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Probe Feed Rectangular Microstrip Patch Antenna for1.5 GHz WLAN Application

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Abstract

In this paper the design of coaxial probe feed one layer microstrip patch antenna (MSA) . for 1.433 GHz WLAN application is presented, The impedance equivalent and the radiation physiognomies of this proposed assembly are planned and analyzed. by CPU Simulation Knowledge (CST) Microwave Studio. which is a commercially obtainable electromagnetic simulant founded , on the technique of fixed change time sphere method to attain. the wanted specification, The projected antenna founded on coaxial probe feed structure has the supreme possible bandwidth gotten. around 9.3 MHz -10 dB replication coefficient which agrees to WLAN 1.433 GHz frequency band, the supreme possible gain is 4.48 dB. Stable radiation physiognomies exist found crossways the frequency band .

Keywords: WLAN, Impedance Bandwidth. Coaxial probe feed, Microstrip Patch Antenna (MSA), CST Deep awake Studio

1-Introduction

The growing of wireless methods and successful claim for a change of new wireless applications, such as WLAN (Wireless Resident Space Network). It is significant to design broadband and high gain antennas, to shelter a wide incidence range. The design of an effective extensive, band small size antenna aimed at current wireless applications is a main challenge. In claims like extraordinary performance aircraft, satellite, missile, moveable receiver, wireless infrastructures minor size, low-cost fabrication and small profile. Conformability and security of connection and addition with feedstuf nets are the central constraints, Also. with development of the machinery the condition of an antenna to resound at added than one frequency i.e. multi-banding. is similarly collective generation through day. Here microstrip patch antenna is the best select to fulfill all the overhead requirements, Along with that a microstrip patch antenna proposals numerous advantages above other conservative antennas similar small manufacture, cost chains both line as well as spherical polarization etc. Microstrip patch antenna have some difficulties also like superficial groundswell excitation. Narrow bandwidth etc, but bandwidth of a microstrip patch antenna container be improved by different systems similar cutting U-slot [1]. Amassed the substrate height diminishing $\varepsilon\varepsilon_{rr}$ of substrate etc. Antenna collection can also be recycled to advance the bandwidth [2], here. Near start with a artless microstrip patch antenna by coaxial feed is calculated [3-4], in this feeding technique, the internal conductor of the coaxial connector covers from ground complete the substrate and stays soldered to the radiating patch. Though the outside conductor spreads since ground up to substrate, The main advantage of this kind of feeding arrangement is that the feed container be located at any wanted location confidential the patch in order to correctly competition with its response impedance. This feed technique is easy to construct and has low false radiation, however. Its main drawback is that it affords narrow bandwidth and stands difficult to classical since a hovel has to be bored in the substrate and the connector projects outside the ground plane. Thus not making it totally planar for profuse substrates. But the bandwidth can be better by various means written above. Recently many microstrip patch antenna for dissimilar applications with coaxial feed have remained presented. Figure 1 expressions the coaxial feeding technique, further the details, of the wished-for design presentation are obtainable and discussed (1).

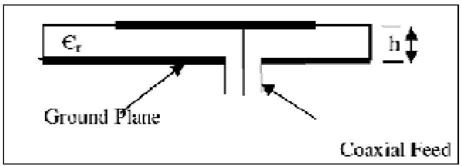


Figure 1. Coaxial feeding method.

2- Literature Review

In 2009, researchers Thomas and Sreenivasan [3]. Design a low-cost model for a three-band thin tape antenna for WiMAX / WLAN network applications. The antenna is made up of a radioactive patch in the form of a rectangle fed through an asymmetrical 50 Ω impedance supply line and the ground plane is trapezoidal. Horizontal rectangular segments extend over the radiator to generate different pathways, making the antenna compatible with the WiMAX / WLAN frequencies where each Monopole as the total antenna dimensions (38 × 30 × 8) mm3. In 2010 the researcher Dang et al. [4]. (35 x 30 x 1.6) mm3 The antenna works in three packs and has a simple installation compared to three-band antennas, consisting of a linear chip connected to the feed line. The type of chip is printed on a layer of Insulation The ground level contains some cracks. For the purpose of verifying the validity of the design, it was printed in practice and practical measurements were made. The results showed that the antenna works at high frequency at three frequencies of 5.6 GHz with a 1300 MHz band width. In 2011 the researcher Koo et al. [5]. Designed a model of a thin tape antenna with a double-shaped U-shaped patch printed on a layer of

FR-4 insulation and fed in a line-width pattern with a 50 Ω input impedance. Total antenna size (39.5 x 27 x 0.8) mm3 The antenna works in three different packages to cover WiMAX network applications. The antenna has been practically implemented and the practical results of its radiative properties are observed from the compatibility of the impedance and the radiological pattern of the antenna.

