CPW-fed Band-notched Monopole Antenna For UWB Applications

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***Abstract*— A printed rectangular monopole antenna fed by a tapered coplanar waveguide (CWP) with a band-notched characteristic is proposed for ultra wideband (UWB) applications. It is shown that the notched or rejected band with a wide operating bandwidth is obtained by embedding an E shape slot in the rectangular radiation patch and its parameters studied in detail. The notched band is controllable by adjusting the lengths and location. With a compact size of 36×34mm^2, the proposed antenna showing UWB omni-directional radiation patterns that is suitable for UWB applications.**

Ⅰ. INTODUTCION

Recently, Ultra-wideband (UWB) technology has attracted attention for use in wireless communication and sensing applications. From mobile telephones to wireless internet access to network appliances and peripherals, there is an increasing reliance on wireless communications to provide functionality for products and services, Therefore, the technologies for wireless communications always need further improvement in order to satisfy higher resolution and data requirements. That is why UWB communications systems coving 3.1-10.6GHz, released by the Federal Communications Commission (FCC) in 2002, are currently under development [1-3]. One of key issues in UWB communication system is the design of a compact antenna while providing wideband characteristics over the whole operating band. Because of their attractive features of wide bandwidth, simple structure, and omni-directional radiation pattern, planar monopole antennas have been used as possible candidates for UWB applications [4-6].

However, since 5.15-5.825GHz frequency band has been reserved for wireless local area network (WLAN) system. One can use a filter to provide the band-stop characteristic but it will increase the frequency complexity of the UWB system. Therefore, an UWB antenna with frequency band-stop characteristic is natural choice to overcome this problem. Several antennas with band-stop characteristic have also been reported in [7-9]. In this paper, the compact and simple CPW-fed monopole antenna with band-stop characteristic is presented. The frequency notch characteristic for the 5GHz WLAN band can be obtained and the band-notched frequency is easily controlled by adjusting the parameters of the E shape slot. The measured and simulated VSWR, radiation patterns, and gains are presented and discussed [10-12].

Ⅱ. ANTENNA DESIGN

Figure 1 shows the geometry of the proposed UWB antenna fed by a CPW line, which is made up of a planar rectangular monopole and impedance transformer at the CPW-fed line for effective impedance matching. The proposed antenna ,having compact dimensions of 36×34mm^2 (W0×L) , is fabricated on one side of a FR4 dielectric substrate with thickness of 0.8mm and relative permittivity of 2.65, The width of the CPW-fed transmission line is fixed at 4.1mm and the distance of the gap between the line and the symmetric ground planes is fixed at 0.3mm to achieve 50 Ohz characteristic impedance. An E-shaped slot is inserted in the radiation patch to realize the frequency band-stop characteristic. In addition, for testing the antenna in the experiment, a 50Ohz SMR connector is used. Parameters L2, L1, Ls2, Ls3, W1, W2, W3, W4 , Lsc, G and W are optimized to ensure good performance. The optimal values of these parameters for the proposed antenna are listed as follows, L2=15mm, L1=17.5mm, Ls1=2.5mm, Ls2=11.5mm, Ls3=3.6mm, W1=15mm, W2=0.4mm, W3=1.2mm, W4=0.5mm, Lsc=8.2mm, G=0.3mm,W=4.1mm.

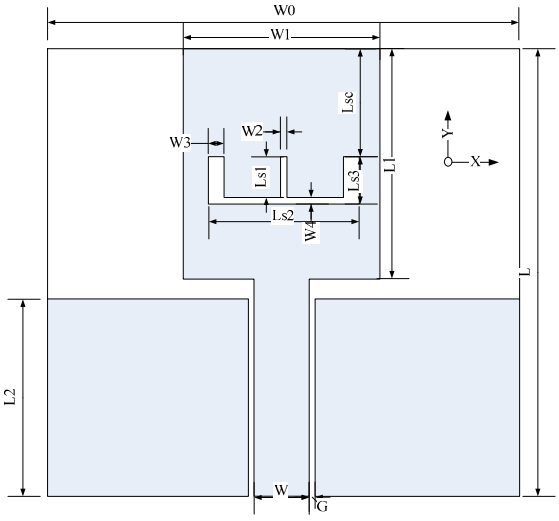

Figure1 Geometry of the proposed CPW-fed antenna with E slot

Ⅲ. BAND-NOTCH CHARACTERISTIC STUDY

The parameters such as Lsc and Ls2 of an E-slot are studied to see the influences on the performances of the antenna by using the software HFSS. It is seen that by embedding an E-slot on the radiation patch, band-notched characteristic is obtained. Figure2 shows the antenna with different Lsc of the slot location while the length Ls2 is fixed

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at 8mm. It can be seen that the length of the slot determines the frequency range of the notched band, as Ls2 increases, the notched band shifts toward the lower frequency.

