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DESIGNING AND ANALYSIS OF 2X1 MIMO ANTENNA USING FULL GROUND AND SLOTTED GROUND FOR WIRELESS APPLICATION

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ABSTRACT
The micro strip patch antenna is a low profile antenna suitable for compact devices and suitable for other low profile application. In this research, two element transformer coupled slot antenna using full ground and slotted ground was presented and given study provides comparison of both configuration in terms of antenna parameter. The designed antenna with slotted ground resonates at 5.2 GHz frequency and produce return loss of -21 dB and good isolation in the range 5.1 to 5.3 GHz band. In second case where full ground is considered the antenna resonate at 4.3 GHz and provides -17 dB of return loss with isolation of less than -10 dB. The other antenna parameter like gain, ECC, Radiation pattern are demonstrated and compared for both the cases, full ground and slotted ground. The presented result shows the better isolation achieved for slotting case.

KEYWORDS: Isolation, MSA, VSWR, ECC, FR-4.

I. INTRODUCTION
An Antenna is one of the essential parts for microwave communication. Since it help both transmitting and receiving the information. Antenna is a transducer which converts the voltage and current on a transmission line into an electromagnetic field which consists of an electric and magnetic field travelling right angles at each other. Microstrip patch antenna is a small size antenna and it can be printed directly on a circuit board. Microstrip patch antennas due to their many attractive features have drawn attention of industries for an ultimate solution for wireless communication [1].

It is analyze that the patch is generally square, rectangular, circular, triangular, and elliptical or some other common shape. The most commonly employed microstrip patch antenna is a rectangular patch. The rectangular patch antenna is a one wavelength long section of rectangular microstrip transmission line. When the air in the antenna substrate the length of the rectangular microstrip antenna is approximate one half of a free space wavelength. The antenna consists of a dielectric as its substrate the length of the antenna decreases as the relative dielectric constant of the substrate increases the proper miniaturized antenna will improve the transmission and reception.

Antennas play a very important role in the field of wireless communication. Few of them are Parabolic Reflector, Patch Antennas, Slot Antennas, and Folded Dipole Antennas. Each type of antenna is good in their own properties and usage. It is said that the antennas are backbone in the wireless communication without which the world could have not reached at this age of technology.

Patch antennas play a very significant role in today's world of wireless communication. A Microstrip patch antenna is very simple in the designing & using a conventional Microstrip fabrication technique. The most commonly used Microstrip patch antennas are rectangular and circular patch antennas. Some important phenomena like dual characteristics, circular polarizations, dual frequency operation, frequency agility, broad band width, feed line flexibility, beam scanning can be easily obtained from these patch antennas .

II. MATERIALS AND METHODS

Literature Review and Methodology
Prior to start my thesis, it is important to have a deep understanding on the existing pages of Microstrip antenna. The main sources of information are books, journal, theisis, dissertations and the internet. There are three major areas for improving performance of microstrip patch antenna and related simulation software. The papers referred are mainly for wireless application various techniques like simple patch antennas, microstrip patch

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antennas using slots in patch, microstrip patch antennas using Defected Ground Structure (DGS) for size reduction.

The concept of microstrip antenna with conducting patch on a ground plane separated by dielectric substrate. For different configurations many researcher have described the radiation from the ground plane by a dielectric substrate. The early work of Munson on micro strip antennas for use as a low profile flush mounted antennas on rockets and missiles showed that this was a practical concept used in many antenna system. Various mathematical analysis models were developed for this antenna and its applications were extended to many other fields. In this section, the microstrip antenna literature survey is discussed.

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. In the paper a dual band L-shaped Microstrip patch antenna is printed on a FR-4 substrate for WLAN systems, and achieves a frequency range from 5.0 GHz to 6.0 GHz with maximum gain of 8.4 and 7.1 dB in lower and higher frequency bands respectively.

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. In this proposed antenna exhibits wideband characteristics that depend on various parameters such as U-slot dimensions, circular probe –fed patch. This antenna shows 36.2% impedance bandwidth with more than 90% antenna efficiency and is suitable for 2.3 / 2.5 GHz WI-MAX and 2.4 GHz WLAN application.

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. The measured 10dB bandwidth for return loss is from 2.01 to 4.27 GHz and 5.06 to 6.79 GHz, covering all the 2.4/5.2/5.8 GHz WLAN bands and 2.5/3.5/5.5 GHz WI-MAX bands.

This paper [8] has been proposed for describing various feeding techniques. In this a circular polarized patch antenna of shape similar to alphabet 'I' on FR4 substrate for BLUETOOTH applications has been investigated. This paper describes a good impedance matching condition between the line and the patch without any additional matching elements.

