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Research paper

Polarization and Frequency Reconfigurable Antenna for Dual Band ISM Medical and Wi-Fi Applications

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Abstract

A hybrid reconfigurable reception apparatus is intended to work in ISM medicinal band (2.5 GHz) and Wi-Fi working groups (3.4 GHz). A winding sort of transmitting structure with absconded ground is taken in the development of the proposed recieving wire show. The planned model is furnishing recurrence reconfigurability and polarization reconfigurability with great impedance data transfer capacity and hub proportion transmission capacity. The created model estimation results are giving incredible connection reenactment results got from HFSS instrument. Explanatory examination as for the reflection coefficient, radiation design with LHCP and RHCP and hub proportion are displayed in this work.

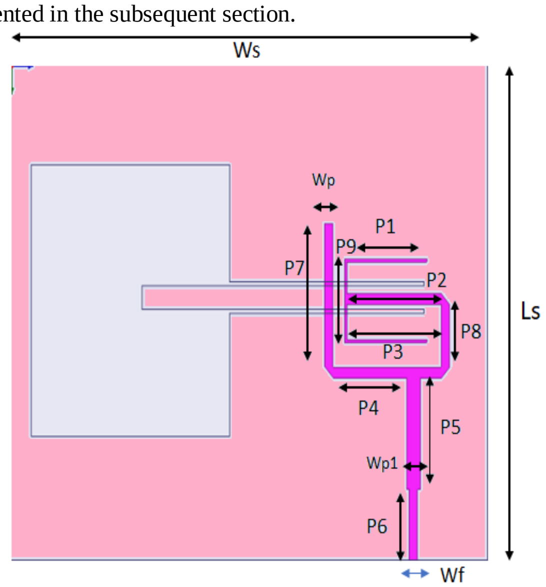
Keywords: *Dual Band, Frequency Reconfigurability, Left Hand Circular Polarization, Polarization Reconfigurability, Right Hand Circular Polarization*

1. Introduction

In the ongoing years, circularly spellbound monopole recieving wires have pulled in a lot of consideration for the present remote correspondence framework, as the round polarization (CP) assumes a vital part in enhancing the nature of the got flag [1]. In this way, the exploration on double band CP radio wires configuration turns into a hotly debated issue. A few double band CP reception apparatus outlines have been accounted for in the writings, including opening radio wires [2], [3], crossed dipoles [4], and stack fix recieving wires [5]. In [6], a solitary feed double band CP space recieving wire which comprises of two concentric collapsed annular openings is introduced, and it can cover WLAN 2.4 GHz/5.8 GHz groups with a recurrence proportion (FR) of 2.4.[7-9]
As of late, reconfigurable CP radio wires have pulled in huge consideration. The Stick diodes are exchanged in various states to acquire the tunable property of the radio wire [10] and it is additionally used to produce reconfigurable CP microstrip reception apparatus [11]. It is regularly utilized exchanging gadgets for RF and microwave application frameworks, as it has favorable circumstances of low addition misfortune, great separation and minimal effort [12]. It has been seen from writing audits that basically two extensive issues are regularly experienced in reconfigurable CP radio wire plans. The over the top diodes will prompt a mind boggling dc-inclination arrange [13-14] and giving free predisposition to every diode by some uncommon component, for example, utilizing capacitors [15].

2. Antenna Geometry

A hybrid reconfigurable antenna is designed to operate in ISM medical and Wi-Fi operating bands. The construction of the antenna model is shown in Fig 1. The structure consisting of spiral kind of radiating element and defected ground for good impedance matching. the dimensions of the proposed antenna are presented in Table 1. FR4 substrate material of 4.4 permittivity is used in this work. The feed line is constructed with quarter wave transformer to provide impedance of 50 ohms. Two diodes are placed at the bottom side of the defected ground structure as shown in Fig 1(b). PIN diodes are arranged at two slots on the back side for switching purpose through biasing network. The performance characteristics of the antenna model with and without PIN diodes switching is presented in the subsequent section.



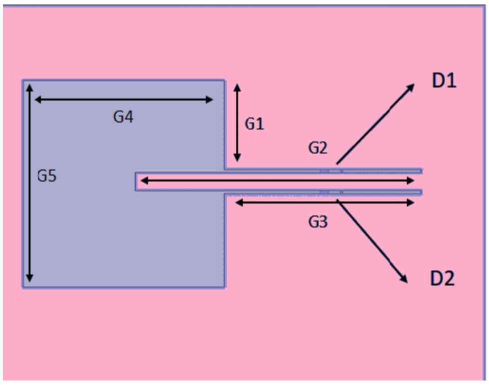


Fig 1. Circularly Polarized Antenna, (a) Top View, (b) Bottom View

Table 1. Antenna Dimensions

Parameter	Dimensions	Parameter	Dimensions	Parameter	Dimensions
Ws	120	P6	13.5	G4	50
Ls	94.7	P7	27.4	G5	52
P1	20.7	P8	12	Wp	2.1
P2	23.8	P9	14	Wp1	2.8
P3	26	G1	22.43	Wf	2.1
P4	19.7	G2	71	D1	PIN Diode1
P5	21.4	G3	48.9	D2	PIN Diode2

3. Results and Discussion:

The designed antenna operating at dual band with bandwidth of 600 MHz and 250 MHz at resonating frequencies of 2.5 GHz and 3.4 GHz respectively.

