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RESEARCH ARTICLE

A VERNAL DESIGN OF MICROSTRIP PATCH ANTENNA FOR 2.4 GHz/ 5 GHz WLAN APPLICATIONS

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Abstract

In this paper, a dual-band microstrip patch antenna for WLAN (2.4 GHz and 5.0 GHz) applications has been designed and results are analyzed using Ansoft HFSS software. Two notches of same dimension are loaded on the top of the patch to enhance the bandwidth and gain of conventional rectangular microstrip patch antenna. The return loss is lower than 10 dB in 2.32 GHz to 2.48 GHz frequency range for lower resonating frequency and 4.8 GHz to 5.1 GHz for upper resonating frequency and gain of the designed antenna is 4.9 dB at resonating frequency 2.4 GHz.

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Introduction:-

Microstrip patch antennas are designed to transmit and receive electromagnetic waves with numerous applications in different fields such as wireless local area network (WLAN) communications, satellite communication, radar, remote sensing, and GPS receivers and find use in other wireless products. Microstrip patch antennas are popular due to their attractive features, such as compactness, planar structure, light weight, and compatibility with integrated circuits [1-5]. Narrow bandwidth is a considerable problem of microstrip patch antennas that restricts its applications. There are various bandwidth enhancement techniques but the simplest one is the loading of different shape and size of slots and notches on the patch or in the ground plane. A number of researchers have reported microstrip patch antennas for WLAN applications such as F-shape microstrip line fed dual-band antenna for WLAN applications [6], M-slot folded patch antenna [7], and W-shaped microstrip patch antenna for wireless applications [8].

In this paper, two equal notches are loaded on top of radiating patch of conventional patch antenna to obtain dual-band behavior for WLAN applications. By selecting proper dimensions and positions of the notches, 3 dB bandwidth improved up to 160 MHz and gain up to 4.9 dB at lower resonating frequency of 2.4 GHz and 300 MHz 3 dB bandwidth at upper resonating frequency of 4.95 GHz. The proposed antenna is optimized using HFSS simulation software and results are discussed in terms of antenna parameters.

Antenna description:-

Designed antenna structure shown in fig. 1 and fig. 2 consist of radiating patch of copper on duroid substrate of relative permittivity 2.2 and having thickness of 1.6 mm. Dual-band behavior with enhanced gain and bandwidth is obtained by providing two equal notches of dimensions L_n x W_n near the radiating edges of patch [1-4]. Antenna Specifications of the proposed antenna is mentioned in Table I.

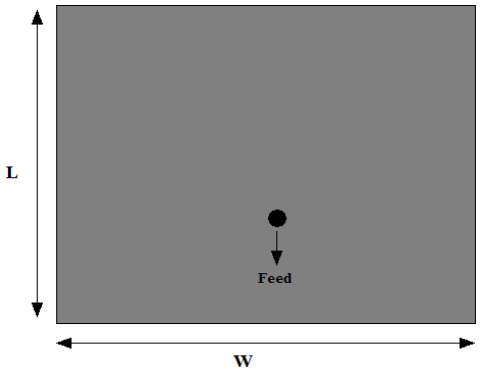


Figure 1. Geometry of conventional patch antenna

Table. I Antenna specifications

Parameter	Specifications
Length of patch (L)	40 mm
Width of patch(W)	40 mm
Substrate thickness(h)	1.6 mm
Dielectric constant of substrate (ε_r)	2.2
Dimension of two notches(L_n x W_n)	28 mm x 2 mm
Feed point (X_0, Y_0)	(0, 6) mm