3-Antenna Design

Figure 2 expressions the geometry of planned coaxial feed microstrip patch antenna with lone band act for WLAN application. The antenna is eager through coaxial feed line designed for a 50 ohm typical impedance and is published on substrate with a thickness of 0.02 mm, dielectric constant of 4.3 and Height of substrate, (h) [6]. 1.6mm, Length of the patch, (L) 48.18mm and Width of the patch and (W) 61.42mm and point of the feed, (Xf) 1/3 mm and Rduis of the coxiale probe and (ro) 2.5 mm and rduis of the pin,(ri) 0.5mm which is actual much local to 50 ohm. This has stood done through smearing parametric sweep for detecting the feed point in the filled variety of x-axis in the space of transitory solver. Proper impedance alike continuously yields the best required result[7].

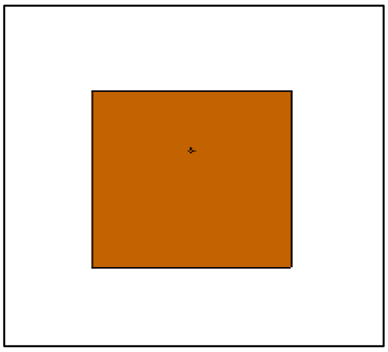


Figure 2. Front sight of projected microstrip patch antenna

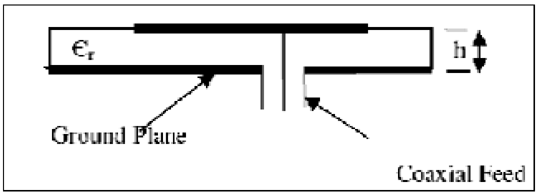


Figure 3. Bottom sight of the projected microstrip patch antenna

As the projected antenna is coaxial feed so [8], we can sight outer and internal conductor of the coaxial suckle line very undoubtedly in the overhead diagram.

Calculate design dimensions

The width of the square is calculated according to the following equation

$$W = \frac{1}{2f_o\sqrt{\mu_o\varepsilon_o}}\sqrt{\frac{2}{\varepsilon_r+1}} = \frac{c}{2f_o}\sqrt{\frac{2}{\varepsilon_r+1}} \quad ....(1\text{-}2)$$

F : represents the antenna frequency of the antenna.

E_o : represents the relative insulation constant of the vacuum.

M_o : represents the relative permeability of the vacuum.

E_r : represents the relative insulation constant of the substrate material.

C : represents the velocity of light by vacuum.

$L= L_{eff} - 2\Delta L$ ....(2-1)

ΔL : represents the difference between the physical and electrical

length of the patch.

L: is the physical length of the patch.

4-Simulation Results

Simulation educations of planned antenna stated here are carried out by CST Microwave Studio, figure 4 expressions the simulated repetition coefficient (S_{11}) of the projected antenna in dB. S_{11} gives the replication coefficient at seaport 1 where we smear the input to the microstrip cover antenna. It would be fewer than -10 dB for the suitable operation. It expressions that the projected antenna resounds at frequency equivalent to 1.433GHz which stretches the amount of the wideband typical of the patch antenna. The replicated impedance bandwidth of about 9.3 MHz, is realized at -10 dB replication coefficient (VSWR≤2). The replication coefficient value that remains achieved at this booming frequency is equal to -4.48 dB. This replication coefficient value proposes that there is respectable matching at the frequency opinion under the -10 dB region, it shelters the frequency band for the WLAN application. The height of the ground which is underneath the substrate and completed of PEC mental is occupied to be three eras the thickness of substrate for simulation resolutions i.e. 3×1.6mm , of the patch which is also completed of measureable PEC (Picture-perfect Electric Conductor) is 0.02mm. The projected antenna is feed through coaxial cable with a typical impedance of 50 ohm. So, the outside conductor (from bottommost of ground toward upper of ground) is completed of substrate measurable and outer conductor (from bottommost of ground to upper of patch) is completed of PEC material. The internal and outside radius of coaxial probe is 2.5 mm,The feed point for the projected antenna remains found to be (1/3) where the greatest impedance corresponding of 49.5 ohm has remained achieved.

