Dual Ports L-Shaped Microstrip Antenna for WLAN Band Frequency

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Abstract. The future of mobile communications is still promising in which the reduced size of mobile handsets is a very attractive technology. MIMO antenna is a considerable design for such a system which required a small size, low mutual coupling, high gain and wide bandwidth. In this paper, the antenna model with dual-polarized ports of microstrip feeding lines with a radiator having an L-shape is proposed. Such a radiator geometry dimension is achieved at the WLAN operating frequency. The results confirm that the bandwidth frequency is 1.66 (4.62-6.28) GHz at -10 dB along with an isolation approach -15 dB, while VSWR is not exceeded 2 dB.

Keywords: Dual Ports, L-shaped, Microstrip Antenna, MIMO.

1 Introduction

The capacity of a wireless system in multipath environment can be enhanced by MIMO system [1]. Recently, the user equipment of Fourth Generation (4G) has been employed for MIMO system and promising to use such technology in future communications [2]. Accordingly, mitigation of multipath fading and increasing frequency spectrum without wasting resources can be achieved [3]. However, designers of MIMO antenna take into account antenna reducing size meanwhile eliminating the mutual coupling which stims from reducing the space between adjacent ports [4], [5]. On the other hand, a dual polarization is a technique that exploits to increase the bandwidth efficiency and consequently reducing the size of the prototype [6]. In order to achieve a compact model, easy fabrication and increasing the operating frequency bandwidth, incorporating more than one design method in MIMO antenna model such as modification of the radiator shape of patch microstrip feeding line [7]. Furthermore, to reduce the mutual coupling affected by the current surface, many techniques are used, such as parasitic geometry [8], metamaterial surface [9] and slitted pattern etched in the ground [10]. In [11], proposed a single port composite of right/left-handed patch antenna with a ground etched unit cell included a composite split resonator ring (CSRR) as a type of defected ground structure (DGS) in order to distribute radiation uniformly. Also, [12] presented a diversity MIMO system with dual ports, each one fed by a microstrip ended with L-shaped with hexagonal aperture etched in the ground resulted with UWB. This research aiming to more reducing size by proposing a dual-polarized MIMO antenna with patch microstrip L-shaped with CSRR to reduce the mutual and increase efficiency.

IMDC-SDSP 2020, June 28-30, Cyberspace

DOI 10.4108/eai.28-6-2020.2298220

2 Design Single Element of MIMO Antenna

The schematic diagram of the proposed antenna has shown in **Figure 1**. It consists of dual patch microstrip feeding lines ended by L-shaped as a radiator and connected to power with SMA connector. Such feeding lines are printed on the dielectric layer of FR-4 with a height of 1.6 mm, 4.4 permittivity and 0.025 tan δ. In order to achieve isolation between ports, a CRSS etched in the ground structure represented as a shunt LC. The geometry dimension details in Table1.

