# Review Paper For Circular Ring DGS Microstrip Patch Antenna

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***Abstract-*** *In this review paper an antenna is presented for S-band for wireless applications. The proposed antenna will designed by using circular ring type defected ground i.e DGS (Defected Ground Structure) for microstrip line feeding technique. There are four feeding techniques which are used to fed the antenna port out of which two are contacting: Microstrip line feed and coaxial probe feed whereas Proximity and Aperture coupled are non-contacting coupled feed. The Paper will give a better understanding of design parameters of an antenna and their effect on return loss, S-Parameters, smith chart, radiation pattern, bandwidth, VSWR and resonant frequency. The software used for simulation is HFSS*

***Keywords***- S-band, DGS, Circular Rings, Rectangular Microstrip patch antenna, S-Parameters, Smith chart, Radiation pattern, Bandwidth, VSWR, HFSS.

## I. INTRODUCTION

Antenna is the most fundamental block of the wireless communication. Recently, the growth of wireless systems leads to a lot of innovations in the Microstrip antenna designs. Microstrip patch antenna has become an integral part of these devices working in ultra to super high frequency ranges. A variety of wireless communication engineering applications, such as wireless links, remote sensing, cellular mobile phones and internet are in extensive demand and have witnessed a tremendous growth recently. The microstrip antenna has narrow bandwidth of the order upto 5%. This low bandwidth is not useful for many wideband wireless applications. Previously published literature has reported several possible techniques to improve bandwidth of the microstrip antenna. Utility based applications opened the way for research in the design and development of Microstrip antennas. Federal Communication Commission (FCC), in 2002, defined and drafted a frequency range from 3.1 GHz to 10.6 GHz for commercial ultra-wide band (UWB) communication. In high performance systems such as spacecraft, aircraft, satellite, and military applications where small size, light weight, low cost, high performance, easy to installation, low profile, easily integral to circuits, high efficiency antennas are required.

The patch and ground planes are fabricated by using same conducting material. However, its inherently narrow impedance bandwidth is the only factor which is to be considered while designing such type of antenna for a prescribed application. Many intensive researches have been carried out in past years to develop bandwidth enhancement techniques.

Circular polarization (CP) is very popular in a number of applications like RADAR system, navigational system, communications, etc. because its reception strength is independent of orientation and the motion of the transmitter or receiver unlike linear polarization. CP discriminates the reflected signals from the signals coming from the direct path as LHCP changes into RHCP after reflection and vice-versa. Various MSAs using CP have been described. Though single layer structures are easier to design, multilayer structures provide higher gain.

With the advancements in personal mobile communication systems, requirements of antennas with smaller size and conformability to the hosting surface have increased. Due to numerous advantages, microstrip antenna (MSA) finds role in these applications. The MSAs operated in their fundamental mode having symmetrical field distribution gives lower cross polar radiation pattern thereby realizing linear polarization.

**Advantages of Microstrip Patch Antenna**

- Light Weight and low volume.
- Low profile planner configuration.
- Low fabrication cost.
- Support both, linear as well as circular polarization.
- Can be easily integrated with microwave integrated circuits.
- Capable of dual and triple frequency operation.
- Mechanically robust when mounted on rigid surfaces.

**Disadvantages of Microstrip Patch Antenna**

- Narrow bandwidth & Low efficiency
- Extraneous radiation from feeds and junctions
- Poor end fire radiator except tapered slot antennas

- Low power handling capacity.
- Surface wave excitation

**Application of Microstrip Patch Antenna**

- Microstrip patch antennas are increasing in popularity for use in wireless applications due to their low profile structure. Therefore they are extremely compatible for embedded antennas in handheld wireless devices such as cellular phone, pager etc.
- Missile and telemetry
- Satellite Communication
- Radio Altimeter
- Command and Control
- Remote Sensing
- Satellite Navigation Receiver

## III. PROSE APPRAISAL

**Zuhura Juma Ali [2014],** This paper presents a miniaturized planar circular disc UWB antenna design for wireless communications. Printed on a dielectric substrate and fed by 50Ω microstrip line with truncated ground plane, the proposed antenna has been demonstrated to provide an ultra wide 10dB return loss bandwidth with satisfactory radiation properties. The special structure reduces the spatial volume and it is used to realize the miniaturization of the antenna. Ansoft High Frequency structure Simulator (HFSS) software tool has been employed for obtaining the simulation results. The return loss, voltage standing wave ratio (VSWR), radiation patterns and current distributions of the antenna are discussed.[11]

**Udit Raithatha,S.et al. [2015]**, This paper represents the design of Swastika shaped microstrip patch antenna for Industrial Scientific and Medical (ISM) band applications. The design has four slots as same as Swastika shape into it. Feeding method used for this design is Inset feed. Gain, Bandwidth, Return loss, Voltage Standing Wave Ratio (VSWR) and Directivity are investigated[13].

