

A HIGH EFFICIENCY DIPOLE-TYPE ANTENNA
FOR VHF PORTABLE RADIO TERMINAL

Takayuki SASAMORI *, Tomoyuki KATO **, Kunio SAWAYA * and Futoshi DEGUCHI †

* Department of electrical Communications, Tohoku University
Aza Aoba, Aramaki, Aoba-ku, Sendai 980-77, Japan

** DDI Corporation

1 Bancho FS Building, 8, 1 Bancho Chiyoda-ku, Tokyo 102, Japan

† Kyusyu Matsushita Electric Co., Ltd.,

1-62 4-chome, Minoshima, Hakata-ku, Fukuoka 812, Japan

1. Introduction

The VHF portable radio communications are very important because these are used for the socially important aims such as the fire and police communications. In the conventional portable radio terminal of the VHF radio communications, monopole antennas or normal mode helical antennas are installed on the body of the radio terminal. It is known that the characteristics of such antennas change greatly when the body of the terminal is touched with hand [1]. This problem is caused by the fact that the size of the radio terminal is much smaller than the wavelength and the body of the terminal do not function as the earth ground. When the radio terminal is touched with the hand, the human body behaves as the earth ground or a radiating structure and the radiation characteristics change due to the influence of the human body.

In this report, a dipole-type antenna is proposed to decrease the influence of the human body and improve the radiation characteristics. Experimental results for the single helical antenna and the dipole-type helical antenna are presented to show the improvement of the radiation efficiency and the stable characteristics.

2. Single Helical Antenna

Figure 1 shows the geometry of the conventional single helical antenna mounted on the conducting rectangular box. Figure 2 shows the VSWR characteristics of the helical antenna, where size of the metallic box is 35 mm × 75 mm × 150 mm and the length of the helical antenna is 150 mm. It can be seen that the VSWR characteristics and the center frequency changes greatly when the box is touched with the hand. Figure 3 shows the actual gain of the single helical antenna. The gain for the case that the body of the terminal is not

touched with the hand is very low. When the hand touches the body of terminal, the gain greatly increases. This phenomenon is interpreted that the human body behaves as a radiating structure. Although the gain of the helical antenna increases by the presence of the human body, the radiation efficiency is not satisfactory.

As described above, the radiation characteristics of the conventional antennas for the VHF portable terminal change by the influence of the human body. This problem is caused by the fact that the size of the conducting box is much less than the wavelength.

3. Dipole-Type Helical Antenna

In order to increase the radiation efficiency and decrease the influence of the human body, a dipole-type antenna composed of two helical antennas is proposed. Figure 4 shows the geometry of the dipole-type antenna mounted on the same metallic box. A 180° hybrid circuit is used to divide in input power. Two helical antennas are fed with a phase difference of 180°. Thus, the two helical antennas behave as a dipole antenna. Since the structure is symmetry the conducting box becomes the earth ground.

The VSWR characteristics of the dipole-type antenna are illustrated in Figure 5. It can be seen that difference between the VSWR characteristics and the center frequency for the cases with and without the hand is almost negligible.

Figure 3 shows the actual gain of the dipole-type antenna for the cases without hand, touched with the hand and touched with the hand through dielectric insulator. It is noted that the gain of the dipole-type antenna decreases when the box is touched with the hand. The difference is 1 – 1.5 dB and almost negligible. Moreover, the gain is much higher than that for the case of the single helical antenna. Thus, the improvement of the radiation efficiency and suppression of the influence of the human body by employing the dipole-type antenna are confirmed.

4. Conclusion

It has been shown that the radiation efficiency of the VHF single helical antenna mounted on the conducting box is very low and the characteristics change when the box is touched with the hand. A dipole-type antenna composed of two helical antennas has been proposed to increase the radiation efficiency and suppression of the influence of the human body. Improved characteristics of the dipole-type antenna have been confirmed by the experiments.

Reference

- [1] The Institute of Electronics, Information and Communication Engineers, Japan ed., "Antenna Engineering Handbook," p. 319, OHM Tokyo, Oct. 1980.

