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A Typical Compressed Wideband and High Gain Microstrip Patch Antenna for GSM Applications

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ABSTRACT: This paper depicts a design of Microstrip antenna for GSM communications at 900MHz. As the recommended antenna can attain such wide functioning bandwidth with moderately low profile, it is very appropriate for multi-band mobile communication handsets. The antenna is proper for utilization in hand-held or other mobile appliances. This typical antenna can be used for numerous applications, specially in the GSM domain as well as for Wi-Fi and Bluetooth. This design has a lot of benefits as the total antenna volume can be used again, and so the total antenna will be compact. In this paper we depict designs of compressed little size Microstrip antennas appropriate for GSM band (1.8 GHz band) operations. The design is demonstrated by numerical simulations. The consequences substantiate excellent performance of the single and multiband antenna design

KEYWORDS: Microstrip Antenna, GSM, VSWR, Return Loss.

I. INTRODUCTION

Cellular Wireless Communication is the necessity of the world. In this age we cannot think of the common life without cell phone. The Microstrip patch is one of the most favored antenna arrangements for low cost and compact design for Wireless scheme. Patch antenna has various benefits like low profile, light weight, small volume and congruent with microwave integrated circuit (MIC) and monolithic microwave integrated circuit (MMIC). Nevertheless, the narrow bandwidth is the main impediment in broad applications for the microstrip antenna. Usually, the impedance bandwidth of the conventional microstrip antenna is merely a small percent (2% - 5%). Even though rectangular and circular geometries are mainly utilized, other geometries possessing larger size reduction discover broad applications in recent communication schemes, where the main interest is compactness.

Methods like global position system (GPS) and Global System for Mobile Communications (GSM) are needed to function at two diverse frequencies at a distance very far from one another. Micro-strip antennas can avoid the utilization of two diverse single band antennas. Different techniques have been recommended to acquire dual frequency operation. Amongst them, loading slits , utilizing slots in the patch , loading the patch with shorting pins , utilizing stacked patches , or employing two feeding ports are the mainly used ones. Additionally, there are planar antennas of particular geometries to attain dual-band operation. A usual microstrip Patch Antenna comprises essentially of a radiating metallic patch on one side of a dielectric substrate, and has ground plane on another side. Commonly reconfigurable antennas posses same radiation patterns for all designed frequency bands and permit effective utilization of electromagnetic spectrum and frequency selectivity which is helpful for decreasing the undesirable consequence of co-site interference and jamming.

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II. ANTENNA CONFIGURATION

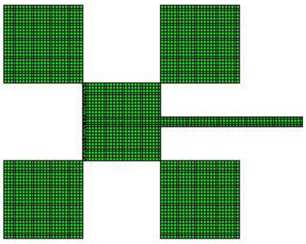
Fig. 1 (a) Structure of Antenna

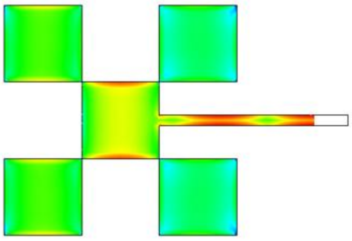
Fig 1 (b) Current Distribution of Antenna

Fig. 1(a) demonstrates the method of constructing the innovative shape of square patch antenna. The measurement of square shaped antenna are as follows :length of inner box = 9.13 mm, width of inner box = 16.41 mm $\varepsilon_{r=}2.2$ and height of patch = 2mm.The figure depicted in Fig.1 (b) demonstrates the current distribution performance of Square patch at 6 GHz excitation. The important alterations in radiation pattern of arrays can be attained by altering current distribution array of the antenna

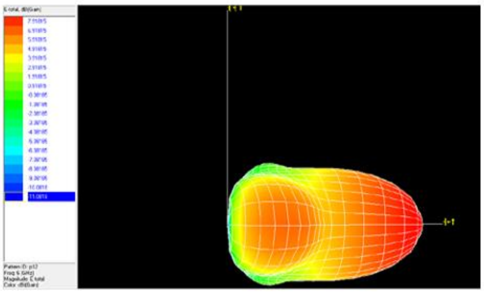
Fig. 1 (c) Gain Pattern of Antenna

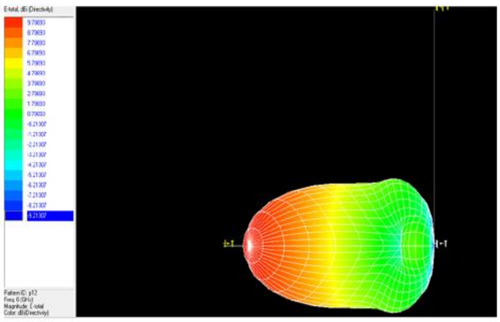
Fig. 1 (d) Directivity Pattern of Antenna

Fig. 1 (c) illustrates the three dimensional pattern of gain of Square Patch Antenna in dB scale for the antenna. Gain as a parameter determines the directionality of a specified antenna. An antenna having a low gain discharges radiation in all directions uniformly, while a high-gain antenna will favorably emit in specific directions. The above Fig. 1 (d) illustrates the three dimensional pattern of gain of Square Patch antenna in dB scale for the antenna. Gain as a parameter determines the directionality of a specified antenna.

III. DESIGN SPECIFICATIONS

[a] 1. Calculation of width (w) of patch computed by the formula

$$w = \frac{v_0}{2 f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \qquad (1)$$

Where, v_0= speed of light in free space, ε_r =dielectric constant of patch

2. Calculation of effective dielectric constant (ε_{reff}) computed by the formula

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

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Here, h and w signify the height of the patch, width of the patch respectively.

