# Design of CPW-Fed Multi-Band Microstrip Antenna

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**Abstract: The proposed antenna utilizes the advantages of the CPW line to simplify the structure of the antenna into a single metallic level, thereby making easier the integration with the microwave integrated circuits. Four operating modes of the proposed antenna are associated with various lengths of four monopoles. The structure of T-shaped monopole antenna and L-shaped monopole antenna are used in the design of the multi-band microstrip antenna. Experimental results show that the bandwidth, determined from 10-dB return loss, is greater than 50 MHz for four operating frequencies. Details of the experimental results are presented and discussed. The size of antenna is 37mm × 34mm.**

## I. Introduction

The rapid development of modern wireless communication systems has caused wide interests in designing wide-band and multi-band antennas. Antenna has many structures, such as the coplanar waveguide (CPW)-fed antennas [1, 2, 3, 4, 5], and the planar monopole antenna [6, 7, 8].

CPW-fed antennas for wireless communications have been discussed by many authors for dual-band operations because of their many attractive features such as wide bandwidth, single metallic layer, and easy integration with active devices. We propose a novel CPW-fed monopole antenna with simple structure and compact size.

The antenna can meet the demand of the communication standards for GPS at 1575MHz、WLAN for 802.11b at 2412~2484 MHz, WiMax at 3.40Ghz~3.60Ghz and WLAN for 802.11a at 5150~5350 MHz. The design and measured results are given in the following sections.

## II. Circuit Design

The structure of dual-band antenna is shown in Fig 1, the simulated return loss by changing microstrip width b will move the resonant frequency to the higher frequency, and changing microstrip c will move the resonant frequency to the lower frequency, witch is shown in Fig 3.

The structure of a three bands antenna is shown in Fig 4, the additional operating mode can be made by changing the strip width d, and the simulated return loss is shown in Fig 5.

The structure of four bands antenna is shown in Fig 6, the simulated return loss is shown in Fig 7, the forth operating mode can be made by changing the microstrip width e.

The geometry of the multi-band antenna is shown in Fig 8, and details of the design dimension is shown in Fig 9. The antenna is printed on a FR4 substrate with a thickness of 0.8 mm and relative permittivity of 4.6. Two ground planes are placed symmetrically on each side of the CPW line of 50Ω. The antenna consists of four strips with different width and length. All the design parameters are optimized by using commercial software IE3D.

