DEFECTED GROUND STRUCTURE MICROSTRIP ANTENNA BY USING FINITE GROUND PLANE

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Abstract:*It is proposed that a DGS be connected to a dual-layer, single-layer (DGS) ground-floor structure for communication with a limited ground aircraft. Ring frequency achieved by cutting different slots on patch. Finite ground plane state that there is also different slots and slits are present in the ground plane. We design the micro strip antenna by cutting different slots and slits in the top and bottom layer and try to achieve MSA with increased frequency ratio and low VSWR (Voltage Standing Wave Ratio). The proposed MSA properties are designed using an electromagnetic analyzer based on MoM, IE3D. A comprehensive analysis of loss of return, radiation scheme, absolute gain (dBi) of the proposed array antenna is analyzed in this project. There are two types of ground plane named as: a) Finite Ground Plane and b) Infinite Ground Plane. We achieve large bandwidth in finite ground plane over infinite ground plane and also achieve very closer to minimum value of VSWR. There are so many antennas which are used to design for array structure.*

Keywords:**Compact, Finite ground plane, Increased frequency ratio, DGS, Slit, VSWR**

I. INTRODUCTION

To talk about a new era of communication, the microstrip design of the small antenna evokes much interest among young engineers and especially microwave engineers [1]. For microwave transitions, we need a small, lightweight antenna. On this basis, the Microstrip Antenna is the most suitable device. For microwave communication as well as for wireless communication, more than one operating frequency is required per day for many reasons. Operating frequencies are required mainly because most microwave and wireless engineers use different communication bands and engineers use different frequency bands. Therefore, engineers recently designed antennas with multiple properties. Another standard required for antenna design is to reduce the size. Reducing size is the new method. In this way, the size of the antenna is the same as for the conventional antenna. To reduce size, the most useful technique is to cut different structures in the correct position on a traditional microstrip antenna [2-5]. Reducing the size of the antenna means a very low resonance frequency for the cleaved antenna compared to the traditional antenna [6-8]. Unlike slotted antennas, there are other antennas such as DRA (aerial resonance buffer), fractional antenna, etc. to reduce antenna size [15-20]. Hard to design fractal antennas and DRA need to high substrate substrates are readily available. Today, microstrip micro size of the microstrip is very small and can be reduced to increase demand for applications in various communications, especially microwave and mobile communications [9-10]. The microstrip antennas had some traditional limitations, ie individual operating frequency, low bandwidth resistance, low gain, large volume problems, polarization.

A number of techniques have been reported to enhance the parameters of traditional microstrip antennas, ie using stacking, different feeding techniques, frequency selective surfaces (FSS), electromagnetic field gap (EBG), photonic band gap (PBG), meta-material, and so forth. The DGS component has gained popularity among all reported techniques to enhance parameters due to its simple structural design. The drilled openings or defects are referred to at the ground level of the microstrip circuits as the dissociative ground structure.

Individual or multiple defects on the Earth's surface can be considered DGS. Initially DGS was reported for filters under the microstrip line. The DGS was used down the microstrip line to achieve the off-range properties and suppression of the harmonics in high-mode and reciprocal coupling. Following the successful implementation of DGS in the field of filters, DGS is currently in wide demand for various applications. This paper presents the development and development of DGS. Basic concepts, work principles, and equivalent DGS models are discussed in the field of antennas.

II. ANTENNA STRUCTURE

Proposed antenna configurations designed in Figure 1 and Figure 2 are displayed with the PTFE substrate. A Y shaped slot is cut in the top layer and a rectangular slit is added at the top. Two rectangular slots are cut at in the bottom layer as shown in Figure 2. The insulation materials specified for this design are epoxy FR4 substrate with electrostatic dielectric constant (ε_r) = 4.4 and height of substrate (h) = 1.6 mm. The three transmission line probe feed is used for proposed antenna. Figure 1 illustrates the configuration of the top layer display of the proposed antenna. Figure 2 shows the composition of the bottom layer display of the proposed antenna designed with a similar type of PTFE.

