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DESIGNING AND COMPARISON OF FOUR PORT ANTENNA USING PLANE GROUND AND SLOTTED GROUND STRUCTURE

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ABSTRACT

Microstrip patch antenna is basically a low profile antenna used where space is the prime issue. Antenna plays a significant role in the wireless communication. In electronic equipments, an antenna can be work as a transmitter or receiver or it can work as both. Now days, a variety of antennas have been investigated and each antenna has its own importance and applications. A Four-port compact microstrip antenna, with and without slotting in ground structure is presented here to improve the isolation. The proposed antenna is constructed using FR4 substrate. After simulation with CST software the performance of the proposed antenna is investigated and compared to both the structures. An improvement of 2 dB in coupling loss (S_{41}) and minor improvement in other parameter is found. The various result like S-parameter, gain, radiation pattern, and ECC is calculated and compared for plane ground and slotted ground.

Keywords: Decoupling, Isolation, Slotted Ground , CST Microwave Studio suite, ECC.

I. INRTODUCTION

Antenna is a basic element, which is used to link transmitter and receiver by using the free space. It is used to transmit and receive the electromagnetic waves. It is a system of elevated conductors which couples the transmitter or receiver to the free space. Transmitting antenna is connected to the transmitter with the help of transmission line, by which electromagnetic waves enter into the free space and after travelling from free space it is received by the receiving antenna, which then transfer the electromagnetic wave to the receiver. In this way, the transmission of Electromagnetic wave completes. Antenna is a transducer which converts electrical power into radio power. An antenna is an essential element for all the equipment which uses the radio waves for the transmission.

In this paper, isolation enhancement mechanisms of printed MIMO antenna systems are described. Improved isolation is observed from the measured s-parameter curves over a band of 14 MHz [1]. Two/Sixteen-element MIMO antenna array was for isolation enhancement [2].

A double L-slot microstrip patch antenna [3] array with a feed technology has been proposed for microwave access and wireless local area network applications. There is a compact antenna with good omnidirectional radiation characteristics for proposed operating frequencies. It can be observed that the peak gain can be higher than 3dBi at 3.5 GHz. A microstrip patch antenna [4] for dual band WLAN application is proposed. A microstrip slot antenna [5] fed by a microstrip line has been proposed in this paper. In this bandwidth of antenna has been improved. This antenna was presented for WLAN and satellite application. A Broadband patch antenna [6] for WI-MAX and WLAN is developed. A dual Wideband printed antenna [7] is proposed for WLAN/WI-MAX application. A microstrip feed line for excitation and a trapezoidal conductor- backed plane used for band broadening [8]. The achieved reflection coefficient value is lower than -10 dB [9]. The given structure produced low value of mean effective gain (MEG) and low correlation between the signal channels [10]. The 3-dB AR(Axial Ratio) bandwidth and impedance bandwidth of the proposed of the antenna design are found to be 8MHz (907-915 MHz) and 37 MHz (891-928 MHz) [11]. The designed MIMO antenna has a low ECC (<0.00425), which means that MIMO antennas 1 and 2 operated independently [12]. The work used four miniature and wideband defected ground structure to reduce the mutual coupling [13]. A circular polarisation performance can be obtained with a miniature physical footprint [14].

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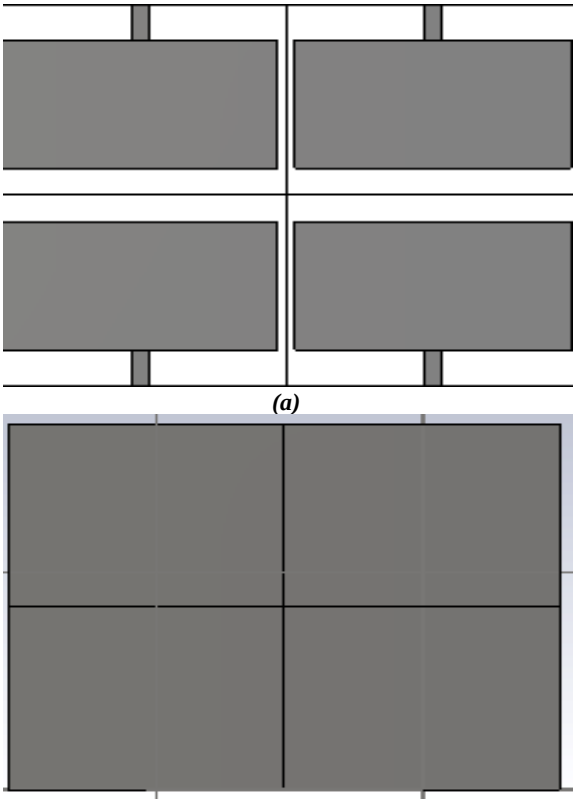
II. DESIGN OF ANTENNA