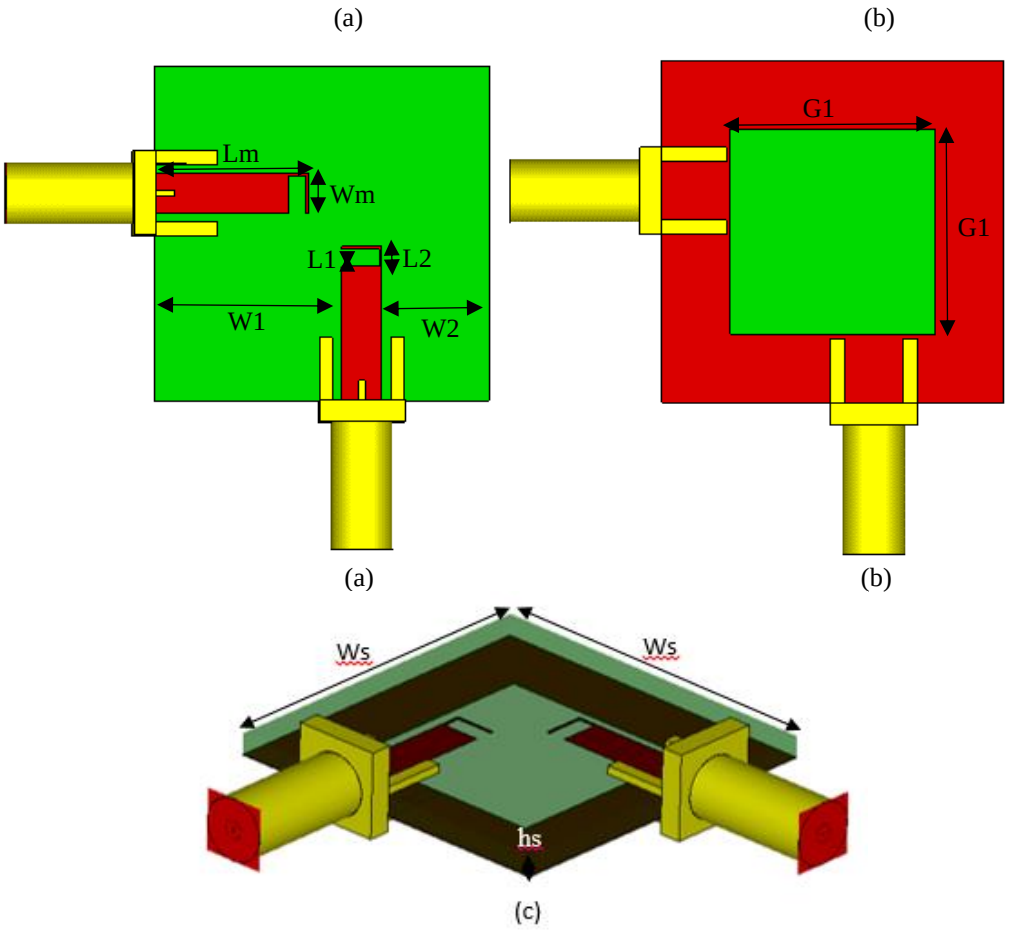

Fig.1. Single MIMO Antenna Geometry (a) Front View, (b) Back View and (c) Side View.

Table 1. MIMO Antenna Dimension.

Parameter	Value (mm)	Parameter	Value (mm)
Lm	11.5	G1	15
Wm	2.8	W_s	25
L1	1.3	W1	14.1

L2	1.5	W2	8.1

3 Results and Discussions

The proposed MIMO antenna model is simulated by CST-STUDIO 2019 covering the operating frequency 1.66 (4.62-6.28) GHz with an operating point of 5.04 GHz. **Figure 2** shows the S-parameter results which illustrated -25 dB for $S_{1,1}$ and $S_{2,2}$ and less than -12 dB for mutual coupling between adjacent ports.

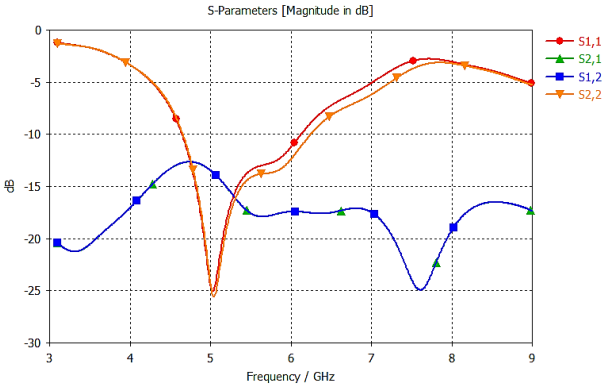

Fig. 2. S-Parameter of Single MIMO antenna element.

Also, VSWR which is the indication of antenna quality must be less than 2dB. Accordingly, **Figure 3** shows VSWR of the proposed antenna that is investigating such condition.

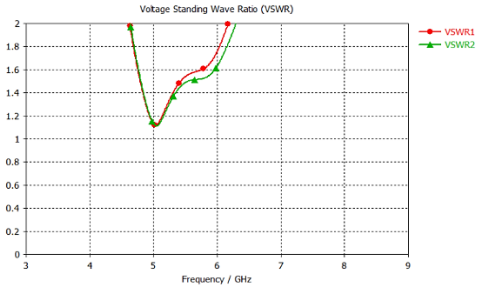

Fig. 3. VSWR of the Single MIMO antenna element.