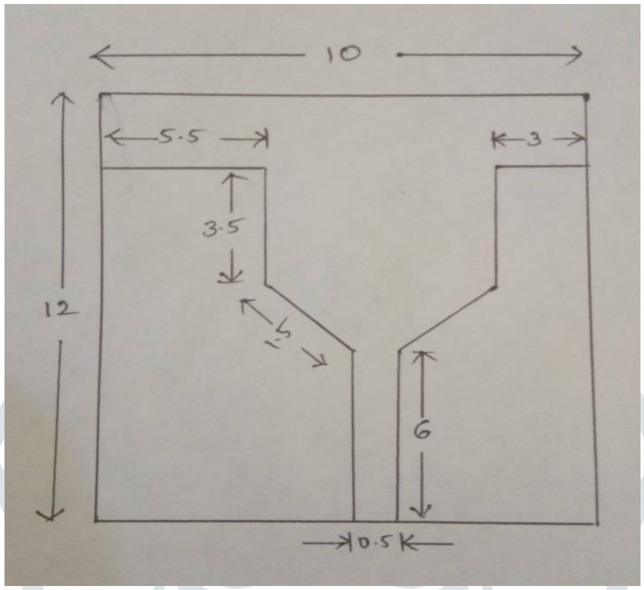

Figure 1: Proposed Antenna Configuration (Top View)

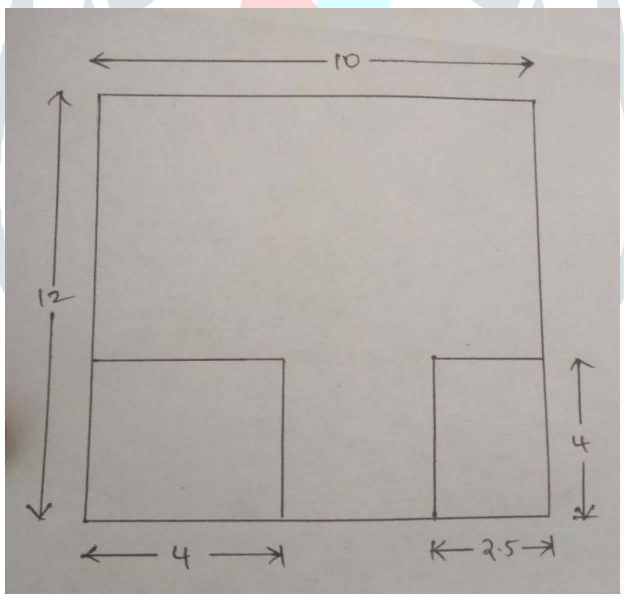

Figure 2: proposed Antenna configuration (Bottom View)

The proposed antenna configuration is designed with a similar PTFE substrate. The proposed antenna is 10 mm x 12 mm of rectangular patch.

III. Simulated Results and Analysis

Different parametric analysis of the proposed antenna is performed and displayed. Several antenna parameters have been investigated to improve bandwidth and antenna loss and loss. Figure 3 and Figure 4 shows the simulation return loss for the proposed antenna.

