The Design of a Circular Microstrip Patch Antenna (CMPA) with Defected Ground Structure (DGS) for Wireless Applications

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Abstract
In this paper, we propose a design of Circular Microstrip Patch Antenna (CMPA) with a rectangular slot as DGS. The defected ground structure concept is used to improve the bandwidth, impedance matching and the relocation of resonant frequency to make the compact CMPA. The size reduction of about 4.6% compared to the actual area required to resonate at 5.6GHz. The bandwidth 260MHz with respect to center frequency 5.595GHz which covers wireless bands such as HiperLAN/2 band. The percentage bandwidth of 4.6% and the average gain of 4.5dBi is achieved.

Keywords
CMPA, DGS, HiperLAN/2.

I. Introduction

The main aim of next generation wireless communication is high-speed networking service for multimedia communication. For the Wireless Local Area Networks (WLANs). IEEE 802.11 The most important high-data-rate wireless broadband networking systems for next generation wireless communications are European Telecommunications Standards Institutes (ETSI) High Performance Local Area Network type 1 (HIPERLAN/1), and High Performance Local Area Network type 2 (HIPERLAN/2) which uses the frequency bands 5.150 GHz– 5.350 GHz and 5.470 GHz- 5.725 GHz [1].

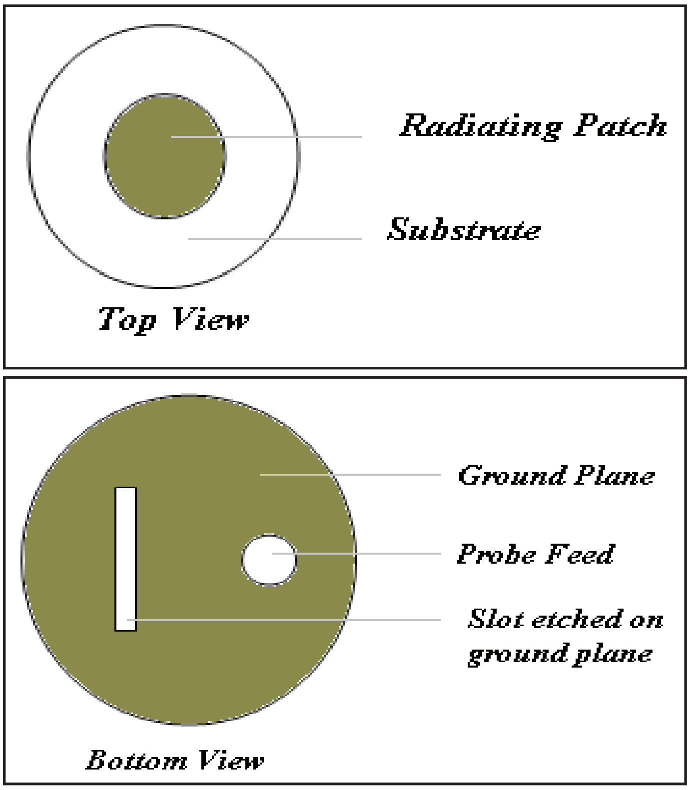

Fig. 1: The Top View and Bottom view of CMPA.

Circular Microstrip Patch Antenna can be designed by embedding suitable slots on the radiating patch and on the ground plane as Defected Ground Structure (DGS).

II. Antenna Design

The antenna is fabricated on substrate of FR4_epoxy with relative permittivity εr = 4.4 and the thickness of 1.6mm. The radius of the patch (a) and ground plane are calculated using the formulas given in [1], for the resonant frequency of 5.6GHz. The actual radius of patch as per formula is 7.12mm; we reduced the radius of the patch to 7mm so the size of the CMPA is reduced by 4.6% because of rectangular slot etched on the ground plane..
The dimensions of the ground plane, patch are tabulated in the Table 1 given below.

III. Simulated Results

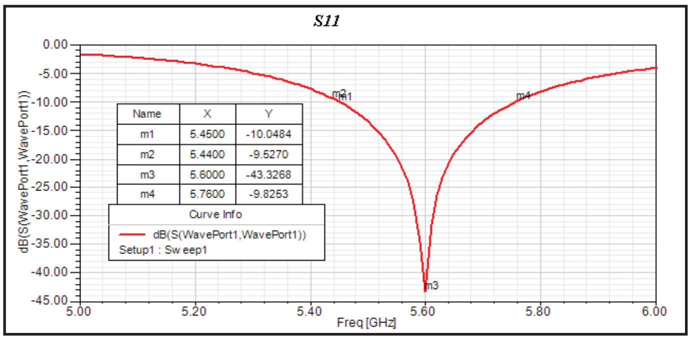

Fig. 2: Simulated Return Loss Versus Frequency of a CMPA

Simulated s11 can be seen from fig. 2 refection co-efficient is very less at resonance return loss of the antenna is less than 10dB from 5.45GHz to 5.725GHz which satisfies the HiperLAN/2 frequency. Effect of DGS on the bandwidth and relocation can be easily explained from fig. 3 comparison of return loss with DGS and without DGS.

