CPW fed Antenna for Mobile Handset with Metal Wire Mesh

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ABSTRACT

The radiation pattern of a Coplanar Wave guide (CPW) fed printed monopole antenna is modified to that suitable for a mobile handset is presented and discussed. The printed metal wiremesh structure in the back side of the monopole modify the far field pattern, ideal for mobile handset. The antenna offers a bandwidth of 125MHz(measured) when printed on a substrate of dielectric constant (ε_r) 4.4 and thickness 1.6mm with an overall dimension of 42X31.7X1.6mm^3. Experimental and simulation studies of the antenna radiation characteristics are presented and discussed. A 21 dB reduction of radiated power in one quadrant of the radiation pattern offers a reduction of radiation towards the users head.

. **Keywords: CPW feed, mobile handset antenna, planar monopole antenna.**

1. INTRODUCTION

The wide spread use of wireless communication devices that operate in the GSM or DCS band with close proximity to the human body remains a topic of growing public concern. Hence, there is a need to develop techniques to reduce radiations from these wireless devices when they are in use. Different methods are used for reducing this type of radiations. Adding an external shield [1] to mobile phones is the most common method adopted for reducing the unnecessary radiations. Here shielding structure has to be integrated with the antenna to provide better shielding effectiveness and the material selection and position of the external shield is also very important. A ferrite sheet attached [2] to the front side, close to head can also reduce radiation, however, the parameters such as attaching location, size and material properties of ferrite sheet played an important role in the reduction effectiveness. Wire meshes are potentially attractive for use as electromagnetic shielding because of their reduced weight per unit area compared to metallic sheets.[3,4,5] Highly directive antennas [6,7] can also reduce radiation towards human head significantly. However, the adoption of highly directive antennas certainly causes degradation in signal reception from other directions. Parasitic elements are also used to get end fire pattern. Complicated truncated ground plane is used in [8] to get end fire pattern throughout the operating band. In [9] a folded vertical copper wire of length 0.48λ as a reflector is used. But the very large reflector is a major problem in compact devices. Researchers have explored PIFA (Planar Inverted F Antenna) with EBG (Electromagnetic Band Gap) surface [10] on the ground plane to reduce radiation towards human head. But this deteriorates the structure simplicity and compactness, and also there is no appreciable reduction in radiation towards human head. An antenna which reduces radiation tremendously towards human head by suitably adding wire mesh structure on the backside of CPW fed monopole antenna without sacrificing the radiation characteristics, which is required for a mobile handset is discussed.

2. ANTENNA GEOMETRY

Antenna is basically a monopole strip fed by coplanar waveguide (CPW) feed. The antenna geometry and the associated parameters are shown in Figure1(a). The main radiating element is a vertical stripe of length L_1=25mm and width W_1=3mm.This is acting as a λ_g /4 monopole, where λ_g is the wavelength in the substrate. The ground plane dimension are L_2=17mm and W_2=14mm. The gap between monopole strip and ground plane (g) is 0.35 mm. Figure 1(b) and Figure1(c) shows the back and side view of the antenna. Wire mesh having sixteen vertical metal stripes and 15 horizontal stripes with length L_3=30mm ,widthW_3=0.3mm , L_4=12.3mm and W_4=0.3mmwith a separation of d_1= 0.8mm and d_2=1.7mm is off sited by (P) 9mm from the top of the monopole and Q = 12mm are printed at back side. By properly choosing the metal wire mesh position, the radiation pattern can be modified. The prototype was fabricated on a substrate of dielectric constant (ε_r) 4.4 with a height of h=1.6mm.

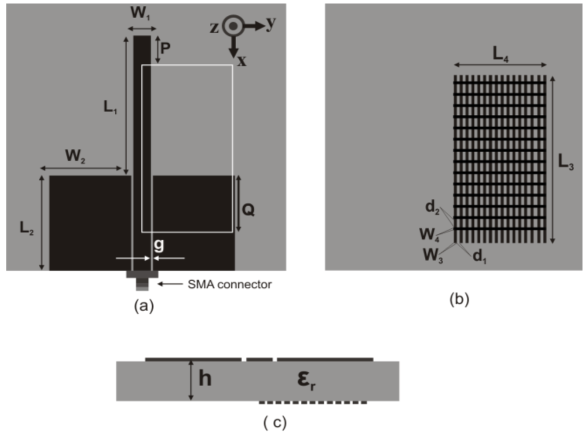


Figure1. Geometry of the proposed antenna(a)front view(b)bottom view (c) side view (L_1=25mm, W_1=3mm, L_2=17mm, W_2=14mm, g=0.35mm, L_3=30mm, W_3=0.3mm, L_4=12.3mm, W_4=0.3mm d_1=0.8mm d_2=1.7mm, h=1.6mm, ε_r= 4.4.)