Figure 1 given the four port four element antenna with plane ground. The substrate choose here as an FR-4 with height of 1.524 mm ,ground height is 0.07 mm. the prospective view given the open and add space boundary condition with frequency range of 1 GHz to 2.6 GHz. Figure 2 given the design of same antenna with slotted ground.



(a)

(b)

Figure 1. 2x2 antenna with plane ground (a) Front View (b) Back View

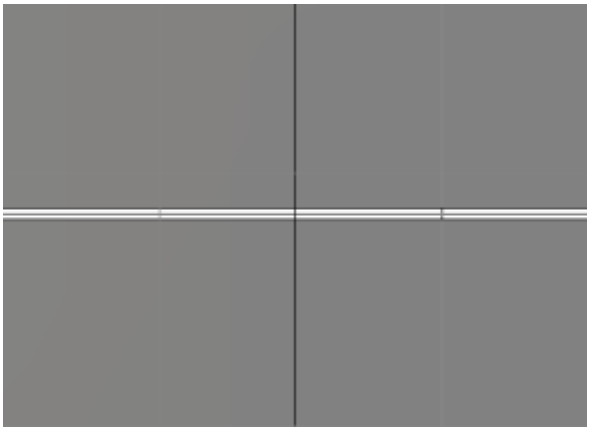


Figure 2. 2x2 antenna with Slotted ground

Table 5.1 Dimension of design

Ground Size (W X L X H)	**Substrate Size**	**Patch size**
52X52X.07 mm^3	52X52X1.524 mm^3	49X28X.07 mm^3
Slot Size	**Port Dimension**	**Feed**
2X51.5X.07 mm^3	4X4 mm^2	2.9X7.8X.07 mm^3

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III. RESULTS AND DISCUSSION

S-Parameter: The parameter S11 represents return loss and S12 given the transmission coefficient. Figure 3 presented the simulation result with full ground plane. It is observed that antenna resonate at frequency 2.4 GHz and produced good isolation in frequency range. In figure 4 S-parameter presented for slotted ground. The presented result showed up to 2 db improvement in S41 parameter and minor improvement observed in other S parameter.

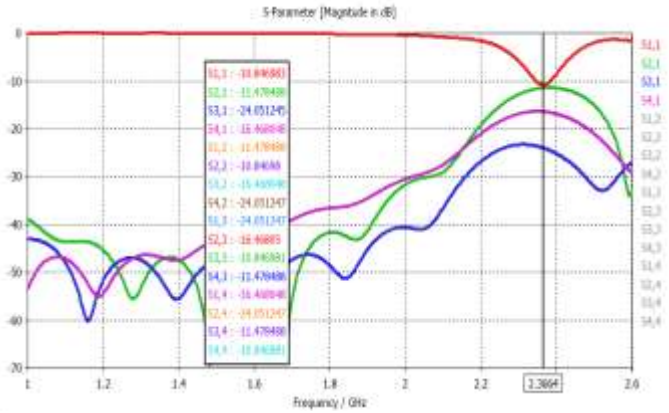

Figure 3 S-Parameter 2x2 antennas without Ground slot

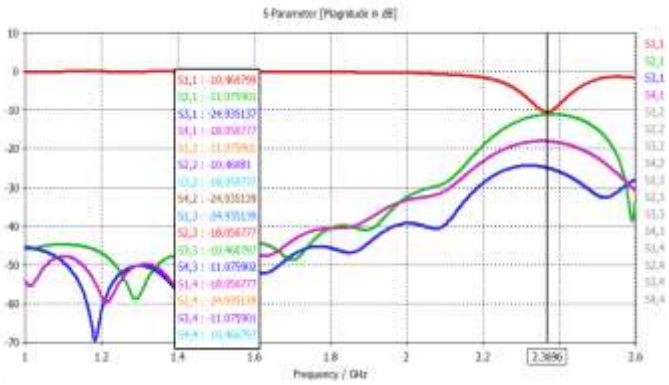

Figure 4 S-Parameter 2x2 antennas with Slotted ground

Bandwidth and Envelop Correlation Coefficient: Bandwidth is the operating range of frequency. The lowest band observed at 2.347 GHZ and upper band at 2.386 GHz. The difference between lower and upper band is .038 GHz. Thus bandwidth is 38 MHz observed with plane ground. Figure 6 given the bandwidth 29 MHz which is less as compare to slotted ground. The Envelop correlation coefficient represented the correlation among antenna element. It must be as low as possible. In first case where ground is full, the ECC value given as in figure 7 is .0092 whereas in second case it improve to 0.0016.

