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Multiband Monopole Antenna Using Defected Ground Structure with Cross Shaped Feed

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Abstract — *A novel compact multiple frequency operation cross shaped microstrip-fed monopole antenna is proposed. Defected ground structure is used in this proposed antenna to achieve additional resonance mode and to enhance bandwidth. The proposed cross-shaped microstrip fed monopole antenna consist of rectangular patch with dual inverted L-shape strips with fed by cross-shaped microstrip line. The proposed antenna operate over the three different frequency ranges, 2.48-2.76 GHz,3.66-3.90 GHz, and 5.86-6.42 GHz which is suitable for WLAN and WiMAX application with has a small overall size of 26x30 mm^2.The simulation result shows that the antenna gives the bi-directional radiation pattern. In addition, effect of variation in width and length of cross shaped is also discussed.*

Keywords- Monopole Antenna, Defected ground structure, return loss, multiband, microstrip line feed.

I. INTRODUCTION

Now a days the demand is for design of antenna with multiband operation has increased since such antenna is essential for integrating more than one communication standards in a single compact system. For this demand, the planar monopole antenna has become a candidate because of its attractive characteristics, such as low profile, simple structure, compact size, and easy integration with circuit. Also, the planar monopole antenna is capable of integrating both wireless local area network (WLAN) and worldwide interoperability for microwave access (WiMAX) into one single system [1-5]. Monopole antenna is implanted using defected ground structure which is help to improve bandwidth, In DGS ground is not total solid ground plane it's having different shapes and slots such as triangular, U slot, I slot, E slot etc. Defected ground structure has recently investigated and found to be a simple and effective method to reduce the antenna size as well as excite additional resonance mode [6-9].

In this paper, a novel compact multiband cross-shaped microstrip-fed monopole antenna with defected ground structure is proposed. The antenna consists of a radiating element with a pair of inverted L-shaped protruding strips with fed by cross-shaped microstrip fed line, and the ground modified by loading it with a I-shaped strip. By properly selecting the dimensions of the proposed antenna, it can provide three resonance mode at 2.6 GHz, 3.7 GHz and 6.1 GHz for the operating frequency band 2.48-2.76 GHz, 3.66-3.90 GHz and 5.86-6.42 respectively. The antenna is simulated using HFSS software. The simulated results give bidirectional radiation pattern with satisfactory performance.

II. ANTENNA DESIGN

The proposed compact multiband cross-shaped microstrip-fed monopole antenna with DGS is shown in Figure1. It is designed on a 1.6mm thick FR-4 substrate with relative permittivity of 4.4, and the overall dimensions are only 26x30 mm^2. The radiating patch of the antenna, which is printed on the top of the substrate, consists of a rectangular patch with dual inverted L-shaped strips fed by cross shaped feed line. In regard to the defected ground plane, it consists of I shape with dimension of 26 x 30mm^2. For design of rectangular microstrip patch antenna there is need of three parameter such as Resonant frequency, Dielectric constant and Height of substrate.

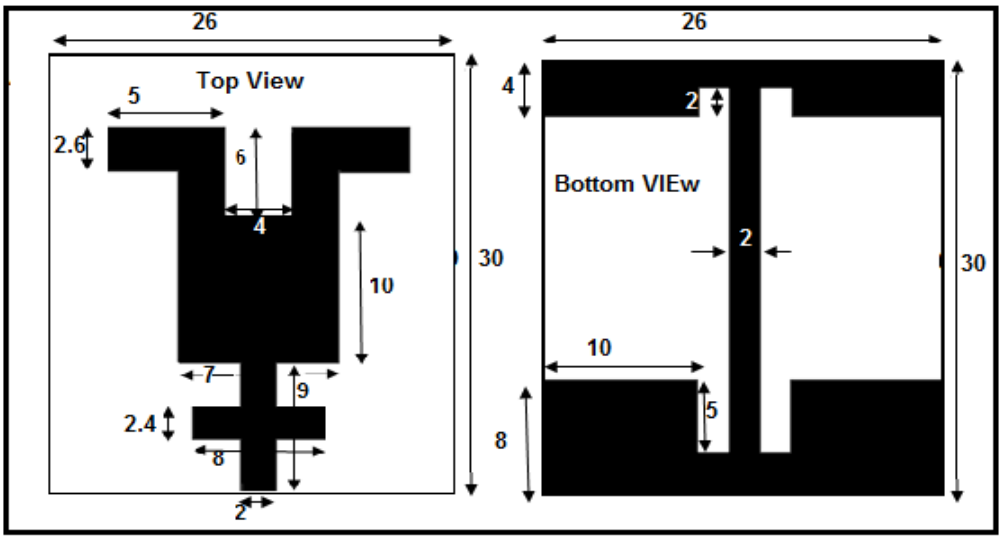

Figure1- Geometry of proposed antenna

III. SIMULATION RESULT AND DISCUSSION

3.1. Return Loss

The simulated return loss for proposed antenna is shown in figure2. The result shows that proposed antenna operate at three resonant band at frequency of 2.6, 3.7 and 6.1 GHz with return loss -10.52,-19.65 and -23.41dB respectively and its having bandwidth 280, 240 and 560 MHz respectively.

