Design of a low-profile wideband patch antenna with L-shaped feeding mechanism

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***Abstract*-This paper has presented the design of a novel low-profile wideband patch antenna. The antenna structure is formed of three layers of substrates with the radiating patches on the top, the grounded patches in the middle and the feeding portion at the bottom. The large operating frequency bandwidth has been obtained due to the L-shaped feeding technique. Moreover, the low cross-polarization level can also be achieved as the feeding structure can be regarded as the preferred differential feeding. The obtained results can confirm that the proposed antenna has achieved a wide impedance bandwidth (VSWR ≤ 2) of about 60% (3-5.5 GHz) and the whole height of the antenna is 6 mm (around $0.06\lambda_l$ at the lowest operating frequency). The obtained cross-polarization level is less than -30dB compared with co-polarization.**

Keywords: wideband antenna, feeding mechanism

I. INTRODUCTION

The research on wideband antennas has attracted much attention and proliferated in the last decade due to the allocation of the frequency band for unlicensed use by various international regulators. Various types of wideband antennas have been developed in the literature. The most utilized antenna elements include double-ridged waveguide horn antenna, tapered slot antenna, log periodic antenna, helix antenna and self-complementary antenna [1-3], while the mentioned antennas occupy a large size of several wavelengths. To reduce the size of wideband antennas, some compact planar antennas have been proposed and studied recently. The typical designs are microstrip-fed patch antennas, microstrip-fed slotted antennas, CPW-fed patch antennas and CPW-fed slot antennas with various shapes [4-5]. Both results in frequency and time domains have been intensively investigated. However, the above mentioned antennas can achieve wideband impedance matching while the radiation patterns are not stable across the operating frequency band.

Most recently, K. M. Luk et al. has proposed a new type wideband antenna which can obtain both good impedance matching and stable radiation patterns over a wide frequency band [6-8]. In [6], the magneto-electric antenna consists of bowtie patches and an electric dipole. Two shorted-circuited patches placed in mirror to each other act as an open-ended slot antenna. In addition, a pair of parasitic L-wires is added to excited electric dipole radiation. The proposed antenna features similar E- and H-radiation patterns across the operating bandwidth.

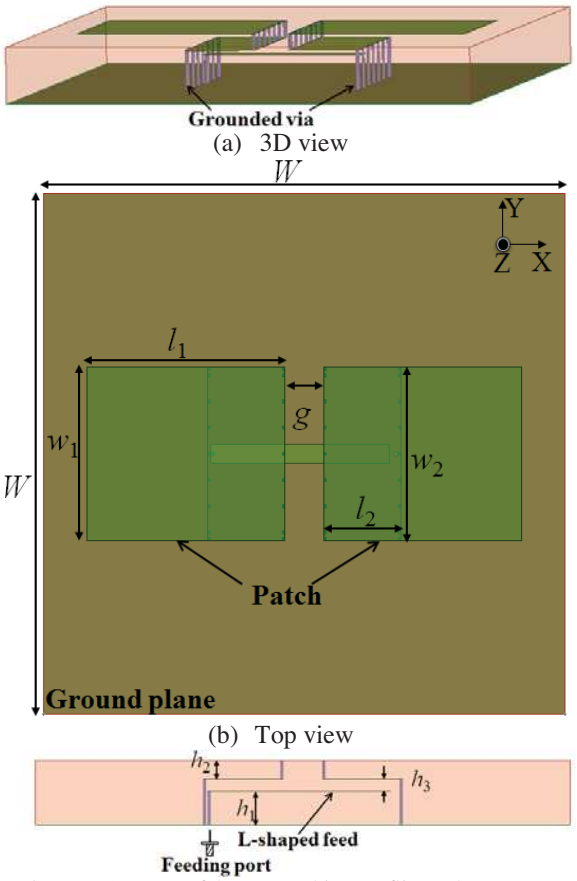

Figure 1. Geometry of the proposed low-profile patch antenna.

In this paper, a novel wideband patch antenna has been presented. The antenna consists of an L-shaped feeding strip and a pair of grounded radiating patches. The rest of the paper is organized as follows: the configuration and results of the proposed wideband patch antenna are demonstrated in Section II, a conclusion is drawn in Section III.

