Dual-Band Planar Monopole Antenna for WLAN/Wi-Fi Application

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Abstract

The proposed planar monopole antenna with dual band character for WLAM/Wi-Fi application. This can obtain the impedance bandwidth of 2.3-2.9 and 4.70-5.90 GHz with s11 less than -10d. The total dimension of the antenna is 30 x 26 $mm^{2.}$ This antenna was printed on the substrate of FR-4 with two "C" – shaped strips and a microstrip feed line on the front side and the grounded plane on the flip side. As the resonant bands of this antenna are excited by different strips, the resonant frequency in different bands could be flexibly tuned with little effect on the other. The results between the experiment and simulated one are agree well, great impedance matching and good gain are obtained. The details of the analysis of them are discussed below.

Keywords

Monopole antenna, WLAN/Wi-Fi, dual-band.

INTRODUCTION

Recently, as the rapid development of (WLAN) Wireless local area network and Wireless fidelity (Wi-Fi) communications systems, antennas with dual-or multi-band character, compact size, low profile, light weight, and flush mounted which could satisfy the demand of

covering 2.4//5.2/5.8 -GHz WLAN operating bands and 2.4/5.5 -GHz Wi-Fi bands have attracted high attentions. This antenna provides a way better for multiple communications. These antennas are very important for combining multiple communications standards in single wireless communication system and promoting the growth of wireless communication systemsThese planar monopole antennas are widely used in WLAN/Wi-Fi because of their compactdimension and multiband operation capability. A planar monopole antenna in [1] operates indual frequency bands.

Literature survey

All the antenna's which were surveyed, numerous monopole antenna's have been proposed because of size reduction, bandwidth enhancement, and resonance-mode realization, etc. For example, Compact planar inverted "F" antenna is presented in [1],[2], and coplanar waveguide (CPW)-fed antennas with inverted L-Strip in [3].
They all cover WLAN operation band, but the structure of PIFA needs a big ground plane, while the CPW-fed structure has low gains and narrow impedance matching band. Furthermore, some antennas exhibit complex structure [6]-[8].
So far, the best antenna presents a dual-band 'CP' Planar Monopole Antenna for WLAN/Wi-Fi application. The antenna has a compact and simple structure with total size of just 40 x47x1.5 mm^3.The radiator is composed of '2' parts. A" C" shaped strip here was mainly used for obtaining a good impedance match and CP performance in lower band. The proposed antenna had a measure of (-10dB) impedance bandwidth for 380 MHz and a 3-dB axial ratio (AR) bandwidth for 1240 MHz and a 3-d AR bandwidth of 870 MHz the overlapped impedance and AR bandwidth can cover 5.2/5.8-GHz WLAN bands and the simulated and results measured are focused in the further discussions.

Existing method

Methodology

In this paper, Dual Band Planar Monopole Antenna with the dimension of 30 x $26mm^2$
Is presented for WLAN (2.4-2.485 GHz/5.15-5.35 GHz/5.725 – 5.825 GHz), and also for Wi-Fi (2.412 - 2.472/5.15-5.85 GHz) application. Although the "L" shaped strip was initially proposed in [9],
The "C" shaped strip on the left of the radiator is used for producing resonance at upper band, and the length of the strip is approximately a quarter wavelength at its operating frequency. The "L" shaped stirp on the right side at the radiator is mainly used for producing resonance in the lower band, which is approximately a quarter-wavelength. Geometric parameter's of this antenna were listed at Table-1.
The antenna optimization and design are carried by using this commercial software called High Frequency Structure Simulator- (HFSS).

Existed antenna details:

Parameter	S1	S2	W1	W2	W3	Lg	L1
Value(mm)	47	40	3.2	2	2.2	10	10
Parameter	L2	L3	L4	L5	L6	L7	
Value(mm)	12	5.25	8.6	6.1	15.45	19	

Table 1: Parameter's of the Existed antenna.