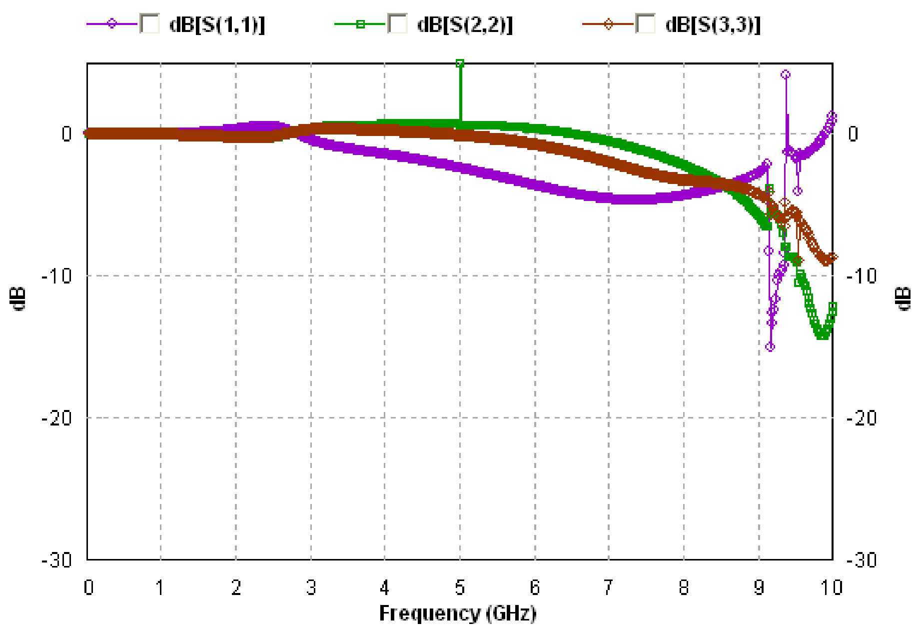

Fig 3: Return Loss when one port is active

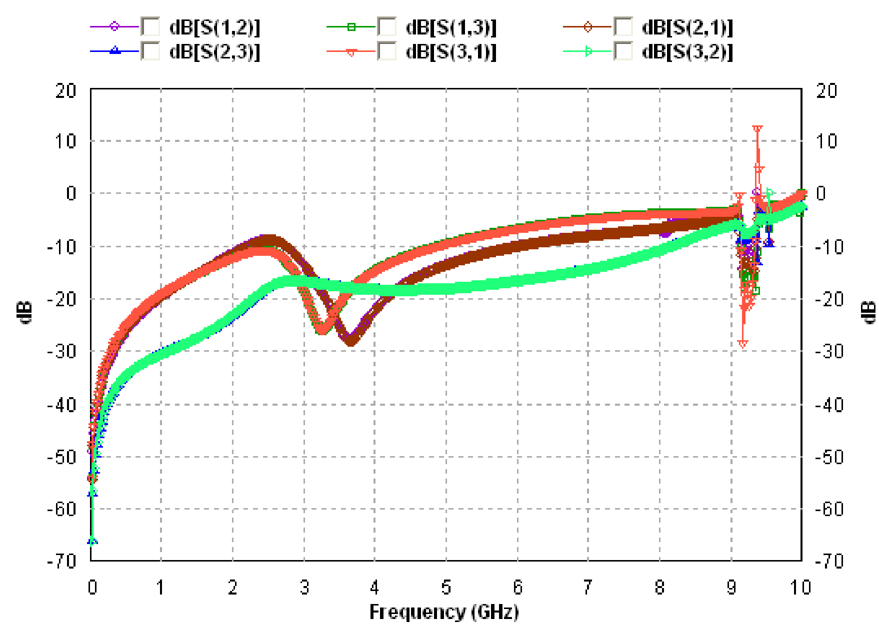

Fig 4:Return Loss when all ports are active

Since the aperture is cut in the correct position of the antenna, the resonance frequency operation is obtained at large values of the frequency ratio with a significant loss of antenna return. The first resonance frequency of a proposed antenna is obtained at f1 = 9.16 GHz with a return loss of about -14.17 dB. The second resonance frequency is obtained at 0.02 fH = 0.02 GHz with a return loss of -54.17 dB. The corresponding 10 dB bandwidth from the antenna proposed in f1 and f2 is 207.09 MHz and 223.0 MHz, respectively.

