Mesh-Loading Antenna Design for PDA Phone Operation

Chien-Pang Chou, Jwo-Shiun Sun, YD Chen *, and Guan-Yu Chen
Department of Electronic Engineering, National Taipei University of Technology, Taiwan
Antenna & EMC Laboratory, HTC, Taiwan *

1. Abstract

A high performance wire and patch co-design monopole antenna fabricated using two kinds of folded wire and metal mesh as radiator is presented. A prototype of the proposed monopole antenna with a compact area size of 40mm×9mm×9mm is implemented, and the antenna shows a wide operating bandwidth of about 275MHz and 660MHz for low band and high band bandwidth, making it easy to cover the GSM, EDGE, CDMA, CDMA 2000, W-CDMA and UMTS band for wireless communication and 2.5G/3G dual mode operation of a mobile handset phone.

2. Introduction

Mobile antenna that can be easily integrated on the wireless circuit board and module of a wireless device for wireless consumer electronics operations has been reported recently. Some antenna structures [1, 2] to satisfy specific bandwidth specifications for modern wireless cellular communication systems such as GSM (824-894MHz), EGSM (880-960MHz), DCS (1710-1880MHz), PCS (1850-1990MHz), CDMA Cellular (824-894MHz) and CDMA PCS (1750-1990MHz) have been implemented and developed. Wireless communications have progressed very speedily and many mobile terminals are required small dimensions and compact size then to meet the miniaturization requirement and are very capable quality for satisfying concerns of antenna design. In this paper, monopole antenna analysis [3-5] and design in practical PDA handset size for experiment is implemented. Frequency characteristics and antenna input impedance optimized with various design parameters are analyzed and measured. Designed internal monopole antenna on the handset is simulated and measured. And the internal monopole antenna attached on the handset is tested for far-field antenna anechoic chamber. And a result of the external monopole antenna bandwidth is referenced -6dB return loss and bandwidth cover 750-1025MHz and 1695-2355MHz, respectively. So the internal folded wire and metal mesh monopole antenna has a wider antenna bandwidth in comparison with traditional external monopole antenna. The proposed antenna, therefore, has advantages to meet wider bandwidth requirements, easy fabrication, matching tuning, and radiation pattern control by wire and metal mesh radiator.

3. Antenna Design

In this paper, the folded wire and metal mesh co-design monopole antenna has several advantages over conventional monopole-like antenna and planar antenna for mobile handsets. In this antenna design, the wire and metal mesh monopole antenna must consider radiator, antenna input impedance and radiation polarization for specific absorption rate issue. In this design, we designed a novel compact internal monopole antenna for multi-band operation covering the GSM, DEGE, CDMA, CDMA 2000, W-CDMA and UMTS bands and application. We present an innovative monopole antenna (Fig.1) suitable for application as an internal antenna in a 2.5G and 3G mobile handset. The proposed dual path monopole antenna co-design is designed on a practical PCB size (100mm x 60mm), which serves as a support for the monopole, and has a radiator compact size of 40mm x 9mm x 9mm. The proposed monopole is formed by two folded wire line

and metal mesh loading. This long folded wire line radiator has a total length of about (L7+L6+Long Metal Mesh), which excited low band antenna bandwidth of the wire monopole antenna. The short metal mesh with wire line radiator has a length of about (L12+L21+Short Metal Mesh), which excited high band antenna bandwidth of the monopole antenna. With the finite dimensions of the folded wire monopole antenna in this design, the total length of the effective radiator wire path of the antenna is close to one quarter wavelength at free space of the center frequency of low band and high band, the low band resonant frequency of the long wire radiator occurs at about 921MHz center frequency and high band resonant frequency of the short wire radiator occurs at about 1950Hz center frequency

4. Results

Fig.2 shows the VSWR data of the proposed antenna structure. We used PCB (100mm x 60mm) for practical PDA phone size. A 50Ω semi-rigid RF cable is used to feed the monopole antenna, and is co-design and co-testing on the same PCB board. The feeding network is a wideband 50Ω low loss RF cable as probe. The PCB material is metal conductor and dielectric substrate with the thickness 1mm and relative permittivity 4.6. The main radiator part of the wire antenna is to approach ground plane spacing about 5 mm. These two wider resonant frequencies of wire and mesh metal monopole antenna, has a wider antenna impedance bandwidth, thereby making it possible that the resonant frequencies of the antenna be tuned to occur, respectively, at bandwidth (reference VSWR=3) about 750-1025MHz and 1695-2355MHz. The dual wideband radiator in this monopole antenna structure, the operating impedance bandwidth for the further wireless communication bands can be obtained. Besides, it can also generate the good radiation patterns in the azimuth plane and good antenna performance has been obtained. Based on the measurement coordinates for H-plane, E1-plane and E2-plane. The measured peak gain data as shown in Table 1.

5. Conclusion

In this paper, a compact and low profile internal monopole antenna for multi-bands has been proposed. This antenna was designed and measured. A good agreement between measurement and analysis has been obtained. The proposed antenna shows a wider operating bandwidth and it easy to cover the GSM, EDGE, CDMA, CDMA 2000, W-CDMA and UMTS band for wireless communication and 2.5G/3G dual mode operation of a mobile handset phone, co-design, co-integration and application.

