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Compact Dual Band Microstrip Patch Antenna with Defected Ground Structure for GSM and ISM Band Application

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ABSTRACT

In this paper a compact dual band microstrip patch antenna has been designed with defected ground structure for GSM(1800-1900 MHz) and ISM(2.4-2.5 GHz) band application. This antenna is designed on a FR4 lossy substrate with dielectric constant 4.3. Dual frequency bands are obtained by inserting a many slot in ground as well as gain enhancement on the GSM band. The gain is 14db on GSM band and 1.685db on ISM band. The return loss of this antenna is S11<-19.95dB on GSM band and S11<-32.46db on ISM band. The antenna simulated by using CST Microwave Studio 2010.

Keyword:- Dual band, Microstrip, Ring(antenna design), DGS and CST software.

I. INTRODUCTION

Now a Days increase the interest in microwave and wireless communication in microstrip patch antennas. The demand for low profile, compact, less cost [1]. For two frequency bands to avoid the use of two separate antennas and to achieve the demand of communication market there is a need to develop the dual band antennas [1]. There are many design technique and structure such as defected ground structure, slotted and compact etc. Now a Days DGS microstrip patch antennas, slotted and compact antennas have been recently developed for multiband communication system. It has been observed that good gain is achieved by increasing the number of slots on the ground [2]. In this paper the microstrip feeding technique is used for antenna. Different defected ground structure(DGS) have been developed and analysed [3]. There are different techniques reported by the researchers for the gain enhancement such as array configuration [4], using the synthesized substrate [5], using parasitic elements technology [6] and using the electromagnetic band gap structures (EBG) [7] etc. In this paper presents the gain enhancement of the microstrip antenna using the ring shaped DGS. In this work, a compact dual band microstrip patch antenna with defected ground structure is suitable for GSM and ISM band application.

II. ANTENNA DESIGN

Compact dual band microstrip patch antenna is designed for GSM and ISM band application. This antenna is simulated by FR-4 lossy substrate, thickness 1.6 mm and the loss tangent is 0.02 and the dielectric constant 4.3. The size of ground is designed of microstrip patch antenna is 33×33 mm^2. Gain enhancement of designed dual

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band microstrip patch antenna get enhanced using ring shaped Defected Ground Structure (DGS). The antenna size (length and width) is calculated by using this formula.

a. Width of the patch is given by,

$$W = \frac{c}{2.f_0\sqrt{\frac{(\varepsilon_r+1)}{2}}} \text{ ---------- (1)}$$

b. Effective dielectric constant is given by,

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

c. The length extension of the patch is given by,

$$\Delta L = 0.412\frac{(\varepsilon_{reff}+0.3)(\frac{W}{h}+0.264)}{(\varepsilon_{reff}-0.258)(\frac{W}{h}+0.8)} \text{ ---------- (3)}$$

d. The effective length of the patch is given by,

$$L_{eff} = \frac{c}{2.f_0\sqrt{\varepsilon_{reff}}} \text{ ---------- (4)}$$

e. The actual length of the patch is given by,

$$L = L_{eff} - 2.\Delta L \text{ ---------- (5)}$$

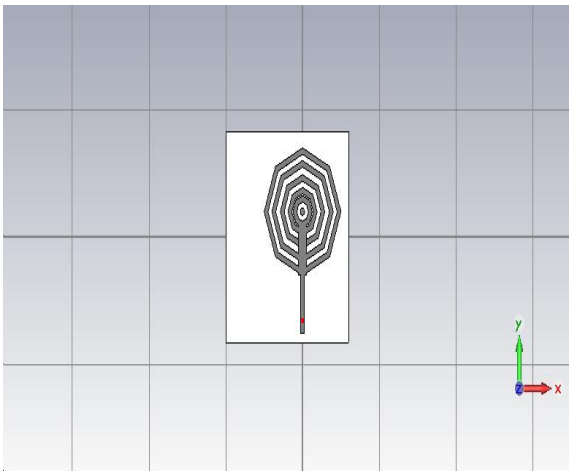

Fig.1. front view of the antenna

III. DEFECTED GROUND STRUCTURE

In this work the DGS technique is used for the performance enhancement of microstrip antennas. Back view of compact dual band microstrip antenna with octogonal DGS is shown in fig.2. The design of the DGS is ring type. The dielectric material has been taken of dielectric constant 4.6 with thickness of 1.6 mm. The DGS structure locates on the ground plane of the antenna

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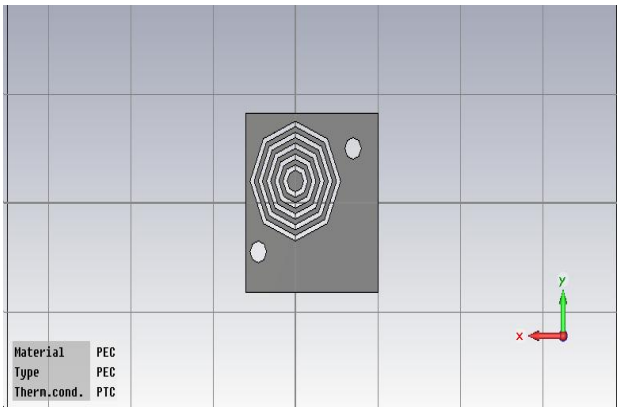

