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1	Effect of Change in Dimensions of the Circular Antenna and Feedpoint on the Antenna Performance	
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7 Abstract

Circular microstrip antennas have several interesting properties that makes it attractive in 8 wireless applications. A circular microstrip antenna is designed in order to obtain the required 9 parameter responses from 2.7 GHz to 2.9 GHz by using IE3D software based on the method of 10 cavity model due to simplicity and ease of analysis. The circular microstrip antenna is fed by 11 a coaxial probe (Teflon probe) and glass epoxy is used with the specified information include 12 the dielectric constant of substrate (fr = 4.2), the resonant frequency (fr = 2.8 GHz) and 13 substrate height (h=1.6mm). The circular microstrip antenna exhibits appropriate required 14 parameters depend on the feedpoint position, size of the circular patch. A prototype of a 15 circular microstrip antenna has been built and tested by spectrum analyzer. There is slight 16 difference between the measured and simulated results caused by several factors that would be 17 discussed in result part. 18

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20 Index terms— Circular microstrip antenna, coaxial probe

²¹ 1 Introduction

microstrip antenna in its simplest form consists of a radiating patch (of different shapes) on one side of a dielectric substrate and a ground plane on the other side. Microstrip antennas are used in communication systems 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 [1].

The performance of the antenna is affected by the patch geometry, substrate properties and feed techniques [8]. In a circular microstrip antenna, the mode is supported by the circle shape on a substrate with height is very small compared to wavelength. Referring to the dimensions of the circular patch, only one degree freedom to control the radius, of the patch. This would not change the order of the modes but the absolute value of the resonant frequency [1].

In this paper, the circular microstrip antenna is being fed by a coaxial probe. The main advantage of this feed is that it can be placed at any desired location inside the patch to match with its input impedance.

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³⁶ matching is necessary to ensure that the power transferred to the antenna is maximum [9].

37 **2 II.**

38 3 Methods of Analysis

- 39 There are three popular analytical techniques:
- 40 The transmission line model

41 4 The cavity model

The MNM In Transmission line model the microstrip radiator element is viewed as a transmission line resonator with no transverse field variations. In the cavity model, the region between the patch and the ground plane is treated as a cavity that is surrounded by magnetic walls around the periphery and by electric walls from the top and bottom sides. The MNM for analyzing the MSA is an extension of the cavity model. In this method, the

46 electromagnetic fields underneath the patch and outside the patch are modelled separately [9].

47 To begin with the radius of the circular patch is calculated by using the cavity model method.

$_{48}$ 5 a) Equations used

Basically a circular microstrip antenna can only be analyzed via the cavity model and full-wave analysis. The 49 cavity model also provides the method that the normalized fields within the dielectric substrate can be found 50 more accurately and it does not radiate any power. According to the cavity model approach the radius of the 51 antenna is [1]: Using this expression the radius of the antenna was calculated to be 14.80mm. Simulation of the 52 design was carried out by using IE3D software. The flow of work then continues with the fabrication process. This 53 process begins with the layout. After that, the etching process was carried out according to the dimensions from 54 the simulation. Finally, the antenna was measured using a spectrum Analyzer to compare the simulation and the 55 measurement results. Figure 1 shows the proposed circular antenna with the circular patch and the probe feed. 56 This circular patch is printed on glass epoxy substrate having dielectric constant of 4.2 and thickness, h=1.6mm. 57 58 The objective of the patch is to resonate at 2.8 GHz.

⁵⁹ 6 III.

60 7 Results and Discussion

From the results of simulation it is found that the value of loss -14. The figure 3 show a comparison by increasing and decreasing the radius of the circular antenna from the calculated values of 14.80mm and maintaining the feedpoint coordinate of (x=-2.6,y-2.6)constant. As the radius of the antenna is increased to 14.85mm while keeping feedpoint coordinates constant ,the value of the return loss decreases to -26.65 dB. Further higher values of the radius are chosen to observe the response of the antenna with the increase in the radius. Since the return loss is due to the mismatched load so the lowest of the return loss is required for the design. The VSWR value also changes. It decreases from 1.47 to 1.098 with the increase in radius from 14.80mm to 14.85 mm this shows

68 that at the load the reflection coefficient is high.

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As the radius is decreased from the original value of 14.80mm to 14.75mm, the value of return loss increases to
-9.148 dB and the value of VSWR is increased to 2.071. The obtained results indicate that the performance of
the antenna in terms of return loss and VSWR is satisfactory when increasing the radius of the circular patch
keeping feedpoint constant but the decrease in radius leads to an unsatisfactory result.

The figure 4 As the feedpoint coordinates are changed from x=-2.6, y=-2.6 to x=-2.4, y=-2.4, the value of return loss increases from -14.4 db to -13.62 db and the value of VSWR increases from 1.47 to 1.527. Similarly if the feedpoint coordinates are changed to x=-2.8, y=-2.8 the value of return loss increases to -13.91 dB and VSWR

⁷⁷ increases to 1.504. So from the result obtained it can be inferred that the variation in the feeedpoint coordinates ⁷⁸ from the original coordinates leads to an unsatisfactory antenna performance.

Figure 5 shows the trend in the performance of the antenna in terms of the return loss & VSWR values for various other values of the patch radius. Now the antenna performance is measured using spectrum analyzer. From the results of the measurement of the values of return loss and VSWR it was observed that the values measured were slightly different from the values obtained from simulation. According to the measured result the return loss and VSWR were -10.94 & 1.792 respectively.

Figure 6 show the measured & simulated result on a single graph and the table 1 gives the value of measured & simulated results. There are several factors responsible for the difference between the simulated & practically obtained values. During fabrication, the improper handling can influence the obtained result such as during etching process; the circular patch might not be precisely obtained, since at higher frequency the MSA are very sensitive to diemensions of the patch.

The difference in the result could be due to parasitic components in the screw that are used to fix the antenna. Here the screws act as capacitor that exhibit fringing effect between the patch and ground plane. Due to this effect the amount of signal transmitted to air reduces .so there must be sufficient distance, larger than /4, between the patch & screws to avoid this problem. The skin effect due to solder leads used to connect the probe to the patch is another reason for the mismatch in the simulated and practical result.

Another reason is the loss due to the substrate properties. A higher dielectric loss will result in worst return loss and VSWR. So a good substrate with low value of loss must be chosen to prevent some loss in the antenna [5].

97 IV.

98 9 Conclusion

99 Design of circular ring microstrip antennas has been investigated via the cavity model. A circular microstrip

antenna with a probe feed is obtained and the required parameters at the frequency of 2.7 GHz to 2.9 GHz

have been investigated successfully. From the simulated results it is found that the return loss is -14.4dB and
 VSWR value is 1.47 and from the measured values it is found that the return loss is -10. The microstrip antenna

VSWR value is 1.47 and from the measured values it is found that the return loss is -10. The microstri performance can be upgraded concerning the feed type, the size of the patch and the substrate used.



Figure 1: Figure 1 :

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Probe feed

Figure 2:



Figure 3: Volume Figure 3 :



Figure 4: Figure 4 :

 $\mathbf{5}$

Figure 5: FigFigure 5 :



Figure 7:

1

Measured Results at the resonant frequency		
Parameter	Simulted	Measured
Return	-14.4dB	-10.94dB
VSWR	1.47	1.792

Figure 8: Table 1 :

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