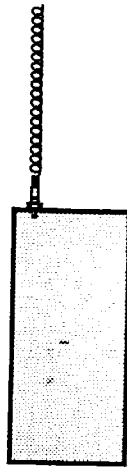


Fig. 1 Single helical antenna mounted on conducting box

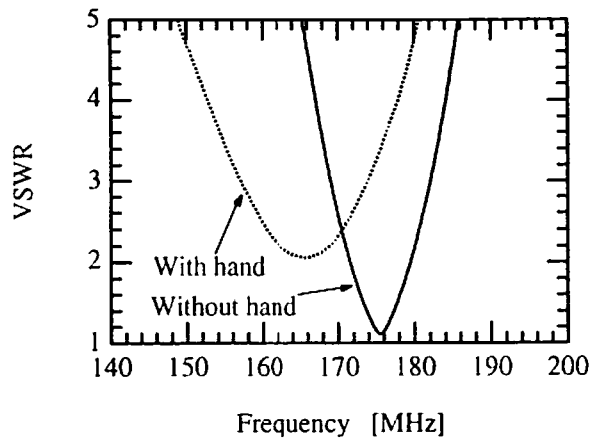


Fig. 2 VSWR of single helical antenna

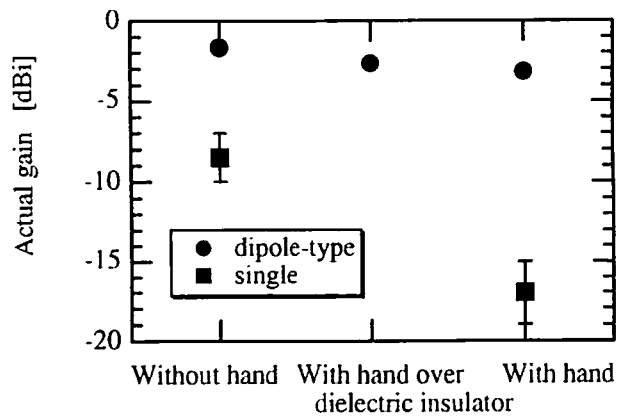


Fig. 3 Actual gain of single and dipole-type helical antenna

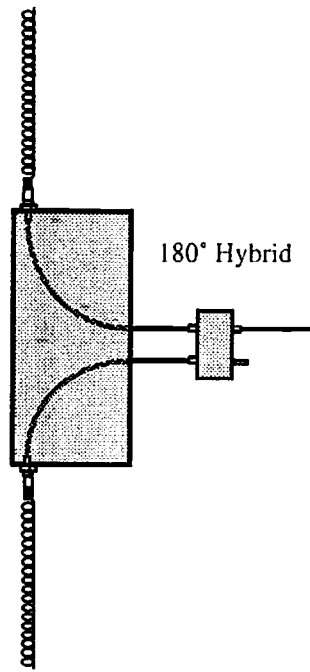


Fig. 4 Dipole-type helical antenna

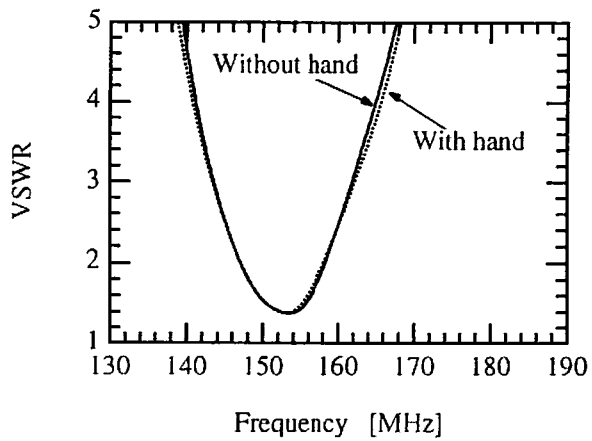


Fig. 5 VSWR of dipole-type helical antenna