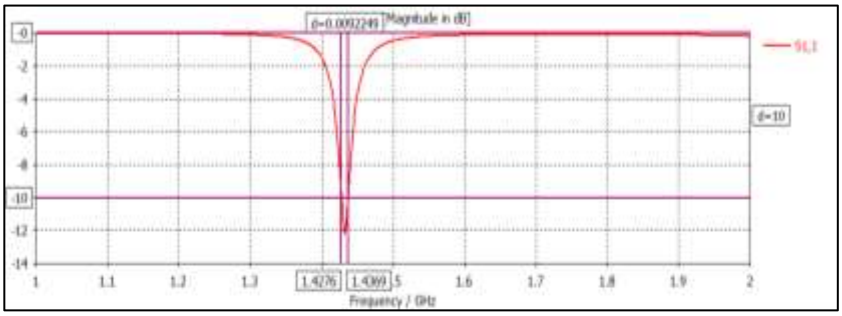


Figure 4. Sham replication coefficient [S11] of the projected microstrip patch antenna.

Figure 5 expressions the smith chart of the projected antenna. It is a graphical symbol of the regularized representative impedance. The Smith chart is one of the greatest beneficial graphical tackles for great frequency circuit applications, the goalmouth of the Smith chart is to organize all conceivable impedances on the dominion of presence of the replication coefficient.

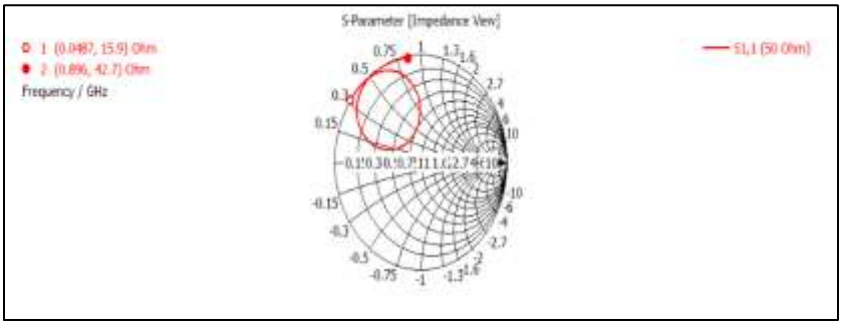


Figure 5. Smith chart of the projected microstrip patch antenna.

Radiation design is a graphical representation of the qualified field forte transmitted from or conventional by the antenna. The antenna would not have the lateral sections and back parts ideally. We cannot eliminate them totally but we can minimize them. Figure 6 expressions the simulated 3-D radiation pattern with directivity of 6.99 dBi for projected antenna shape at the hollow frequency of 1.433 GHz.

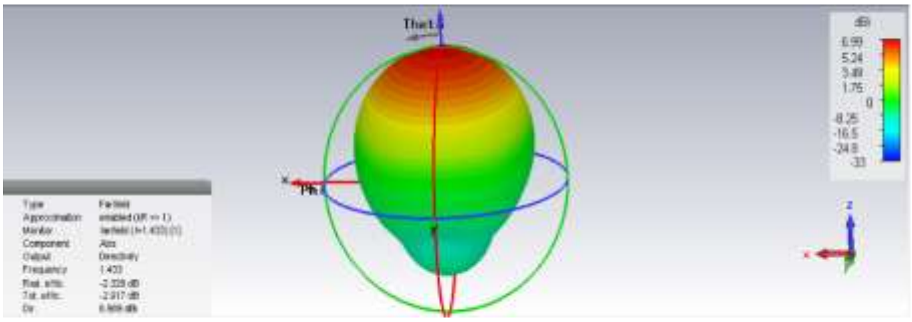


Figure 6. 3D Radiation design for ff_{rr} =1.433 GHz

Figure 7(a) and (b) expression the replicated E-plane (phi=90º, theta=varying) and H-plane (theta=90º, phi=varying), radiation designs for projected probe shape at the hollow frequency of 1.433 GHz.