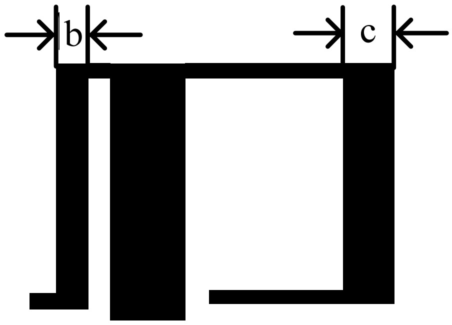


**Figure 1** The structure of dual bands antenna.

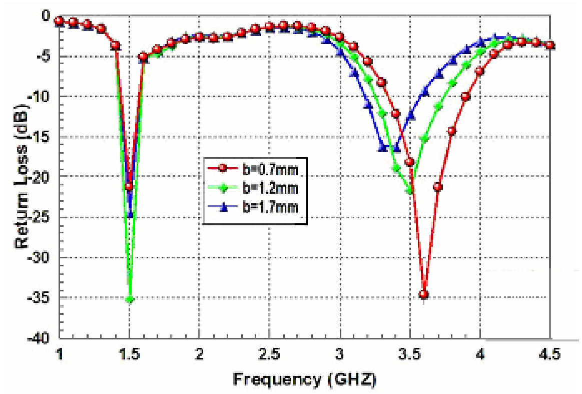


**Figure 2** The simulated return losses of dual-band antenna.

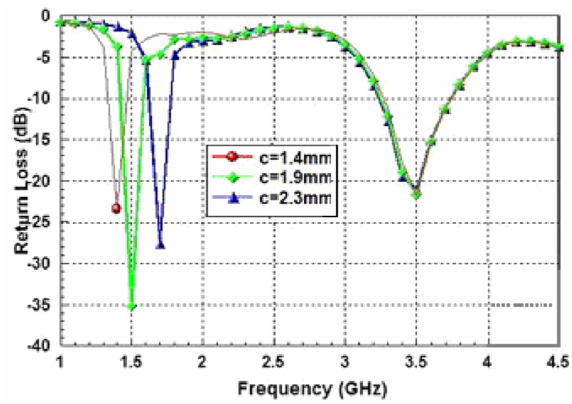


**Figure 3** The simulated return losses of three bands antenna.

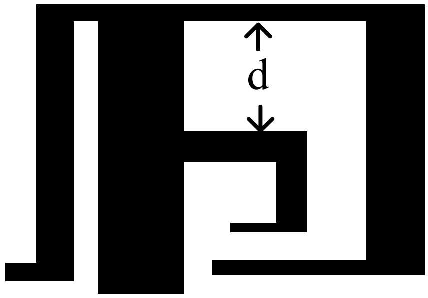


**Figure 4** The structure of three bands antenna.

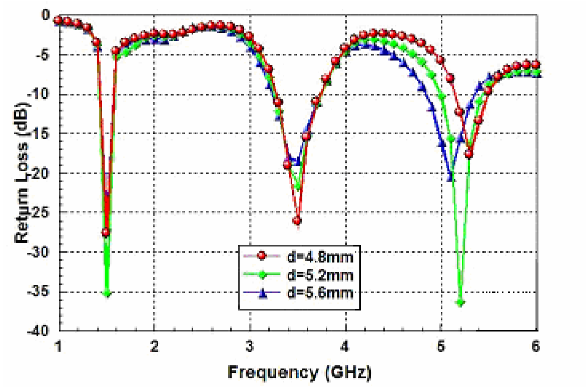


**Figure 5** The simulated return losses of three bands antenna.

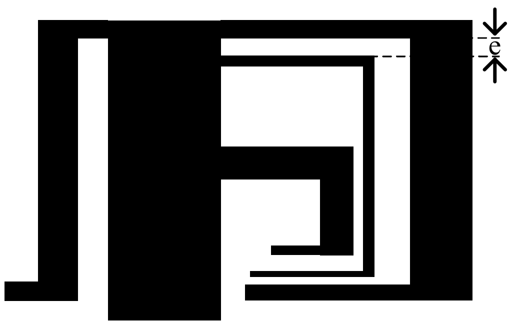


**Figure 6** The structure of four bands antenna.

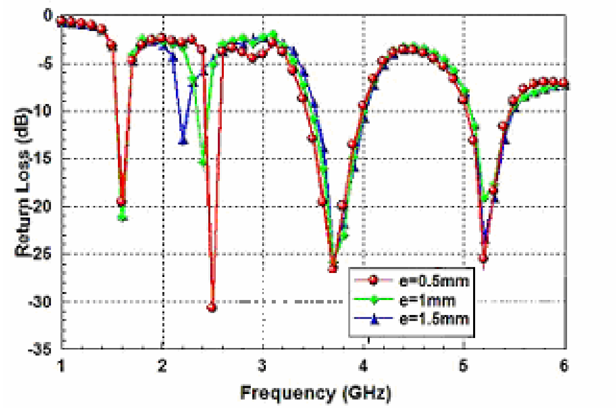


**Figure 7** The simulated return losses of four bands antenna.

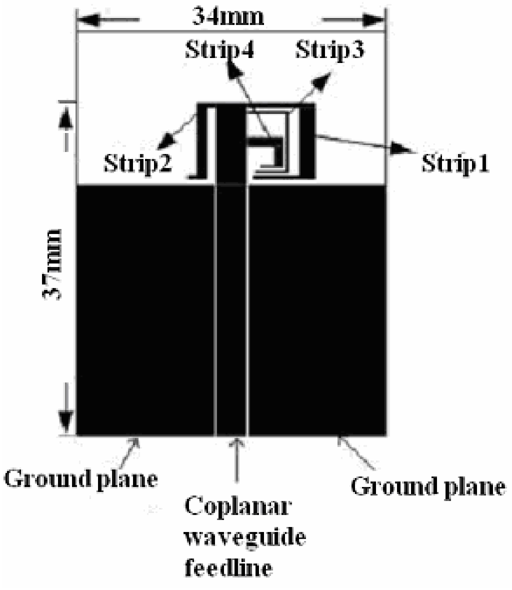


**Figure 8** Geometry of the proposed antenna

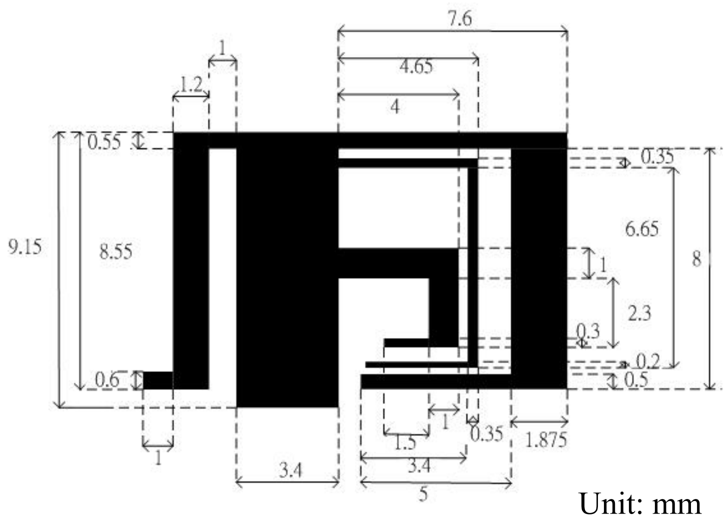


**Figure 9** Details of the design dimensions

## III. Simulation and Test Results

The simulated and measured return losses for the multi-band antenna is shown in Fig 10. The operating bandwidth of the first mode is 50MHz, covering the frequency range of 1.53GHz to 1.58GHz, the bandwidth for the second mode is 100MHz, covering the frequency range of 2.4GHz to 2.51GHz. The operating bandwidth for the third mode is 200MHz, covering the frequency range of 3.45GHz to 3.65GHz. The operating bandwidth for the fourth mode is 500MHz, covering the frequency range of 4.86GHz to 5.36GHz, all the bandwidth measured at $S_{11}$ is -10dB. The E-field and H-field radiation characteristics of the antenna are shown in Fig 11, Fig 12, Fig 13, and Fig 14 for the operating frequencies at 1.55GHz, 2.46GHz, 3.5GHz and 5.1GHz.

