A Novel Small Size and High Gain Antenna for 2.45GHz Band Application

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Abstract: In this paper, we propose a novel patch antenna with a small size and high gain. The conventional chip antennas are made of very high dielectric materials; and then they have small size but low radiation gain. Instead of using the dielectric material, the proposed antenna has a small size while retaining high gain. The proposed antenna has the size of 15×10×6(*mm*), a bandwidth of 7.4%(@2.44GHz, $|S_{11}| \le -10$dB) and 2.73 dBi gain.

1. Introduction

Recently a hot issue of the wireless data communications (WDC) is a technique of wireless connection between PC and other equipments such as mouse, keyboard, printer, and *etc*.. One of main concerns is the size reduction of each module in this wireless data communication, especially of antenna. Decreasing the size of antenna, a volume of module can be reduced with a competitive price. Antenna size can be reduced with using very high dielectric materials that sacrificing the antenna gain. If antenna gain were reduced, a circuit of module should amplify output power as mush as amount of the decreased radiation power. Therefore this circuit consumes much power, it cannot ignore in small portable equipment. One of the solutions for the above problem is to design of small size and high gain antenna. In this paper, we proposed a novel patch antenna, which is satisfied such size and gain.

2. Design and Manufacture of antenna

New methods are applied to a conventional patch antenna for reducing antenna size. A conventional patch antenna and our novel patch antenna are presented in Fig. 1 and 2, respectively. In Fig. 2 (a), in order to minimize antenna, firstly the meander line is applied between a coaxial probe feeder on the ground plane and a patch, and between an edge of the other side of patch and the ground plane [1], [2]. As the second method, the ended meander line is shorted to the ground plane [3]. As the

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third method, both skirts (length *S*) are added to both edges of patch into downward. As the fourth method, the patch has the offset slot (length *T*) at the connection part (between meander line and patch) with maintaining the same width of meander line. The above-mentioned methods have an effect on dropping the resonant frequency of antenna. Since antenna material is just a copperplate, the proposed has an advantage of low cost.

3. Experimental results

The experimental results include the return loss (RL), radiation pattern, and antenna gain. An HP8722D network analyzer and an HP8510C antenna measurement system are used for the measurement. Fig. 3 (a) shows the measured RL against frequency for a conventional and proposed antenna at the same size ($15\times10\times6mm$). The measured and computed results (using HFSS Ansoft) of the RL for the above-mentioned antenna are shown in Fig. 3 (a). Fig. 3 (b) and (c) show the measured results that vary with parameter S (skirt's length) and T (slot's length). In that case, all other parameters are fixed (following L = 15, H = 10, W = 0.9, B = 6, G = 0.5 unit: *mm*). It can be seen that the resonant frequency decreases with increasing *S* or *T* parameters. The measured and simulated results of the *xy* and *xz*-plane radiation pattern are shown in Fig. 4 that is the proposed 4^{th} antenna model at 2.44GHz. There is a good agreement with each other. The resonant frequency of this antenna can be reduced by 50 % when compared with the conventional patch antenna (Fig. 1). The proposed antenna has useful application for the ISM-Band (2.4–2.4835 GHz).

4. Conclusions

The proposed antenna has a small size and high gain that was verified with measurement and simulation. According to Fig. 3 (a), the resonant frequency of our model can be reduced by 50 % compared to the conventional patch. And resonant frequency can be controlled with varying skirt and slot's length without increasing the length, height, and width of antenna. The measured antenna gain has 2.73 dBi, as seen in Fig. 4. Although the size of proposed antenna is similar to that of chip antenna, a gain of antenna is higher than that of chip antenna [4].

References

[1] M. Ali, and S. S. Stuchly, "A Meander-Line Bow-Tie Antenna", Antennas and Propagation Society Int. Symp., 1996, Vol.3, pp:1566-1569.

[2] M. Ali, S. S. Stuchly, and K. Caputa, "A Wideband Dual Meander Sleeve Antenna", Antennas and Propagation Society Int. Symp., 1996, Vol.3, pp:1598-1601.

[3] R. Chair, K.M. Luk, and K.F. Lee, "Miniature Multilayer Shorted Patch Antenna", Electron. Lett. 2000, Vol.36, pp: 3-4.

[4] Yujiro Dakeya, Tsuyosi Suesada, Kenji Asakura, Norio Nakajima and Haruhumi Mandai, "Chip Multilayer Antenna for 2.45GHz-Band Application Using LTCC Technology", IEEE MTT-S International, 2000 Vol.3, pp: 1693 -1696.

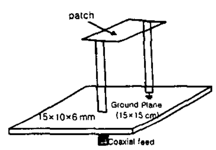
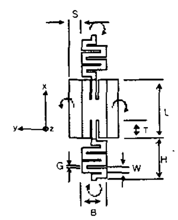
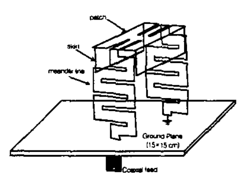


Figure 1. Conventional patch antenna



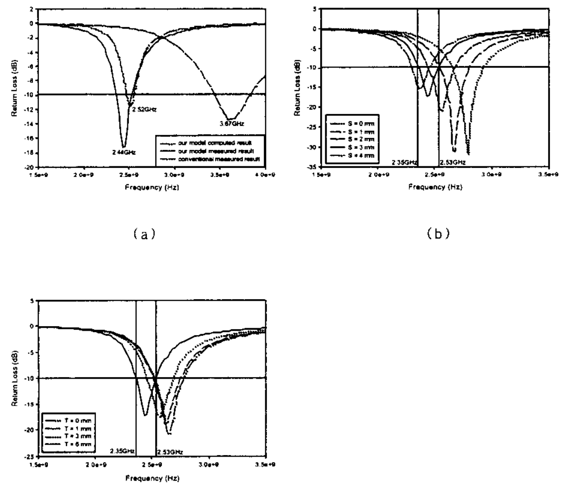
(a)



(b)

(c)

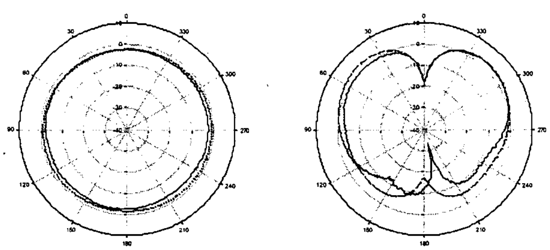
Figure 2. The proposed model (a) unfolded (b) folded (c) photograph



(a) (b)

(c)

Figure 3. (a) RL of experiment and computation (b) experimental RL for different S (c) measured RL for different T



(a) (b)

Figure 4. Radiation pattern (a) xy-plane (at θ=90) (b) xz-plane (at ϕ=0) (computed: dotted, experimental: solid)