

Design a Circular Slot Patch Antenna with Dual Band Frequency

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Abstract Locale of research work indicates some basic concepts related to patch antenna. The techniques for increasing bandwidth of circular patch antenna are explained with other parameters. Patch antenna is basically used for wireless communication systems. Design a circular slot patch antenna of dual band frequency. Each type of antenna is good in their properties and usage. Antennas are those backbones also almost all that in the wireless communication without which the world could have not arrived at in this period of technology. The proposed micro-strip patch antenna has FR4 lossy as a dielectric substrate with thickness of 1.6 mm and relative permittivity ϵ_r is 4.3. The simulation results of directivity, gain, and return loss of designed patch antenna are determined successfully. It is designed the dual band frequency having a return loss -30 dB at 1.5 GHz and second one is -40 dB at 2.5 GHz, analyzed in CST software.

Keywords Circular micro-strip patch antenna • Dielectric substrate
Gain • Directivity • Return loss • CST software

1 Introduction

Micro-strip Antennas are accepted in the starting of 1970s [1]. Antenna would an irreplaceable and only modern culture, serving as the link between man and his location extending to the external space. Antennas need been around for more than a century now, Also appear will bring an infinite variety, all operating in the same fundamental principles for electromagnetic. Micro-strip Patch antenna is diminutive of antenna implemented for wireless solicitation due to their numerous benefits such as short profile, minimum weight, and relaxed assemble. Micro-strip patch antenna comprises limited restrictions such as low profile, minimum gain, deprived polarization, and minimum proficiency. The micro-strip patch antenna entails in

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accompanying substantial which are copper and gold. Between the published micro-strip patch antenna of numerous contours rectangular, circular and triangular patch antenna are accessible.

An enormous of micro-strip patches use in wireless solicitation has been established. In assessment to patch features, the antennas having slot alignment establish superior appearances comprising broader bandwidth, few conductor losses and enhanced isolation.

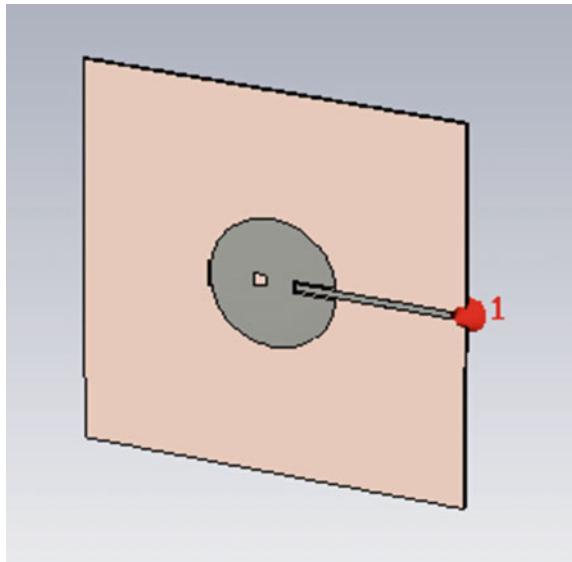
A feed procedure is a route to provide radio effect within antenna assembly. Conducting and non-conducting substantial is utilized for antenna strategy. In conducting scheme, the feed line is unswervingly related to the power of RF like as micro-strip and coaxial line. In assessment to the micro-strip patch, the conducting strip has lesser magnitude. A plane erection is acquired if the feed is engraved on equivalent substrate [1].

The parameters of the antenna are bandwidth, emission pattern and directivity is resolute with CST software and is used to propose a high frequency array of the antenna. This software is more valuable for regularity application. Electromagnetic analysis is performed using CST MICROWAVE STUDIO.

2 Antenna Designing

Structure of recommend circular micro-strip patch antenna is represented in Fig. 1 where radius is calculated by

Fig. 1 Design of circular micro-strip patch antenna



$$a = \frac{F}{\left\{ 1 + \frac{2h}{\pi \epsilon_r F} \left[\ln\left(\frac{\pi F}{2h}\right) + 1.7726 \right] \right\}^{1/2}} \tag{1}$$

$$F = \frac{8.791 \times 10^9}{f_r \sqrt{\epsilon_r}} \tag{2}$$

where,

- a Radius of circular patch antenna
- F .
- ϵ_r Permittivity of antenna
- h Thickness of the substrate.