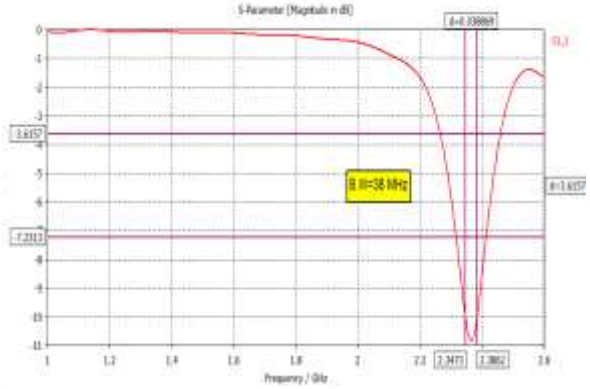

Figure 5. Bandwidth with plane ground

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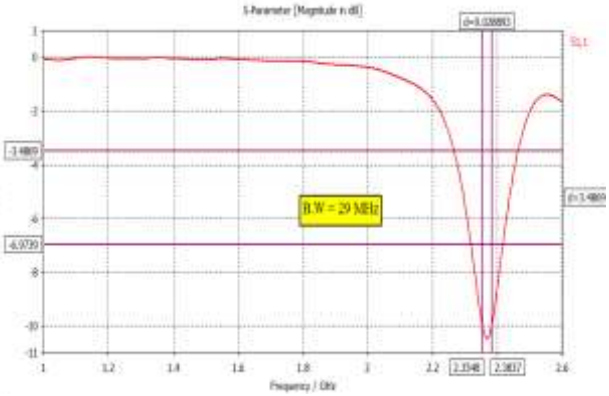
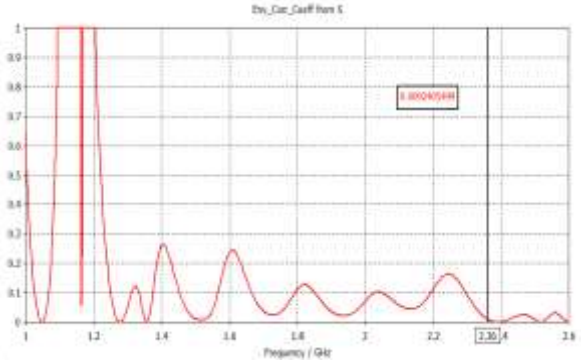
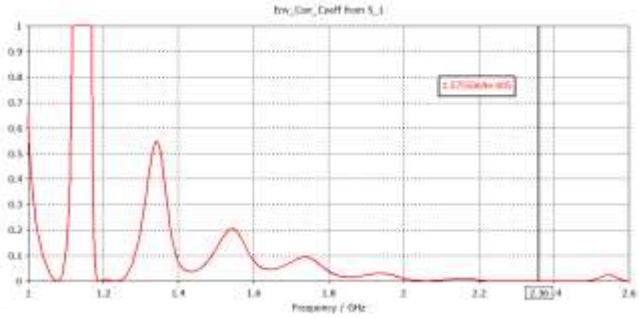


Figure 6. Bandwidth with Slotted Ground

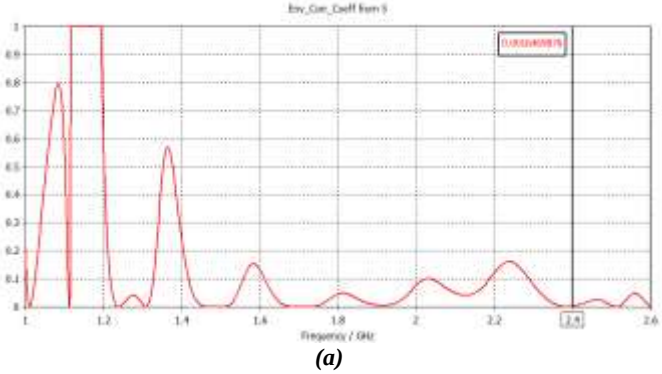


(a)



