

A 3D Crotched Double-band Dipole Antenna with Wide Impedance Bandwidth Novel Design for WLAN System

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Abstract: A novel double-band 3D crotched dipole antenna is introduced. This crotched dipole antenna has dual-band operation. A prototype, which is suitable for application in wireless local area network (WLAN) design in 2.4 GHz and 5 GHz bands, is characterized by wide impedance bandwidths and constructed for laptop as an internal antenna. The L-shaped microstrip feed line structure effectively increases the impedance bandwidth to 11% in lower band covering the 2.4 GHz band (2400–2484 MHz) and 50% in upper band covering the 5.2 GHz (5150–5350 MHz) and 5.8 GHz (5725–5875 MHz) bands for the proposed dipole antenna. [Nature and Science. 2005;3(2):47-51].

Key words: dipole antenna; WLAN; impedance bandwidth

1 Introduction

Compact and wide impedance bandwidth design techniques for planar antennas have been very much concerned recently. In addition, researchers are paying attention in planar antennas for wireless local area network (WLAN) systems in the 2.5 GHz and 5.2 GHz bands. The presented 3D crotched dipole antenna in this letter is desired to put 3D crotched dipole antenna in use on the WLAN and characterized by wide impedance bandwidth to match the limitation of the inner dimension of the laptop. By the result of the experimentation, the radiator patch only needs 5 mm in height to cover 2.4 GHz (2400-2483MHz), 5.2 GHz (5150-5350MHz) and 5.8 GHz (5725-5875MHz) bands for WLAN operation. The geometry of 3D-L shaped two sides microstrip crotched dipole design also enhanced the antenna gains across the lower band and the upper band attractively for practical application.

2 Antenna Design

Figure 1 shows the configuration of the 3D crotched antenna fed by a 1 mm wide and 5 mm in

length microstrip feed line on feeding substrate. In Figure 2, it reveals the wide impedance bandwidth covering 2.4 GHz and 5 GHz double-band operations for the proposed 3D crotched antenna. The fabrication of the proposed antenna uses the FR4 substrate. All of the system circuit can be fitted in with laptop device. The dimension of the ground plan is 1×7.4 mm² and the perpendicular antenna plan is 5×44 mm². The 50 Ω transmission line was pre-designed 1×7 mm² and simulated by IE3D simulator. The total length of the antenna is 44 mm. The positive arm connected to a 4×10 mm² rectangle plane is 23 mm in length and can be excited at 2.4 GHz. The crotched radiator system is 10 mm in length and can be excited at 5 GHz. The width of all line segments is 1 mm. The crotched short circuit connecting to the ground plane established an additional inductance to compensate for the large capacitance arising from the area between the crotched radiator and the ground plane.

3 Experimental Results and Discussion

The measured return loss agrees with the simulated result obtained with the software high-frequency

structure simulator (HFSS) simulator. Figures 3, 4 and 5 are the measured radiation patterns at 2448, 5342 and 5726 MHz, respectively. In the azimuthally plane (x–y plane), the E-component shows small variations, which indicates that stable radiation patterns are obtained in every operating band. Figure 6 shows the measured peak

antenna gain. For the 2.4 GHz band, a stable peak antenna gain is measured about 3.0 dBi. For the 5.3 and 5.7 GHz bands, the peak antenna gain ranges from about 5.8–6.2 dBi, which is attractive for practical use in higher band operation with reduced-size patch antenna.

