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A Corporate-Fed H-ShapedPatch Antenna With UIR's For Wi-Fi / Wi-Max Applications

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ABSTRACT

The wireless communication systems are developing and gaining a wide interest in designing RF components like antennas and filters with special features. Here a microstrip patch antenna for WiFi and WiMax applications is proposed. The antenna is H-shaped with uniform impedance resonators along both sides of the patch. The proposed antenna resonated at both the desired frequencies 2.2 and 3.4GHz. The antenna parameters like radiation pattern gain and VSWR is analyzed for the proposed antenna. From the analysis the antenna was found to have < 2 in both the frequencies. It achieved about 1.6dB at 3.2GHz and 1.7dB, 1.1dB at 2.2 and 2.4GHz respectively. It also achieved an omnidirectional pattern, which helps the antenna to radiate in all directions. The reflection loss in the proposed antenna was found to be minimum of about -15.8dB at 2.2GHz and -31dB at 3.4GHz. the overall size of the antenna is taken to be 45x45x1.6mm^3.

Key words : Microstrip, H-shape, Wi-Fi, Wi-Max, omnidirectional, corporate-feed, gain.

1. INTRODUCTION

In the latter years, the possibility of using wireless applications like Wi-Fi/Wi-max are playing a major role in mobile applications. Designing RF antennas for these applications are tedious process. Microstrip antennas are attractive due to their light weight, conformability and low cost [1-5]. These antennas can be integrated with printed strip-line feed networks and active devices. This is a relatively new area of antenna engineering. The radiation properties of microstrip structures have been known since the mid 1950's. The application of this type of antennas started in early 1970's when conformal antennas were required for missiles.

Microstrip patch antennas have a very high antenna quality factor (Q). It represents the losses associated with the antenna where a large Q leads to narrow bandwidth and low efficiency. Q can be reduced by increasing the thickness of the dielectric substrate. WiMAX stands for Worldwide Interoperability for Microwave Access [6-7]. It was introduced in 2001. IEEE802.16 is the standard of WiMAX [9]. It is an advancement of Wi-Fi technology [9]. And also it covers area larger than Wi-Fi. We can get nearly 1GB speed for fixed users by using current WiMAX technology.

The previous researchers have tried many structures. U slot microstrip array antenna was proposed for WiMAX base station. They have used quarter wave impedance transformer which didn't give desirable impedance matching [1].Y shaped slot and U slot were proposed symmetrically and asymmetrically in order to achieve WiMAX coverage. They were achieved 15 dB of return loss [2]. A reconfigurable microstrip patch array antenna which was achieved by integrating the conventional microstrip antenna with switches. Here patches were movable by helping of RF switch [3].

In pi-shaped slot antenna the substrate thickness was increased to broaden the bandwidths at desired operating frequencies [6].One L-slit and one H-slit were introduced in patch antenna. The antenna size had been reduced by 75% when compared to conventional antenna [7]. A double U slot microstrip antenna was used for mobile WiMAX application. But they were achieved nearly -16dB of return loss only. One of the drawbacks was complicated antenna structure [9].

Here a H-shaped microstrip resonator also called as microstrip patch antenna is proposed with two L-shaped uniform impedance resonators in opposite phases have been discussed. A 50Ω microstrip feed-line has been used. The feed line is divided like corporate feed inorder to divide the power equally in two vertical sides of the H-shaped patch.

2. DESIGN OF H-PATCH ANTENNA

The design procedure is carried out using the transmission line model of microstrip patch antenna[10,11]. The length and width of the patch antenna is taken as 35mmx35mm. The height of the dielectric medium is chosen to be 1.6mm. The dielectric used here is Teflon based material which had relative permittivity value(ε_r) of 2.08.

The proposed antenna is shown in figure 1. The dimensions are taken as discussed above. The H-patch is included with two uniform impedance resonators, which has equal impedance value throughout the structure. The resonators are used here in-order to achieve the desired bands, since usage of resonators helps in resonating at the desired frequency.

The proposed structure was simulated using FEM based Ansoft HFSS simulator.

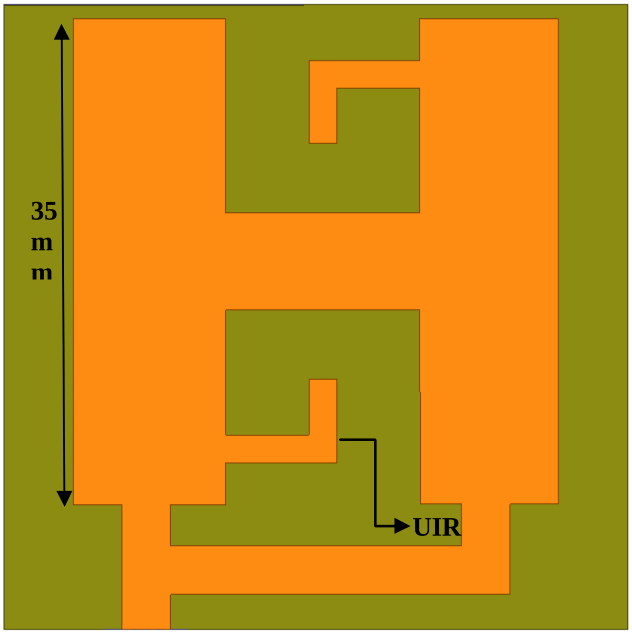

Figure.1. Proposed H-Shaped Microstrip Patch with UIR's.