**Sumeet Singh Bhatia [2015],** A microstrip patch antenna is presented for wireless communication system. In this paper two different feeding techniques of microstrip rectangular patch antenna like direct line feed and proximity coupled feed is designed for the same dimensions of patch, feed and substrate. The designed antennas are resonating at the frequency of 7.5 GHz which is desired frequency for X-band applications[14].

**Gurpreet Kaur et. al [2016],** In this paper an rectangular patch with parasitic stub whose edge have been cut , with two slots near the feed line has been proposed. The antenna is designed using HFSS software. The designed antenna shows wideband characteristics having simulated bandwidth of 96 %.The overall dimension of the antenna are 35×35×1.6 mm3.This antenna obtained maximum gain of 9.55dB having VSWR is less than 2 [15].

**Ranjan Mishra, Raj Gaurav Mishra, Piyush Kuchhal [2016],** This research paper presents a simple design consideration of Ultra-Wide Band (UWB) Microstrip antenna using a centrally loaded rectangular slot. An analytical study of the effects of different size and shapes of slots on the performance characteristic of UWB Microstrip antenna is presented. Insertion of slot and the changes in dimension of ground plane has a high impact on the behavior and parameter of the patch antenna. To improve the bandwidth of the patch antenna, proper insertion of slot on the planer patch structure has been used [16].

**R.Er-rebyiy et. Al [2017]** The concept of Defected Ground Structures (DGS) has been developed to improve the characteristics of many microwave devices. For this purpose the DGS is also used in the microstrip antenna for some advantages such as antenna size reduction, mutual coupling reduction in antenna arrays etc... In this paper the defected ground structure (DGS) has been employed to miniaturize a microstrip patch antenna and to shift the resonance frequency from an initial value of 10 GHz to a final value at 3.5 GHz, without any change in the dimensions of the original microstrip patch antenna. This antenna is designed on a FR- 4 substrate with dielectric constant 4.4 and thickness 1.6 mm and its size is 27 X 30 $mm^2$[17].

**G.Sreedhar Kumar et. Al [2017]** Design of an adapted E-shaped microstrip patch antenna for dual-band operation is presented in this paper. Tuning of the resonant frequencies is achieved by using an adjustable air-gap. The proposed patch consists of Roggers RT/duroid 5880 substrate suspended on air-gap above the ground plane. By varying the height of air-gap, the resonant frequencies of the patch are tuned between 1.99 GHz – 2.634 GHz. Tuning is done for variable heights of air-gap and at different values of thickness of duroid substrate. The patch is excited by a coaxial probe. Good input impedance matching, return loss and a gain of 9.86 dB is achieved in the results over the tuned frequencies. Ansoft HFSS 13 Tool is used for design and simulation of the E-shaped patch. The designed MSA in terms of resonant frequency, return loss, bandwidth and gain for different values of air gap and substrate thickness. For different values of the heights, it is shown that the dual frequencies of the MSA are tuned with good return loss and gain.[18]

**Abhinav Srivastav et. Al [2017]** In this paper, we have investigated a unique design of microstrip antenna with three PLUS-slot of equal area. The geometry is such that three PLUS

symbol at an angle of 0º, 45º and 90º. Simulation has been made using HFSS software. Results of proposed antenna proves it to be a good candidate for Bluetooth and WiMAX applications. Good bandwidth, uniform radiation pattern, VSWR value nearly equal to 1 gives excellent impedance matching and better gain of the antenna are achieved. First, the dimension of patch antenna with PLUS-slot is calculated at 2.45GHz using the formulas. Then the PLUS-slot is incorporated on the patch and the new dimensions of the feed position are obtained for desired resonance frequency, VSWR, bandwidth and gain using HFSS software. HFSS software generated view of the simulated antenna is shown in Schematic view of rotated PLUS slot microstrip patch in base paper. Substrate employed for designing the proposed antenna is Rogers RT/duroid 5880(tm). The dielectric constant value for this substrate is 2.2, Antenna has been optimized to operate at a frequency 2.45GHz.[19]

**M.M.Ali [2017]** In This, a compact dimension with microstrip fed line has been chosen to fulfill the necessities of a portable device. The antenna was built on a 1.5-mm thick FR4_epoxy substrate with a loss tangent of 0.02 and a permittivity = 4.4. The substrate dimensions are 22 mm × 20 mm. A rectangular patch of dimensions Ws × Ys with a half circle cut out placed middle on the substrate. The patch is fed by 50ohm microstrip line. The proposed antenna gives wider bandwidth along with Omni-directional radiation pattern. The antenna achieves a wide bandwidth with wide impedance matching due to its reduced size.[20]

**Qassim Nasir [2017]** In this paper, The study presents an investigation of the effects of a single, or multiple circular shaped slot (cut) can be used to improve the performance of a simple patch antenna operating in Wireless Local Area Network (WLAN) frequencies ( 2.4 Ghz). The design is achieved by cutting single or multiple circular slots at the radiating element of the patch antenna. The effects of different circular slots orientations are also examined. The proposed configurations are simulated using the HFSS software package, where return loss, input impedance (Z-parameter), and radiation patterns are used for the analysis of the different configurations.[21]