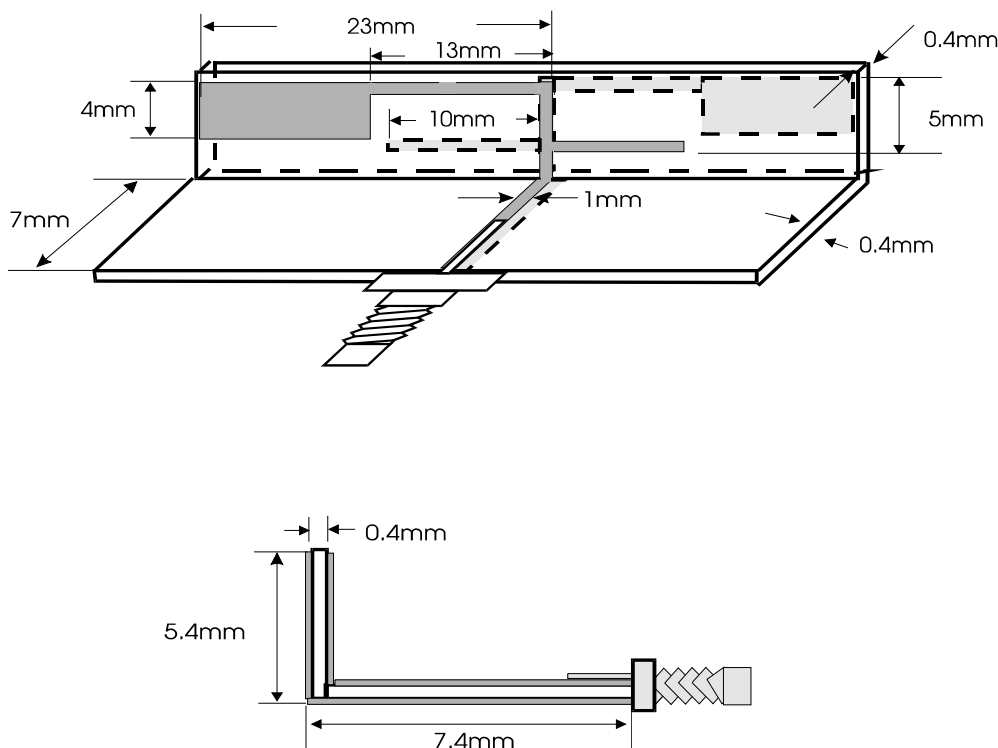


Figure 1. The proposed geometry of double-band 3D crotched dipole antenna.

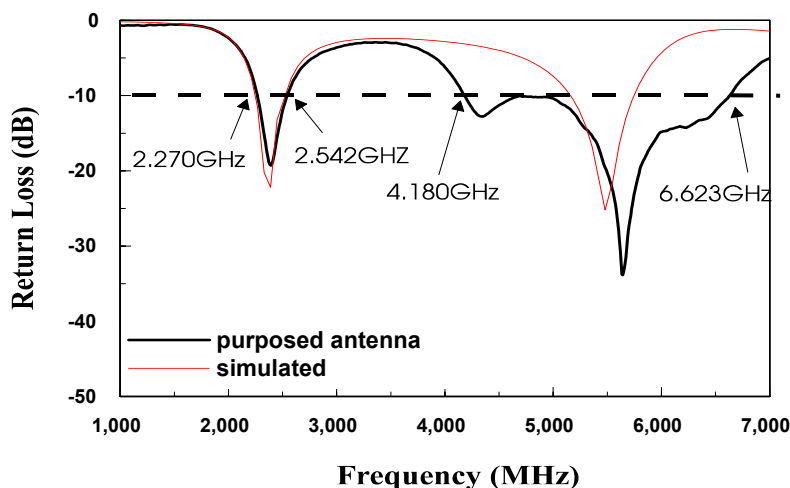


Figure 2. Measured and simulated return loss.