3. RESULTS AND DISCUSSION

Return loss characteristics of the antenna with and without back side wire mesh structure are shown in Figure.2. Return loss measurements indicate that the proposed antenna offers a 2:1 VSWR bandwidth of 125 MHz (1.75GHz to 1.88GHz).The conventional strip monopole is operating at 2.3GHz. The introduction of metallic wire mesh reduced the resonant frequency to 1.81GHz. Therefore, metallic wire mesh reduces the overall size of the antenna.

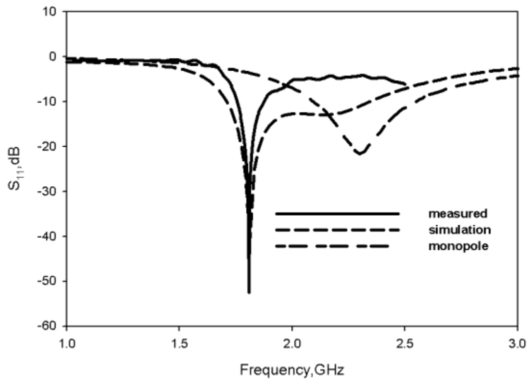
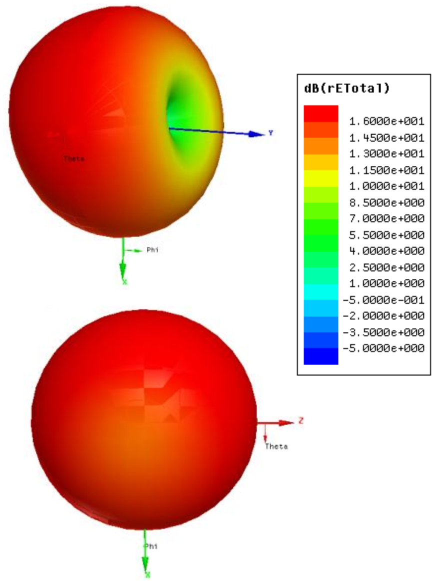
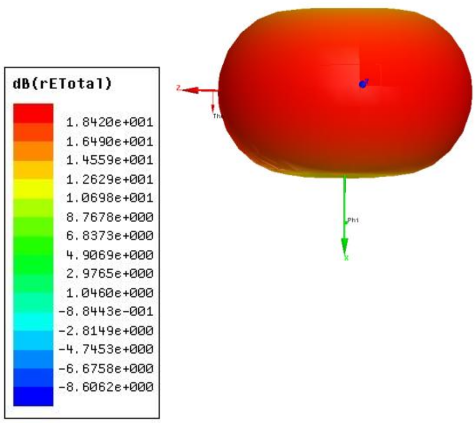


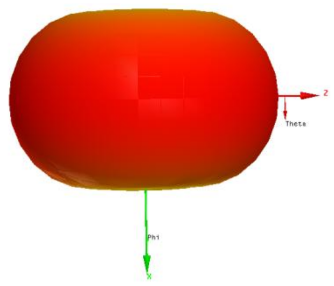
Figure 2. Reflection characteristics of the antenna

The simulated 3D far field radiation pattern at 1810MHz of the proposed antenna along $\varphi=90^0$ plane in two opposite faces and that of monopole antenna is shown in Figure.3 (a) and (b) respectively. It is found that the directional pattern of the monopole antenna in the elevation plane modifies to a pattern suitable for mobile handset. The figure shows that the proposed antenna is radiating in the negative Y direction and offers a null along the positive Y direction. Moreover, there is only one null appeared in the pattern. And this reduction is nearly -21dB.