3 Simulation Results

This circular micro-strip patch antenna was simulated on CST Software. The radiations were measured with the help of CST software in far field. The RF signals were set of connections form 1–3 GHz, simulated adaptively. The simulation results are shown in figure; in Fig. 2 demonstrates the return loss against frequency range in 1–3 GHz for the proposed dual band circular patch antenna at different frequencies. The response of this design of first return loss is –30 dB at the resonant frequency 1.489 GHz and second return loss is –40 dB at the resonant frequency. Circular patch antenna has dual band characteristics, showing at frequencies 1.5 and 2.5 GHz. Figure 3 shows the ratio for circular patch antenna (Figs. 4, 6).

Gain and radiation pattern with dual band frequency are shown in Fig. 3 or 5, respectively, for circular patch antenna. From Fig. 5 a maximum gain of 2.87 dB is reported (Fig. 7).

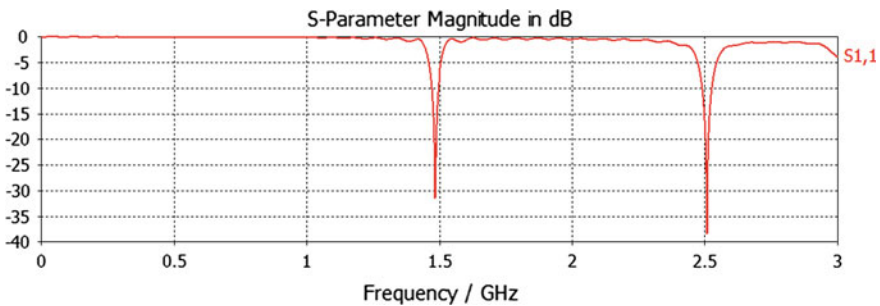


Fig. 2 Return loss simulation

Fig. 3 Radiation pattern Simulation

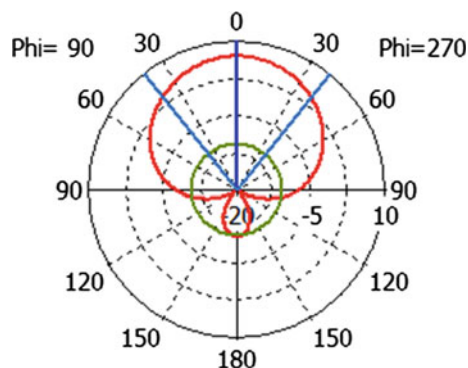


Fig. 4 Smith chart simulation

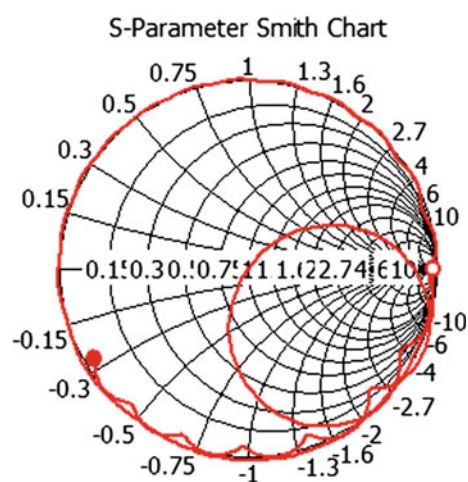
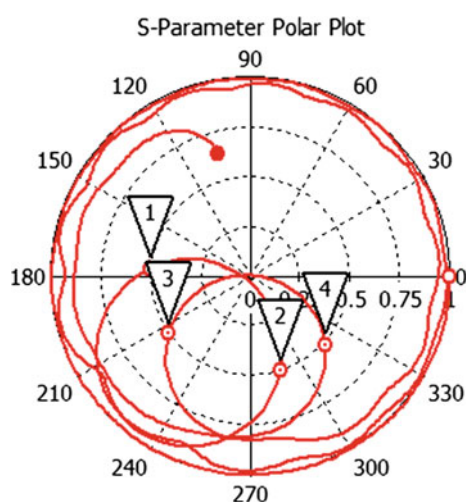