II. ANTENNA DESIGN

Figure 1 presents the geometry of the proposed low-profile patch antenna which is excited by an L-shaped feeding structure. The printed antenna has three layers of substrates with a pair of radiating patches on the top layer, a pair of grounded patches on the middle layer, and the feeding patch on the bottom layer, respectively. The radiating patches and

grounded patches have the same width and different lengths. The whole height of the proposed antenna is 6mm which is around $0.06\lambda_l$ where λ_l is the lowest operating frequency. Figure 2 shows the simulated result of VSWR. As observed, the obtained operating frequency band (VSWR $\leq$ 2) ranges from 3 to 5.5GHz and the relative bandwidth is around 60%. In addition, the presented patch antenna can achieve low cross-polarization levels in both principal planes. Figure 3 presents the typical radiation patterns at 4 GHz. Compared with co-polarization, the cross-polarization level is less than -30dB. It is also noticed that, the front-to-back ratio is around over 15dB. The simulated result of realized gain is also given in Figure 4. The value of the realized gain increases versus operating frequency. The lower antenna gain in the lower frequency band can be improved by enlarging the ground plane.

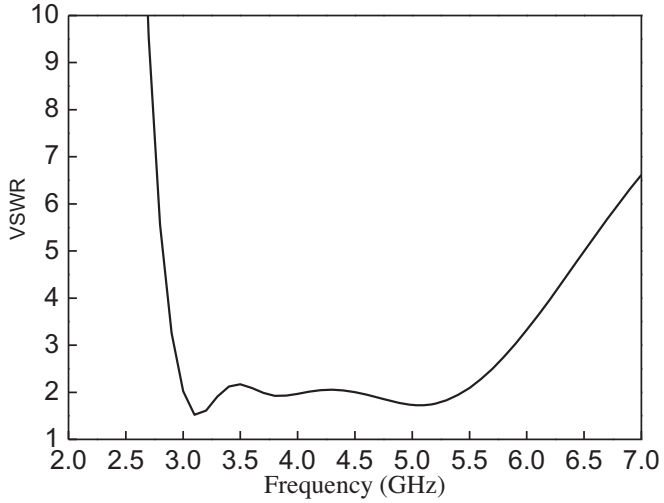

Figure 2. Simulated VSWR of the proposed antenna.

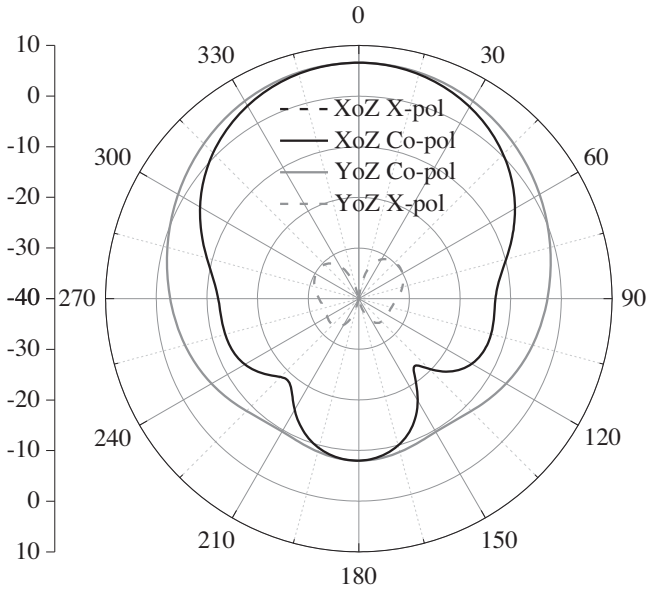

Figure 3. Simulated radiation patterns in two principal planes at 4 GHz.

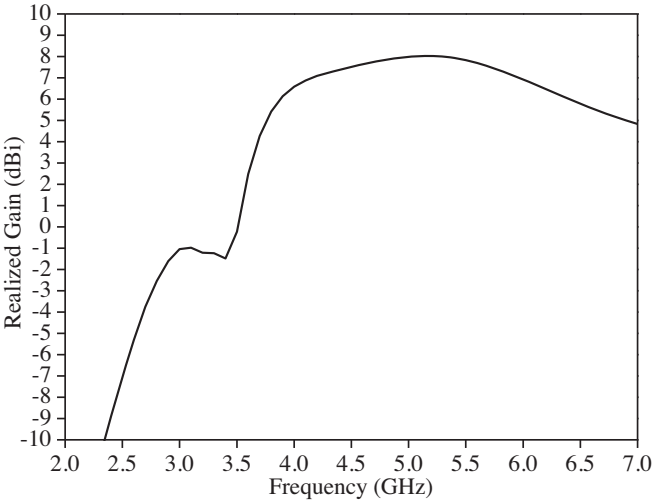

Figure 4. Simulated realized gain versus frequency.

III. CONCLUSION

The design of a novel printed low-profile patch antenna with wide bandwidth has been designed and investigated in this paper. The wideband performance is obtained by employing the L-shaped feeding mechanism. The simulated results show that the proposed antenna can operate over a wide frequency band from 3 to 5.5 GHz with low-cross polarization and high front-to-back ratio.

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