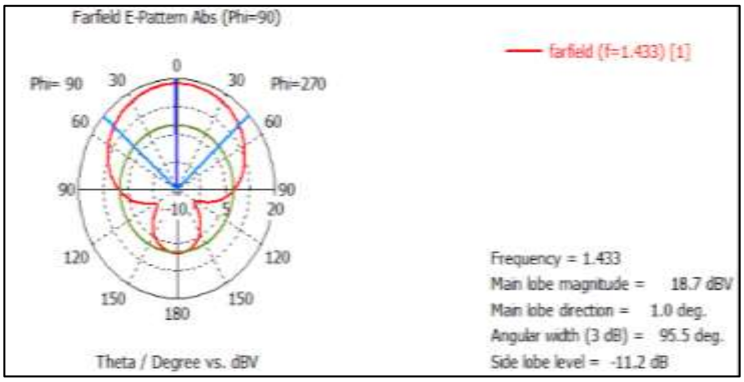
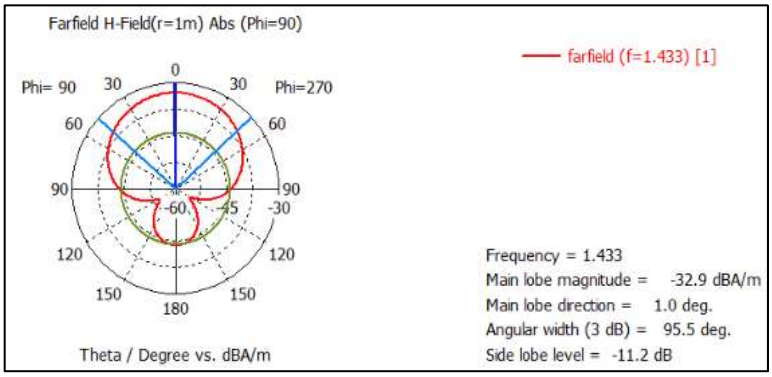


Figure 7.(a) E-plane radiation design for ff_{rr}=1.433GHz



(b) H-plane radiation design for ff_{rr} =1.433 GHz.

Figure 8 expressions the VSWR (voltage stand-up wave ratio) plot for the planned antenna. The value of VSWR would story between 1 and 2. SWR is castoff as an competence measure designed for transmission lines electrical cables, that behavior wireless frequency signals, castoff for determinations such as concerning wireless spreaders and phones with their antennas, and allocating cable television signals. Here the value of the VSWR for the projected microstrip patch antenna is 1.6897414 at the stated deep frequency. The accomplished values of replication coefficient and VSWR are small sufficient and frequency is closed sufficient to stated frequencies bands for 1.433 GHz WLAN application. The maximum attainable gain is 4.48 dB at the hollow frequency of 1.433 GHz.

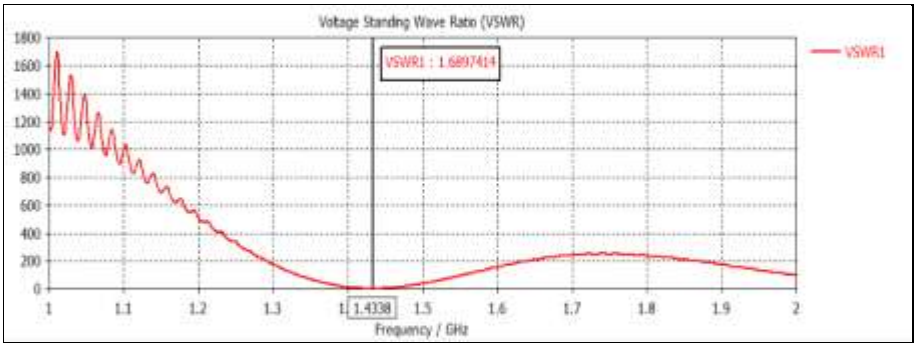


Figure 8. VSWR design for the projected microstrip patch antenna

Figure 9. expressions the surface current delivery for the hollow frequency of 1.433 GHz, the dimensions of patch are wholly accountable for the radioactivity and manufacture the project possible for an request in 1.433 GHz WLAN standard. The feed point is situated such that an outstanding impedance matching of about 50 ohm is obtained.