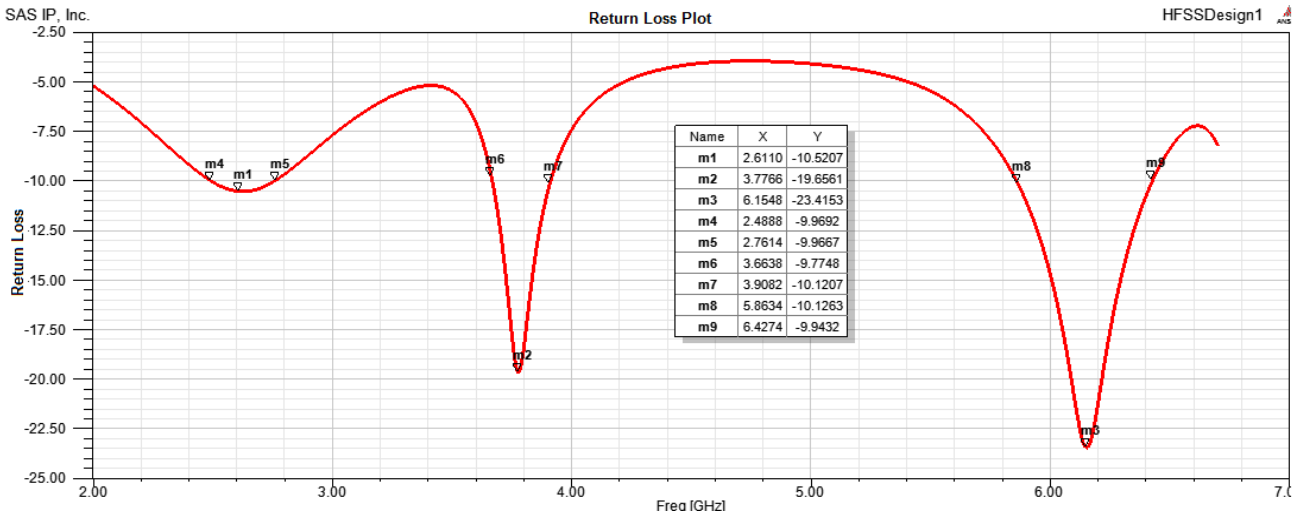

Figure2. Return Loss of Proposed Antenna

3.2. Effect of variation in width and length of cross shaped

By changing the width of cross shaped resonant frequency of first band is shifted towards the left at 2.5 GHz and last resonant band shifted towards the right at 6.3GHz and second resonant mode at 3.7 GHz with return loss -10.54,-30.4 and -41.31 dB respectively. By changing the length of cross shaped resonant frequencies are 2.5,3.7 and 6.3 GHz with return loss -11.43,-38.89 and -41.81 dB respectively.