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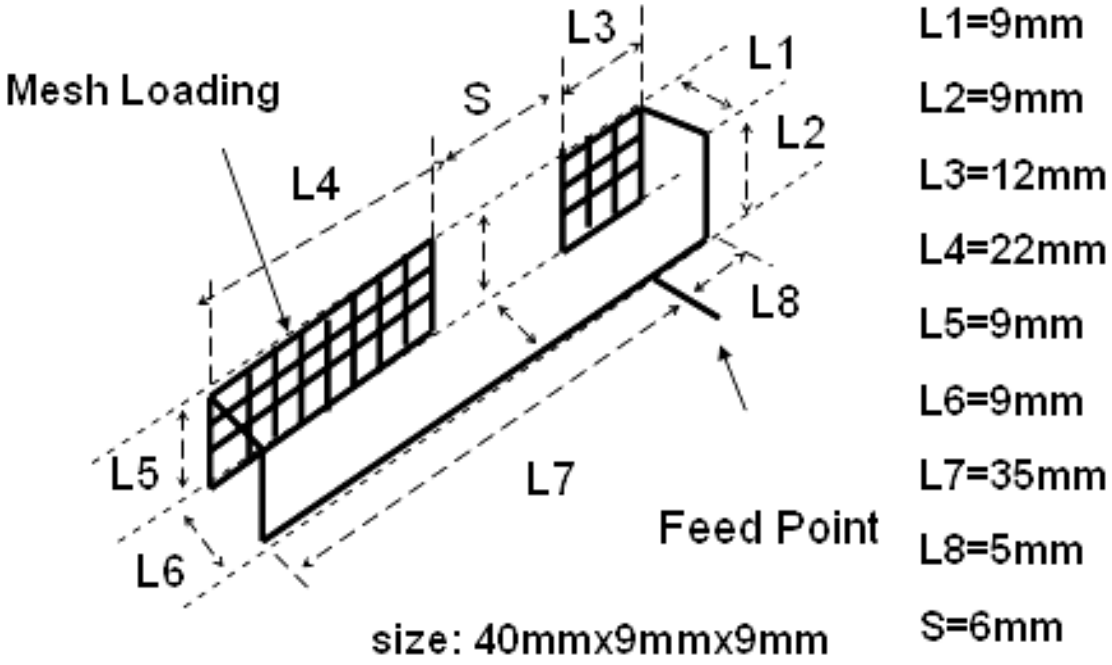

Figure 1: Wideband monopole antenna with metal mesh loading

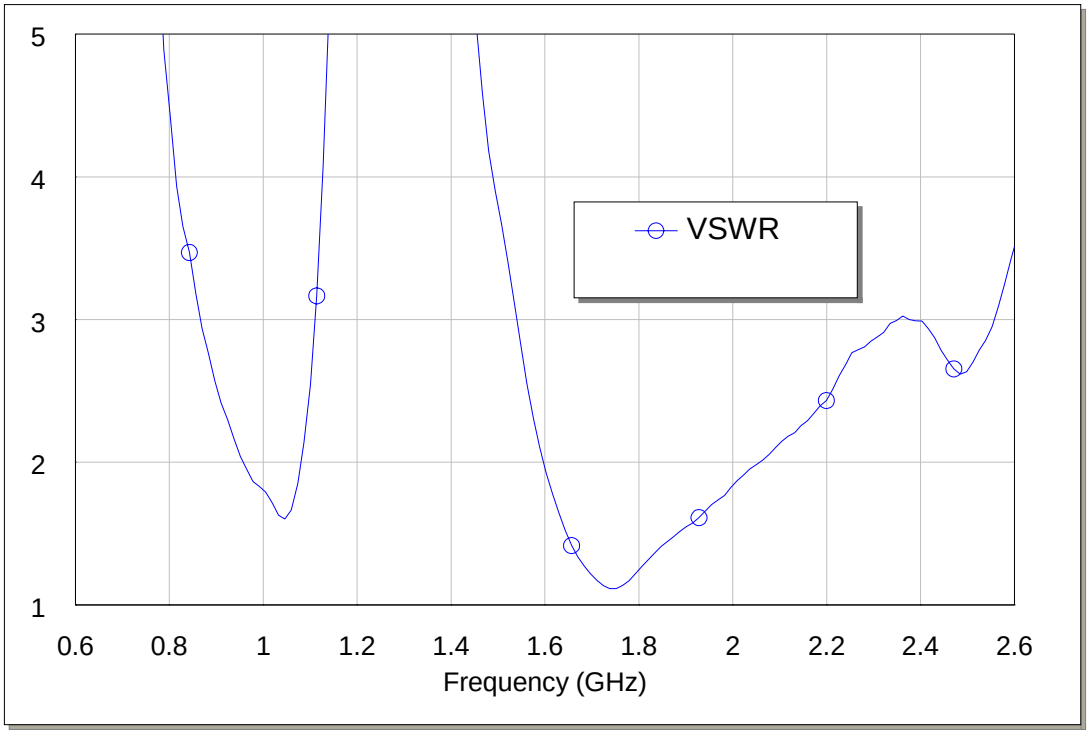

Figure 2: Measured data of VSWR

Table 1: Measured antenna gain

Frequency (MHz)	800	850	900	950	1000	1050
Gain (dBi)	2.6	2.5	2.8	2.9	3.2	2.9
Frequency (MHz)	1700	1800	1900	2000	2100	2200
Gain (dBi)	3.1	3.2	3.6	3.8	3.6	3.9