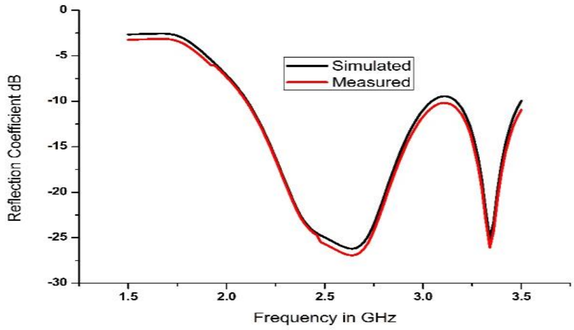


Fig2. Reflection Coefficient Vs Frequency

The axial ratio of the antenna with respect to the parametric analysis is presented in Fig 3 and 4. Fig 3 shows the axial ratio of the antenna at dual band with change in P8 and Fig 4 shows the axial ratio with change in width of the feed W_f. the optimum dimensions are finalized for p8=12 mm and the W_f=2.1 mm respectively.

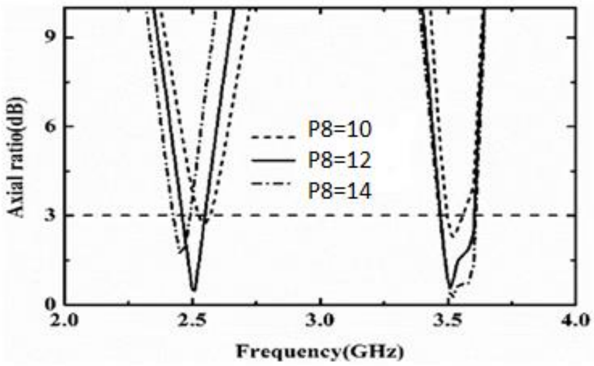


Fig 3. Axial ratio with change in P8

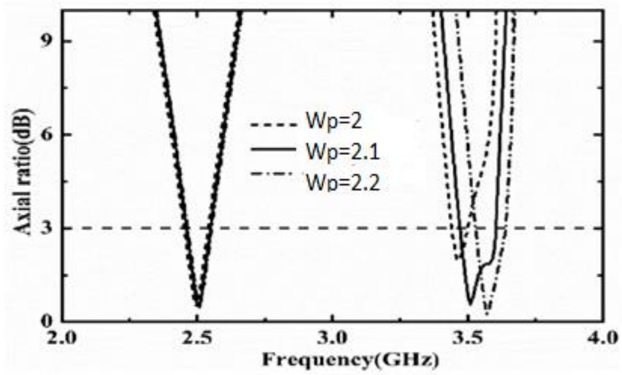


Fig 4. Axial ratio with change in W_f

A peak gain of 2.37 dB in left-hand circular polarization and peak gain of 2.29 dB in the right hand-circular polarization is obtained at this operating band.

