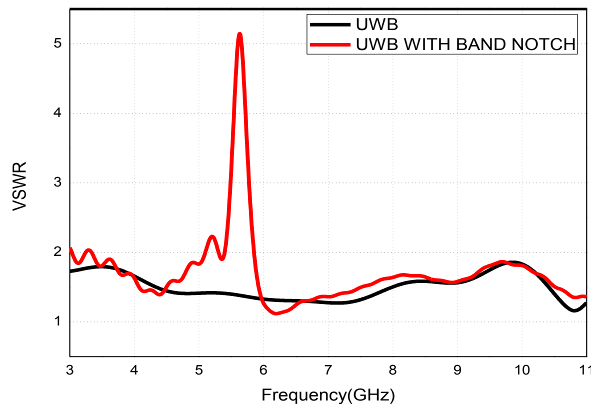

Fig.3.VSWR vs. Frequency

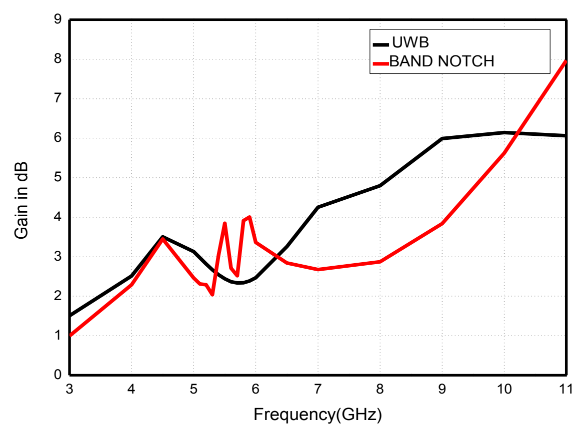

Fig.4 Gain vs. frequency

Fig. 4 presents the measured and simulated gain for antenna 1. The antenna gain in the UWB is about 1.5-6.5 dB.Fig.5 shows the geometry of the antenna by using Ω- shaped slot with dimensions 4 mm, 6 mm, and 9mm.With these slots we have band notch from 5 – 6GHz and the notch frequency is at 5.6 GHz which is dependent on the length of the slots. The notch frequency given the dimensions of the band notched feature can be postulated as

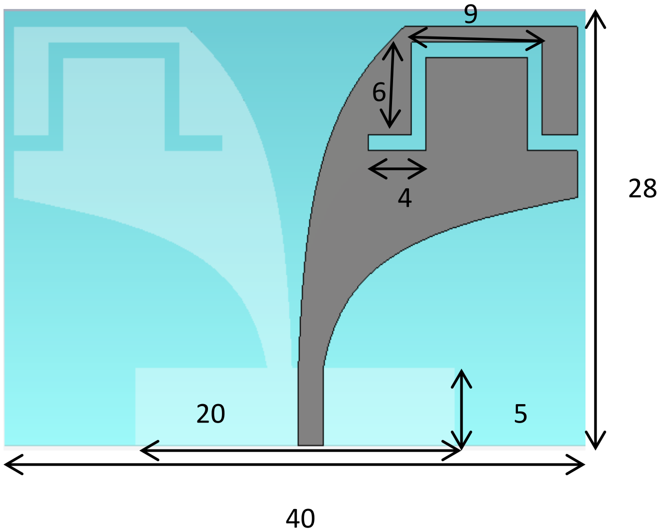

Fig.5. Geometry of the second antenna

$$f_{notch}=\frac{C}{2L.\sqrt{\varepsilon eff}} \qquad (3)$$

Equation 3 represents the notch frequency .Where L is the total length of the Ω-shaped slots which 6mm, ε_{eff} is the effective dielectric constant, and C is the speed of the light. fig.6 and fig.7 shows the simulated far field radiation patterns of the antenna on E(x-y) and H(y-z) planes presents at 4, 7, 10 GHz. Both antennas exhibits omnidirectional radiation characteristics.

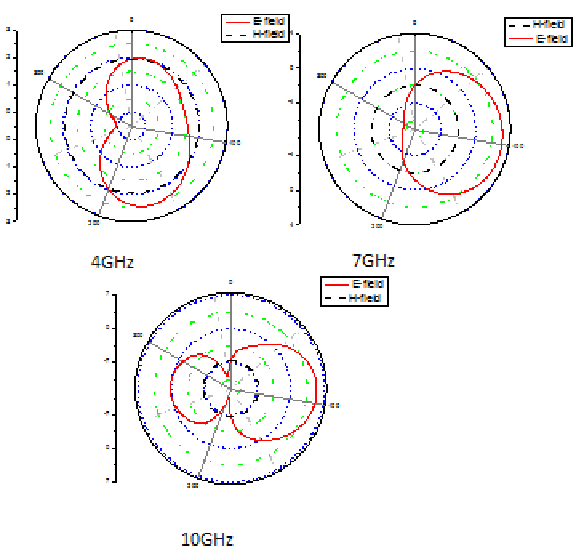

Fig.6.Simulated radiation patterns at of the band notch antenna

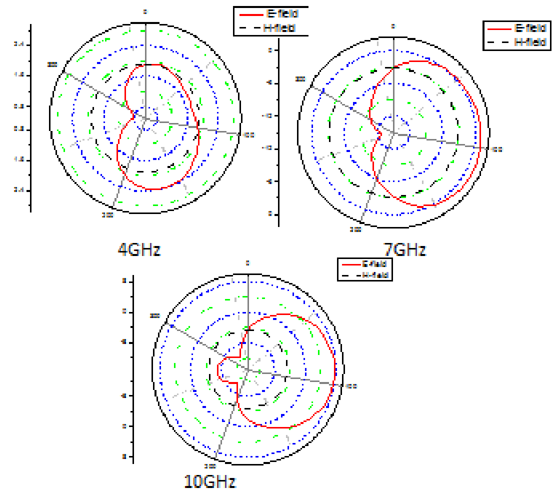

Fig.7 .Simulated radiation patterns at 4,7,10 GHz of UWB antenna.

CONCLUSION

A antipodal Vivaldi antenna and its extended band notched design have been presented.The characteristics of the proposed antennas have been investigated through simulation.The proposed antenna achieved good performance over operating frequency band, furthermore an extended band notch by Ω–shape slot etched in radiating element.

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