On the other hand, the 2D radiation pattern of each port shows in **Figure 4** which explicit that each one has radiated in bidirectional with the angular lobe of 69.5 and 70 degrees for port1 and port 2, respectively. Meanwhile, when such ports operated simultaneously it obtained a 3D view of the radiation pattern in omnidirectional as well as covering the top and bottom of the printed circuit board (PCB) with H-max. -29.67 dB and gain 4.4 dBi as shown in **Figure 5**.

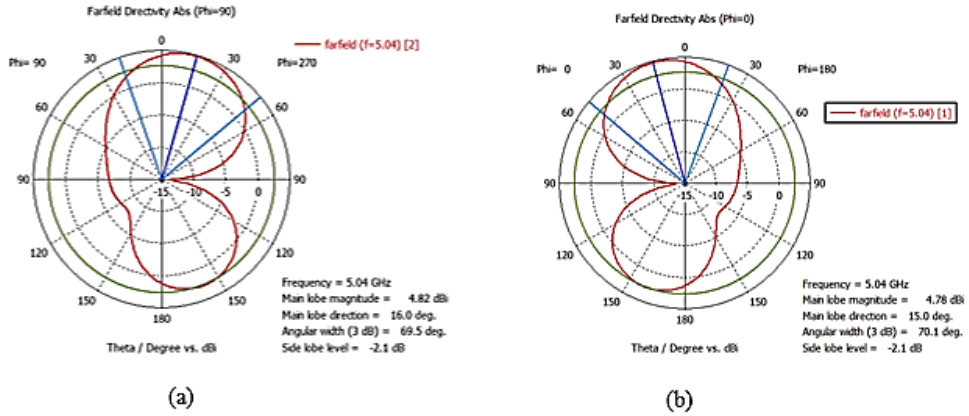

Fig. 4. 2D Radiation Pattern (a) Port1 and (b) Port2.

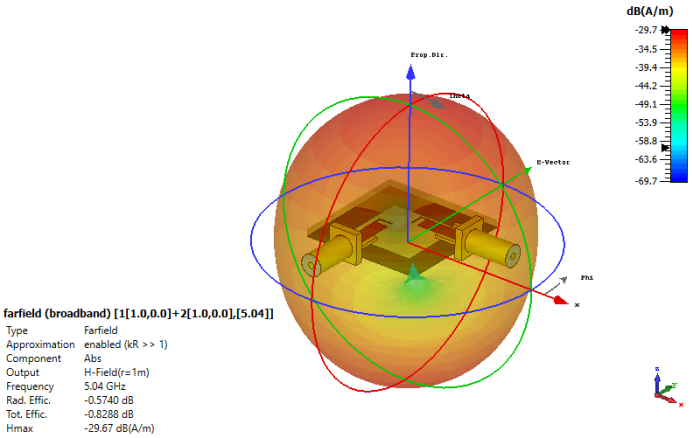

Fig. 5. 3D View of Radiation Pattern for both Ports.

In order to improve this proposed quality, Table 2 details a comparison between the current design and previous references. It is explicit that the current design having a small size with suitable return losses and isolation.

Table 2. Comparison Between Current Proposal and Previous References.

Ref. No.	Element Dimension	Return Losses	Mutual Coupling	Operating Band (GHz) at -10dB	Technique
[8]	25×25	-20 dB	-20 dB	3.4-3.8	Polarization
[12]	25×25	< -20 dB	< -12 dB	3.7-11	Spatial
[13]	30×30	-50 dB	< -20 dB	8.13-10.19	Polarization
[14]	100×60	-30 dB	<-20dB	1.870 - 2.530	Spatial
[15]	40×20	-55 dB	-13.5	1.7-3.66	Spatial
This Work	25×25	-25 dB	< -12 dB	4.62-6.28	Polarization

4 Conclusion

A compact of dual-polarized antenna is proposed in this research in order to match the future wireless communication demands. The proposed model depends on the patch microstrip feeding line ended by L-shaped as a radiator. The results show that the resonance frequency of 5.04 GHz with a bandwidth of 1.66 GHz which is suitable for WLAN band frequency. Such a model can be used for small devices of wireless mobile applications. On the other hand, such a model can be extended to MIMO system for sub-band of 5G communication.

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