A Compact Antenna in Notebook PCs for Digital Terrestrial Television Reception

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1. Introduction

Recently, many countries are switching their terrestrial television broadcasting from analog to digital [1] and the demand of TV reception increases for mobile terminals, such as mobile phones and notebook PCs. Antennas for these devices are required to be compact, operate at the broadband covering the broadcast frequencies. Some antennas have been developed for the purpose but they are large in size or have only narrow bandwidth [2]-[4]. A compact loop-type antenna with wide bandwidth has been proposed but its performance is not presented for installation on real devices [5]. In this paper, we will propose a compact antenna for digital terrestrial television reception. The antenna is based on a planar inverted-F antenna (PIFA) and is made of films. It is designed for an installation on the back of the liquid crystal display (LCD) of a notebook PC. The antenna is installed into the PC by deforming a planar film antenna and has a compact size of 84 x 46 x 6 mm^3. Experiment demonstrates that the antenna works at a frequency range of 470–890 MHz, which covers bands in ISDB-T, ATSC and DVB-T, and radiates with efficiency higher than 50%.

2. Antenna Configuration

Figure 1 shows the configuration of the proposed antenna in its planar form. The antenna is designed for an installation on the back of the LCD in a notebook PC, as shown in Fig. 2, where the LCD is modelled by a copper plate and the antenna is electrically isolated from the LCD by a dielectric sheet of thickness of 50 μm. Top 6 mm of the antenna is right-angle bended to fit the case of the PC and this lets the antenna have a dimension of 84 x 46 x 6 mm^3. The next 10 mm of the antenna is located beyond the top of the LCD. The antenna is fed by a thin coaxial cable which has a diameter of 0.8 mm and a length of 200 mm and is wired to the bottom of the LCD.

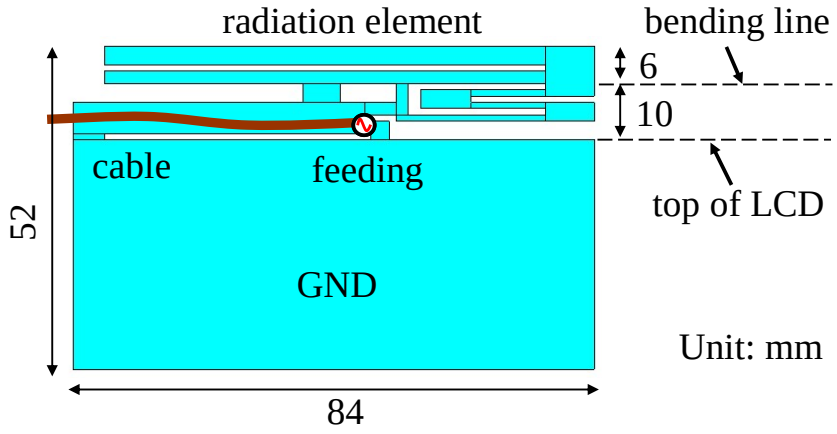

Figure 1: Antenna configuration in planar form.

The antenna is based on a PIFA with two radiation elements where the longest one is for excitation of the lowest frequency. Two extra short-pins are applied for broadening the bandwidth of the antenna. The antenna is tuned to have the best performance when it is installed into the PC but the

antenna shows moderate performance by itself. Figure 3 shows the input characteristics for an individual antenna and one installed on the LCD. Even though the VSWR for the individual antenna is higher than that of the installed antenna, the antenna still has good performance by itself.

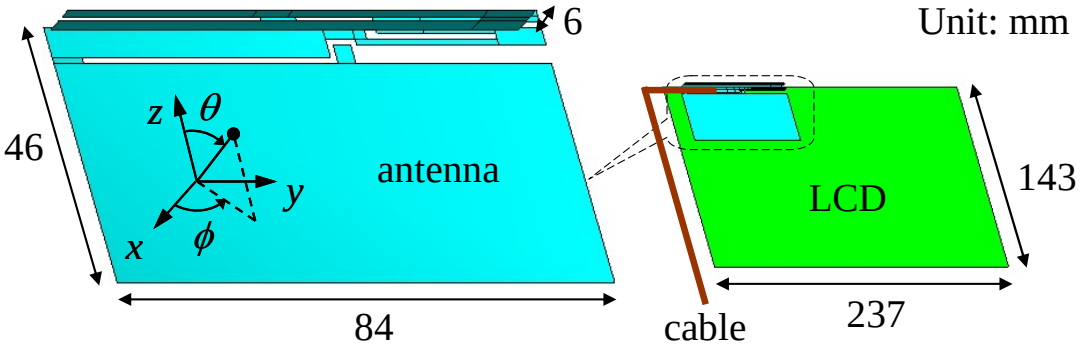

Figure 2: Antenna installation.