A compact rectangular patch antenna [9] has been presented for WI-MAX and WLAN application. This antenna has compact, cost effective, simple structure and suitable for all frequency bands of WI-MAX and WLAN applications.

III. RESULTS AND DISCUSSION

Simulation Results

Patch antenna - Design specification

The proposed designed antenna works for frequency 5.2 GHz and 4.3 GHz for slotted ground and full ground. The antenna for two different cases is simulated and discussed. The result obtained is discussed in later section. 2X1 slotted element antenna is designed with identical size.

Design Parameters- Here calculated the design parameter for single patch. The proposed designed patch antenna that operates at multiband application on a FR-4 substrate. The FR-4 substrate has a dielectric constant of 4.3 and a height of 1.524mm.

The first step is to calculate the length and width of the patch antenna.

Table 5.1 Design Parameters dimension

Parameter	Dimension	Size (mm)
GND	G_w X G_l X G_h	24 X 22 X 0.07
Substrate	S_w X S_l X S_h	24 X 27 X 1.524
Feed	F_w X F_l X F_h	2.7 X 3X 0.07
Feed1	F_{w1} X F_{l1} X F_{h1}	1.1 X 7 X 0.07
Patch	P_w X P_l X P_h	20 X 16 X 0.07
Gnd slot	Gc_w X Gc_l	1.5 X 18
Overall size of MIMO	O_x X O_l X O_w	48 X 27 X 1.6

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The figure 3.1, 3.2 and 3.3 given the proposed structure of front view and back view of slotted and full ground antenna. The antenna simulated in tool CST Suit 2012. The length and width of all parameters are given in table 5.1

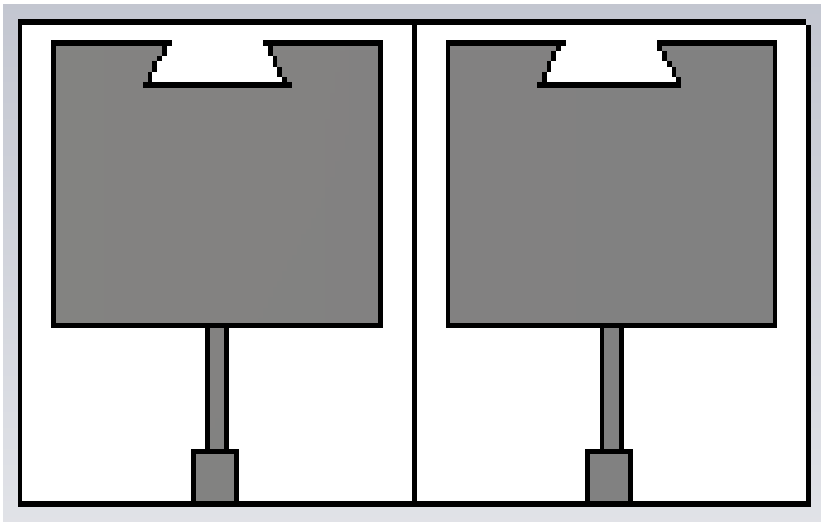

Figure 3.1 2X1 slotted Patch Antenna

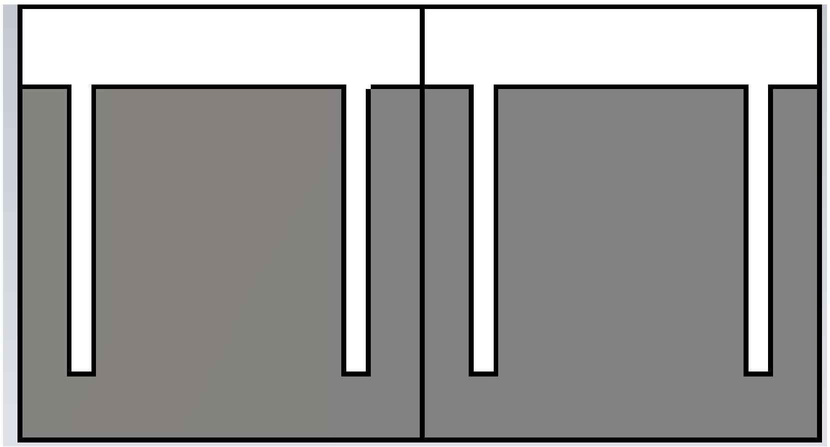

Figure 3.2 Back view of 2X1 patch antenna slotted ground

Figure 3.3 back view of 2X1 patch antenna full ground

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3.2 S-parameter for slotted ground and full ground:

The simulation results of above micro strip patch antenna for slotted ground and full ground is given in figure 3.4 and 3.5. it is clearly observed that return loss of -21 dB obtained at 5.2 GHz resonant frequency with isolation of less than -20 dB in slotted ground. When full ground is considered the resonant frequency is shift to 4.3 GHz and isolation is less than -10 dB obtained. From the above discussion clearly conclude that better isolation achieved using slotted ground.