Software Model for Existed Antenna:

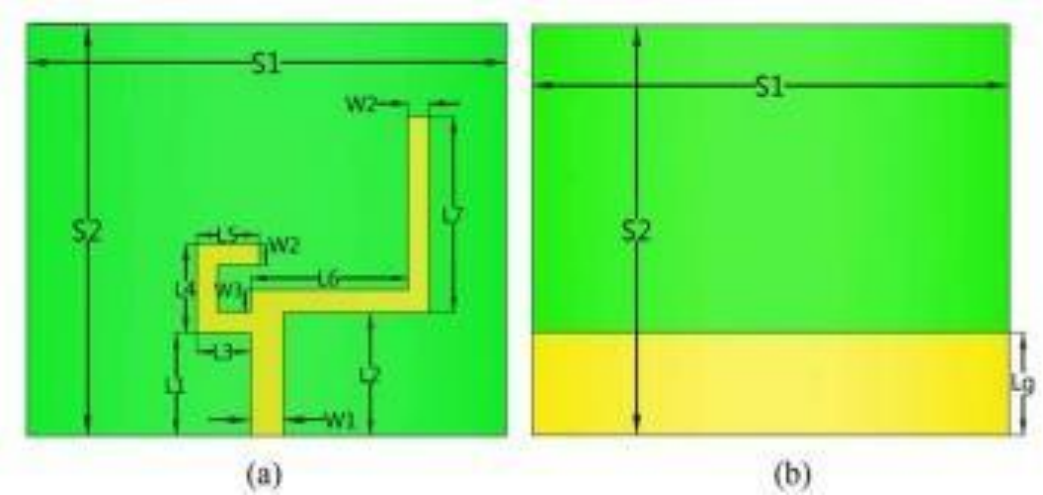

Fig 1: The existed single striped antenna.

Problem defined

In this existed antenna it had few disadvantages like lower gain, lower impedance matching, lower current intensity.

This can overcome by introducing another "C" shaped strip on the left side of the antenna. This "C" shaped strip in place of "L" shaped strip helps in increasing the Impedance matching and increasing current intensity.

So, the two "C" shaped strips bridged together to perform better than the existed antenna.

Proposed antenna (Methodology):

The design in this modified antenna with two "C" shaped stirps, which has many advantages like higher gain, better impedance matching, better current intensity, smaller dimension, comparing with the reported antenna in [9]. The antenna's performance is simulated using the software of High Frequency Structure-Simulator (HFSS) and the prototype is also fabricated. The agreement between measured results and simulation results is observed. This effect of the antenna's key structural parameters on it's performance is analyzed. Details of antenna design with the measured and simulated results are presented.

Proposed antenna details:

Parameter	**L**	**W**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
Value(mm)	26	26	9	12.5	10	4.5	7	3.5
Parameter	**L7**	**L8**	**Lg**	**W1**	**W2**	**W3**	**S**	**h**
Value(mm)	11	9	10	1.8	1	2	3	1.6

Table 1: Shows Proposed antenna parameters.

Software model for Proposed Antenna:

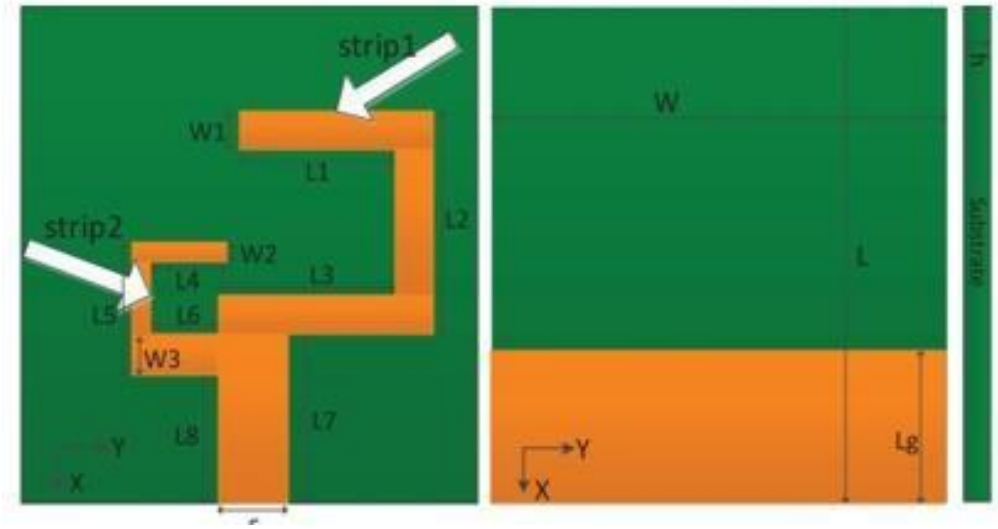

Fig 2: Proposed Software Model.

Software Used:

To perform the discussed antenna results or to observed the result of this designed antenna we used "**(H.F.S.S) High Frequency Structured Simulation".** HFSS will used to get all the types of results such as Frequency plots, gain plots, both discrete and in sweep type. Basically, this HFSS interface has an 3D geometrical interface with X, Y, Z Co-ordinate Axis, where we can build or construct antenna using all the 3D objects.
After a successful construction of this antenna we can analyze all the parameters and we can find the results for it. Following shows the interface of this software and the image of this Antenna that we proposed in it

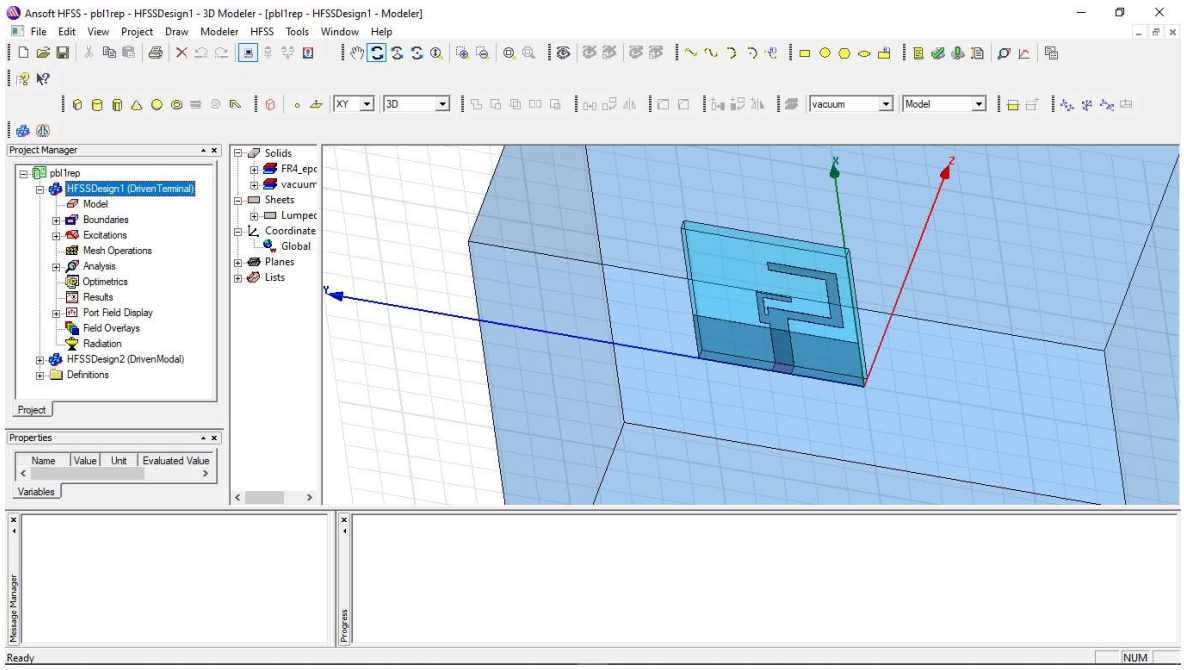

Fig 3: HFSS interface and Proposed Antenna.

