A Small Meander line Antenna for T-DMB Applications

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지상파 DMB에 적용되는 소형 평면 안테나

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Abstract

A small meander line antenna for T-DMB (Terrestrial Digital Multimedia Broadcasting) is presented. The antenna proposed here is based on a typical planar meander line antenna and miniaturized by using a double sided structure. A prototype antenna is manufactured based on the simulation results and the basic performances are measured. The presented antenna designed to operate in T-DMB band (174~216MHz) and can be adopted for various mobile applications.

1. Introduction

In recent years, researches and development efforts have been focused on smaller size and better performance antennas. The electrically small antennas have been tried to improve their bandwidth and the radiation efficiency. Most of the efforts have concentrated on the addition of various loadings such as capacitive, inductive, and resistive loads. Folding the radiating element is one of the useful solutions for increasing the antenna resistance and reducing the antenna size. The folded antennas have been widely using for small wireless devices. As shown in figure 1, a meandered line structure is an extension of the basic folded monopole antenna to reduce the physical size. In the previous studies pertaining to the GSM/DCS, CDMA/PCS, WLAN, T-DMB operating frequencies, various types of meander line antennas have been developed in the personal wireless units [1-8]. It is well known that the meandered element resonates at much lower frequencies than a conventional quarter-wavelength monopole. The number of meander elements per wavelength and the spacing between the elements are critical factors for reducing the antenna size [5]. A coupled gap and backside strips are proposed to reduce the element length [6]. In general, it is obviously concluded that the physically short antennas have poor resonant properties. To improve the bandwidth, a nonuniform meander and the Genetic Algorithm are introduced [9-10].

Recently, T-DMB has been expanding market in commercial wireless applications. Previous efforts for developing T-DMB antennas are limited in a monopole type rod antenna. A meander line is one of the best solutions to miniaturize for an antenna structure for a low frequency band. For the low frequency mobile applications, small size antennas particularly are requested because the overall size of a handheld device is limited by the antenna size.

In this study, we propose a small meander line antenna fabricated on a double sided flexible PCB. This type of antenna is found to present some electrical and mechanical properties allowing convenient placement of tuning elements when configured as an electrically small antenna.

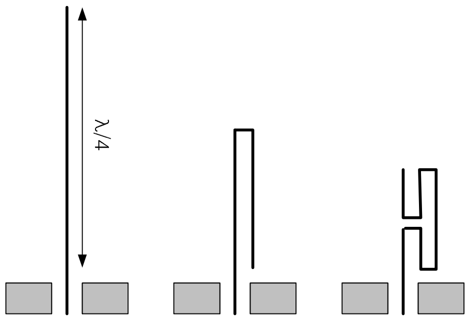
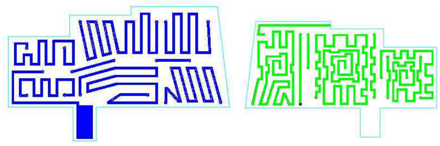


Fig. 1 Folded monopole antenna configurations

2. Antenna design and measurement

The antenna design presented here is an antenna with a printed meander line. The antenna has dimensions of 30mm length, 14mm width, and 0.2mm thickness. To obtain optimum values, various parameters were simulated by CST MWS. Figure 2 shows the antenna pattern on the double sided flexible PCB and the top and the bottom view of the proposed antenna. The radiating strips are just like folded monopole antenna and those strips are printed on the flexible PCB and bonded on the plastic support. In the feeding mechanism, one end of the strip is directly connected to the main feed and the front and back side strips are connected using via hole. In our study, we figured out that the thicker PCB makes the better performance.



(a) (b)

Fig. 2 The proposed meander line antenna
(a) Top view (b) Bottom view

However, to have better installation on the plastic support, it is clear that the thickness of the PCB is supposed to be thin since the antenna should be attached on the curved plastic support. And the flexible PCB thickness is also affecting the performance. We make various meander line patterns and choose one of those which have fairly good performance. The bottom and top side strips are overlapped in small areas to give better performance. The manufactured antenna installed on the actual phone is shown in figure 3. And the suggested matching circuit as shown in figure 4 is used to make better resonance for desired frequency band.

The return loss of the measurement is shown in figure 5 and is fairly good in our desired frequency band. It seems that the bandwidth (SWR < 3) is quite enough for T-DMB band.

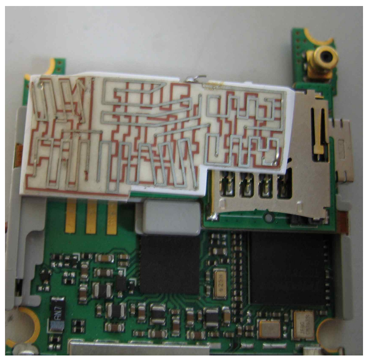


Fig. 3 The proposed antenna mounted on the phone

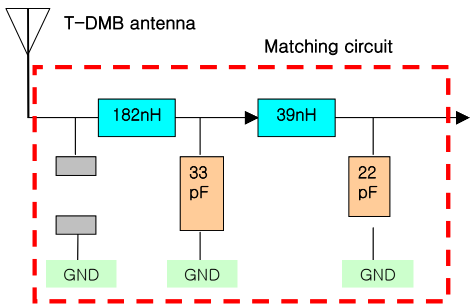


Fig. 4 Matching circuit

The average antenna gain in azimuth plane, however, is measured as -11dBi at 200MHz. It means that the proposed antenna here is not qualified to use for commercial products. The achieved bandwidth mainly results from the matching circuit shown in figure 4 and the metal devices under the antenna affect to the radiation performance. Therefore, our future study will focus on increasing the antenna radiation performance. And we suggest a dual antenna system for stable T-DMB service. The basic concept is shown in figure 6.

3. Conclusions

A small printed meander line antenna is presented. The antenna proposed here is designed based on a typical planar meander line antenna and it is miniaturized by using a double sided structure. A prototype antenna is manufactured by the simulation results and the basic performances

Fig. 5 Measured SWR with matching circuit

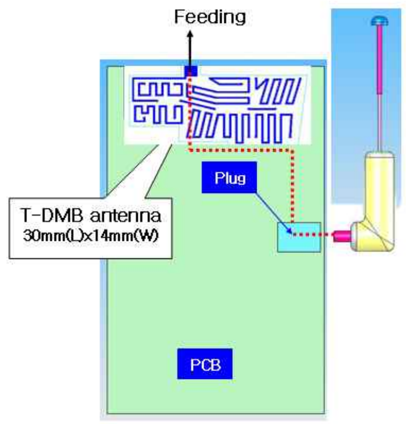


Fig. 6 Dual antenna system for T-DMB receiver

are measured with an actual PCB board. The antenna operates in the T-DMB frequency band (174~216MHz). It seems that the presented antenna has poor radiation efficiency due to the miniaturization and the metal devices. Therefore, the antenna suggested in this study is really requested to improve the electrical performance and then can be adopted for commercial applications. In the future study, we will investigate the coupling effects in the gap between two strips and more detailed theoretical calculation of the length of strips as well as the effects by metal shielded devices. Furthermore, the presented antenna performances will be enhanced to meet the recent commercial requirements.

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