Printed Monopole Antenna for CDMA and GSM Frequencies

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Abstract— **In this paper a novel printed monopole antenna for CDMA and GSM frequencies is proposed. The given antenna is composed of a rectangular patch monopole printed antenna having three rectangular slots, of different dimensions, in decreasing order of area. The antenna is designed for CDMA 800 and GSM 900 standard. It covers the frequency range of both above standard, 824-894 MHz for CDMA 800 and 890-960 MHz for GSM 900, with resonant frequency of 878 MHz having -41.5dB return loss and VSWR < 1.5. A rectangular ground structure is used for minimizing the return loss. The 50 ohm probe feed is used to fed the proposed antenna.**

***Keywords*—monopole, CDMA , GSM, printed antenna.**

I. INTRODUCTION

During the last decade, digital wireless cellular systems have presented an exploding growth. Among different configurations used all over the world, second generation cellular systems, code division multiple access (CDMA) [1-2] and Global System for Mobile Communications (GSM) [3], are considered as the dominant mobile communications systems. In this paper, among various standards of CDMA and GSM, a printed monopole antenna is designed for CDMA 800 and GSM 900 standards. A monopole antenna is a class of radio antenna consisting of a straight rod-shaped conductor, usually mounted perpendicularly over some type of conductive surface, called a ground plane. Many authors have presented monopole antenna designs suitable for WLAN operations [4]. A monopole can be visualized as being formed by replacing one half of a dipole antenna with a ground plane at right-angles to the remaining half [5]. If the ground plane is large enough, the radio waves reflected from the ground plane will seem to come from an image antenna forming the missing half of the dipole, which adds to the direct radiation to form a dipole radiation pattern. Because it radiates only into the space above the ground plane, or half the space of a dipole antenna, a monopole antenna will have a gain of twice (3 dBi over) the gain of a similar dipole antenna, and a radiation resistance half that of a dipole [6-7]. Thus a quarter-wave monopole, the most common type, will have a gain of 5.19 dBi and a radiation resistance of about 36.8 ohms if it is mounted above a good ground plane. Dual-band monopole antennas have been reported [8-9] but these however offer narrow impedance bandwidth characteristics. Rectangular planar monopole antennas have been shown to exhibit a relatively wide impedance bandwidth and good radiation pattern characteristics. π slot dual band patch antennas are discussed [10]. Monopoles having simple structures, but powerful merits, such as pure vertical polarization and horizontal omni directional radiation, have extensively been used in a variety of applications. The impedance bandwidths of simple thin-wire monopoles can be increased by modifying their geometry, such as thickening or loading or folding their wire elements [11]. It is of a particular interest to design an antenna with simple structure, low profile, easy manufacturing, and low cost. In this paper a novel printed monopole antenna is proposed. The proposed antenna are simple to design and offer an effective control of operating bands by controlling the dimensions of the rectangular slots. The antenna design procedure is given in section II, Section III and IV shows the simulated results and conclusion respectively. Finally, the last portion of the paper covers the references.

II. ANTENNA DESIGN THEORY

A novel printed monopole antenna is composed of a rectangular patch monopole printed antenna over the FR4 substrate having thickness of 1.6mm, relative permittivity of 4.4 and loss tangent of 0.02. This rectangular patch monopole antenna has three rectangular slots, having different dimensions, in decreasing order of area. The first rectangular slot is responsible for the antenna operation at CDMA 800 frequency range (824-894MHz). The second rectangular slot, having area lesser than the first rectangular slot, makes the antenna to operate satisfactorily at GSM 900 frequency range (890-960MHz).The third rectangular slot is not designed for antenna operation at other frequency ranges, it is designed to adjust the resonant frequency of the proposed antenna.

The path length of the arms of a monopole antenna structure should be equal to λ/4 in free space to resonate at desired frequency [12-13]. At other side of the substrate, a rectangular ground structure (13×10) is designed for minimizing the return loss. Fig.1 shows the structure of the proposed antenna and the Table. I, show the parameters of the proposed monopole antenna. The antenna is modeled and simulated using method

of moment based electromagnetic simulation software IE3D, version 12 for 50 number of frequency points between 0 to 3GHz.

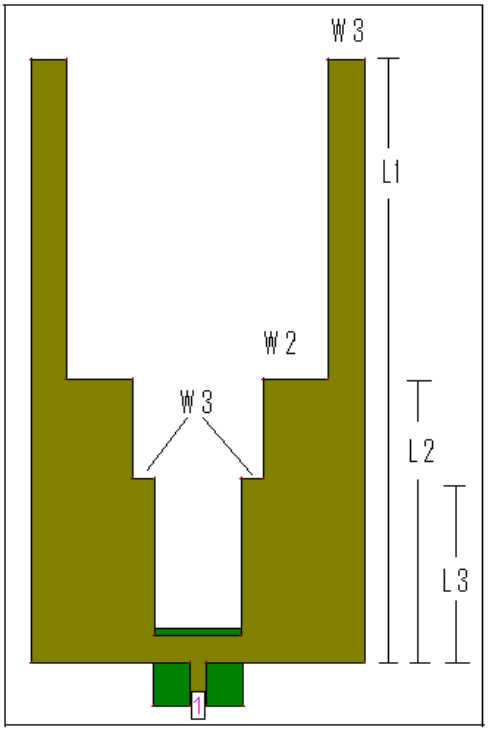

Figure 1: Structure of Proposed antenna.

