Multi-band Folded dipole antenna for Mobile phone

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ABSTRACT: Compact folded dipole antenna, which covers 5 multi bands (GSM850, GSM900 GSM1800, GSM1900 and UMTS), is investigated. Frequency matching is done by changing parameters. The antenna height is less than conventional 4 band antenna (GSM900, GSM1800, GSM1900 and UMTS) that is already on the market. In this paper, we will compare simulation result and measured result.

INTRODUCTION

Recent explosion in the mobile phone market has resulted in emergence of number of operating system at different frequency. Currently, the market is aimed at providing multiple services within a single communication unit. Thus, there is a greater demand for the multi-band antenna such as 5-band (GSM850, GSM900, GSM1800, GSM1900 and UMTS), whose frequency ranges are specified in Table 1.

However, there are only few solutions for 5 bands. One of the solutions is a controllable antenna which controls some resonance frequencies by switches variable reactors (diode, MEMS etc)[1]. Performance might be sufficient, but RF control part is more complex, and extensive work in base band and power circuit in the mobile phone are required.

Another solution is a two antenna-system. One is for GSM850, GSM900, GSM1800 and GSM1900 system. The other is for UMTS system. In this case, antenna size is big, and keeping good isolation is mandatory due to interference between those two antennas.

Also, High Dielectric Antenna (HiDA) can be a solution. HiDA is simple passive antenna, however, it uses dielectric material, such as ceramic, between antenna radiator and feed point [2] [3]. Use of dialectic material makes it possible to cover multi-bands, 4 or 5 bands, but dielectric material is rather expensive. We propose a folded dipole antenna for 5-band coverage as very simple passive solution. This means one antenna covers all the frequency bands. We intend to examine it and to analyze the radiation characteristic of sample.

System		Uplink	Downlink
GSM	850	824 - 849 MHz	869 - 894 MHz
	900	880 - 915 MHz	925 - 960 MHz
	1800	1710 - 1785 MHz	1805 - 1880 MHz
	1900	1850 - 1910 MHz	1930 - 1990 MHz
UMTS		1920 - 1970 MHz	2120 - 2170 MHz

Table.1 Uplink and downlink frequency bands for various cellular networks

Antenna design

Figures.1 shows the proposed folded dipole antenna for GSM850, GSM900, GSM1800, GSM1900, and UMTS applications. The proposed antenna is mounted on the top of a 0.3mm grounded substance (size: 99×39 mm), which is considered to be the ground plane of a practical mobile phone. Antenna feed is located in the center and top of printed-wiring board (PWB) and unbalance type. One of the characteristic appearances of proposed antenna is the configuration where the antenna is placed parallel to the ground plane, and directly above the ground plane. The other characteristic appearance is where the feed and ground are in close proximity physically to each other.

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Further common characteristics are the feed and ground placed in the center of chassis (in terms of the lengthwise direction). Total antenna element length is 150mm. This radiator length is approximately half wavelength at GSM850 and GSM900 bands, one wavelength at GSM1800 and GSM1900 bands and 4/3 wavelength at UMTS band.
The target performances of this proposed antenna in RF point view are the return loss below -5 dB (VSWR 3.6), and the efficiency is up to 40%(-4dB). From mechanical point of view, antenna length in a longitudinal direction is 25mm, width is no greater than PWB, and height is 7mm. Those figures are much tighter than quad band mobile phone (GSM900, GSM1800, GSM1900 and UMTS) on the market at the present day. Figure. 2 shows proposed the antenna current modes. 869MHz and 2111MHz are common mode. These frequencies are picked up due to resonance frequency at figure.3. 1785MHz is differential mode. At 1785MHz, proposed antenna operates as a wavelength folded dipole antenna. At 869 MHz and 2111MHz, propose antenna operate half and 4/3 wavelength transmission line antennas, respectively antenna at 869MHz and 2111MHz resonate transmission line, which consist of antenna radiator and GND. Antenna at 1785MHz resonate antenna radiator it self.[4]