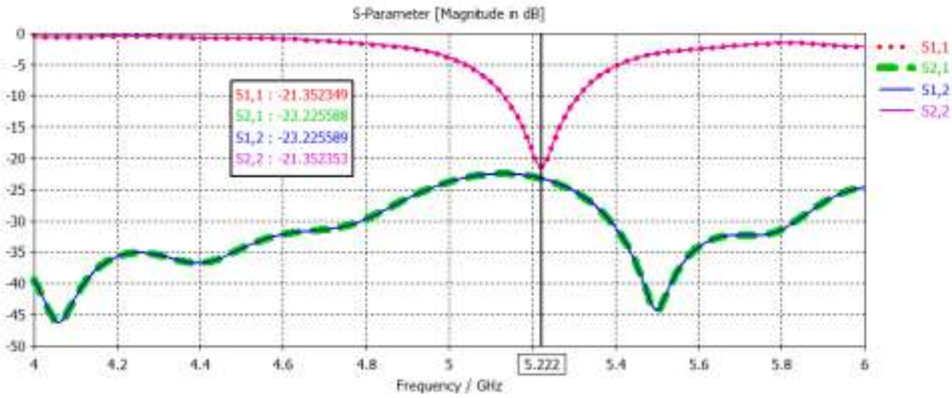

Figure 3.4 S-parameter of 2X1 MIMO Patch Antenna slotted ground

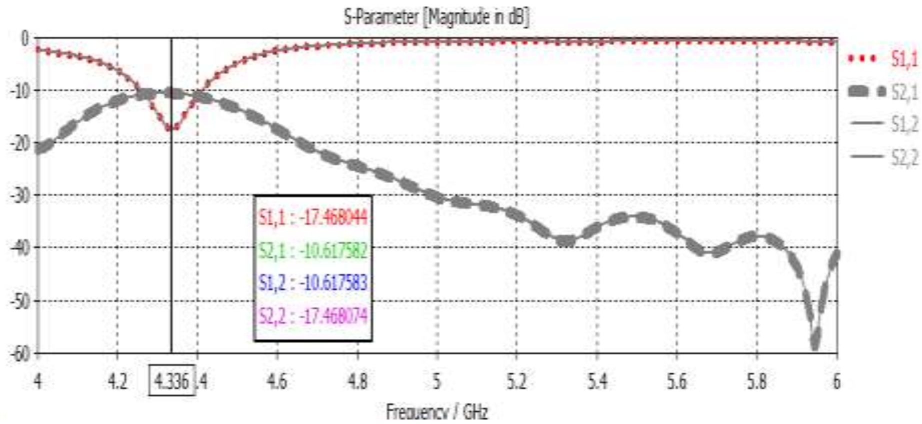

Figure 3.5 S-parameter of 2X1 MIMO Patch antenna full ground

3.3 Bandwidth Comparison: the bandwidth of antenna is the range of frequency antenna produced desired result. In figure 3.6 and 3.7 represented the bandwidth is 197 MHz in slotted ground and 160 MHz bandwidth in full ground case. Thus better bandwidth is achieved in antenna with slotted ground.

