Optimizing and Improvement Performance of Dual Band CPW-fed Monopole Antenna

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ABSTRACT

In this paper, A compact dual-band CPW-fed monopole antenna is simulated to improve its performances. The simulation is done using ADS software. The improvement include return losses, bandwidth, and VSWR. The simulated antenna effectively covers both 2.4 GHz (2.12–2.835 GHz) and 5.8 GHz (4.79–5.901 GHz) bands. The simulation results show the effectiveness of the improvement when they are compared with data published in open literature.

KEYWORDS: Monopole, CPW-fed, dual band, WLAN.

1 INTRODUCTION

Over recent years wireless communication system have evolved to use multiple technologies and protocols. In most of these systems small terminals such as cellular phones and base stations work simultaneously in different frequency bands, and for this reason multiband antennas are desirable. With the rapid development of short range radio links, such as wireless local area network (WLAN), there are increasing demands for antennas having compact single and multi-band operations.

For wireless local area network (WLAN), the operating frequency may be available at different bands, including the 2.4 GHz band (2.4-2.5GHz) and the 5GHz band (5.1-5.9GHz). Since these standards may be simultaneously used in many systems, there is a need for designing a single antenna that can cover all these bands.

Several papers has been published on various key design configurations for dual band operation, including a monopole antenna fed with a meandered coplanar waveguide [1], CPW-fed tapered band folded monopole antenna [2], printed monopole antenna with a trapezoid conductor–backed plane [3], CPW-fed monopole antenna with a cross-slot for WLAN operation [4], flared monopole-antenna with a ’v’ shape sleeve [5], dual-band annular-ring slot antenna[6], compact disc slit monopole antenna [7], and a non-uniform meandered and fork-type grounded antenna (NMFGA) for triple-band WLAN [8].

Recently, a simple structure of a single metallic layer monopole antenna with coplanar waveguide (CPW)-fed has become very popular in wireless systems, owing to its many attractive features such as, wider band width, light weight, low radiation loss, a simple structure of a single metallic layer and easy integration with WLAN integrated circuits.

In this paper, the architecture antenna proposed by [9] is studied to improve its performance.

The ADS software is used to simulate the antenna. The simulated results are presented, discussed, and compared with data published in [9].

2 ANTENNA CONFIGURATION

The geometrical configuration of the simulated compact dual band CPW-fed planar monopole antenna for achieving dual band operation is shown in Figure 1. The simulated antenna is printed on only one side of an FR4 microwave substrate with the substrate thickness of 1.58mm, the dielectric constant of 4.4, and loss tangent of 0.01, while the other side is without any metallization. The longer path is mainly control the lower operating band of the antenna. Alternatively, the upper resonant frequency is excited to be greatly dependent on the smaller path.

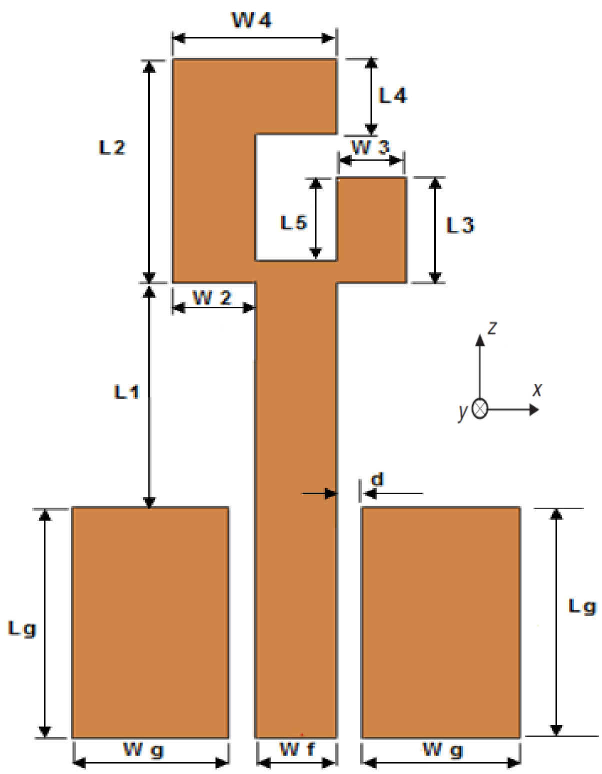


Figure 1. Geometry of the simulated antenna

The monopole is printed on one side of the substrate and fed by a microstrip feed line of width 7.025 mm. The feed line is excited by an SMA launch connector.

The layout dimensions of the designed antenna for operation around 2.4 GHz and 5.8 GHz range are L1 = 23.5 mm, L2 = 19.1681 mm, L3 = 9.0332mm, L4 = 6.3893 mm, L5 = 7.2706 mm, W2 = 7.0503 mm, W3 = 6.0589 mm, W4 = 14.4312 mm, the substrate dimensions are L = 80 mm and W = 60 mm with two equal finite ground planes, each with dimensions of length Lg = 19.6088 mm and width Wg = 13.7702 mm.