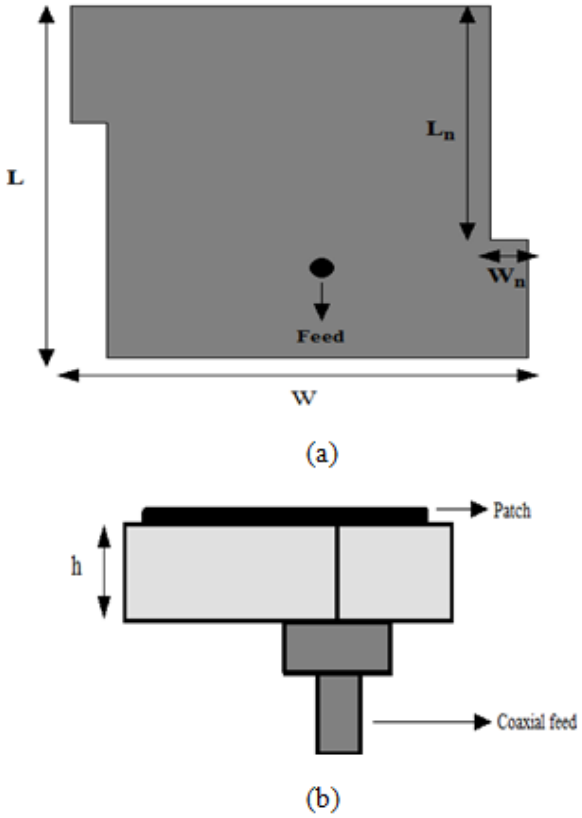


Figure 2. Geometry of proposed antenna (a) top view (b) side view

Results and discussion:-

The proposed patch antenna is simulated using Ansoft HFSS v.13 and simulated results of return loss are shown in figure 3. The return loss of conventional antenna is -27.5 dB at 2.45 GHz with bandwidth of 95 MHz. This low bandwidth of conventional antenna is improved up to 160 MHz by loading two notches, as shown in figure. 2(a), on radiating patch of antenna.

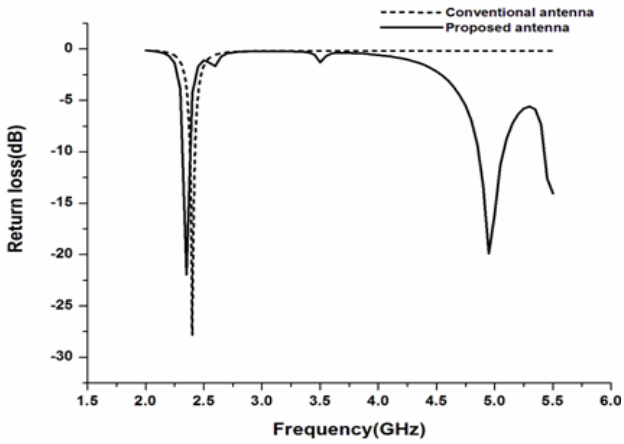


Figure 3. Simulated result of return loss vs. frequency of proposed antenna

By loading the notches a dual-band behavior of proposed antenna is obtained [cf. fig. 3]. A resonant frequency of 2.4 GHz with return loss -22.1 dB, bandwidth 160 MHz and upper resonating frequency of 4.95 GHz, return loss -19.5 dB, bandwidth 300 MHz, is obtained due to these two notches.

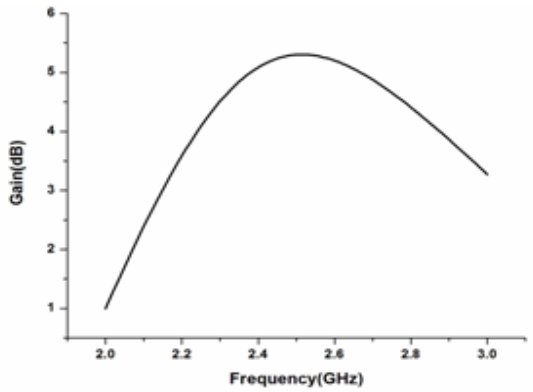


Figure 4. Simulated result of gain vs. frequency of proposed antenna

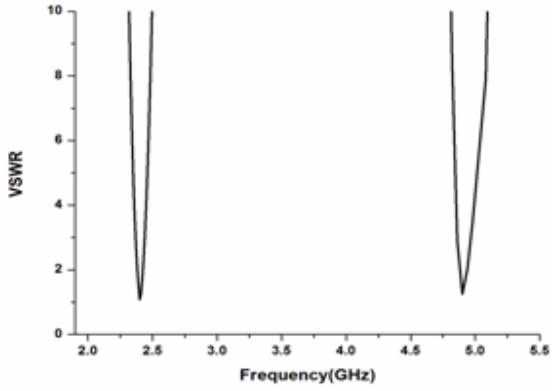
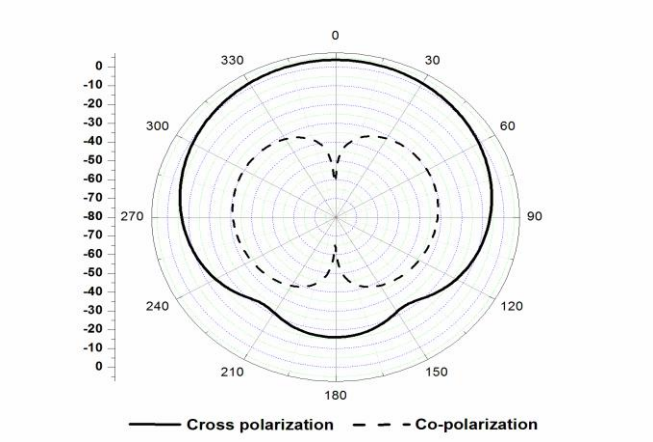
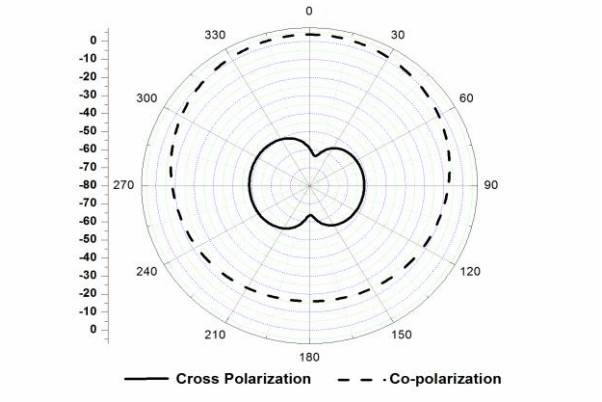