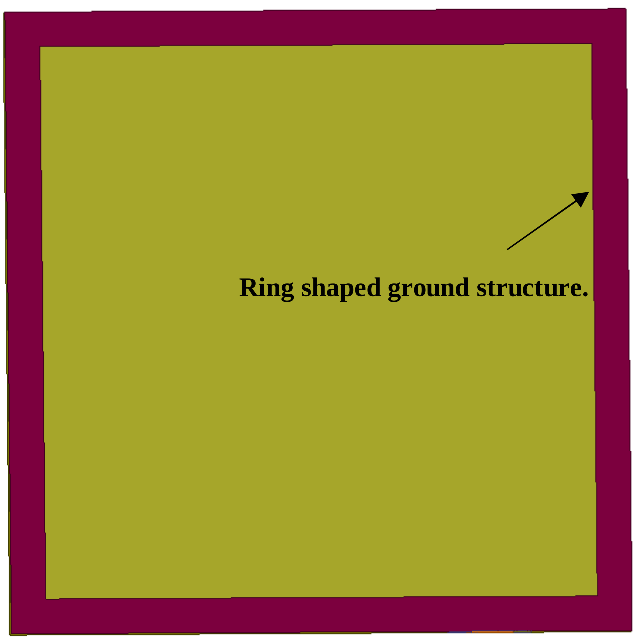

Figure 2. Bottom View of the proposed structure.

3. RESULTS AND DISCUSSIONS

A. Design and Simulations

The design was considered to have two divisions in the strip and it was exited with a full port impedance(Z_c) of 50Ω. The two vertical planes are equally fed. The patch antenna was simulated and the output is shown in figure 3. The proposed patch antenna had a ring shaped ground structure which effectively increased the bandwidth and helped in attaining multiple frequencies in a single patch, which is shown in figure 2.

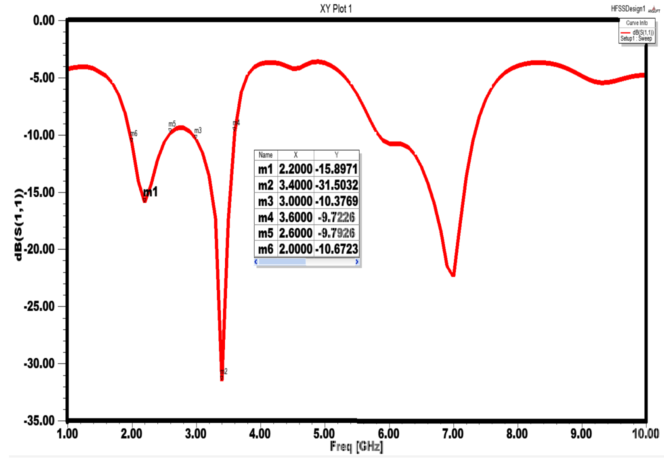

Figure3. Simulated Result of the proposed structure.

The simulated result shows that the antenna resonated at 2.2GHz and 3.4GHz, with a return loss S_{11} of -15.8dB and -31.5dB respectively. The band covered both the frequencies 2.4GHz and 3.5GHz respectively which are the frequencies for wi-fi and wi-max applications.

The individual gain of the proposed antenna is shown in figures 4 and 5 for the corresponding frequencies 2.2,2.4,3.2GHz which had a maximum gain of 1.1dB,1.7dB and 1.6dB respectively.The antenna achieved an omnidirectional pattern which is shown in figure 6. The major lobe occurred at $\theta_{major}=0^0$. The maximum radiation lobe occurred at $\theta_{(major)\ max}=30^0$.

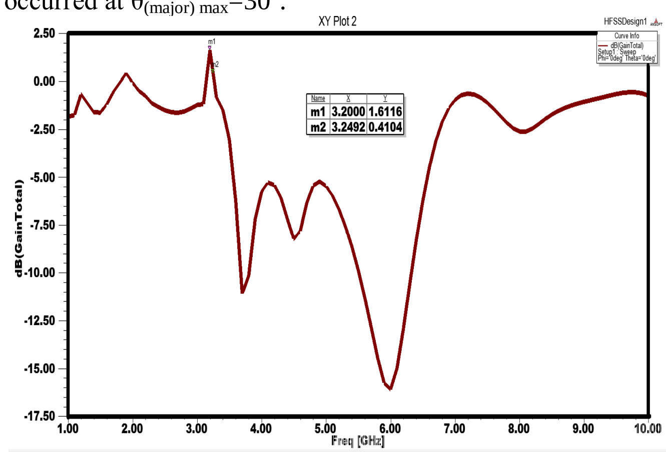

Figure 4. Simulated individual gain pattern at $\theta=0^0$ for 3.2GHz.