Results and Discussions:

Besides, then length of ground plane also effects characteristics of the antenna. It was clear that there was a severe effect on the performance of the antenna by Lg. Not only the upper resonant band is shifted as it changes, but the value of S-11 is affected within the both resonant bands. Though it is hard to explain the exact rule of the impact by Lg, the resonant band is changed when Lg gets smaller or bigger. After the successful preformation of designed antenna the frequency plots for different L1, L4 lengths will be as follows.

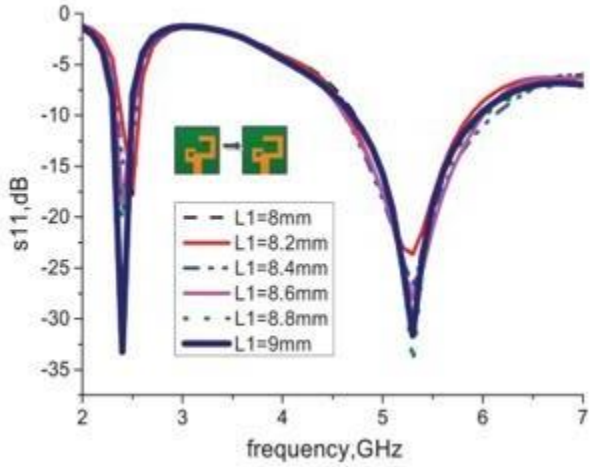

Fig 4: Frequency plot with different L1 length.

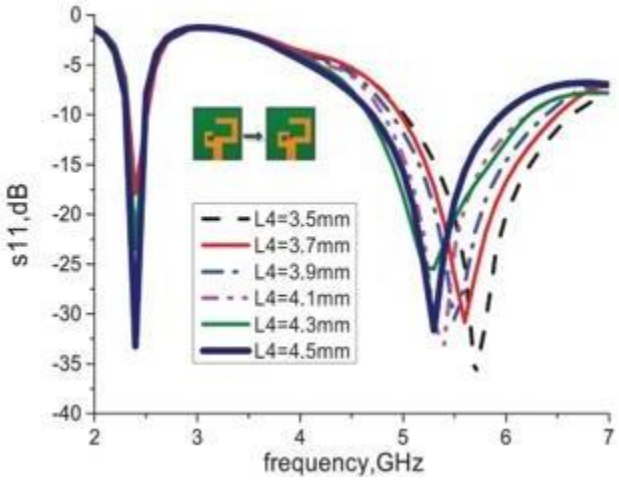

Fig 5: Frequency plot with different L2 length.

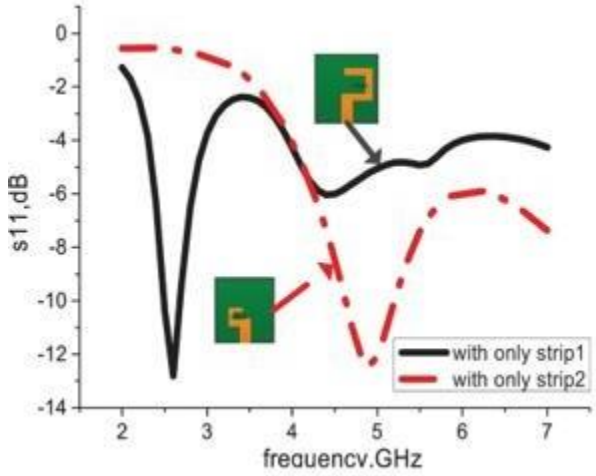

Fig 6: Frequency plot with only one strip.

Conclusion:

This paper, The Dual Band Monopole Antenna at this compact size and simple structure is proposed. The “C” shaped radiation strips on the substrate play a important role for achieving the resonant bands that could cover all the 2.4/5.2/5.8 -GHz WLAN bands and all the 2.4/5.5-GHz Wi-Fi bands. The measured -10dB impedance bandwidths are 190 MHz at the lower band and 1200 MHz at the upper band. From the measured and simulated results, we can conclude that this antenna had many advantages like good impedance matching at both lower band and upper band of WLAN/Wi-Fi, wide resonant bands, independent radiation strips and stable gains.
Glad we have perfectly utilized the HFSS software.

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