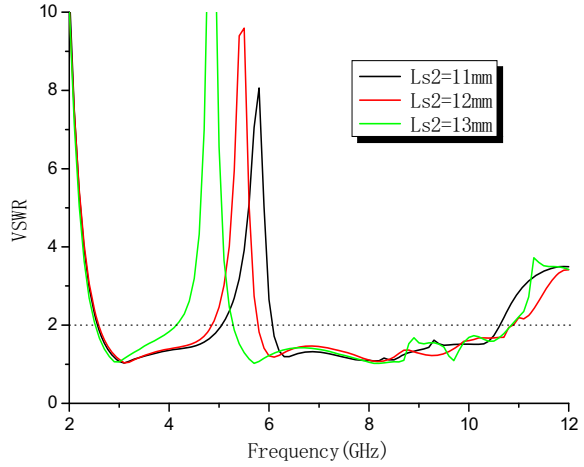


Figure2 simulated VSWR vs frequency of different slot lengths (Lsc=8mm)

Figure 3 shows the VSWR of the antenna with different Lsc of the slot location as the length Ls2 is fixed at 10.5mm, respectively. It is seen that when the location of slot determines the width of the notched band. As Lsc increases, the notched-band becomes wider. It is found that by adjusting the length of the slot a band-stop for 5~6GHz can be realized.

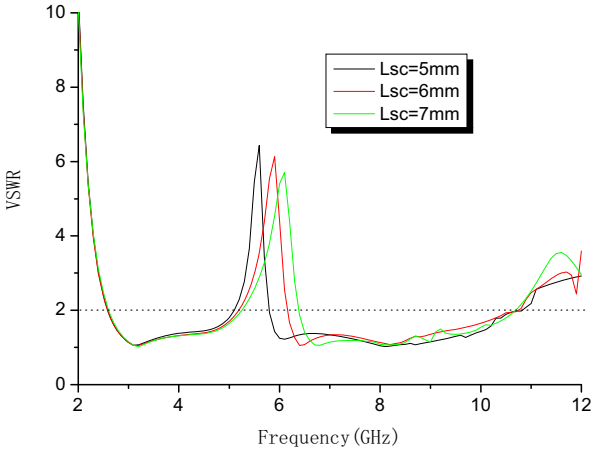


Figure3 Simulated VSWR vs frequency of different slot locations Lsc (Ls2=10.5mm)

Ⅳ. EXPERIMENT RESULTS

The dimensions of the proposed antenna have been optimized with the aid of HFSS software ,The measured VSWR of the proposed antenna with and without E-slot is compared in figure 2.First, the reference antenna without slot is satisfied with impedance bandwidth of UWB band（3.1-10.6GHz）for VSWR<2.In this result ,it is easily find that the proposed antenna has the notch band covered 4.97-5.96GHz .In addition, the proposed antenna maintain UWB characteristics .The VSWR of the Proposed antenna was measured by the vector network analyzer. The measured VSWR is compared with the one simulated by HFSS, as shown in Figure 5.The measured notched band is from 5.04~5.99GHz .The discrepancy is mainly caused by the fabrication error and the external SMA connector. The measured radiation patterns of the proposed antenna in E plane and H plane at 3.5GHz is plotted in figure 5, while 9.5GHz is plotted in figure 6. Similar to a monopole antenna, which has a good omni-directional pattern in the x-y plane and conical radiation in the y-z plane, the measured patterns, in x-y plane, are all nearly omni-directional, and those in y-z plane, as expected are all very monopole like. Also note that, measurements at other operating frequencies across the bandwidth of each band show radiation patterns similar to those plotted here. That is, stable radiation patterns have been obtained for the proposed antenna. The antenna with and without E-slot simulated peak gain is plotted in Figure7, showing a low radiation level in the notched band.