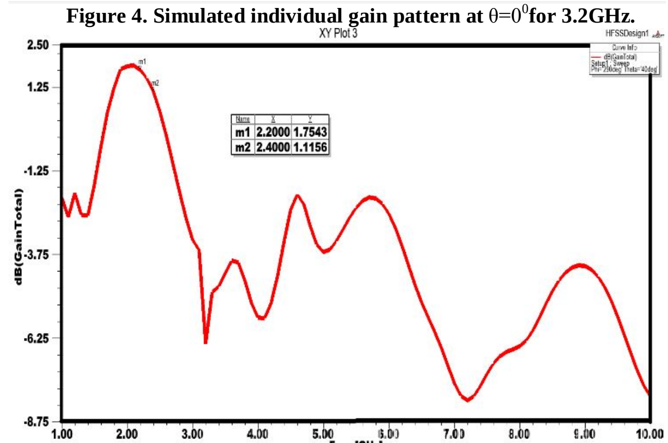

Figure 5.Simulated individual gain pattern at $\theta=40^0$ for 2.2 & 2.4GHz.

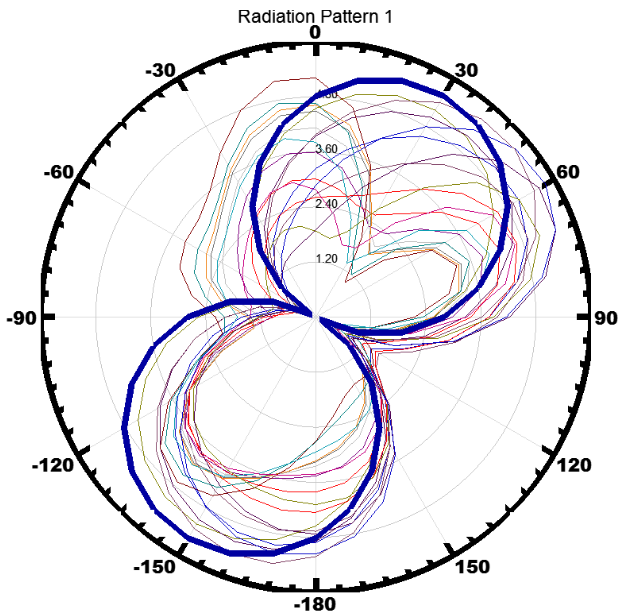

Figure 6. Radiation Pattern of the proposed antenna where $\theta_{(major)max}=30^0$, which is an omnidirectional pattern.

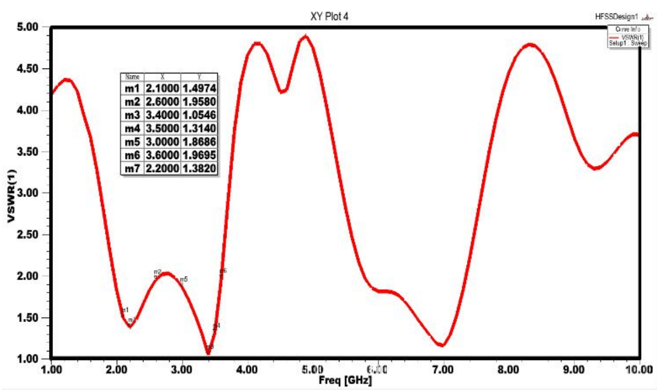

Figure 7. Simulated VSWR values for individual frequency 2.1GHz,3.4GHz.

The value of VSWR of the proposed antenna is shown in figure 7. It shows that the value of VSWR has a minimum value <2 at the desired range of resonant frequencies.

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4. CONCLUSION

This paper proposes a H-shaped microstrip patch antenna with two uniform impedance resonators on either side of the H patch which are oppositely phased. The antenna resonated at the desired frequency ranges 2.2GHz, 3.4GHz which covered the bands of Wi-Fi, Wi-Max applications. Antenna operating at multiple frequency bands are gaining wider concentration with miniaturized size. Hence this proposed antenna is of size 45x45x1.6mm^3 which is of compact size for the above mentioned wireless applications. The antenna achieved a minimum value of VSWR <2, which stands as a proof for reduced reflection of the signal. The S_{11} value is less than -10dB and the gain at the resonant frequencies had a maximum value of 1.7,1.1,1.6dB at the frequencies 2.2, 2.4 and 3.6 GHz,respectively.

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