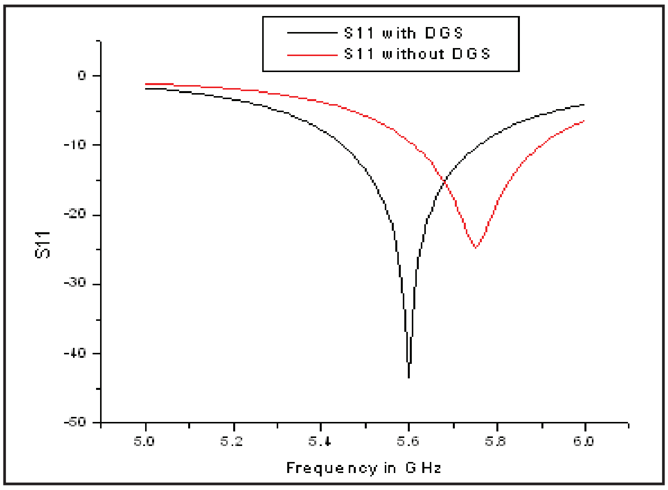

Fig. 3: Comparison of S11 with DGS and Without DGS

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From fig. 3 we can visualize the relocation of frequency which made antenna 4.6% compact, due to the slot on ground plane matching became good and return loss went low, this increased the bandwidth.
Impedance match of this antenna can be seen in fig. 4, this clearly illustrating that the frequency of the interest is very near to point 1. Which is due to the DGS the impedance matching increased, this reduces the loss.

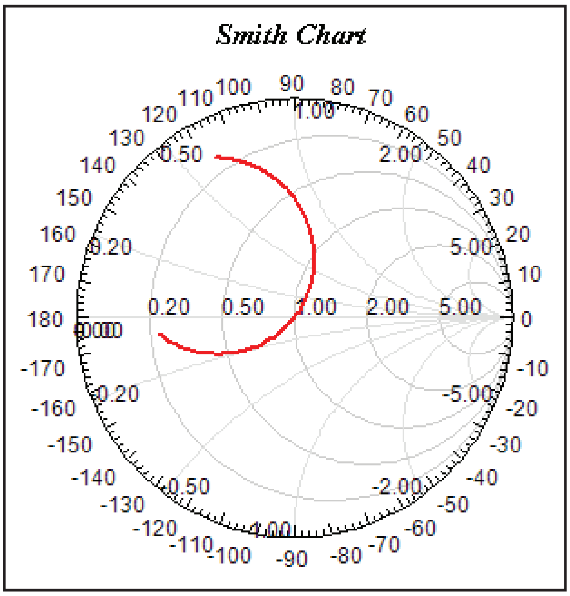
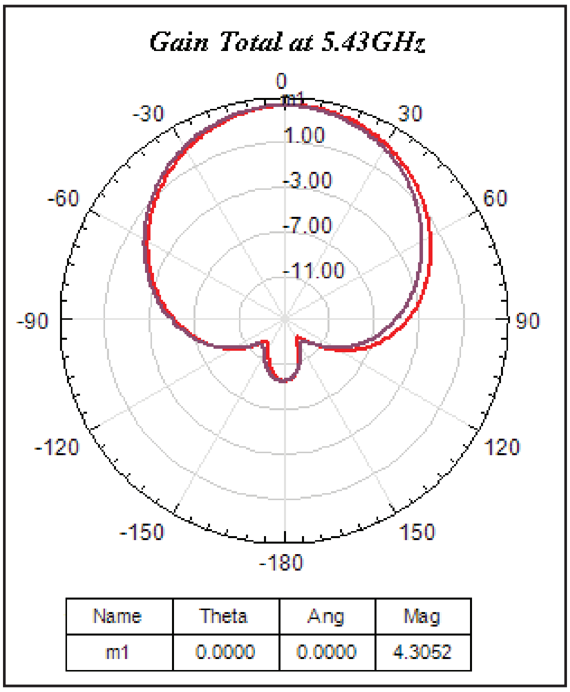
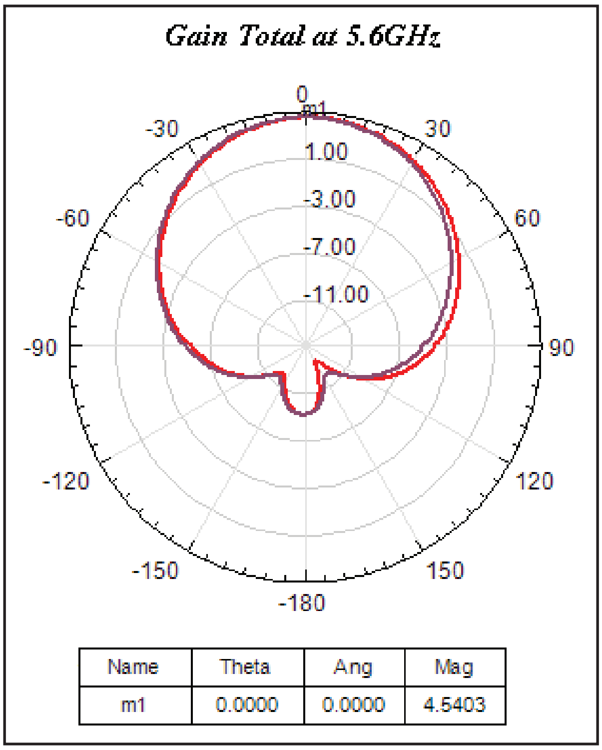