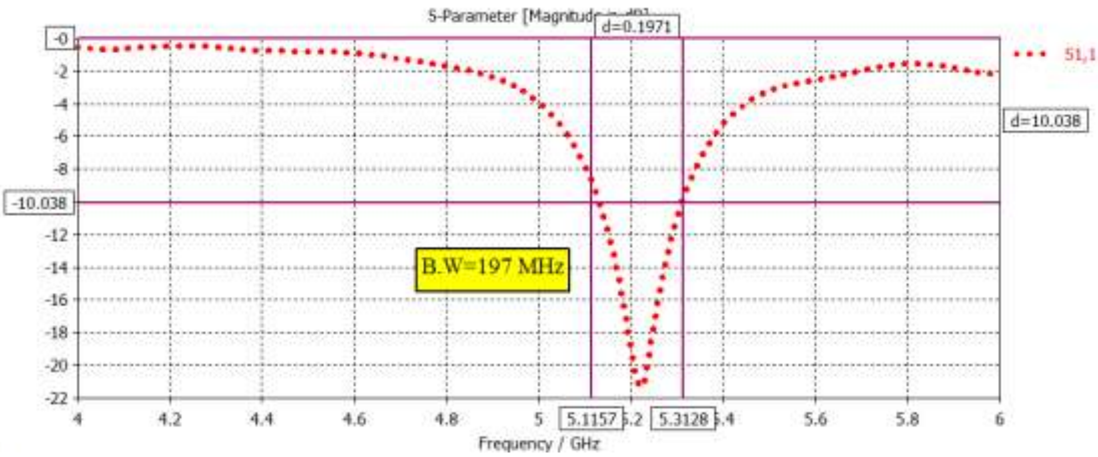

Figure 3.6 Bandwidth of 2X1 MIMO Patch antenna slotted ground

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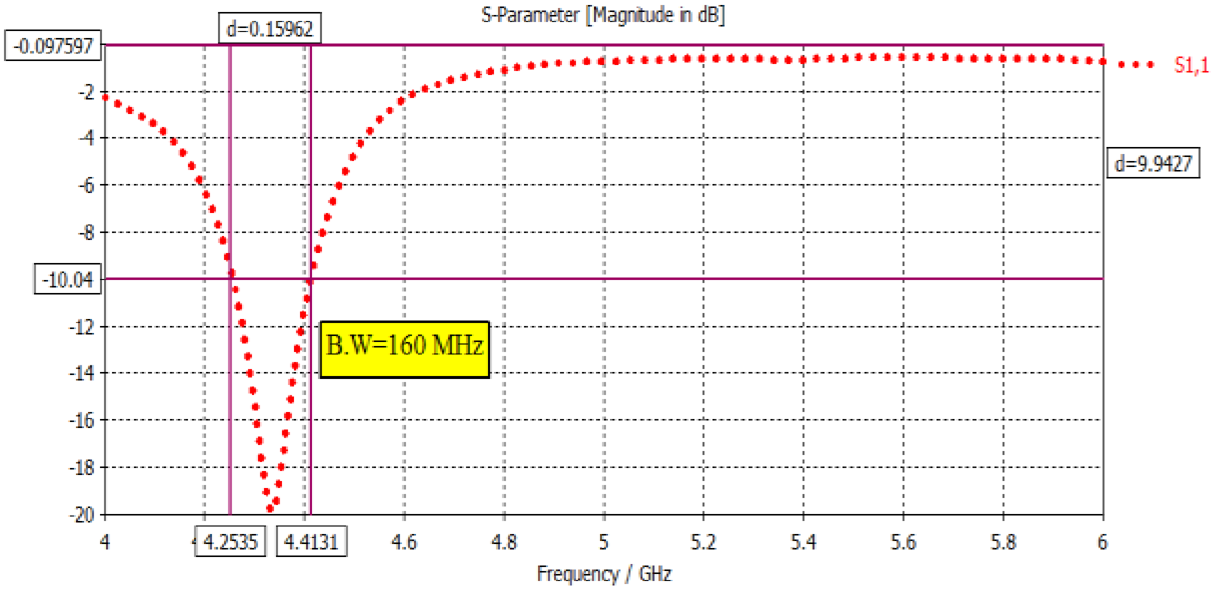

Figure 3.7 Bandwidth of 2X1 MIMO Patch antenna full ground

3.4 Radiation pattern (E-Plane and H-Plane): The E-Field and H-Field radiation pattern is gives in figure 3.8, 3.9, 3.10 and 3.11. The E-field pattern of slotted ground antenna generated side lobe of -3 dB and in full ground antenna the side lobe is -11 dB. The H-field pattern does not contain any side lobe in full ground antenna. Thus better result obtained using full ground antenna.

