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Design and simulation of dual stacked microstrip patch antenna used in wireless communication

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Absract

The purpose of this paper is to present designing and simulation of circular microstrip patch antenna. The return loss, gain and radiation pattern are analyzed and optimization is performed by making dual stacked circular microstrip patch antenna.FR4 is used for designing purpose which is easily available and having low cost. it is able to achieve a return loss of -41.9637dB for dual stacked microstrip antenna from -23.0774dB for simple circular microstrip patch antenna.The increase in gain of 4 dB occur.

Keywords: Circular patch, Microstrip antenna, resonant frequency, and radiation pattern gain, return loss

I.Introduction

MICROSTRIP patch antennas offer an attractive solutionto compact, conformal and low-cost designs of many wireless application systems . It is known that the gain of a single patch antenna is generally low.

The gain of patch antennas can be increased by using multipleMicrostrip antennas are used in communicationsystems due to simplicity in structure, conformability, low

manufacturing cost, and very versatile in terms of resonant frequency, polarization, pattern and impedance at the particular patch shape and model.

The performance of the antenna is affected by the patch geometry, substrate properties and feed techniques . In a circular microstrip antenna (fig 1), themode is supported by the circle shape on a substratewith height is very small compared to wavelength ($h << \lambda$). Referring to the dimensions of the circularReferring to the dimensions of the circularpatch, only one degree freedom to control the radius, a of the patch. This would not change the order of the modes but the absolute value of the resonant frequency.

Basically a circular microstrip antenna can only be analyzed via the cavity model and full-wave analysis.Due to the fringing fields between the patch and the ground plane, the effective dimensions of the antenna are greater than the actual dimensions. The fringing effect was larger due to the fact that some of the waves travel in the substrate and some in the air.

In this paper HFSS 12 software is used (High frequency simulation software). With this tool microstrip antenna is designed.

Substartes

1. FR4=4.4
2. Material1=1.5
   (dielectric constant)

II. Circular microstrip antenna

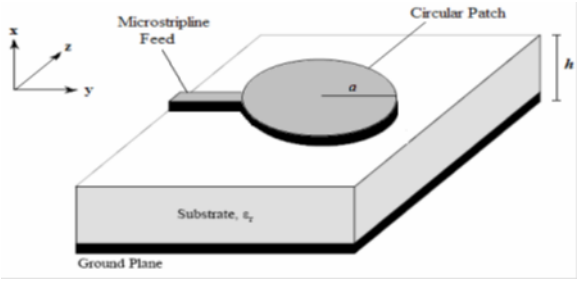


Figure 1: Basic configuration of circular microstrip antenna.

First, a simple circular patch antenna with radius r, has been considered. The substrate of thickness($h<<\lambda$) is taken with dielectric constant ε_r is considered along XY plane.

Microstrip antenna design parameters

The essential parameters for the design of microstrip antenna

- Dielectric constant(ε_r) =4.4
- Frequency =9Ghz
- Height =10mm
- Loss tangent =.02
- Radius = 20mm

For antenna varying the radius will change the resonant frequency.

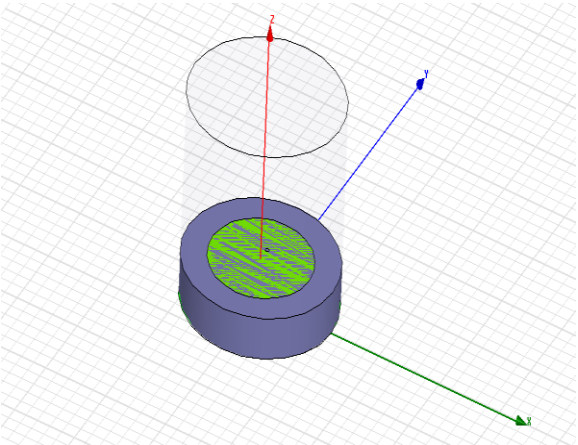


Figure 2. Model of Simple Circular Patch antenna

A. Simple circular patch antenna

For simple circular patch antenna[2] FR4 substrate is used in cylindrical shape of height 10mm with radius of 30mm.The patch which is circular in shape is of radius 20mm is taken. The gain comes out to be 6.995fig(4,5) with the return loss of - 23.0774dB fig.(3).