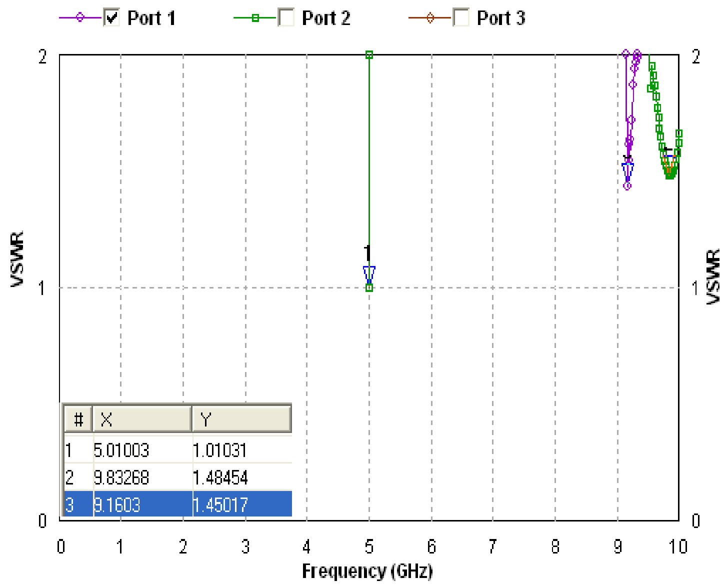

Fig 5: VSWR Pattern of Designed Antenna

Figure 5 illustrates the VSWR simulation scheme against the proposed resonance frequency. All VSWR values are within the range of 2: 1. All simulated results are summarized with the help of Table I, Table II and Table III, which are discussed below:

TABLE I:*FREQUENCY WITH GAIN*

FREQUENCY	FREQUENCY RATIO	MAXIMUM GAIN(dB)	3dB BEAMWIDTH (deg)
0.02	-	-48.68	170.767
3.23	161.5	-6.82	157.93
3.64	182	-6.71	159.69
9.16	458	5.64	168.49
9.378	468.9	6.64	161.66
9.538	476.9	7.89	164.5
9.82	491	10.21	164.8

TABLE II: *FREQUENCY WITH RETURN LOSS (ONE PORT ACTIVE)*

ACTIVE PORT	RESONANT FREQUENCY(GHz)	RETURN LOSS(dB)	10dB BANDWIDTH(MHz)
1	9.16	-14.82	131.67
2	9.82	-14.17	>470
3	-	-	-

TABLE III:*FREQUENCY WITH RETURN LOSS (ALL PORTS ACTIVE)*

ACTIVE PORT	RESONANT FREQUENCY(GHz)	RETURN LOSS(Db)	10Db BANDWIDTH(MHz)
S_{12}& S_{21}	f1=9.16 f2=0.02 f3=3.64	-14.17 -54.17 -28.19	207.09 223.0 329.7
S_{13}& S_{31}	f1=0.02 f2=3.23 f3=9.160	-53.84 -25.812 -27.8	487 487 197.34
S_{23}& S_{32}	f1=9.378 f2=9.538	-13.24 -9.82	- -

IV. CONCLUSION

Double layer, triple-patch small patch antenna broadcast simulated probes were performed using the immediate program of the IE3D electromagnetic solver. When a Y-shaped slot is cut with a rectangular slit from the top layer and a simple rectangular hole from the bottom layer, a significant improvement appears in the maximum return loss of about -54.17 dB and the value of VSWR within 2: 1. Another result is that the 3D for the radiation scheme of about 170.77^0 for the proposed antenna is a package wide enough for the intended applications. If we change feed types, the results give a narrower bandwidth of 10 decibels and fewer signals.

