ISSN 2229-5518

Concentric Slot Antenna Design for Dual-Band Application

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Abstract— The antenna is designed to work in dual frequency band i.e., WLAN and Wi-MAX. The dimensions of the patch are 40mm × 30mm. The substrate used has relative permittivity of 2.2. A coaxial feed is used to feed the antenna with input impedance of 50Ω. Two concentric circular slots are introduced on the patch that resonates at 5.2 GHz and the feed pin resonates at the frequency of 2.4 GHz. The design is simulated using HFSS and Gain, Directivity and VSWR are studied.

Index Terms— Coaxial Feed, Concentric Slot, Dual-Band Frequency, WLAN, WI-MAX

1 Introduction

THE demand of today's cellular communication world is for an antenna design that is efficient and compact in size. Everyone is looking for gadgets that have all the possible applications and features and at the same time are small in size. This has led to more research on antenna designing, aiming to obtain an antenna that provides more bandwidth, high efficiency and a compact size.

The idea of slot antenna is preferred as it helps in designing an antenna that is simple and compact in structure and resonates on multiple frequencies. Slot antenna is omnidirectional which adds to another advantage of using it. The proposed antenna design works on two frequency ranges, i.e., for WLAN and WiMAX as per the frequency set by IEEE standards

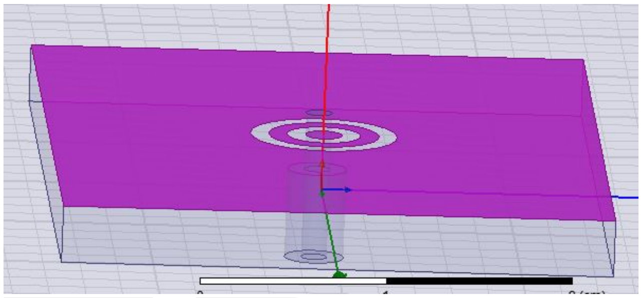

Figure 1. Patch along with slots

2 Antenna Design Analysis

The proposed antenna has complete dimension of 40mm × 30mm. the ground plate has dimensions 100mm × 90mm. The patch is 3.2mm above the ground and a feed pin is inserted between the ground and the patch. This feed pin makes the antenna resonate at the frequency of 2.45 GHz (WLAN). The substrate used is Rogers RT / Duroid 5880 (tm) which has relative permittivity of 2.2.The dimensions of the substrate are 40mm × 30mm × 3.2mm. Now two concentric rings are cut on the patch. These slots make the antenna resonate at the frequency of 5.2 GHz (Wi-MAX). Figure 1 shows the patch along with the feed pin and the concentric slots. Figure 2 represents the complete antenna design.

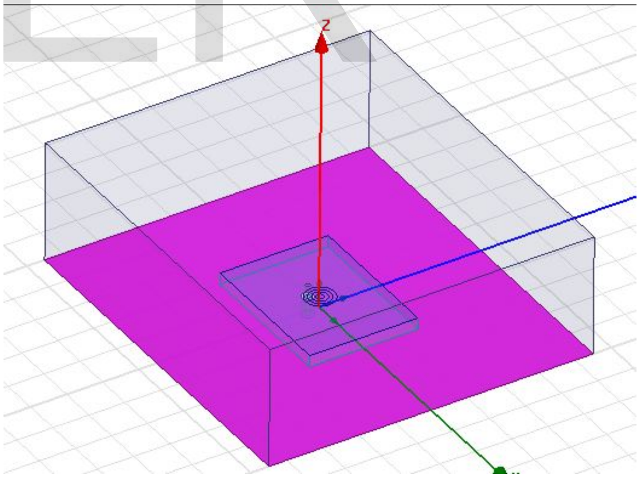

Figure 2. Complete Antenna Design

3 Antenna Parameters And Specifications

Input impedance=50Ω
Resonant frequency= 2.45 GHz and 5.2 GHz
Relative permittivity of substrate= 2.2
Table 1 shows the design specifications of the proposed antenna.

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Table 1.

PARAMETERS	**DIMENSIONS**
Ground	100mm × 90mm
Patch	40mm × 30mm
Substrate	40mm × 30mm × 3.2mm
Feed Pin	Radius= 0.7mm, Height= 3.2mm

4 Results And Simulation

The proposed antenna design was stimulated using HFSS and plots for return loss, gain, directivity, etc were studied. Figure 3 shows the return loss versus frequency plot. Figure 4 and figure 5 show the gain and directivity of the proposed antenna.