3. Calculation of extension of length (Δl) of patch computed by the formula

$$\Delta l = 0.412 \frac{(\varepsilon_{reff} + 0.3)(\frac{w}{h} + 0.264)}{(\varepsilon_{reff} - 0.258)(\frac{w}{h} + 0.8)} \tag{3}$$

4. Calculation of length (l) of patch computed by the formula

$$l = \frac{1}{2 f_r \sqrt{\varepsilon_{reff}} \sqrt{\mu_0 \varepsilon_0}} - 2\Delta l \tag{4}$$

Here, $f_r, \varepsilon_{reff}, \mu_0, \varepsilon_0$ denote the resonant frequency of antenna, effective dielectric constant of antenna, permeability of the substrate, permittivity of the substrate respectively.

[b] The essential parameters for the design of Square Microstrip Patch Antenna are as follows f=2.4 GHZ, ε_r = 2.2, h=2mm. Calculating the parameters We have got w=4.94cm, ε_{reff} = 1.84, Δl= 0.931cm, l=2.74cm

IV. PERFORMANCE EVALUATION

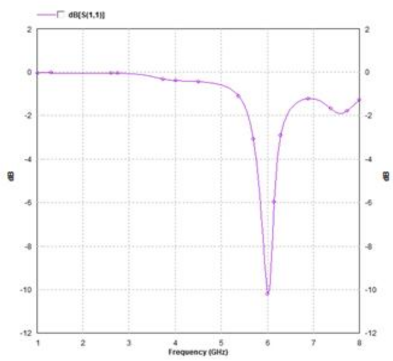

Fig. 2 (a) Return Loss of the antenna

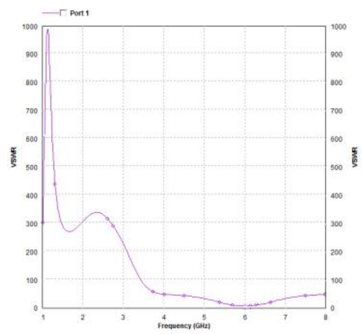

Fig. 2 (b) VSWR of the antenna

Fig. 2 (a) illustrates the Return loss without EBG acquired at 6 GHz frequency about -10.1dB. Return loss is associated to both standing wave ratio (SWR) and reflection coefficient (Γ). It is a determination of how fine devices or transmission lines are matched. Fig. 2 (b) illustrates the VSWR (Voltage Standing Wave Ratio) of the antenna acquired at 6 GHz about 1.2 .VSWR is a determination of how much power is conveyed to an antenna. The VSWR is also a measure of how nearly the source and load impedance are matched

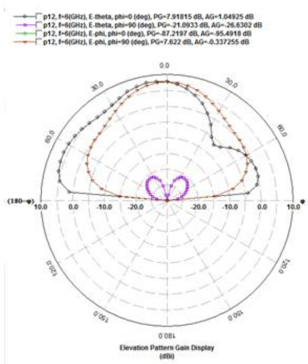

Fig. 2(c) 2-D gain polar plot

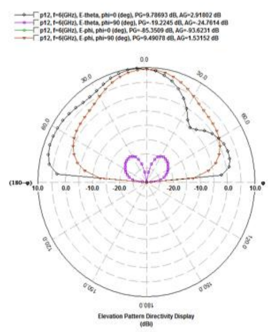

Fig. 2(d) 2-D directivity plot

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Fig. 2 (c) shows the two dimensional polar plot of gain attained at E-theta and E-phi where phi=0^0 and phi=90^0, exciting at 6 GHz. Fig. 2 (d) depicts the polar plot of directivity of the antenna attained at E-theta and E-phi at phi=0^0 and phi=90^0, exciting at 6 GHz.

V. DISCUSSION

The most important quality of the recommended antenna is that it permits an effectual design maintaining all the benefits of microstrip antennas in terms of size, weight and easy manufacturing. Additionally, this antenna possess a fine efficiency on the whole of the three covered bands respectively, GSM, UMTS and WLAN frequency bands. The most favorable outcomes of recommended antenna are demonstrated and tested with the help of IE3D SIMULATOR. So the recommended antenna is appropriate as an innovative improvement for broad band antenna to widen the bandwidth for GSM purposes. This type of a single patch antenna design that can function on frequencies of GPS and GSM applications is very effective and realistic in recent communications methods. The recommended antenna is extremely compact, too easy to fabricate, and is fed by a 50Ω microstrip line which makes it very attractive for recent and future cellular phones purposes. The designed microstrip antenna is optimized to encompass the GSM, DCS, PCS, UMTS and applications in the ISM band utilized by techniques BLUETOOTH and WIFI.

REFERENCES

[1] W.L. Stutzman and G.A. Thiele, "*Antenna Theory and Design*", 2nd ed. New York: Wiley, 1998
[2] Constantine A. Balanis, "*Antenna Theory Analysis and Design*", 2nd Edition, John Wiley & Sons
[3] Adenen rajhi, Said Ghnimi and Ali Garssallah," *Electrical Characteristics of a Dual-Band Microstrip Patch Antenna for GSM/ UMTS / WLAN Operations"* International Journal of Communication Networks and Information Security (IJCNIS), Vol. 2, No. 1, April 2010.
[4] Jeevani W. Jayasinghe , Jaume Anguera , and Disala N. Uduwawala, "*A SIMPLE DESIGN OF MULTI BAND MICROSTRIP PATCH ANTENNAS ROBUST TO FABRICATION TOL ERANCES FOR GSM, UMTS, LTE, AND BLUETOOTHAPPLICATIONS",* Progress In Electromagnetics Research M, Vol. 27, 255, 269, 2012.

BIOGRAPHY

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