## III. TACTIC WORN

Wireless communication systems in various applications have developed rapidly in recent years, and this development has generated a huge need in the use of patch antennas. Among the systems known, we distinguish: mobile worldwide interoperability for microwave access (WiMAX) and wireless local area network (WLAN) …etc. [1].Microstrip patch antenna is a necessary and critical com-ponent of communication systems and a popular choice among microwave designers for their ease of design, low profile and a compact structure. Microstrip antenna has disadvantages like low return loss, less bandwidth and low gain. The current progress of the microwave researches demand to reduce the size of the microstrip patch antenna with high performance. Various techniques can be used to feed microstrip antennas. The four most popular techniques are the microstrip line, coaxial probe, aperture coupling, and proximity coupling. For this challenge, several methods have been proposed recently, we can use Fractal geometry, notches or slots on patch antenna with different shapes, using dielectric substrates with high permittivity, tuning stub and Well as other methods can also be used, such as using Defected Microstrip Structure (DMS), Defected Ground Structure (DGS), Magneto-Dielectric Substrate and the Electromagnetic band gap (EBG). Defected Ground Structure (DGS) is one of the methods, which are used to miniaturize the size of microstrip antennas, DGS consist etching of a simple shape in the ground plane, or sometimes by a complicated shape for the better performance. The DGS can be modeled by an equivalent L-C resonator circuit. The value of the inductance and capacitance depends on the area and the size of the shape. By varying the various dimensions of the etched shape, the desired resonance frequency can be achieved.

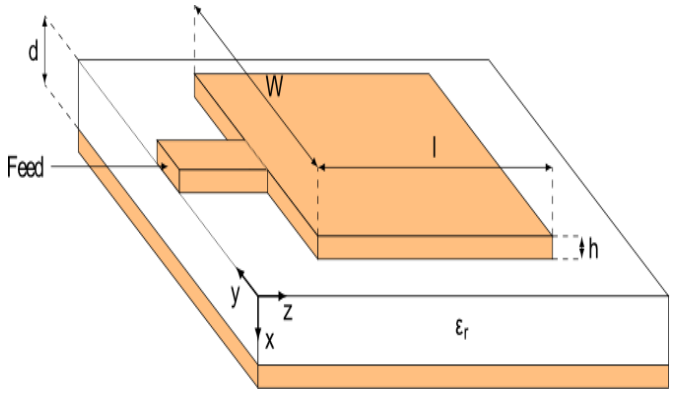


Figure 2 Basic Geometry of Microstrip Patch Antenna[1]

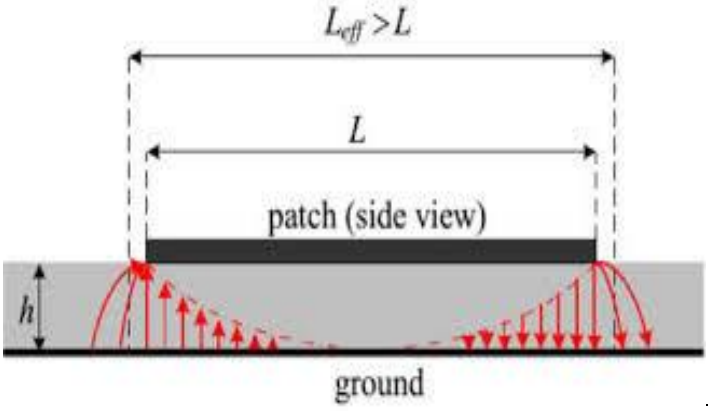


Figure 3. Effect on length due to Fringing[1]

**Various Formulas For Designing A Microstrip Patch Antenna Are Written Below**

Calculation of effective dielectric constant, ɛreff, which is given by:

$$\varepsilon_{reff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}}$$

Calculation of the length extension ΔL, which is given by:

$$\frac{\Delta L}{h} = 0.412\frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)}$$

For efficient radiation, the width W is

$$W = \frac{\lambda_0}{2\sqrt{(\epsilon_r + 1)/2}}$$

Now to calculate the length of patch becomes:

$$L = \frac{\lambda_0}{2\sqrt{\epsilon_{reff}}} - 2\Delta L$$

Length and width of the ground is:

$$L_{g=}6h + L$$
$$W_g = 6h + W$$

## IV. CONCLUSION

A single wide band microstrip patch antenna for wireless application of S-Band will be designed and simulated using HFSS software. A simulation will made in terms of bandwidth, return loss, VSWR and patch size and smith chart. So, we can see that the feeding technique for a microstrip patch antenna can be selected in such a way that it provide maximum bandwidth, minimum losses and it also affects other parameters.

The proposed antenna will be designed by using circular ring type defected ground i.e DGS (Defected Ground Structure) for microstrip line feeding technique. We can also conclude that by changing the feed point where matching is perfect, the high return loss can be achieved at the resonant frequency.

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