(b)

Figure 7. ECC of antenna with Plane Ground (a) ECC antenna 1 to 2 (b) ECC antennas 1 to 3



(a)

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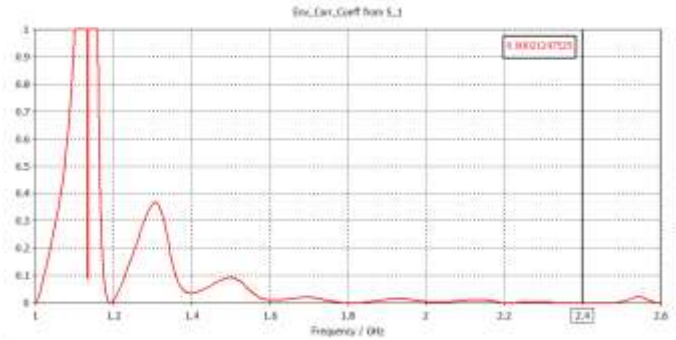
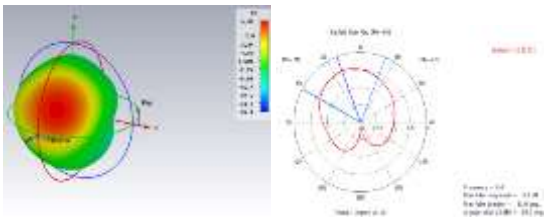


(b)

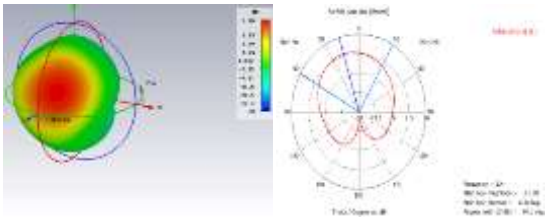
Figure 8. ECC of antenna with Slotted Ground (a) ECC antenna 1 to 2 (b) ECC antennas 1 to 3

Gain and Radiation Pattern: Figure 9 given antenna gain and radiation pattern of antenna with plane ground. The observed value of gain is 4 dBi in plane ground. In second case the gain obtained as 3.98 dBi due to slotted ground. Radiation pattern is identical in both cases.



(a) *(b)*

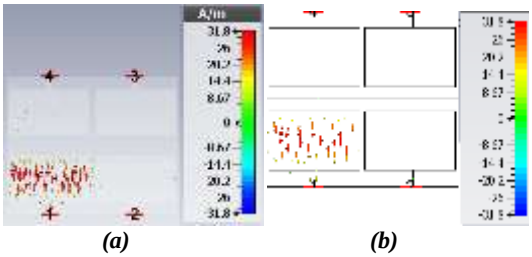
Figure 9. 2x2 antenna with plane ground (a) Gain (b) Radiation Pattern



(a) *(b)*

Figure 10. 2x2 antenna with slotted ground (a) Gain (b) Radiation Pattern

Surface current: Figure 11 and 12 given the value of surface current with plane ground and slotted ground. The observed simulation graph given the better of surface current with slotted ground. The port one is activated and other port terminated to 50 ohm and result observed in figure which showing the surface current effect.



(a) *(b)*

Figure 11. Surface Current with plane ground (a) Simple View (b) Transparent View

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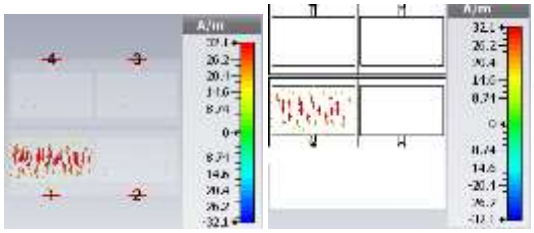

(a) *(b)*

Figure 12. Surface Current with slotted ground (a) Simple View (b) Transparent View

IV. CONCLUSION

A four port antenna is introduced using the plane ground and slotted ground and is simulated by using CST Microwave tools. The antenna is designed for frequency 2.4 GHz frequency with FR4 substrate (ε_r=4.3), h=1.524 mm, tan δ =0.02. The slotted ground structure is used to reduce the coupling and to improve the isolation. With fully ground, Reflection and Transmission parameters are below -10 dB. After introducing the slotted ground structure, Reflection and Transmission parameters are improved to 2 dB.

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