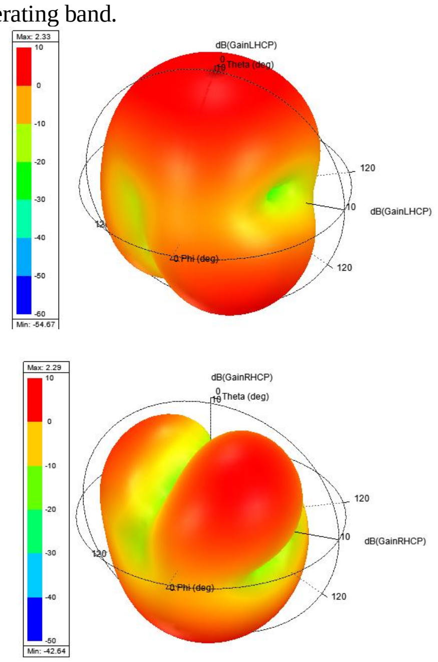


Fig 5. Simulated 3D-Gain of the antenna at 2.5 GHz, (a) LHCP, (b) RHCP

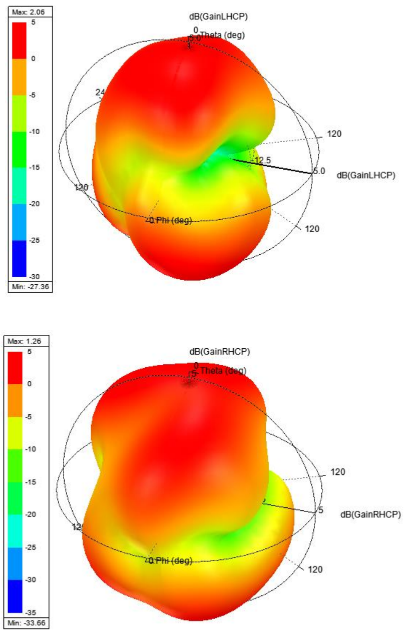


Fig 6. Simulated 3D-Gain of the antenna at 3.4 GHz, (a) LHCP, (b) RHCP

A peak gain of 2.06 dB in left-hand circular polarization and peak gain of 1.26 dB in the right hand-circular polarization is obtained at this operating band.

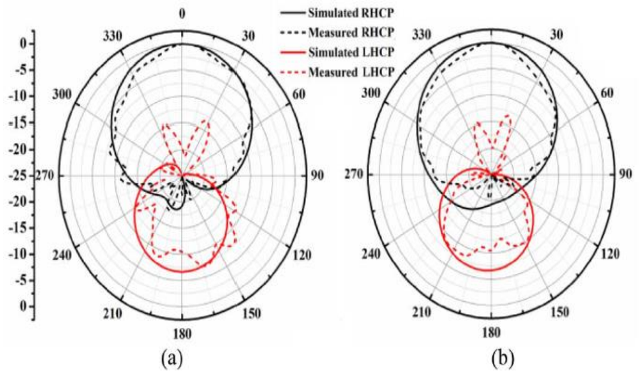


Fig 7. Measured and Simulated Radiation Pattern at 2.5 GHz, (a) XZ-Plane, (b) YZ-Plane

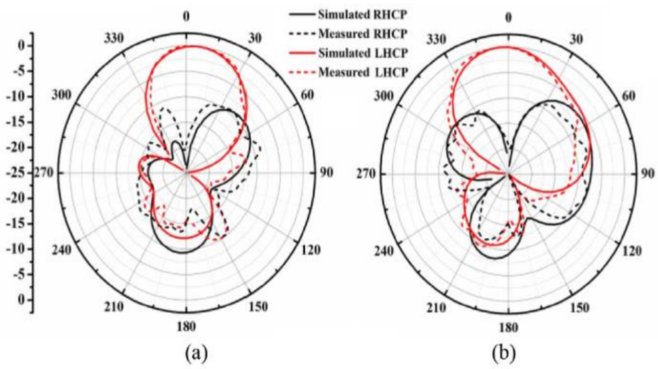


Fig 8. Measured and Simulated Radiation Pattern at 3.4 GHz, (a) XZ-Plane, (b) YZ-Plane

The measured and simulated radiation pattern of the antenna at two operating bands are presented in Fig 7 and 8. The circular polarization can be clearly observed in LHCP and RHCP from the obtained results. Simulated and measured axial ratio values at both the operating bands can be observed from Fig 9. A slight variation in the normal operating bands and the axial ratio operating bands can be observed from the obtained results. Fundamental resonating band is shifted from 2.5 to 2.6 GHz and second resonating frequency is shifted from 3.4 to 3.5 GHz .

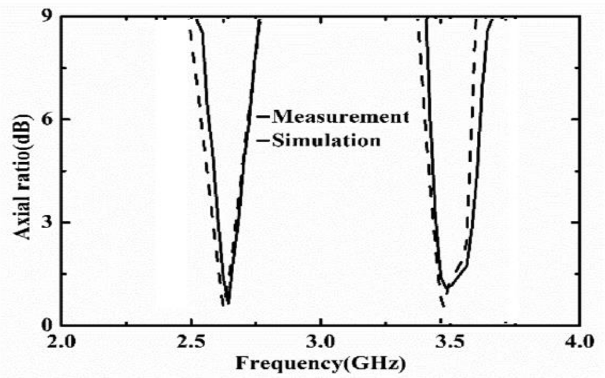


Fig 9. Measured and Simulated Axial Ratio

4. Frequency Reconfigurability

Frequency reconfigurability of the antenna is obtained by switching the diodes D1 and D2 at the defected ground. The diode on and off conditions and the corresponding frequency tuning at different bands can be observed from Table 1 and Fig 10.