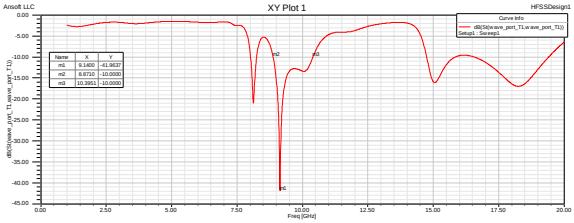
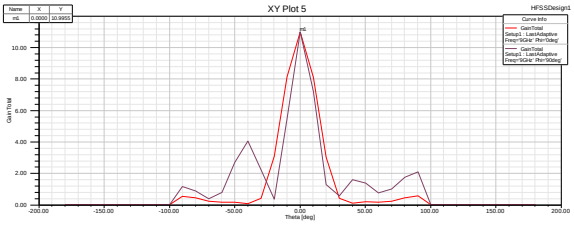


Figure 3. Return loss



Fiigure 4. Gain vs theta

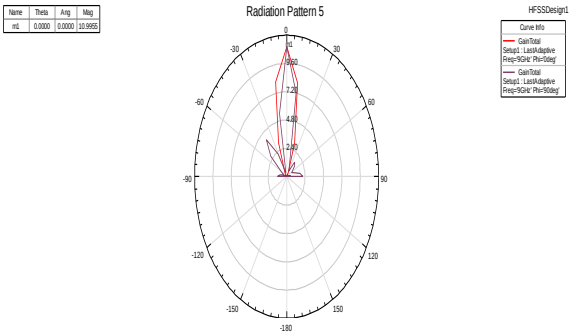


Figure 5. Gain total

B. Dual stacked circular patch antenna

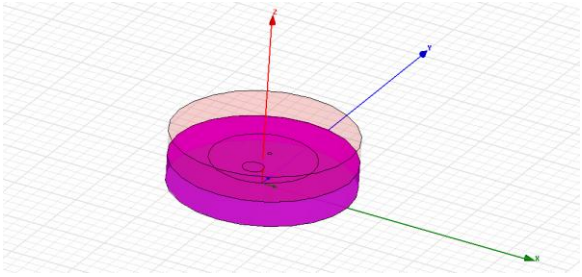


Figure 6. Model of dual stacked circular patch antenna

As shown in figure 6. Dual stacked circular patch antenna, For this FR4 & material1 are used for making substrate. In this 2 substrates are taken of same height. The radius of patch is same as in circular patch antenna. The change in return loss occur and comes out to be -41.9637dB.(fig.7). There is increase in gain of 4 dB occur and the gain in this case comes out to be 10.995 dBfig(8,9).

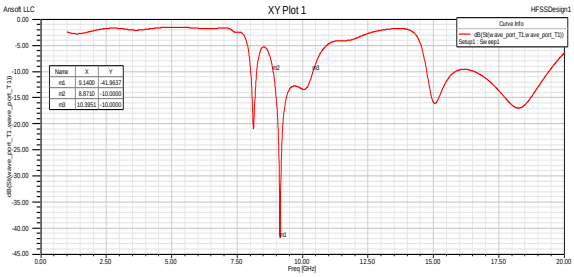


Figure 7.return loss

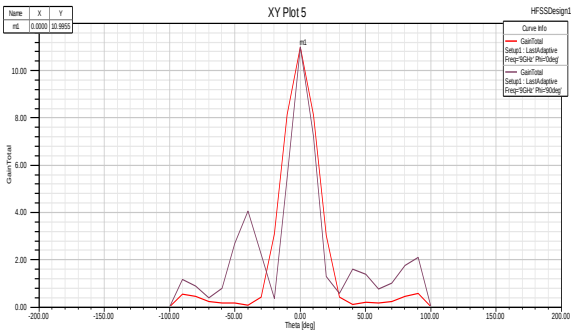


Figure 8.gainvs theta

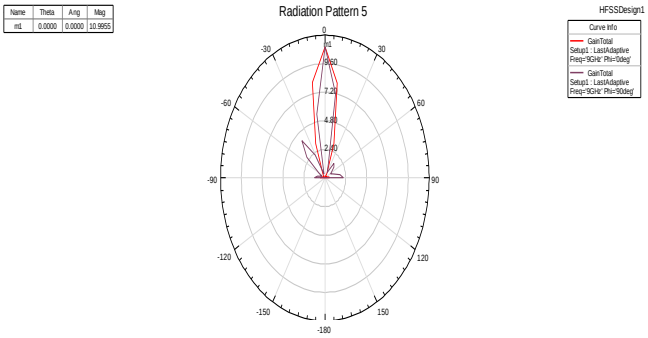


Figure 9. Gain Total

C.Comparative analysis

In table one comparison of result of microstrip antenna is done which are already discussed.

Sr. No.	Configuration	FL	FH	FO	Return loss	Gain
1	Simple circular patch	8.8628	10.4359	9.1	**23.0774**	**6.9935**
2	Dual stacked circular patch	8.8710	10.4951	9.1	**41.9637**	**10.995**

Table 1. Comparison of result of 2 design structures

D. Conclusion

The designing of antenna by making dual substrate has increased the gain and reduces the losses of microstrip antenna.

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