Figure 5. Simulated result of VSWR vs. frequency of proposed antenna

Simulated gain of the proposed antenna as observed in fig. 4, is 4.9 dB at 2.4 GHz. Simulated value of voltage standing wave ratio (VSWR) shown in fig. 5, are observed as 1.07 at 2.4 GHz and 1.2 at 4.95 GHz which are close to unity. The difference between the co-polarization level and cross polarization level of antenna radiation pattern is large, except for E-plane at 4.95 GHz. Fig. 6 (a), (b) and fig. 7 (a) , (b) depicts the radiation pattern in E-plane and H-plane at 2.4 GHz and 4.95 GHz of the proposed antenna. The E-plane radiation pattern at 2.4 GHz shows an omnidirectional pattern, whereas at 4.95 GHz it is nearly omnidirectional.

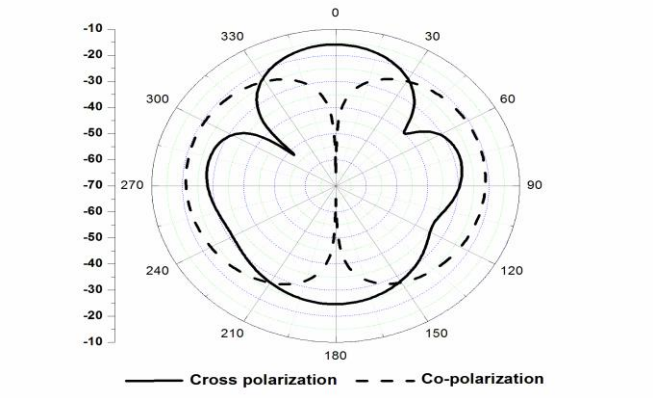


(a)

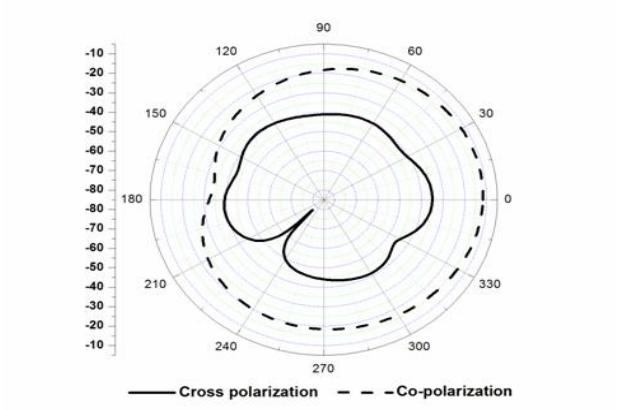


(b)

Figure 6. Radiation pattern of proposed antenna at 2.4 GHz (a) E-plane (b H-plane



(a)



(b)

Figure 7. Radiation pattern of proposed antenna at 4.95 GHz (a) E-plane (b) H-plane

Conclusions:-

Design of a microstrip patch antenna operating at 2.4 GHz and 4.95 GHz, dimensions of 40mm x 40mm x 1.6mm with two equal notches is presented. The results are simulated using Ansoft HFSS software, the effect of notches has been studied and we have obtained the good results for the design frequencies. The designed microstrip patch antenna is simple, compact and can be easily integrated in MMIC. The antenna can be used for WLAN applications.

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