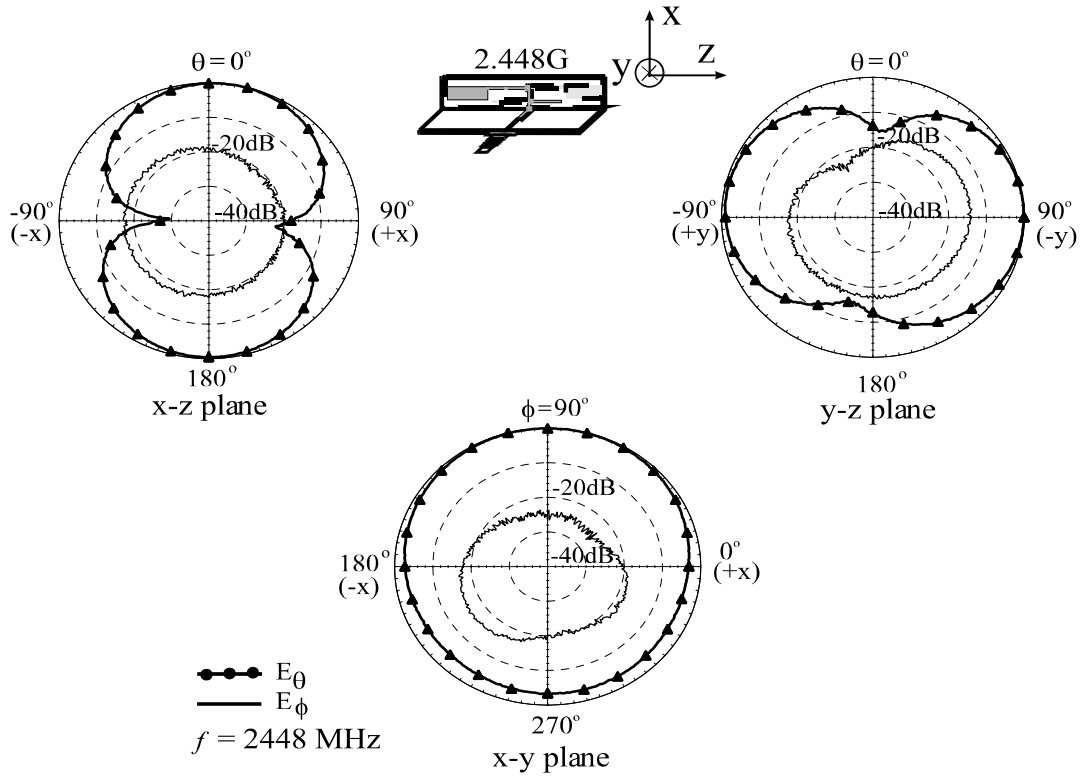


Figure 3. Measured radiation patterns at 2448 MHz.

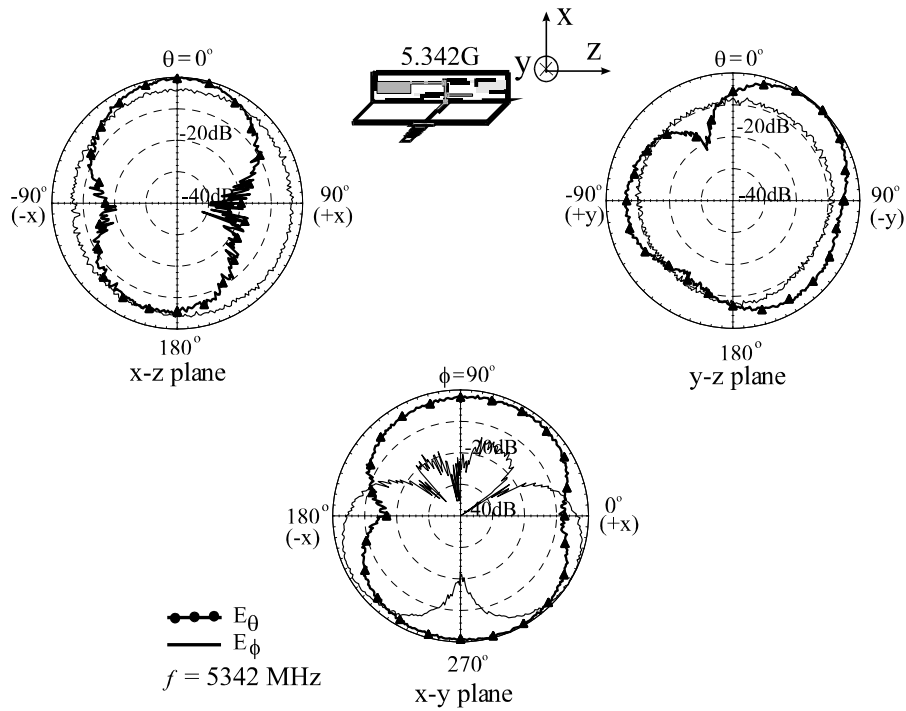


Figure 4. Measured radiation patterns at 5342 MHz.

