A Novel Wire Antenna for GPS and WLAN Co-design

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Abstract: - A high performance dual band monopole antenna fabricated using single folded wires as radiator is presented. A prototype of the proposed monopole antenna with a compact area size of 6mm×6mm×10mm is implemented, and the antenna shows a wide operating dual bandwidth (referenced VSWR=3) of about 295MHz and 343MHz for low band and high band bandwidth, making it easy to cover the GPS and Wi-Fi band for wireless communication and consumer electronics operation of a mobile handset PDA. In this paper, the study mainly focuses on the current trends in development of compact and low profile GPS antenna and Bluetooth/Wi-Fi co-existence antenna built in PDA and Smart mobile phone and provides a dual band monopole antenna design suitable for application in wireless communicating system in the near future. By utilizing the monopole antenna structure, the proposed antenna design is easy to be embedded into the mobile phone application.

Key-Words: GPS Antenna; WLAN Antenna; Wire Antenna

1 Introduction

Antenna structures [1] to satisfy specific bandwidth specifications for modern wireless LAN communication systems have been implemented and developed. Antennas that can be easily integrated on the RF circuit board and module of a wireless device for wireless consumer electronics operations has been reported recently. Mobile WLAN 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. GPS (L1 band 1575.42MHz/L2 band 1227.6 MHz) is a satellite based positioning system that is operated by the United States Department of Defense. Using the difference in the radio signal propagation times of at least three of the 24 GPS satellites, a GPS receiver can accurately determine its position worldwide to within a few meters. Signals for civil use are transmitted at a frequency of 1575.42 MHz. The general GPS function of PDA support the assisted functionality in 2.5/3G wireless networks. In this paper, folded wire line monopole antenna analysis [2] and design in practical PDA handset size for experiment is implemented. Designed internal monopole wire antenna on the handset is analyzed and measured. And the internal monopole antenna attached on the handset is tested for far-field 3D antenna anechoic chamber [3]. And a result of the external monopole antenna bandwidth is referenced -6dB return loss and bandwidth cover 1435-1730MHz and 2200-2544MHz, respectively. So the internal folded wire monopole antenna has a dual band antenna bandwidth in comparison with traditional external monopole antenna. The applications of folded wire monopole antenna provide expertise especially in the area of compact assembly on mobile PDA phone for GPS location and Wi-Fi wireless network operation.

2 Antenna Design

In this paper, the folded wire monopole antenna has several advantages over conventional monopole-like antenna and planar antenna for mobile handsets. The small compact and low profile antenna radiator structure such as the wire monopole antenna that can be mounted on the portable equipment are becoming very attractive for the mobile communications. In this antenna design, the dual band folded wire 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 folded wire monopole antenna for dual band operation covering the GPS and Bluetooth and Wi-Fi bands and application. We present an innovative wire monopole antenna (Fig. 1) suitable for application as an internal antenna in a GPS and Wi-Fi mobile handset. The proposed dual path monopole antenna co-design is designed on a practical PCB size (90mm x 50mm), which serves as a support for the monopole, and has a radiator compact size of 6mm x 6mm x 10mm. The proposed folded wire monopole is formed by two folded wire line. This long folded wire line radiator has a total length of about (S1+H2+W1+2L1+H3) 39mm, which excited dual band antenna bandwidth of the folded wire monopole antenna. The folded wire line radiator has a total length of about 39mm, which excited GPS and Wi-Fi dual band antenna bandwidth of the wire monopole antenna. With the finite dimensions of the folded wire monopole antenna in this design, the total length of the effective radiator of the folded wire antenna is generated dual band of the center frequency of GPS band and Wi-Fi band, the dual band resonant frequency of the folded wire radiator occurs at about 1575MHz center frequency and high band resonant frequency of the short wire radiator occurs at about 2420MHz center frequency.