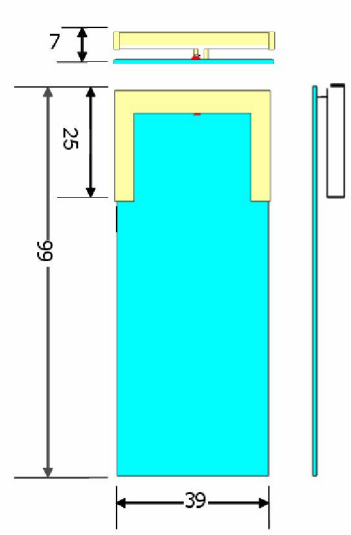

Fig.1 antenna and ground plane (PWB) structure (mm)

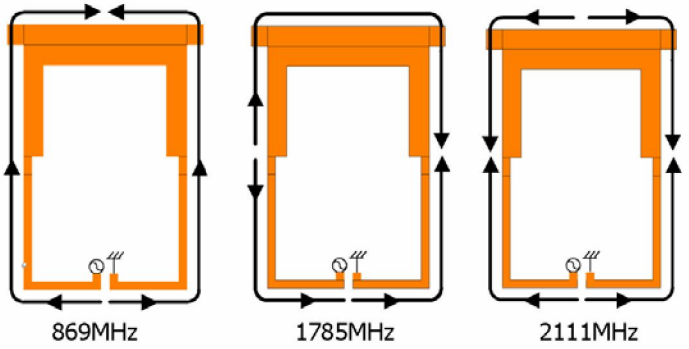

Fig.2 Current modes (Freq. 869MHz, 1785MHz and 2111MHz)

Result

Figure.3 shows the measured and simulated return loss of the proposed antenna. Simulated result was carried out with the aid of the commercially available simulation software CST Microwave studio based on FIM (Finite Integration Method) [5]. Frequency ranges are 824 – 960MHz (GSM850 and GSM900) and 1710 – 2170MHz (GSM1800, GSM1900 and UMTS). Good agreements between the simulated and measured values are obtained in general. However, GSM1800, GSM1900 and UMTS bands are not so good as GSM850 and GSM900 bands, and it needs to be further investigated. Fig.5 and 6 presents the measured and simulated antenna efficiency against the frequency. Efficiency measurement has been performed in 3D multi probe system [6]. It is good correlation between return loss plot and efficiency plot.

Figure.7 shows the plots of the simulated and the measured radiation patterns for X-Z cut (E2) at the 896MHz, 1711MHz and 2111MHz. Results for other frequencies across each band were also measured. Similar radiation patterns plotted here were observed and show a good agreement between two results.