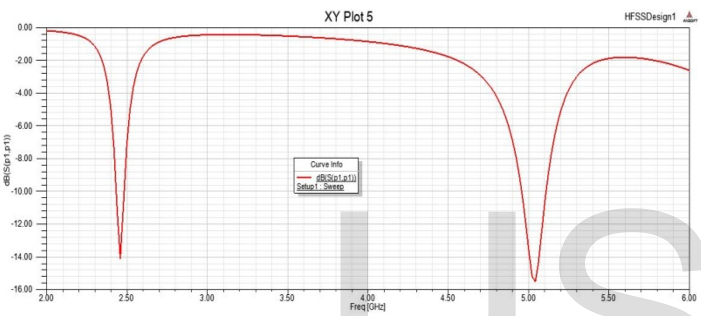

Figure 3. Return loss versus frequency plot

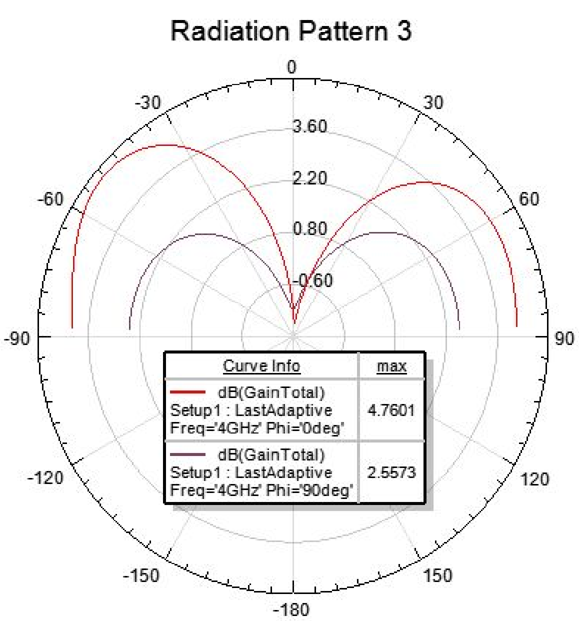

Figure 4. Plot for Gain

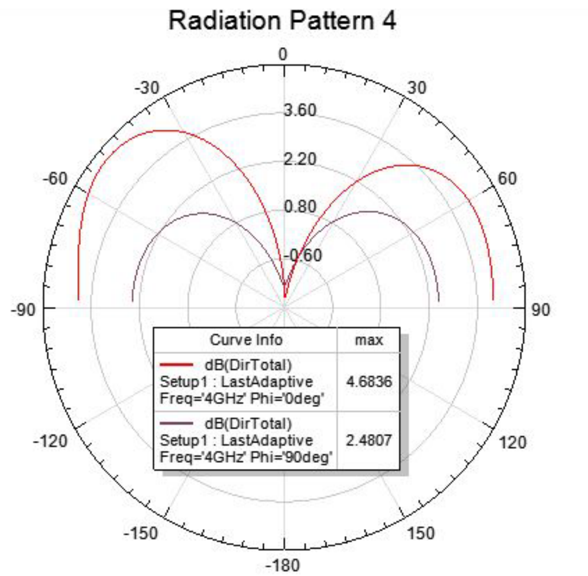

Figure 5. Plot for Directivity

The figures 6, 7 and 8 show the plot of VSWR, Smith Chart and 3-D radiation pattern respectively of the designed antenna.