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REFERENCES

1. I. Sarkar, P. P. Sarkar, S. K. Chowdhury A new compact printed antenna for mobile communication. 2009 Loughborough Antennas & Propagation Conference 16-17 Nov. 2009, Loughborough, UK.
2. J.-W. Wu, H.-M. Hsiao, J.-H. Lu and S.-H. Chang, “Dual broadband design of rectangular slot antenna for 2.4 and 5 GHz wireless communication”, IEE Electron. Lett. Vol. 40 No. 23,11th November 2004.
3. Samiran Chatterjee, Joydeep Paul, Kalyanbrata Ghosh, P. P. Sarkar, D.Chanda (Sarkar) and S. K. Chowdhury “A Compact Microstrip Antenna for WLAN Communication”, National Conference of Electronics, Communication and Signal Processing, 2011, Paper ID: 116
4. Rohit K. Raj, Monoj Joseph, C.K. Anandan, K. Vasudevan, P. Mohanan, “ A New Compact Microstrip-Fed Dual-Band Coplaner Antenna for WLAN Applications”, IEEE Trans. Antennas Propag., Vol. 54, No. 12, December 2006, pp 3755-3762.
5. U. Chakraborty, S. Chatterjee, S. K. Chowdhury, and P. P. Sarkar, “Triangular Slot Microstrip Patch Antenna for Mobile Communication”, India Conference (INDICON), 2010 Annual IEEE, pp 4-7, Paper ID: 511
6. J. -Y. Jan and L. -C. Tseng, “ Small planar monopole Antenna with a shorted parasitic inverted-L wire for Wireless communications in the 2.4, 5.2 and 5.8 GHz bands” , IEEE Trans. Antennas and Propag., VOL. 52, NO. 7, July 2004, pp -1903-1905.
7. S. Chatterjee, U. Chakraborty, I.Sarkar, S. K. Chowdhury, and P. P. Sarkar, “A Compact Microstrip Antenna for Mobile Communication”, India Conference (INDICON), 2010 Annual IEEE, pp 1-3, Paper ID: 510
8. Danideh, A., R. S. Fakhr, and H. R. Hassani, “Wideband coplanar microstrip patch antenna,” Progress In Electromagnetics *Research Letters*, PIER 4, 81–89, 2008.
9. Samiran Chatterjee, Joydeep Paul, Kalyanbrata Ghosh, P. P. Sarkar and S. K. Chowdhury “A Printed Patch Antenna for Mobile Communication”, Convergence of Optics and Electronics conference, 2011, Paper ID: 15, pp 102-107
10. J. Bahl and P. Bhartia, “Microstrip Antennas”, Artech House, Dedham, MA, 1980.
11. U. Chakraborty, S. Chatterjee, S. K. Chowdhury, and P. P. Sarkar, "A compact microstrip patch antenna for wireless communication," *Progress In Electromagnetics Research C*, Vol. 18, 211-220, 2011
12. R.Fallahi, A.-A.Kalteh, M. Golparvar Roozbahani, "A novel UWB elliptical slot antenna with band-notched characteristics," *Progress In Electromagnetics Research C*, Vol. 18, 211-220, 2011
13. Samiran Chatterjee, Santosh Kumar Chowdhury, Partha Pratim Sarkar and Debasree Chanda Sarkar, “Compact Microstrip Patch Antenna for Microwave Communication”, Indian Journal of Pure & Applied Physics, Vol. 51, November 2013, pp 800-807.
14. C. A. Balanis, “Advanced Engineering Electromagnetic”, John Wiley & Sons., New York, 1989.
15. Werner, D.H and S.Ganguly, “An overview of fractal antenna engineering research”, IEEE Antennas and Propagation Magazine, Vol. 45, No. 1, 38-57, 2003
16. A.Aggarwal and M.V.Kartikeyan, “Pythagoras Tree: A Fractal Patch Antenna for multi-frquency and ultra Band-Width Operations”, Progress in Electromagnetics Research C, Vol. 16, 25-35, 2010
17. Gianvittorrio, J.P and Y. Rahmat-Samii, “Fractal Antennas: A novel antenna miniaturization technique and applications”, IEEE Antennas and Propagation Magazine, Vol. 44, No. 1, 20-36, 2002
18. Carles Puente Baliarda, Jordi romeu and Angel Cardama, “The Koch Monopole: A small fractal antenna”, IEEE Transactions on antennas and propagation, Vol. 48, No. 11, 1773-1781, November-2000
19. M. Saed and R. Yadla, “Microstrip fed low profile and compact dielectric resonator antenna”, Progress in Electromagnetics Research, PIER-56, 151-162, 2006
20. Aldo Petosa and Apisak Ittipiboon, “Dielectric Resonator Antennas: A Historical review and the current state of the Art”, IEEE Antennas and Propagation Magazine, Vol. 52, No. 5, pp 91-116, October 2010
21. Zeland Software Inc. IE3D: MOM-Based EM Simulator. Web: http://www.zeland.com