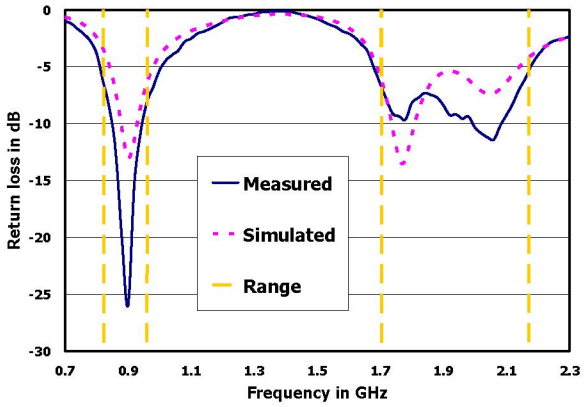

Fig.3 Return loss characteristics

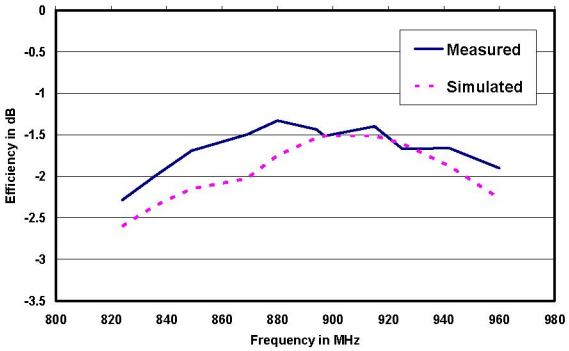

Fig.5 Antenna efficiency at GSM850 and GSM900

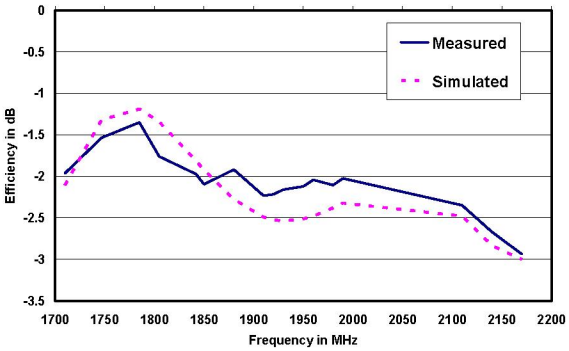

Fig.6 Antenna efficiency at GSM1800, GSM1900 and UMTS

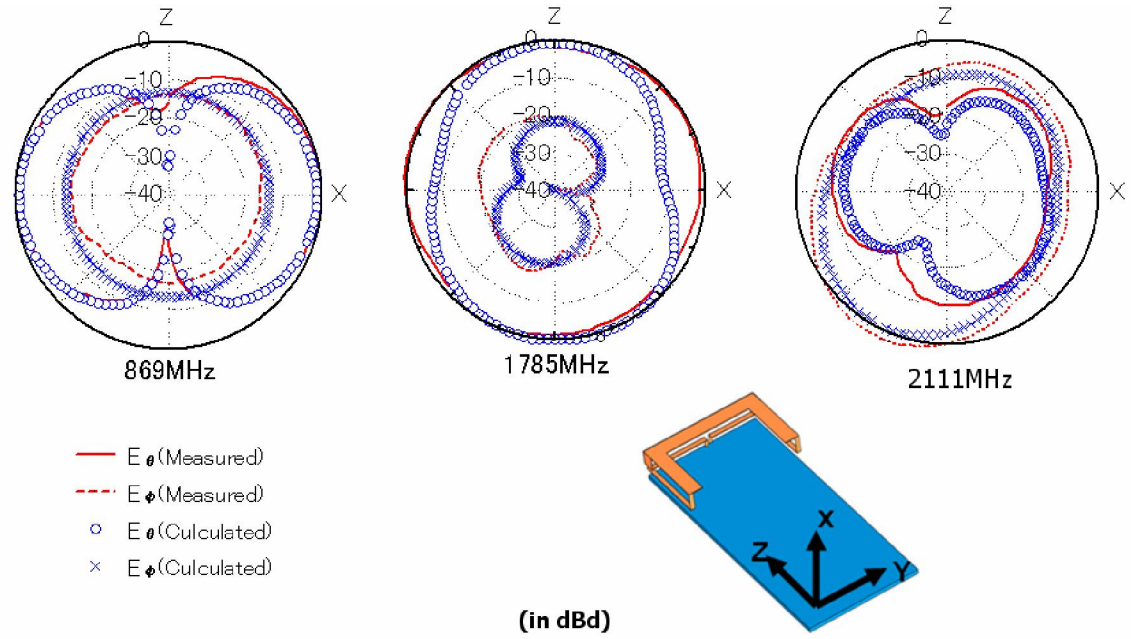

Fig.7 Radiation patterns for proposed antenna at 896MHz, 1785MHz and 2111MHz

Conclusion

A folded dipole antenna has been proposed as 5 multi bands antenna. Good agreements between simulated and measured results were obtained. Thus this proposed antenna is considered as an alternative method for 5 bands antenna (GSM850, GSM900, GSM1800, GSM1900 and UMTS), however, improvement at GSM850/900 bands are needed especially band width and effect from comportment like camera, shielding can and speaker etc should be studied.

Reference

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