3 RESULTS AND DISCUSSION

The simulated return loss for the proposed antenna is shown in Figure 2. It is clearly seen that two wide bandwidths are obtained. The lower resonant frequency is 2.406 GHz, and the upper resonant frequency is 5.792 GHz.

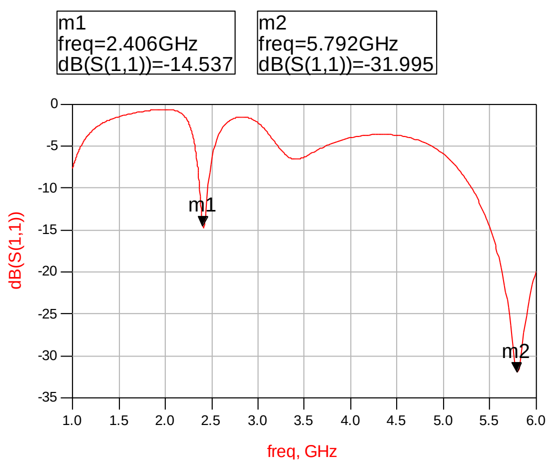


Figure 2. Simulated Return losses

In the 2.4 GHz band, the -10 dB impedance bandwidth is 715 MHz ranging from 2.12 GHz to

2.835 GHz, and the relative bandwidth is 5%. While the absolute frequency bandwidth of the upper band reaches 2.11 GHz ranging from 4.79 GHz to 6.901 GHz, and the relative bandwidth is 41.5% referred to the center frequency of 5.845 GHz.

The simulation results of dual-band miniaturized printed monopole antenna for wireless local area network (WLAN) are summarized as in Table 1.

Table 1. The parameter The simulated results of dual band monopole antenna

Resonant frequency (GHz)	Return loss (dB)	Gain (dBi)	Bandwidth (%)	VSWR
2.4	-14.7	2.39	5	1.43
5.8	-31.995	5.44	41.5	1

In Figure 3 clarify to the return loss on the smith chart and to clarify process the matching of the antenna, in other words agree the input impedance with impedance of Patch

Figures 4 and 5 show the simulated far field radiation patterns in the xz, and yz planes for the two resonant frequencies. Nearly good omnidirectional patterns have been observed in the yz-plane (H-plane), and the patterns in the xy plane (E-plane) are close to bidirectional.

The comparison between the simulated results of this work and the data published in [9] is summarized in Table 2. From this comparison, we note that the performance of the dual band monopole antenna is improved, where the gain of the simulated antenna is increased by 1.09 dBi, and 3.41 dBi at 2.4GHz and 5.8GHz respectively. At 2.4 GHz VSWR, and return loss are the acceptable values to meet requirements of WLAN applications. While at 5.8 GHz the value of the parameters is strongly enhancement, where VSWR is decreasing from 1.5 to 1, that is mean perfect matching, the return loss is enhanced by 12.83 dB, and the bandwidth increase by 8.15%, and the gain is improved by 3.14 dBi.

Table 2. Comparison of results [9] and ours

Parameters	Result this work		Result [9]	
	2.4GHz	5.8GHz	2.4GHz	5.8GHz
VSWR	1.43	1	1.2	1.5
S11 (dB)	-14.7	-31.995	-30.1	-19.157
Bandwidth	5%	41.5%	5.8%	33.35%
Gain (dBi)	2.39	5.44	1.3	2.3