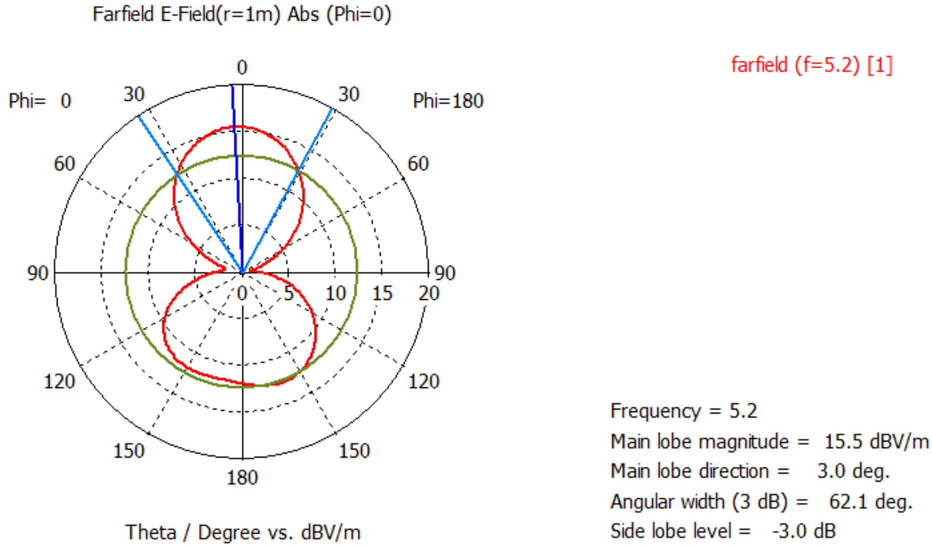

Figure 3.8 E-Field at 5.2 GHz Slotted Ground

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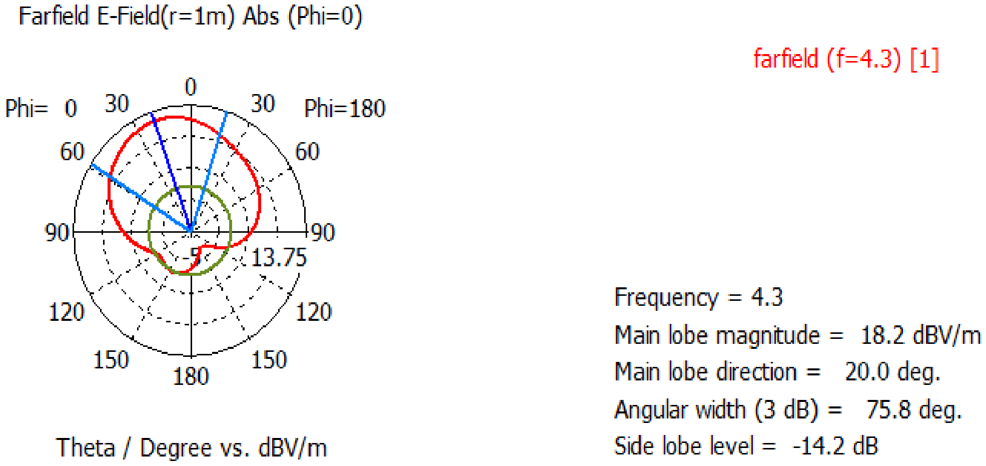

Figure 3.9 E-Field at 4.3 GHz full Ground

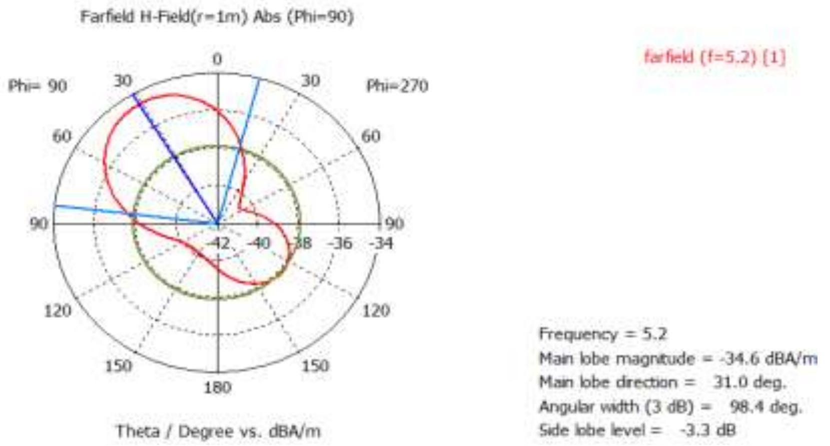

Figure 3.10 E-Field at 5.2 GHz Slotted Ground

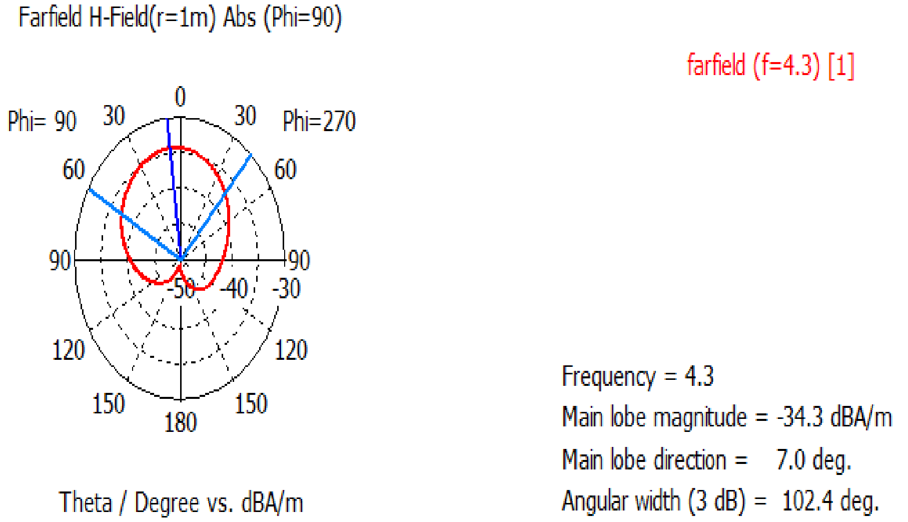

Figure 3.11 E-Field at 4.3 GHz full Ground

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3.5 Far Field:

The gain of slotted ground and full ground antenna is given in figure 3.12 and 3.13. The better gain achieved 4 dBi in full ground antenna whereas only 2.2 dBi gain obtained in slotted ground antenna due to ground losses.

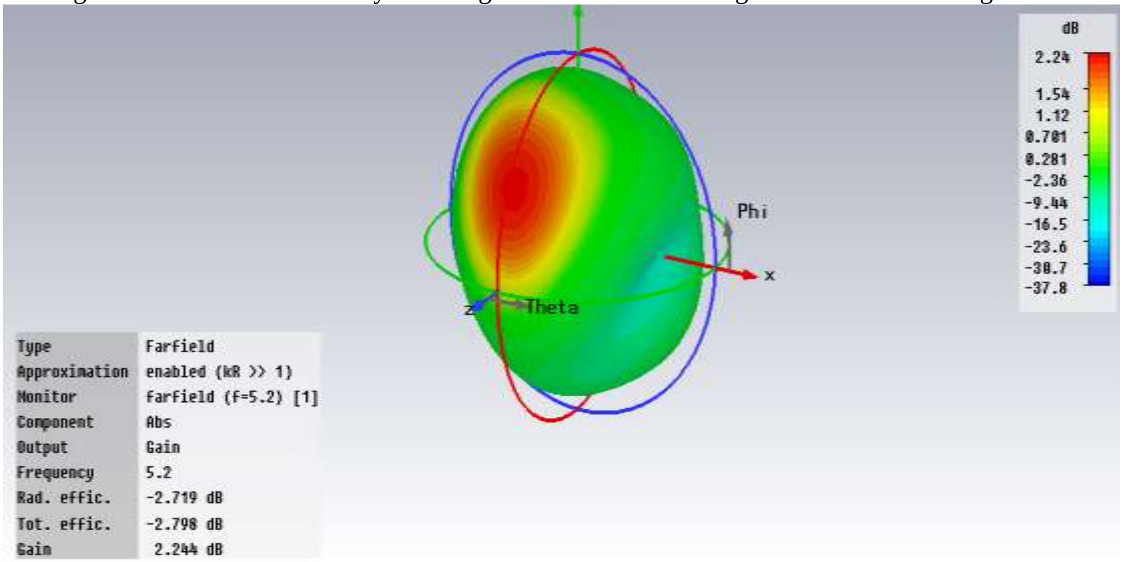

Figure 3.12 Gain Measurement at 5.2 GHz Slotted Ground

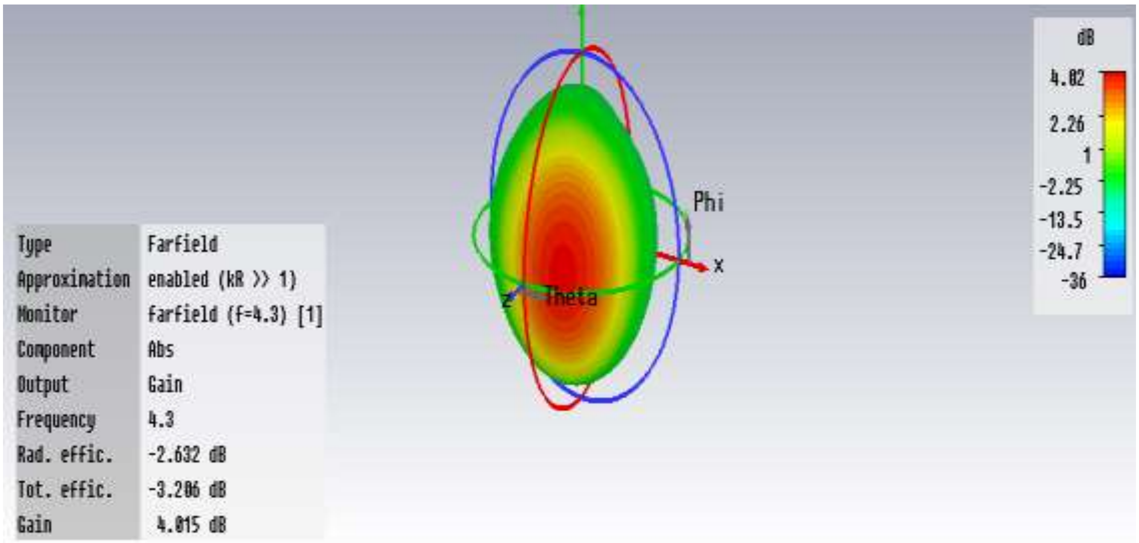

Figure 3.13 Gain Measurement at 4.3 GHz full Ground

3.6 Surface current

Here we are presenting surface current distribution at patch of antenna system. Surface current presents an analytical view of how much and how current flows in the antenna? It is also present direction of flow of current. The figure 3.14 and 3.15 gives