(a)





(b)

Figure 3. Simulated 3D pattern of the antenna (a) with and (b) without metallic wire mesh

The measured value is validated by Ansoft HFSS simulation tool and all antenna measurements were carried out with HP8510C network analyzer.

Measured 2D radiation patterns of the proposed antenna in YZ and XY plane at the resonance frequency are shown in figures 4 and 5 respectively. It is observed that the radiation pattern of the conventional monopole gets modified by the addition of the metallic wire mesh structure. The fringing field between the monopole and any of the lateral ground plane is affected by adding the wire mesh structure, but the coupling on the other lateral ground plane remains same. As a result the electric field gets redistributed giving a null along positive Y direction and filling the original two nulls of the conventional monopole. This change in radiation pattern can be conveniently employed to reduce the EM interaction towards the head of a mobile phone user.

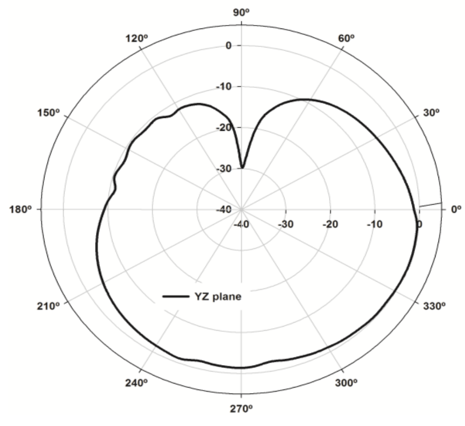


Figure. 4 Measured radiation pattern of the proposed antenna in YZ plane

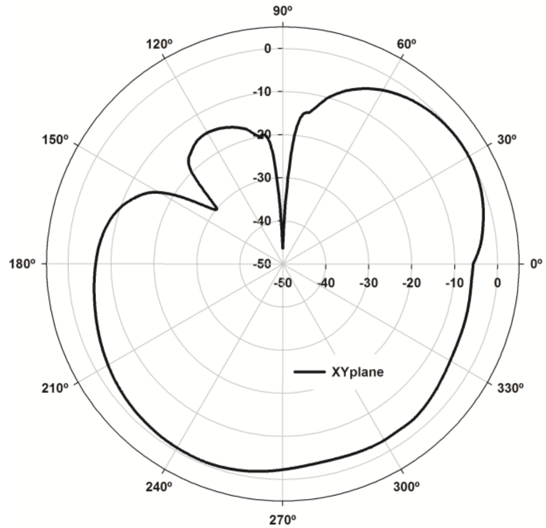


Figure 5 Measured radiation pattern of the proposed antenna in XY plane

From figure it is clear that the figure of eight pattern in YZ and XY plane is modified to a pattern with single null. A 21dB reduction in radiated power is observed at the beam minima, with appreciable power in all other directions.

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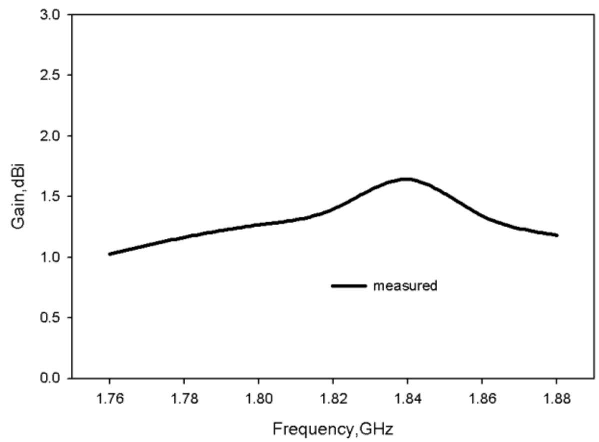

Figure. 6 Measured gain of the proposed antenna

Figure 6 shows the measured gain plot of the antenna While adding metallic wire mesh the direction of radiating power gets redistributed without affecting much on the gain of the antenna. The proposed antenna shows an average gain of 1.29dBi.

4. CONCLUSIONS

A novel CPW fed monopole antenna with printed wire mesh structure at the back side, producing radiation characteristics suitable for a mobile handset is presented. The proposed antenna operates at GSM 1800 band. A good agreement between measurement and simulation is obtained. This antenna structure is very simple and can efficiently be used in mobile handset.

5. ACKNOWLEDGMENTS

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6. REFERENCES

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