3 Measured Results

Fig. 2 shows the measured VSWR data. We used PCB (90mm x 50mm) for practical PDA phone size. A 50 Ω semi-rigid RF cable is used to feed the monopole wire antenna, and is co-design and co-testing on the same PCB board. The feeding network is a wideband 50 Ω 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 about 10 mm spacing from main antenna. In addition, by fine-tuning the length of the wire length of the long and short folded wire radiators, the antenna resonant frequency of the bandwidth can be effectively controlled, but antenna multi-coupling effect for long wire and short wire multi-interference so the antenna resonant frequency has affected with each other. These two wider resonant frequencies of wire 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 1435MHz-1730MHz and 2200MHz-2544MHz. Therefore, the prototype of the proposed wire monopole antenna has been successfully implemented, manufacture, and in addition to the dual wider frequency resonator behavior obtained, wider antenna matching conduction, good quality radiation integrity characteristics across the operating bands have also been experimental. The dual band impedance bandwidth is easily to apply practical PDA handset application and wireless system integration and easily to fine tuning the antenna and RF circuit matching interface. The dual path folded wire radiator in this monopole antenna structure, the operating impedance bandwidth for the further wireless communication bands can be obtained. In this design and experiment, operating antenna resonant frequency and bandwidth can be easily obtained by adjusting the folded wire length for GPS band and Wi-Fi band bandwidth. The operating bandwidths of the proposed antennas can cover the GPS and Wi-Fi mobile handset operation, and the antenna gain is stable. Besides, it can also generate the good radiation patterns in the 3D measurement environment and good antenna performance has been obtained. Based on the 3D measurement system and far-field antenna scanning technology [4]. The measured data of antenna radiation efficiency and peak gain is shown in Table 1.

4 Conclusion

In this paper, a compact and low profile internal folded wire monopole antenna for dual band has been proposed. This antenna was designed and measured. A good agreement between 3D measurement and analysis has been obtained. The proposed antenna shows a suitable operating bandwidth and it easy to cover the GPS and Wi-Fi band for location wireless operation

and VoIP application of a mobile handset phone, co-design, co-integration and application.

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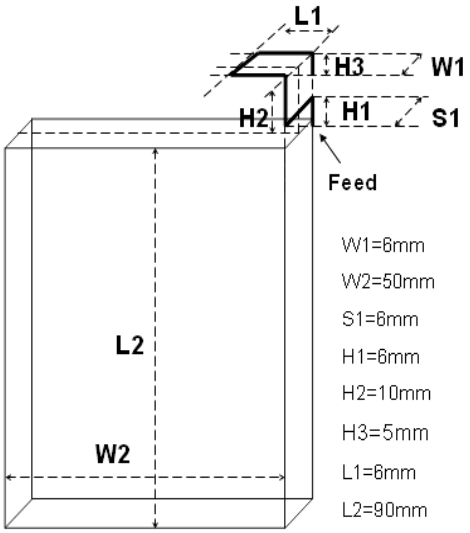

Fig.1 Multi-frequency antenna

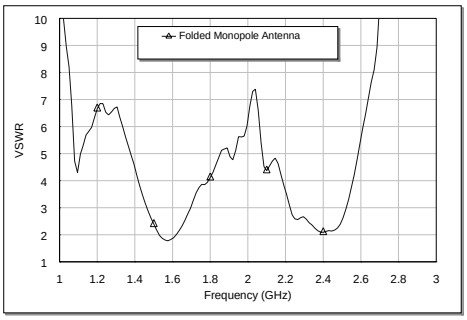

Fig.2 Measured data of VSWR

Table 1 Measured radiation data

Frequency(MHz)	1500	1525	1550	1575	1600
Efficiency (%)	86.15	96.55	99.07	99.72	99.07
Gain (dBi)	3.42	3.95	4.51	4.67	4.25
Frequency(MHz)	2400	2425	2450	2475	2500
Efficiency (%)	52.98	50.01	51.98	50.23	50.96
Gain (dBi)	4.66	4.5	4.61	4.4	3.83