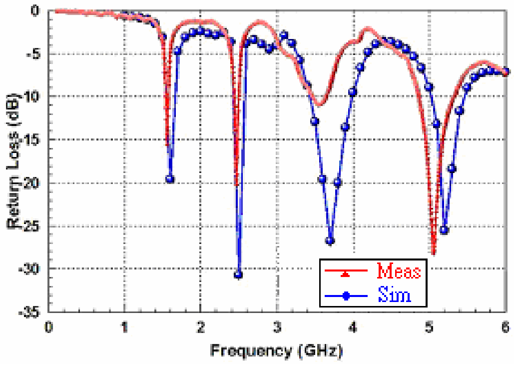


**Figure 10** The simulated and measured return losses of the multi-bands antenna.

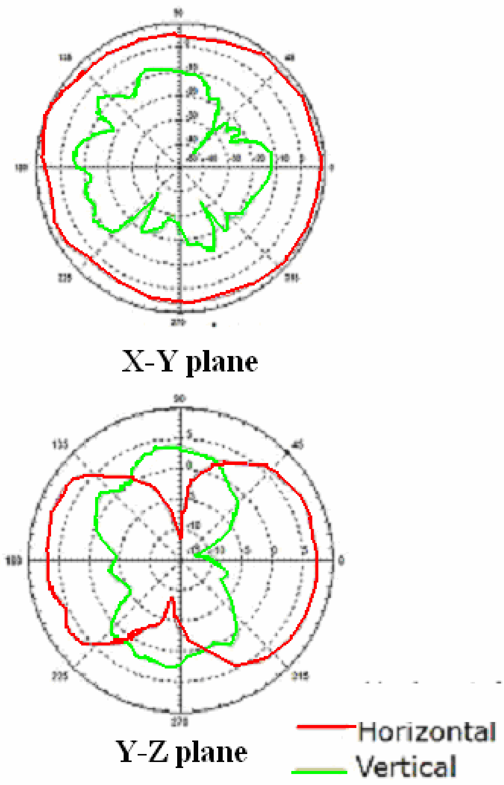


**Figure 11** Radiation patterns at 1.55GHz

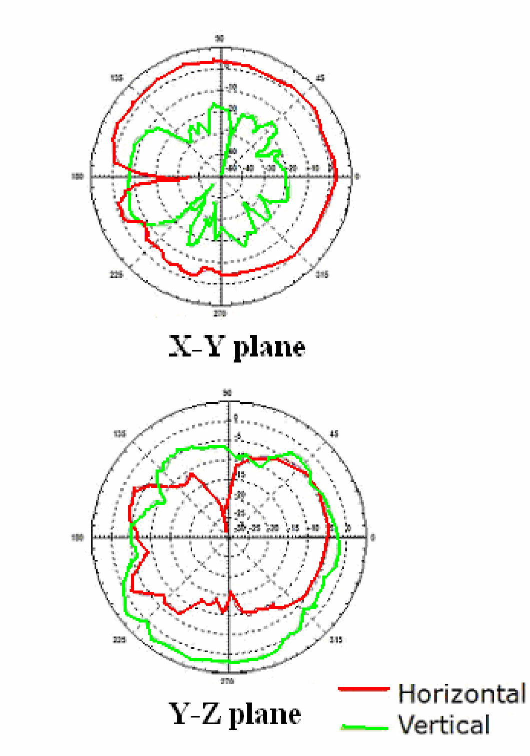


**Figure 12** Radiation patterns at 2.46GHz

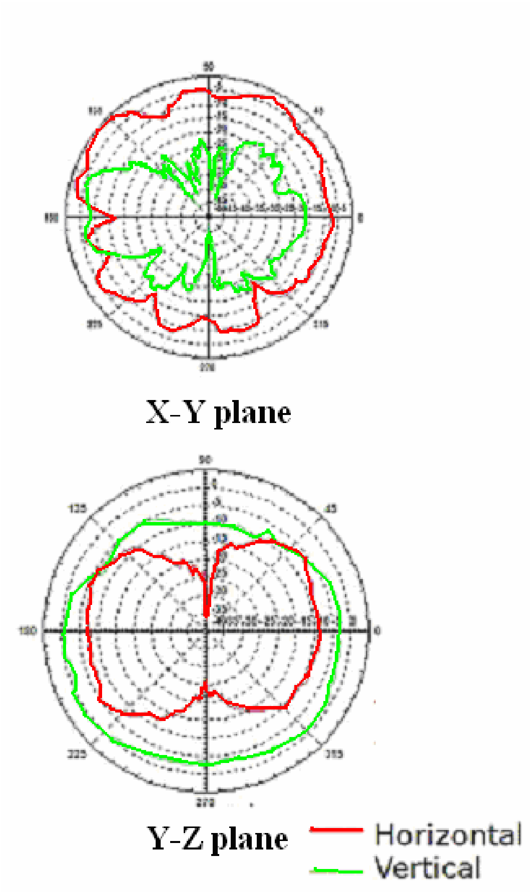


**Figure 13** Radiation patterns at 3.5GHz

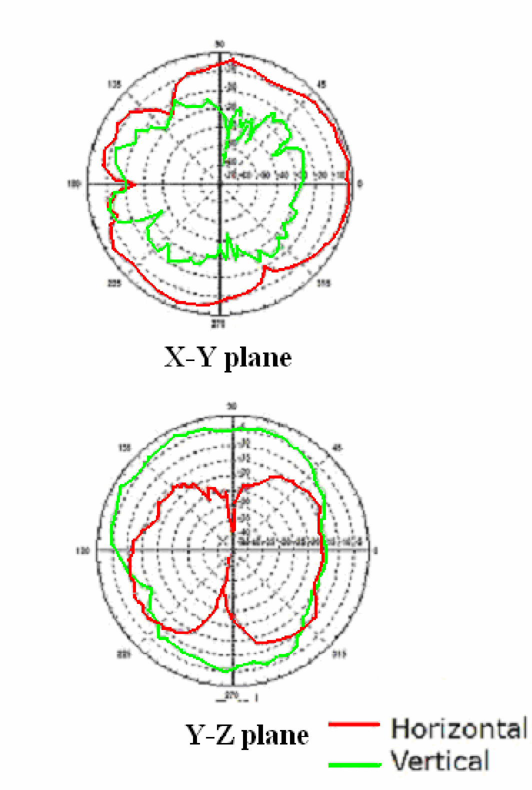


**Figure 14** Radiation patterns at 5.1GHz

## IV. Conclusion

A novel printed monopole antenna for multi-band operations has been designed. The antenna has a compact structure with the design of 37mm×34mm, and easy to fabricate. The desired operating bands can also be easily controlled by adjusting the lengths and widths of the microstrip widths. Furthermore, good radiation characteristics are also shown for the specified four operating bands.

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