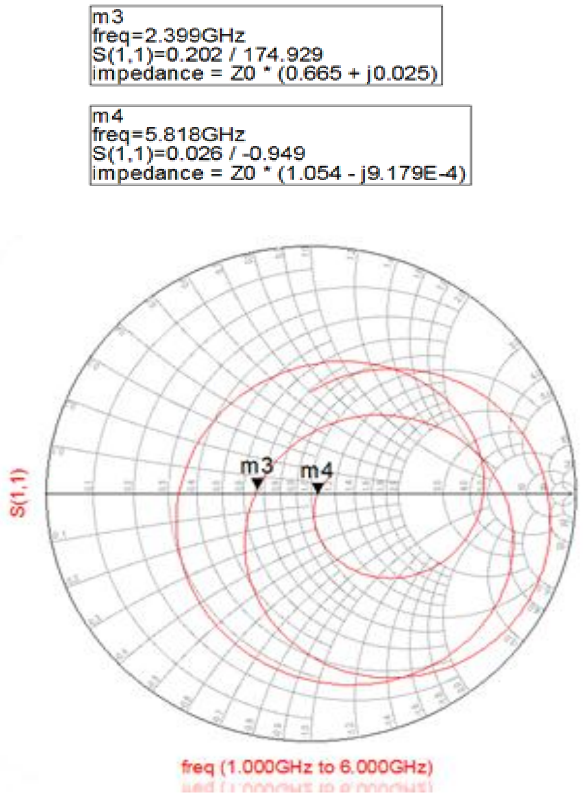
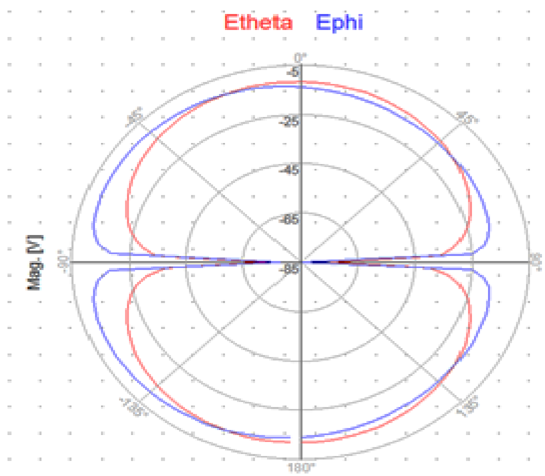
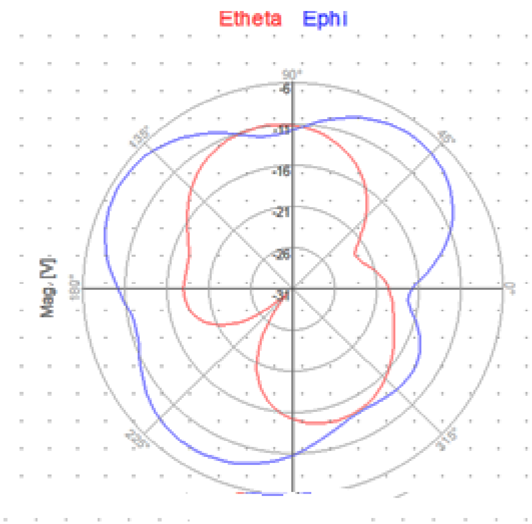


Figure 3. Simulated return loss representative on the smith chart

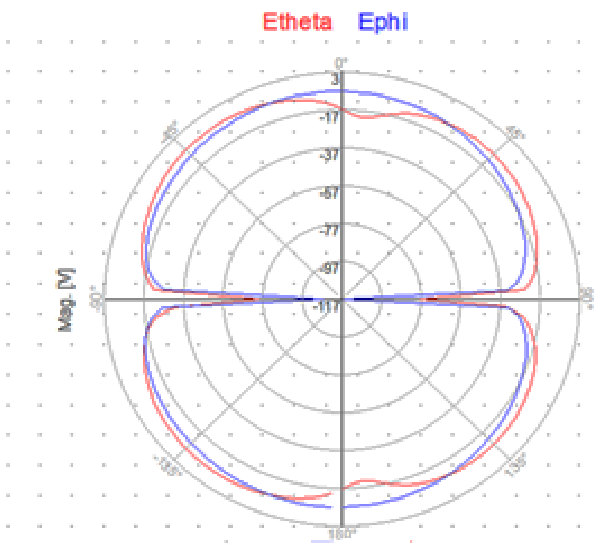


x-z plane

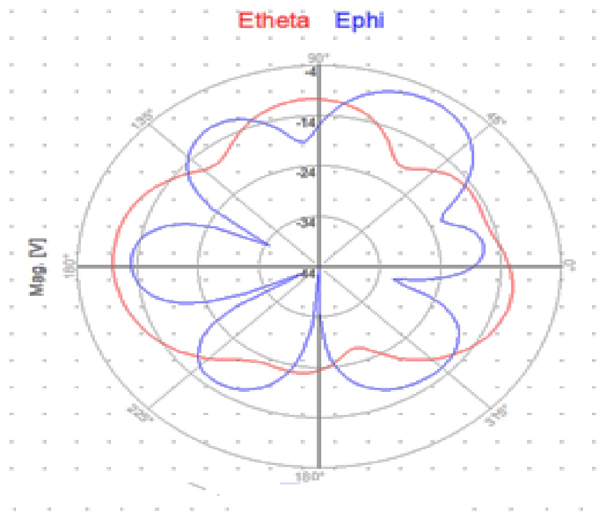


y-z plane

Figure 4. Simulated E-field radiation pattern at 2.4 GHz



x-z plane



y-z plane

Figure 5. Simulated E-field radiation pattern at 5.8GHz

4 CONCLUSIONS

In this paper a comparative study was done to improve the performance of a dual band monopole antenna improved, where the gain of the simulated antenna is increased at 2.4GHz and 5.8GHz respectively. At 2.4 GHz VSWR, and return loss are the acceptable values to meet requirements of WLAN applications. While at 5.8 GHz the value of the parameters is strongly enhancement, where VSWR is meet a perfect matching, the return loss is enhanced, the bandwidth and the gain are also increased.

5 References

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