Fig.2. Defected ground structure of the antenna

IV. RESULT AND DISCUSSION

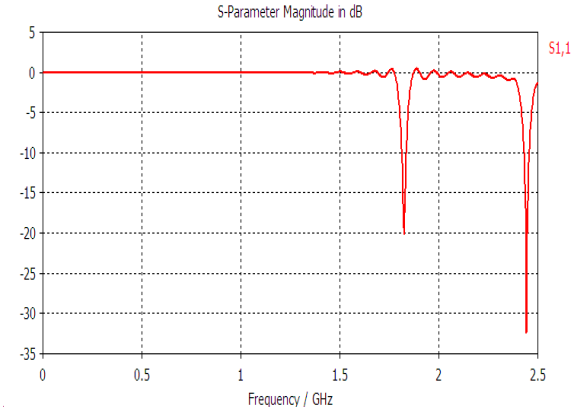

Fig.3: Return loss for dual band microstrip antenna with DGS

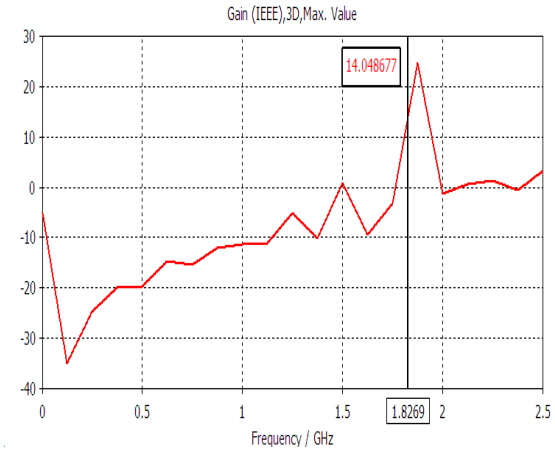

Fig.4. increasing gain on GSM band

Table.1. simulation results

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Band	Gain	Return loss	VSWR
GSM	14db	-19.95db	1.226
ISM	1.685db	-32.46db	1.0634

From simulation, the return loss for dual band microstrip patch antenna with DGS is shown in fig.3. It shows that, the proposed antenna resonates at resonating frequencies of 1.83GHz and 2.45GHz with return loss of -19.95db and -32.46db respectively. Observed gain of a GSM band is 14db and for ISM band is 1.69db. The design and simulation of this antenna has been carried out using full wave EM simulator CST microwave studio [8]. The main objective of this research work is increase the gain of compact dual band microstrip antenna. The increasing gain on GSM band is shown in fig.4. The gain of the antenna with two ring shaped DGSs is found to be 14 dB as an increment in the gain of the antenna without DGS i. e. -2 dB. The simulation result of the compact dual band microstrip antenna with DGS is shown in table 1.

V. CONCLUSION

compact dual band microstrip antenna with DGS has been designed and simulated using the CST microwave studio for the gain enhancement on the GSM . The gain of the antenna is found 14 Db with the DGS whereas the gain without the DGS was found -2 dB on the GSM. This antenna can be used for GSM and ISM band application.

VI. FUTURE WORK

The antenna fabrication will be performed using the FR4 lossy substrate to compare the performance of the antenna with the simulation results and increase the gain on ISM band.

REFERENCES:-

1] Sayali J. Pawar, Mandar P. Joshi, " Design of Dual Band Circular Microstrip Patch Antenna with Defected Ground Structure for ISM and WLAN Band Applications," IGETAE, vol. 6, Issue 7, July 2016

[2]K. Arya, A. Patnaik, M. V. Kartikeyan , "Microstrip Patch Antenna With Skew-F Shaped DGS For Dual Band Operation" Progress In Electromagnetics Research M, vol. 19, pp.147–160, 2011

[3] M. Akbari, J. Khalilpour, M. Mighani, S. Rastgar, "A Novel very Compact Printed Antenna using Defected Ground Structure for 2.4 and 5 GHz Communication," IJECT, vol. 2, Issue 4, Oct –Dec 2011

ISBN: 978-93-86171-60-3

[4] M. Khayat, J. T. Williams, D. R. Jakson, and S. A. Long, "Mutual coupling between reduced surface-wave microstrip antennas," IEEE Trans. on Antenna and Propagation, vol.48, pp. 1581-1593, Oct. 2000

[5] K. Bhattacharayya, "Characteristics of space and surface-waves in a multilayered structure", IEEE Trans. on Antennas and Propagation, vol.38, pp. 1231- 1238, Aug. 1990

[6] R.G. Rojas, and K.W. Lee, "Surface wave control using nonperiodic parasitic strips in printed antennas", IEE Pros.-Microwave, Antennas Propagation, vol.148, pp. 25-28, Feb. 2001

[7] J. Park, A. Herchlein, and W. Wiesbeck, "A Photonic Bandgap (PBG) structure for guiding and suppressing surface waves in millimeter-wave antennas", IEEE Transaction on Antennas Propagation , vol. 49, pp. 1854-1857, Oct. 2001

[8] CST Microwave studio" TM, V.9