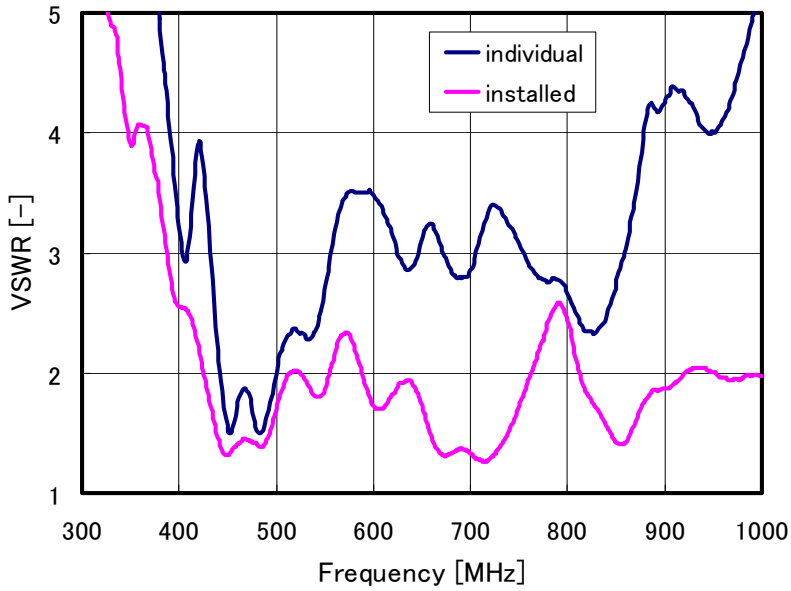

Figure 3: Measured input characteristics for individual antenna and installed one.

3. Antenna Characteristics

Figure 4 shows the measured input characteristics for the antenna installed on the pseudo-LCD. It is shown that the VSWR is lower than 2.5 almost at frequencies of 470–890 MHz which covers the bands of ISDB-T (470–770 MHz, used in Japan and South America), ATSC (470–860 MHz, in North America) and DVB-T (470–890 MHz, in Europe).

Figure 5 shows the radiation efficiency for the installed antenna, which is obtained from a 3-dimensional measurement. The antenna radiates with an efficiency higher than 50% in almost all the operating frequencies.

Figure 6 shows the radiation patterns at 700 MHz and Fig. 7 the radiation patterns of total field at several frequencies. It is shown that the antenna radiates quite omni-directionally.

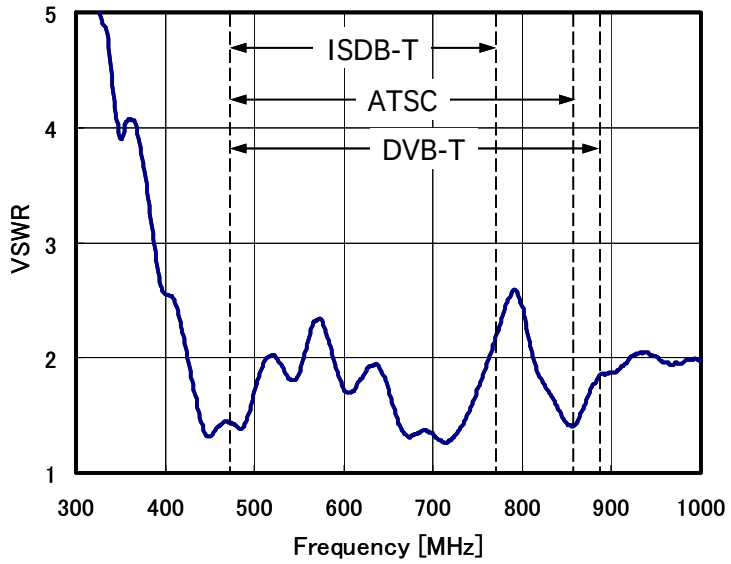

Figure 4: Measured input characteristics for installed antenna.

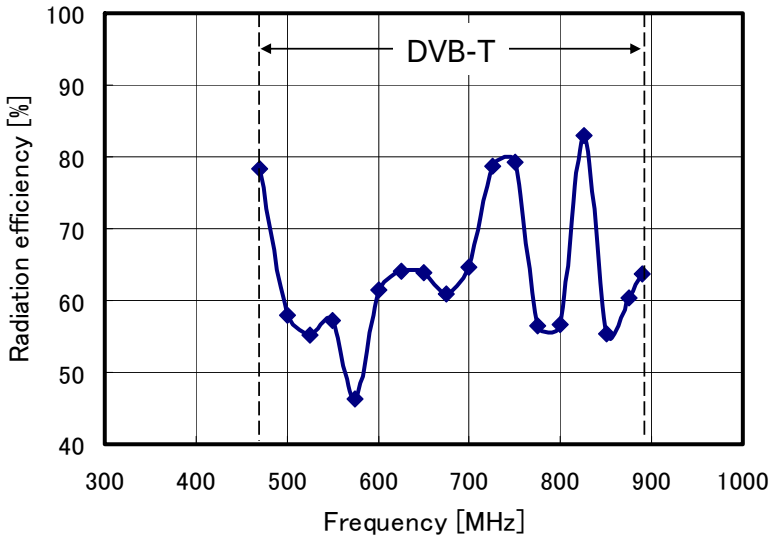

Figure 5: Measured radiation efficiency for installed antenna.