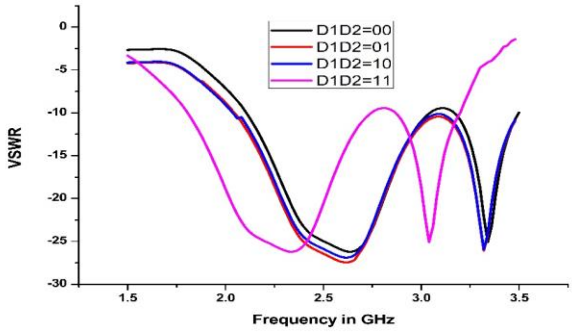


Fig 10. Frequency Tuning with Diodes Switching

Table 2. Frequency Reconfigurability with diodes switching

S. No	D1	D2	Operating Band1	Operating Band2	Bandwidth
1	0	0	2.2-3	3.3-3.5	800 & 200 MHz
2	0	1	2.1-3	3.25-3.5	900 & 250 MHz
3	1	0	2.1-3	3.25-3.5	900 & 250 MHz
4	1	1	1.8-2.6	2.8-3.2	800 & 400 MHz

5. Polarization Reconfigurability

The polarization reconfigurability of the proposed antenna is presented in the previous section and the axial ratio variation with respect to the diode switching can be observed here in Fig 11. The change in axial ratio and the axial ratio bandwidth can be observed from Table 3. It is ben observed that a slight change in the axial ratio bandwidth

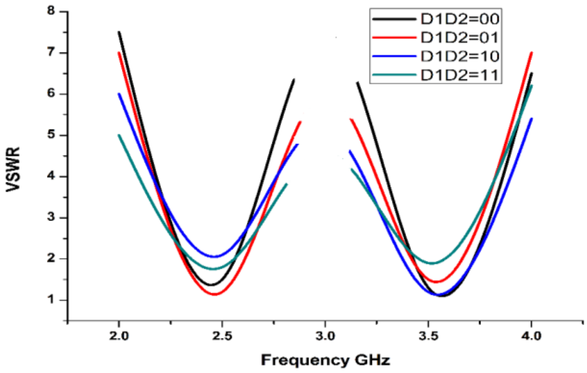


Fig 11. Axial Ratio with Diode Switching

Table 3. Diode switching based axial ratio

S. No	D1	D2	Axial Ratio Bandwidth at first band	Axial Ratio Bandwidth at second band
1	0	0	10%	14%
2	0	1	12%	12%
3	1	0	14%	11%
4	1	1	26%	11.5%

5. Measured Results

The proposed antenna model is prototyped on FR4 substrate with Nvis 71 prototype machine at ALRC-R&D of KLEF. The diodes are soldered at appropriate location and biasing voltage applied for testing the tunable behaviour of the antenna. Fig 12 shows the fabricated antenna front and back view and Fig 13 shows the impedance measurement result of the antenna on aniritsu combinational analyzer.

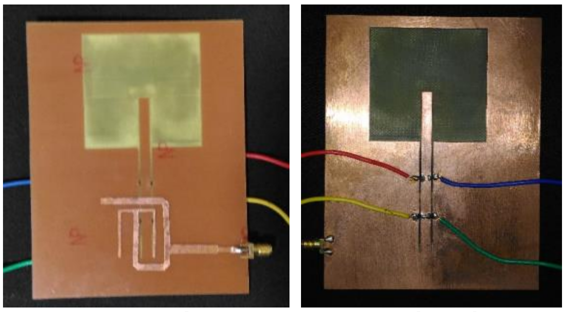


Fig 12. Prototyped Antenna (a) Front View, (b) Back View

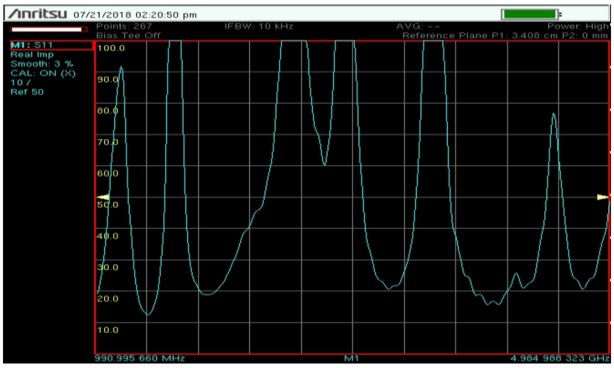


Fig 13. Measured Impedance of the antenna

6. Conclusion

A frequency and polarization reconfigurable dual band antenna model is designed, and the analysis is presented in this work. The designed model is operating at ISM band of 2.5 GHz for medical applications and IoT based Wi-Fi applications at 3.4 GHz. The proposed model is providing excellent measurement results in correlation with simulation results obtained from commercial EM tool of HFSS. Antenna providing circular polarization and at two operating bands the axial ratio is less than 3dB.

7. Acknowledgements

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