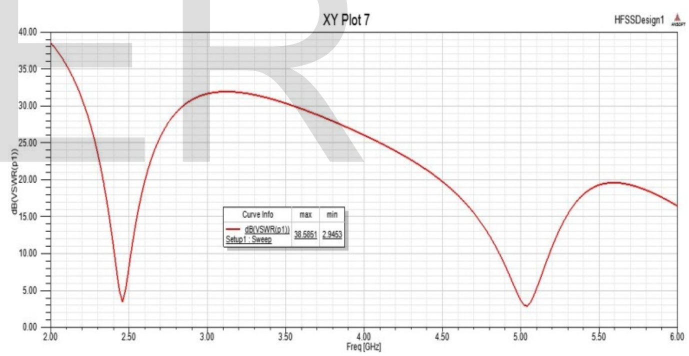

Figure 6. VSWR versus Frequency

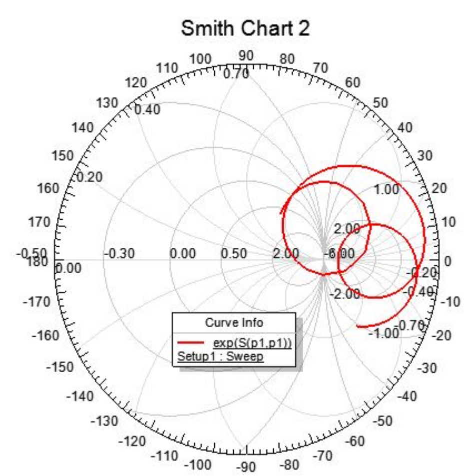

Figure 7. Smith Chart

ISSN 2229-5518

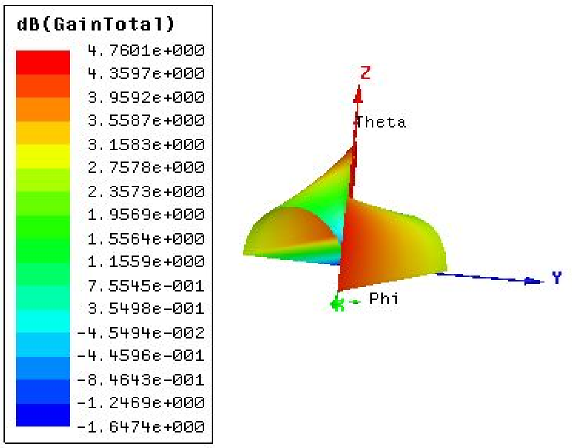

Figure 8. 3-D Radiation Pattern

The electric field vector and the magnetic field vector on the patch are shown in figure 9 and figure 10.

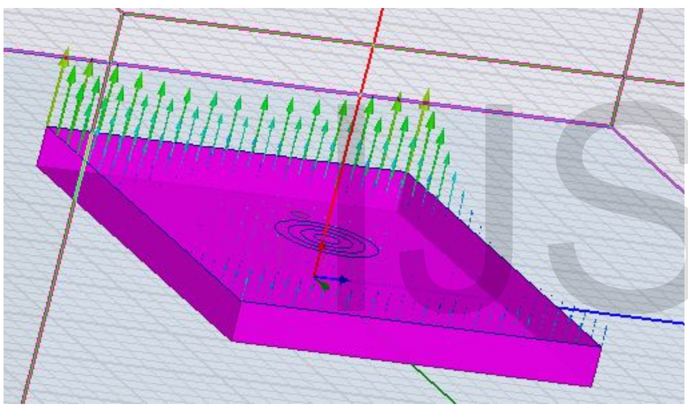

Figure 9. Electric Field Vector

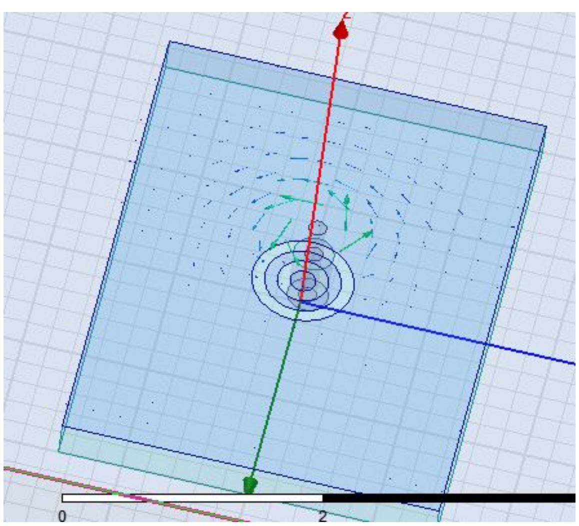

Figure 10. Magnetic Field Vector

5 Calculations

Return Loss at 2.45 GHz = -14.20 dB
Return Loss at 5.2 GHz = -15.60 dB
Maximum gain at Phi = 0 deg, 4.7601 dB and Phi = 90 deg, 2.5573 dB
Maximum Directivity at Phi = 0 deg, 4.6836 dB and Phi = 90 deg, 2.4807 dB
VSWR = 2.9453

6 Conclusion

The proposed antenna is designed to work on dual frequency band that is suitable for WLAN (2.45 GHz) and Wi-MAX (5.2 GHz). The antenna is suitable for handheld devices due to its compact size and efficiency.

However, further modifications for enhancing the bandwidth and decreasing the antenna size are possible.

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