Fig. 4: Impedance Match

The radiation pattern of the proposed antenna showing the Gain total at different frequencies is shown in fig. 5. Gain total at 5.43GHz (at the beginning of the HiperLAN/2) is 4.3dBi, and the gain total at 5.6GHz (at the resonant frequency) is 4.5dBi, gain total at 5.73GHz (at the end of the HiperLAN/2) is 4.66dBi overall gain total in the whole frequency band of interest is tabulated and average gain is found out which is 4.5dBi

The important property of any antenna is VSWR in our proposed antenna we have achieved VSWR < 2 over the operating frequency. This can be seen in fig. 6





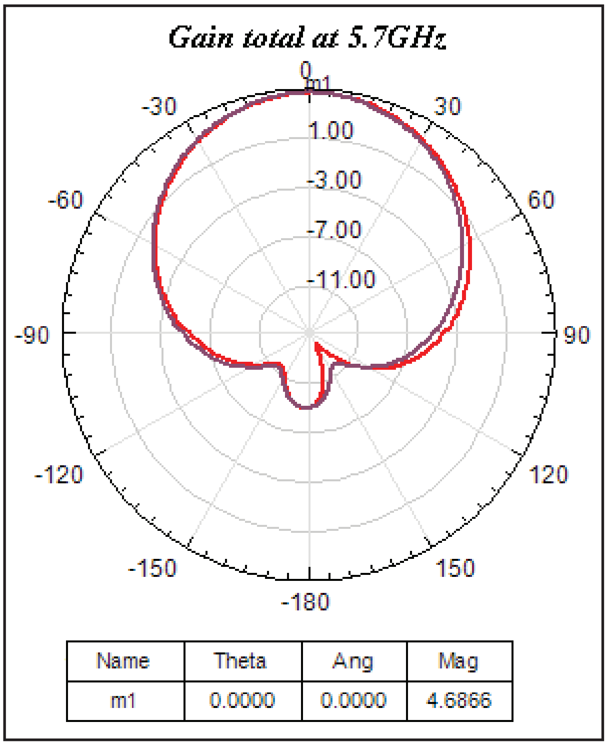


Fig. 5: Gain Total at 5.43GHz, 5.6GHz and 5.73GHz.

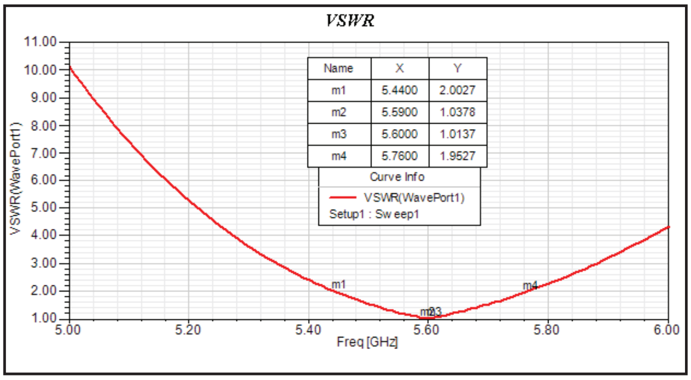


Fig. 6: VSWR of Proposed Antenna

Table 1: Parameters and Dimensions of CMPA

Parameters and Dimensions of CMPA	
Patch Radius (a)	7mm
Ground Plane Radius (gpr)	14mm
Height of the substrate	1.6mm
S11	-43.4dBi
BW	260MHz
%BW	4.6%
Average Gain	4.5dBi
Size Reduction	4.6%

IV. Conclusion

In this design we used effectively the DGS to improve the bandwidth and s11, we also achieved the size reduction of 4.6% so we can call this one as compact antenna. The CMPA with DGS is fabricated and testing is under process. All the parameters and dimensions are tabulated in Table 1.

V. Acknowledgement

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