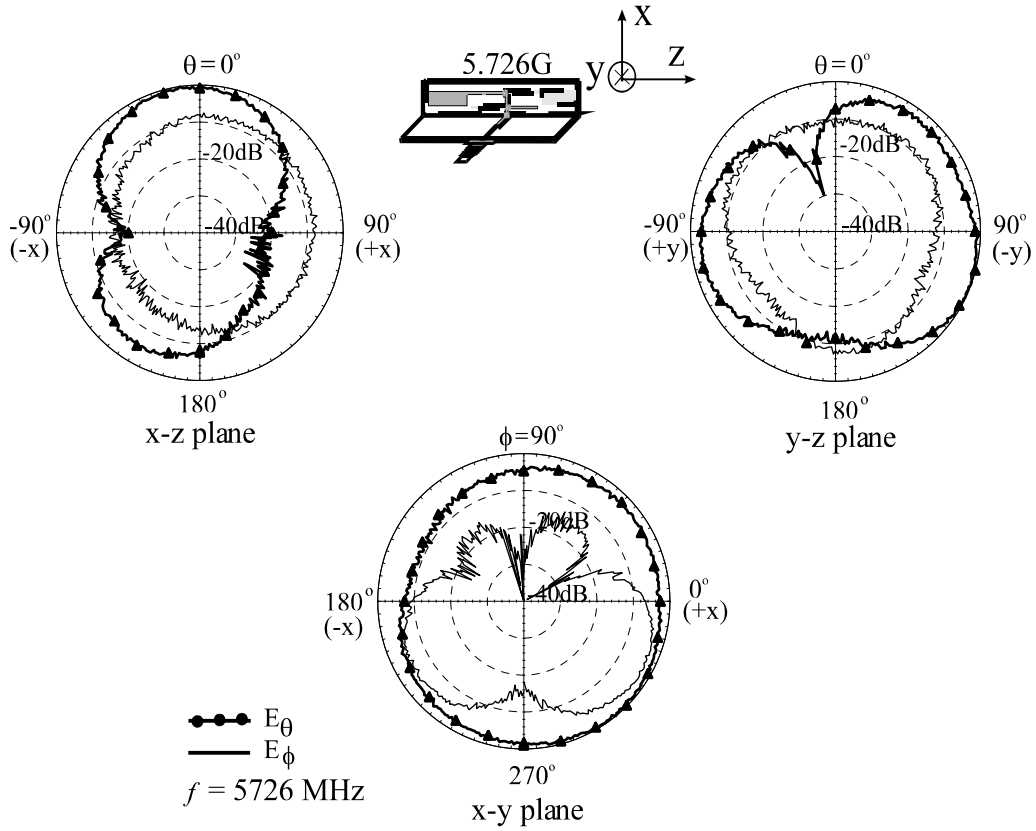


Figure 5. Measured radiation patterns at 5726 MHz.

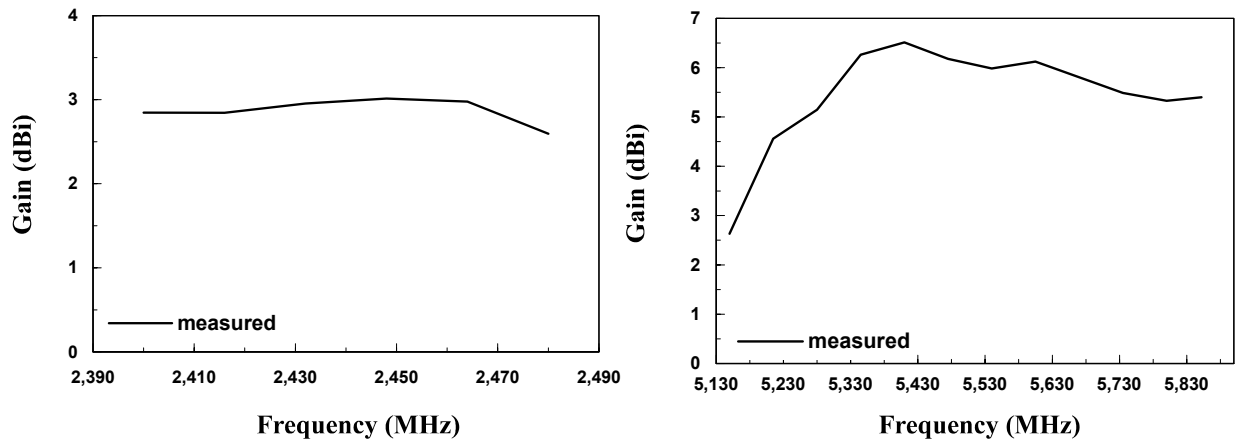


Figure 6. Measured peak antenna gain. (a) The 2.4 GHz band. (b) The 5.3/5.7 GHz bands.

4 Conclusions

The geometry structure of novel 3D crotched antenna is simply L shaped [2] with 5 mm in height, which is suitable for the size of laptop and provides attractive antenna gains across the dual band in operating frequencies at different excited modes. We are successful to design an antenna, which is applicable for WLAN with wide impedance bandwidth, 11 % in lower band and 50 % in higher band, and attractive antenna gains, 3.0 dBi across the lower band and 6.0 dBi across the upper band as well. In addition, L-microstrip line feed structure effectively reduces the difficulty to compromise between the inducing capacitance of feed

substrate and inductance of the probe.

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