TABLE.I: STRUCTURAL PARAMETERS OF PROPOSED ANTENNA

Sr. No.	Parameters of proposed monopole antenna		
	Parameters	*Dimension*	*Unit*
1.	L1	8.00	Cm
2.	L2	4.11	Cm
3.	L3	2.97	Cm
4.	W1	0.51	Cm
5.	W2	1.13	Cm
6.	W3	0.30	Cm

III. SIMULATION RESULTS

Fig. 2, 3 and 4 shows the graph of return loss V/s frequency, VSWR Vs. frequency and impedance variations V/s. frequency respectively. The graph of return loss shows that antenna is resonating at 878MHz frequency with return loss of -41.5dB and voltage standing wave ratio (VSWR)<1.5 and covering the frequency range of CDMA 800 and GSM 900.

The graph of vswr V/s frequency shows that the vswr for CDMA 800 and GSM 900 frequency range is less than 2 that indicates the good impedance matching capabilities of the proposed monopole antenna.

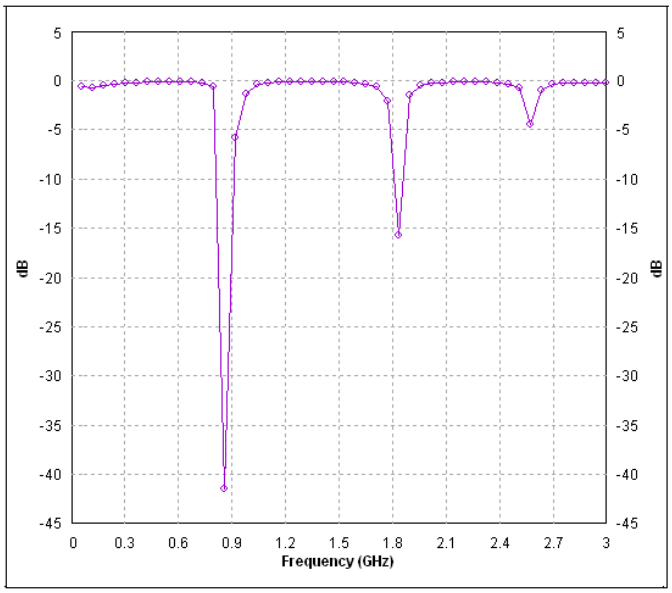

Figure 2: Return Loss V/s Frequency.

It is clear from Figure 2, that the antenna, un-intentionally, is resonating at 1837MHz for GSM 1800 standard (1710-1880MHz) with return loss of -15.7dB and VSWR<2.

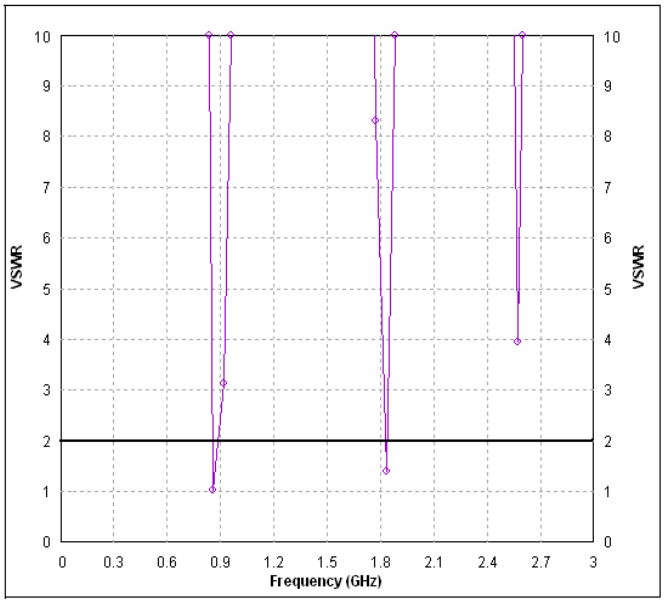

Figure 3: VSWR V/s Frequency.

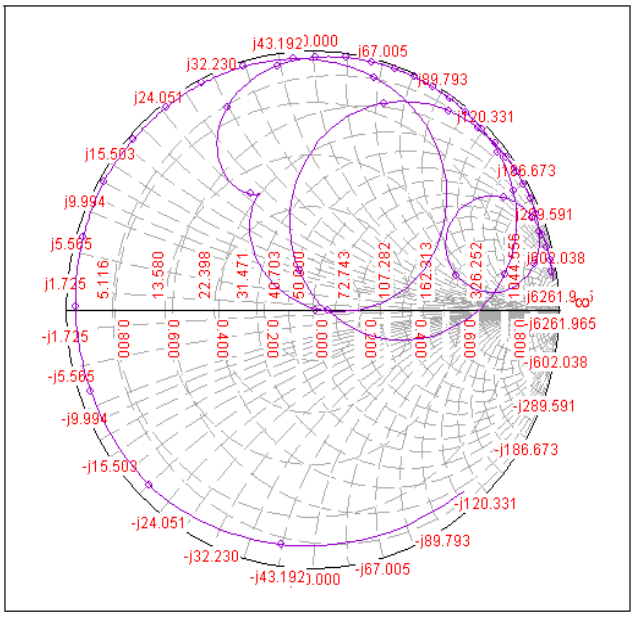

Figure 4: Impedance variation V/s Frequency.

Dark line at vertical axis of figure.3 is only for indicating that the VSWR of the antenna should be lesser than 2. Figure.4 shows the variation of impedance at every frequency points between 0 to 3GHz.

IV. CONCLUSION

A printed monopole antenna for CDMA and GSM frequencies is analyzed. The antenna is modeled on low cost and easily available FR4 substrate. The antenna covers the frequency range of CDMA 800 and GSM 900 at resonating frequency of 878MHz with return loss -41.5dB and VSWR<1.5. By adjusting the dimensions of the structure at the ground plane, the return loss for GSM 1800 standard can also be minimized.

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