the surface current distribution. The maximum current flowing in slotted antenna is 45.3 A/m and in full ground 45.9 A/m.

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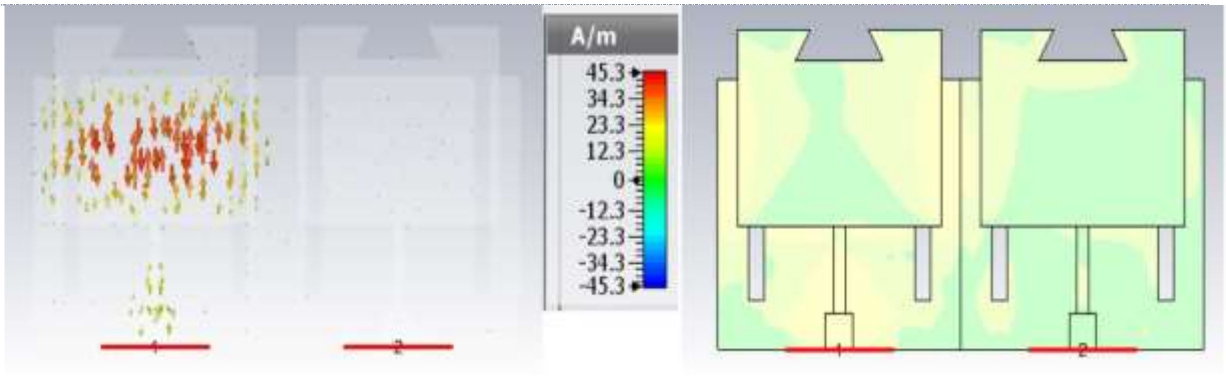

Figure 3.14 Surafce current at 5.2 GHz slotted ground when port 1 excited

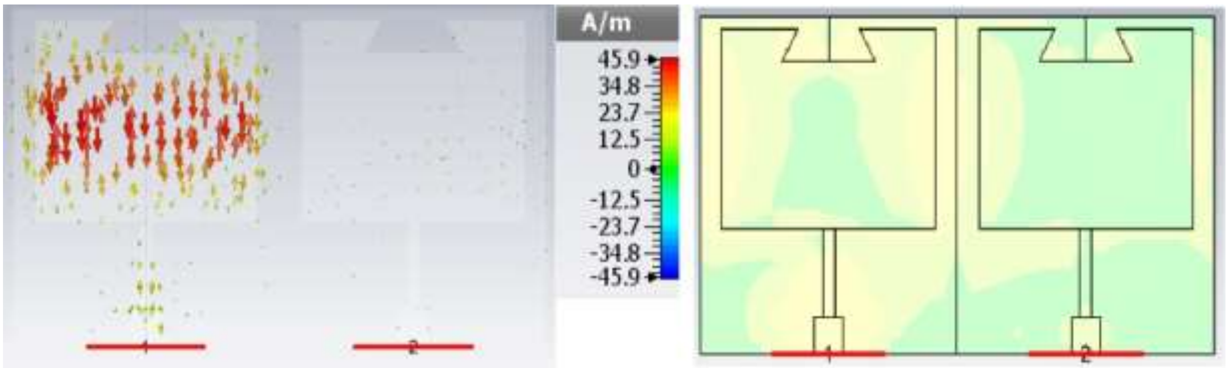

Figure 3.15 Surafce current at 4.3 GHz full ground when port 1 excited

3.7 Envelope Correlation Coefficient (ECC):

The better value ECC is presented when ground is slotted which is 0.0001 and in case of full ground it is 0.0013. Here clearly observed that better ECC can be seen in slotted ground antenna. Figure 3.16 and 3.17 presented the ECC result.