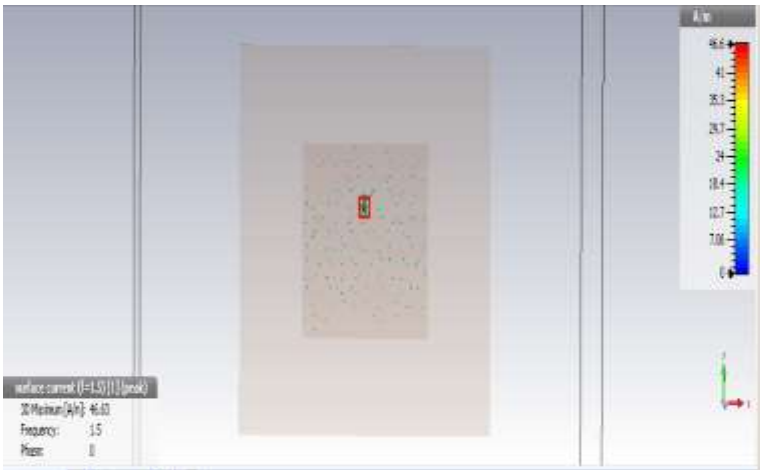


Figure 9. Surface current delivery for ff_{rr} =5.244 GHz

5-Discussion

In this study, a humble coaxial feed microstrip patch antenna, for request in 1.433 GHz WLAN frequency band has remained confirmed and applied by CST

Microwave Studio software. The projected antenna is planned to function at 1.433 GHz WLAN frequency band. It container be experiential that the attainable impedance bandwidth of 9.3 MHz at the hollow frequency of 1.433 GHz is gotten due to appropriate impedance corresponding at the improved feed point on the design. The replication coefficient attained at the reverberating frequency is equal to -11.8 dB. It can be observed that satisfactory attack radiation design is got at the hollow frequency of 1.433 GHz . In this projected project a gain of 4.48 dB has remained examined for the frequency of 1.433 GHz. The worth of gain is not good sufficient for an satisfactory operation. We container added study this calculated construction through wounding dissimilar openings on the patch. We container also understand the power of holes on the dissimilar antenna parameters hip future.

6- Conclusion

In this study a humble coaxial feed microstrip patch antenna for request in 1.433 GHz WLAN frequency band has stood established, and applied by CST Microwave Studio software. The projected antenna exhibitions a bandwidth of about 9.3 MHz at -10 dB likeness constant which relates to 1.433 GHz WLAN standard. The maximum doable gain is 4.48 dB with the conforming likeness number of -11.8 dB. The suitable impedance corresponding of the projected antenna is accomplished by correcting the coaxial feeding structure, in addition. the projected antenna expressions a well defined steady radioactivity pattern done the band which types the project appropriate for wireless communication applications. Though this antenna was deliberate for WLAN band application, the project thought can be protracted to extra frequency bands of attention by wounding several openings on the patch or in the ground, thus manufacture the ground a absconded ground structure. Effort is working on to become smooth healthier fallouts with amplified gain and bandwidth and manufacture this project cover other WLAN bands also through creation this structure a multiband one, also. unpaid to the absence of fabrication amenities by our institute. This project is motionless not made-up which is a hole for this paper and also a following purpose for us.

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تصميم هوائي شريطي مستطيل يعمل بتردد رنيني 1.5 GHz وتغذيته بواسطة الكيبل المحوري

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قسم الفيزياء ، كلية العلوم ، جامعة تكريت ، تكريت ، العراق

الملخص

في هذا البحث يتضمن تصميم هوائي شريطي دقيق احادي الطبقة ويتم تغذيته بواسطة الكيبل المحوري ويعمل بتردد رنيني قدره (1.433 GHz) في نظام تحديد المواقع. وأن الخصائص الفنية للنموذج المقترح، مثل موائمة الممانعة وغير ذلك قد تمت دراستها وتحديدها بأستخدام برنامجCST أصدار 2014 المتوفر تجارياً. ويعتمد النموذج المقترح على نظام تغذية بأستخدام الكيبل المحوري, وله أقصى عرض حزمة ممكن أنجازه والحصول عليه 9.3 MHz وله معامل أنعكاس يتطابق مع نظام تحديد المواقع الذي يعمل في تردد 1.433 GHz. وتم تحديد كسب الإشارة 4.48 dB ، وكذلك تم الحصول على خصائص الأشعاع المستقرة عبر حزمة التردد التي تم حسابها.