4. Conclusion

We have developed a compact film antenna for installation in a notebook PC for digital terrestrial television reception. The antenna has a compact size of 84 x 46 x 6 mm^3 and shows a VSWR less than 2.5 and a radiation efficiency higher than 50% in a frequency range of 470-890 MHz, which covers almost all the bands of digital terrestrial television broadcasting in the world such as that in ISDB-T, ATSC and DVB-T.

References

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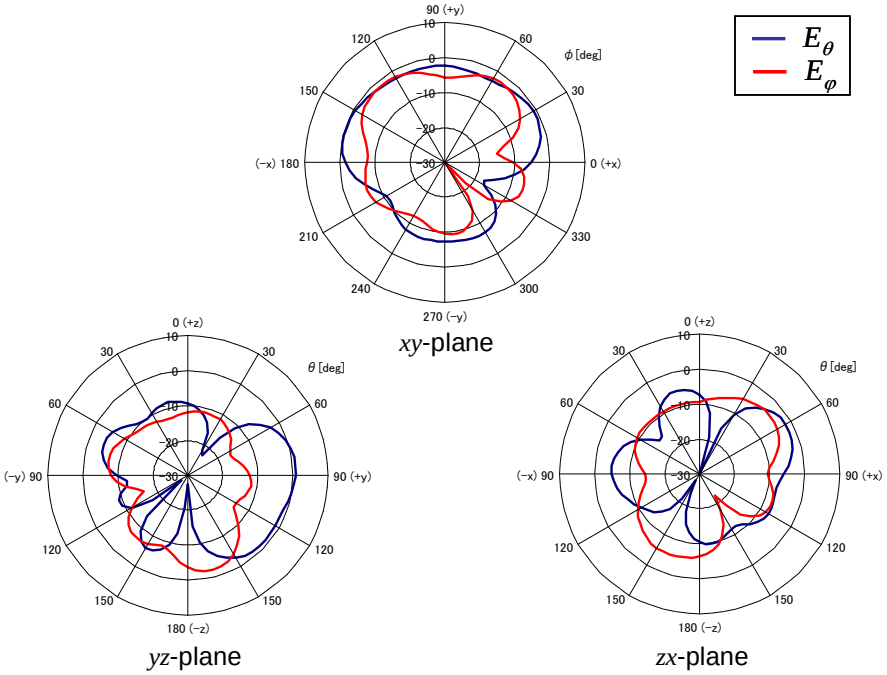

Figure 6: Measured radiation patterns at 700 MHz.

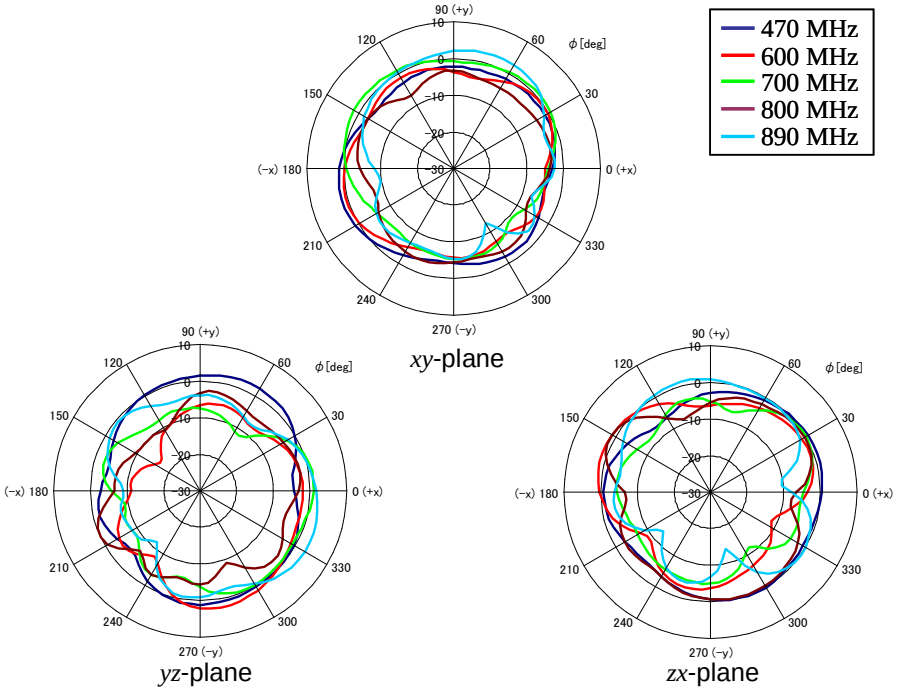

Figure 7: Measured radiation patterns of total field at several frequencies.