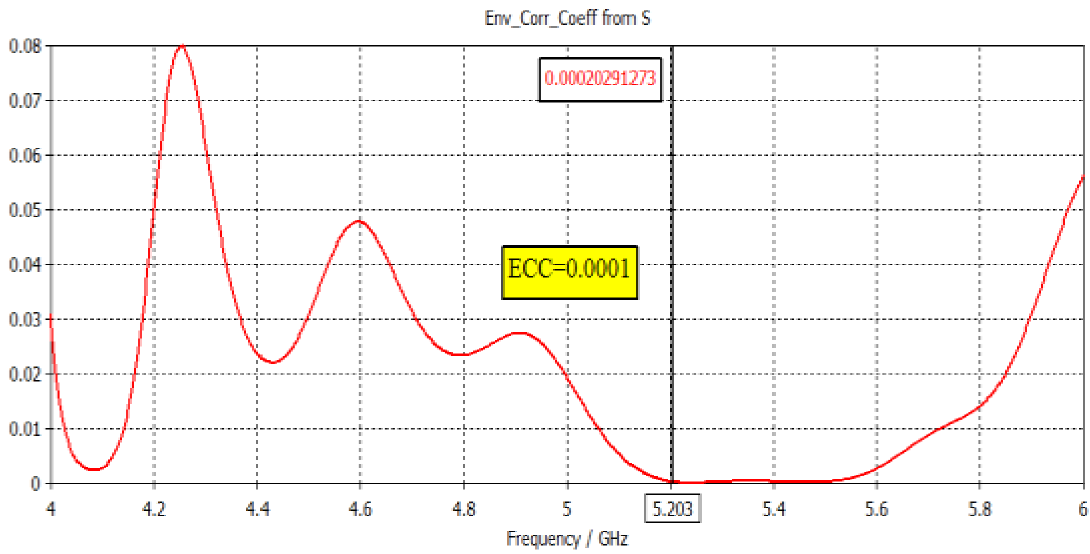

Figure 3.16: ECC at 5.2 GHZ slotted ground

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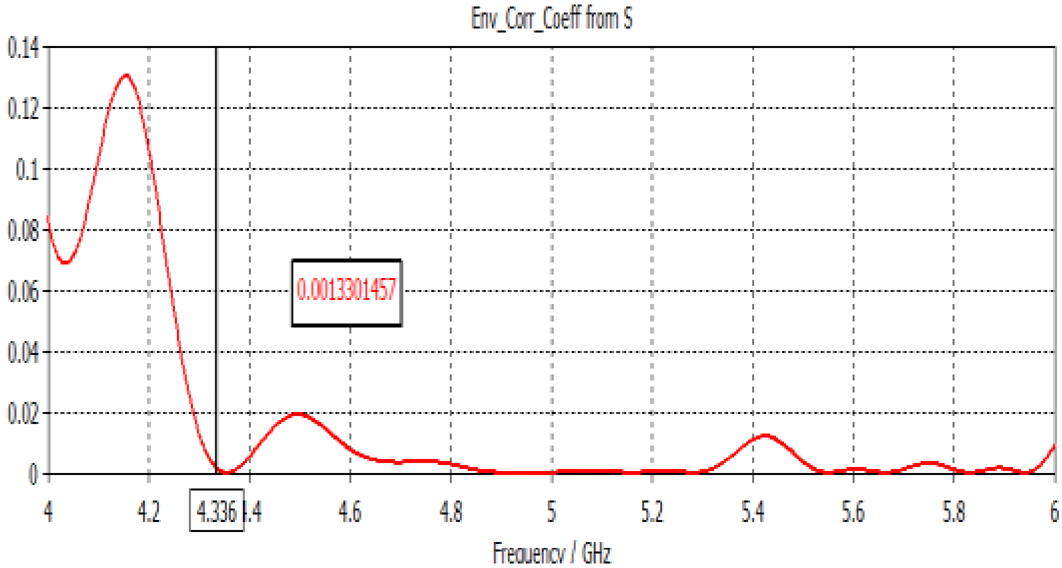

Figure 3.17: ECC at 4.3 GHZ full ground

IV. CONCLUSION

Conclusion

The two element slotted patch antenna designed and simulated for full ground and slotted ground. The presented result shows that at full ground the resonant frequency is 4.3 GHz and isolation and return loss is poor as compare to slotted ground which has return loss and isolation is more that -20 dB. At the same time the value of obtained gain is good of full ground antenna as compare to slotted ground. The surface current also compared for both cases. The ECC is also found good in slotted ground antenna as compare to full ground.

Suggestion for future work:

It can be extend to four, eight or more antenna with proper dimension and assumption. One can also calucate the bandwith effect using different dielectric material or Meta material.

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