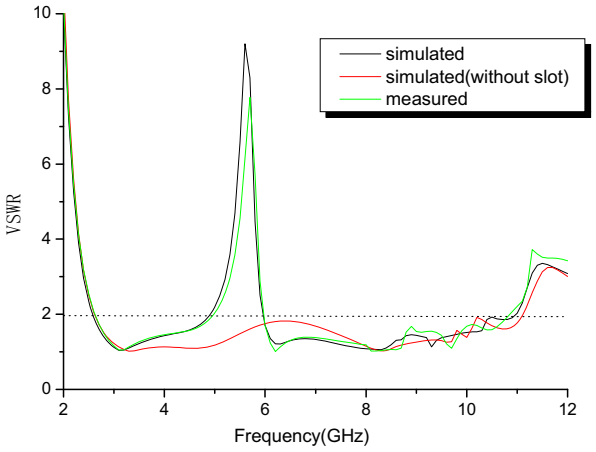
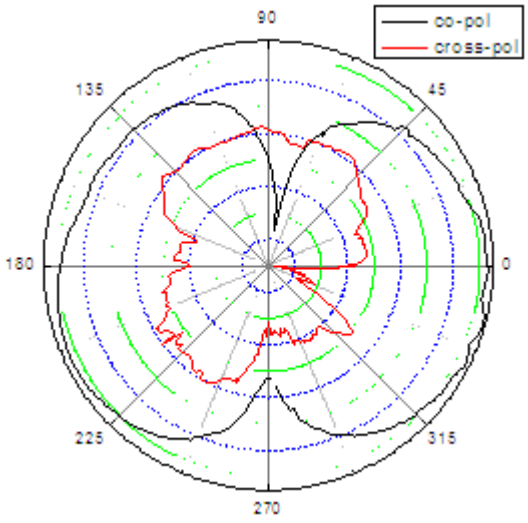
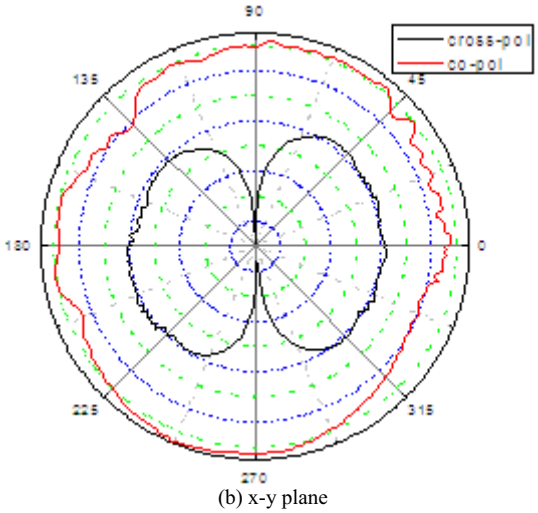


Figure4 Measured and simulated VSWR of proposed antenna

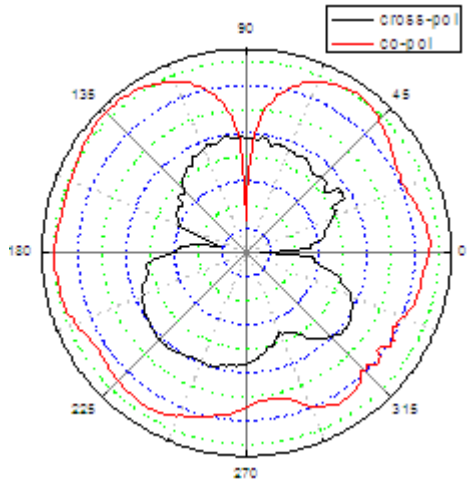


(a) y-z plane

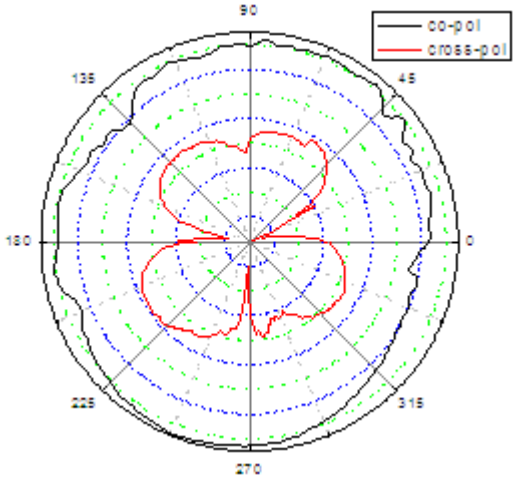


(b) x-y plane

Figure5 Measured radiation patterns at 3.5GHz for the proposed antenna



(a) y-z plane



(b) x-y plane

Figure 6 Measured radiation patterns at 9.5GHz for the proposed antenna

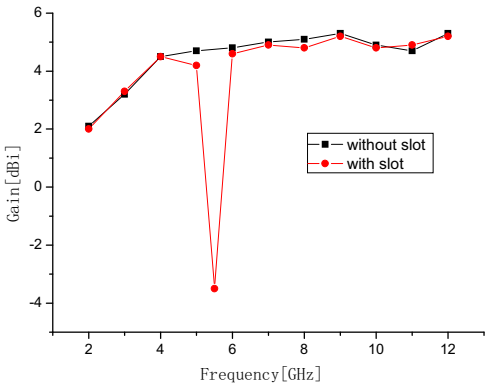


Figure 7 Measured antenna gain for the proposed and reference antenna

Ⅴ. CONCLUSIONS

In this paper, a CPW-fed compact monopole antenna with band-notched function has been proposed ,the proposed antenna can be easily printed on low cost FR4 substrate and perform well .The bandwidth of the antenna covers 3.1-10.6GHz for VSWR<2, while the band rejection about 5-6GHz is obtained. Thus, the proposed antenna is applicable to the UWB system without the additional circuit for the suppression of the 5-6GHz band or using multi-band antennas.

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