Fig. 5 Polar plot simulation



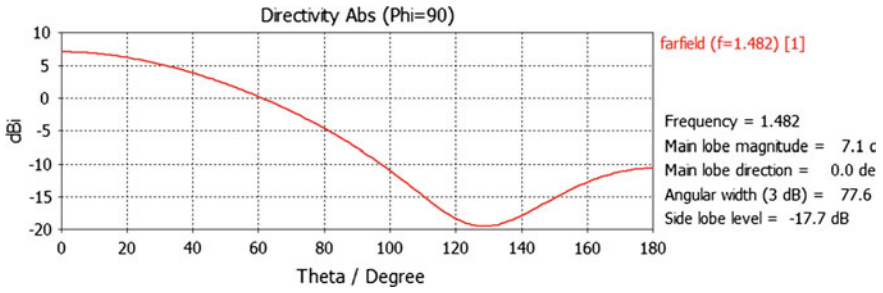


Fig. 6 Cartesian plot simulation

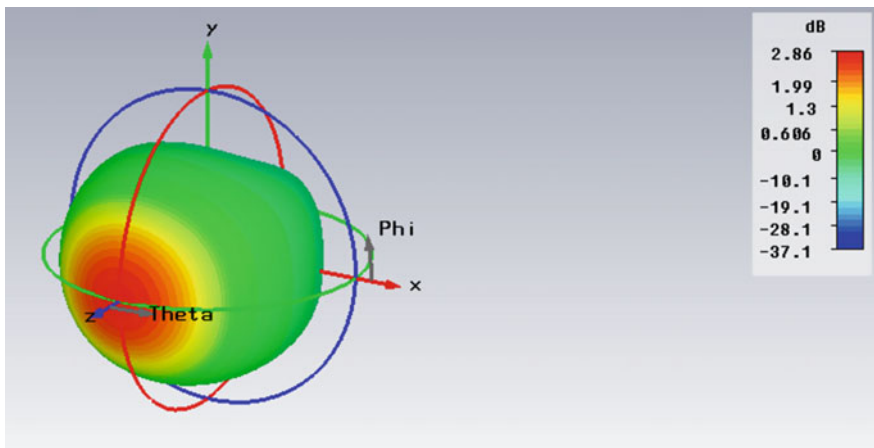


Fig. 7 Gain of circular patch antenna with dual band frequency

4 Conclusion

The design of circular patch antenna with dual band frequency is presented in this paper, first return loss is -30 dB at 1.5 GHz and second one is -4 dB at 2.5 GHz and results were analyzed (Table 2). Then the directivity of this antenna is 7.05 dBi and gain is 2.87 dB in CST studio software. The results confirm good performance of the dual bands antenna design as shown in Fig. 2. Antenna parameters such as return loss, gain, and directivity are calculated with good results. In this paper enhancement in return loss in large amount this will give the maximum output.

Table 1 Advantage and disadvantage of micro-strip patch antenna

Advantages	Disadvantages
Light weight & low volume	Narrow bandwidth
Low profile planar setup which can be effectively made conformal to host surface	Low efficiency
Low creation cost, along these lines can be produced in expansive amounts	Low gain
Underpins both straight and in addition round polarization.	Extraneous radiation from feeds & junctions
Can be effortlessly incorporated with microwave integrated circuits (MIC's)	Poor end fire radiator except tapered slot antennas
Fit for double and triple recurrence operations	Low power handling capacity
Mechanically vigorous when mounted on unbending surfaces	Surface wave excitation

Table 2 All dimensions of circular patch antenna is demonstrates in Table 1

Parameter for circular patch antenna	Values
Length of the ground plane	80 mm
Width of the ground plane	80 mm
Radius	28.5 mm
Thickness of substrate	1.6 mm
Bandwidth	0.018 GHz
Directivity	7.056 dBi
Gain	2.85 dB
Return loss at 1.5 GHz	-30dB
Return loss at 2.5 GHz	-40dB

References

1. Balanis, Constantine, "Antenna Theory Analysis and Design", John Wiley & Sons Ltd (2005).
2. NehaParmar, Manish Saxena, KrishnkantNayak, "Review of Micro strip patch antenna for WLAN and Wimax application", International Journal of Scientific & Engineering Research, pp. 168-171, January (2014).
3. Saurabh Jain, Vinod Kumar Singh, Shahanaz Ayub, "Design of slotted micro strip patch antenna having high efficiency and gain", National conference on synergetic trends in engineering and technology, pp. 21-26, November (2014).
4. Sanjay Singh, AmitSaini, Kishor Chandra Arya, RachnaArya, "Design of a Tri Band H-Shaped Micro strip Patch Antenna for L, C and X-Band Application", IJARCCCE Trans., vol. 4, pp. 9-11, June (2015).
5. Rahul Tiwari, Dr.SeemaVerma,"Inverted l-slot Wideband Rectangular Micro strip Patch Antenna", International Journal of Advanced Technology & Engineering Research, vol 4, pp. 118-123, January (2014).