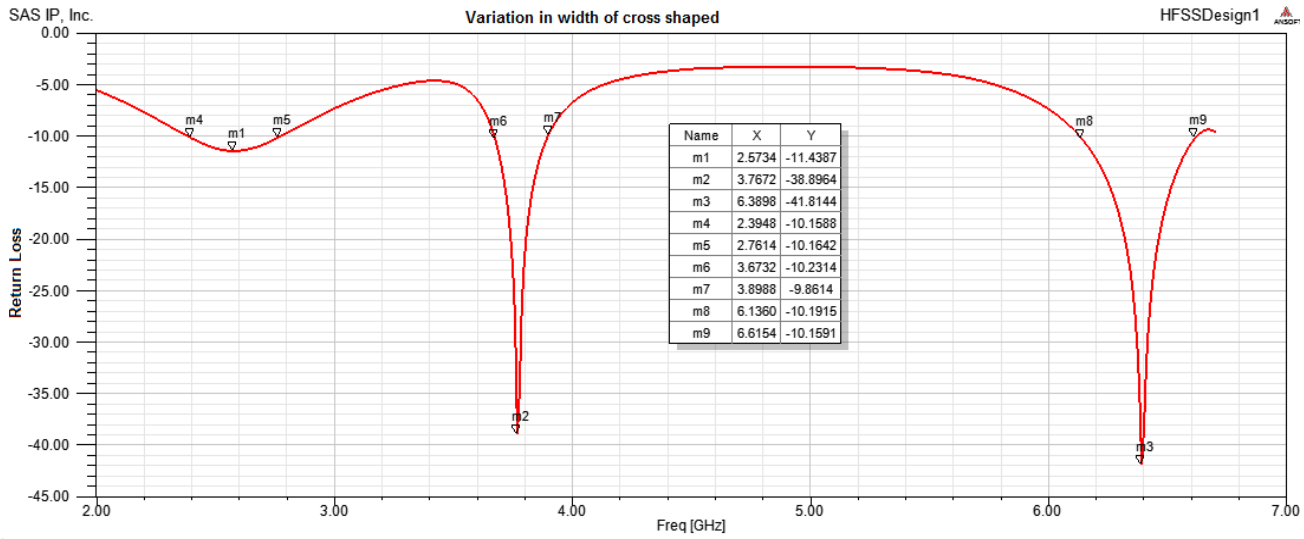

Figure3. Return loss by Variation in width of cross shaped

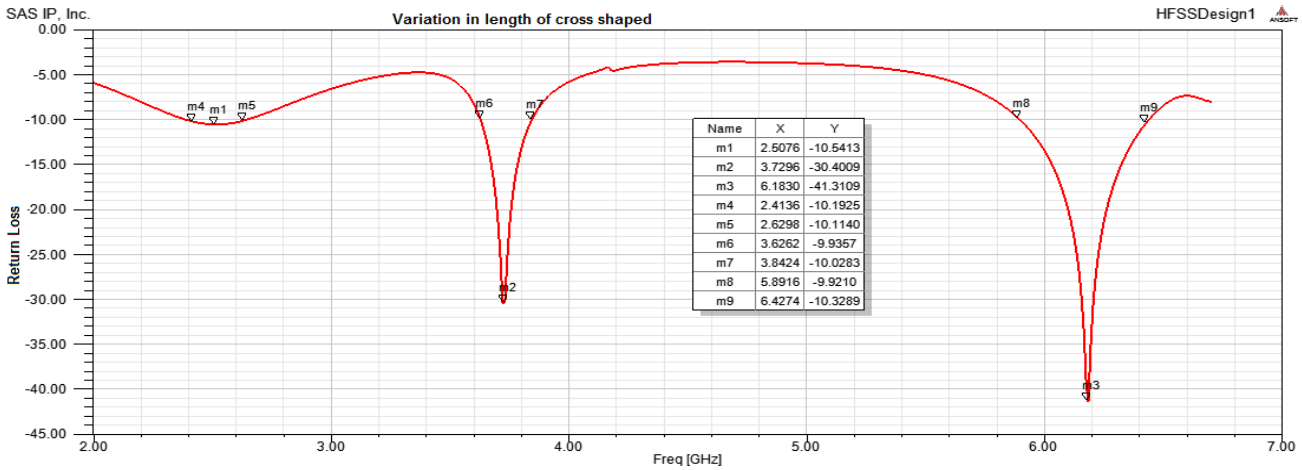

Figure4. Return loss by varying the length of cross shaped

3.3. VSWR

Figure 5 shows the VSWR plot of proposed monopole antenna with defected ground structure (DGS). For proposed antenna , the simulated value of VSWR at three resonant frequencies are 1.84, 1.23 and 1.14 respectively.

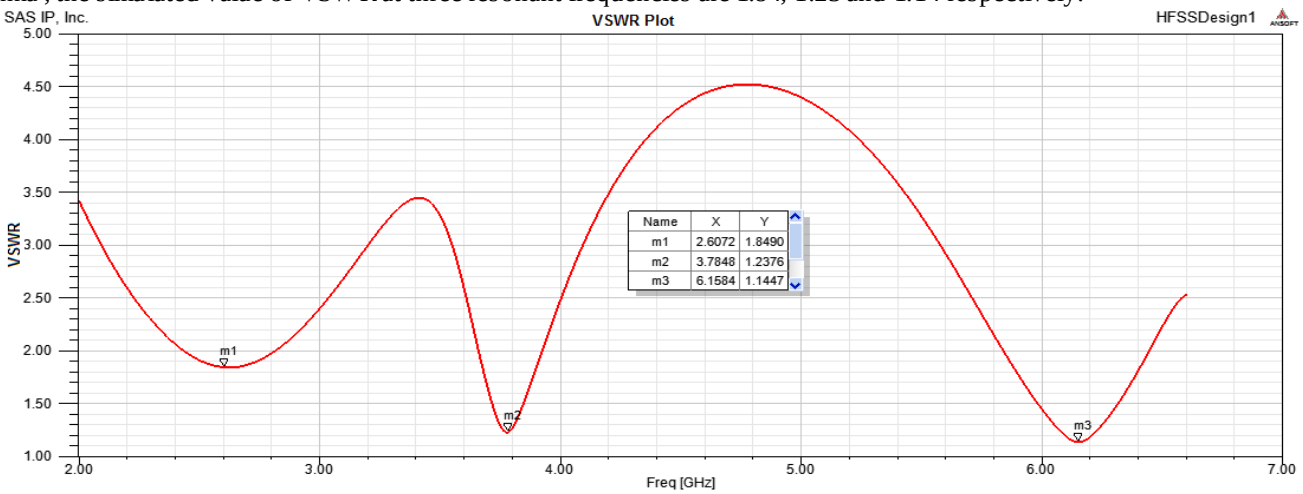

Figure5.VSWR Plot

3.4. Radiation Pattern

Figure 6 shows the radiation pattern of proposed monopole antenna. It shows that the antenna radiates in bi-direction manner.

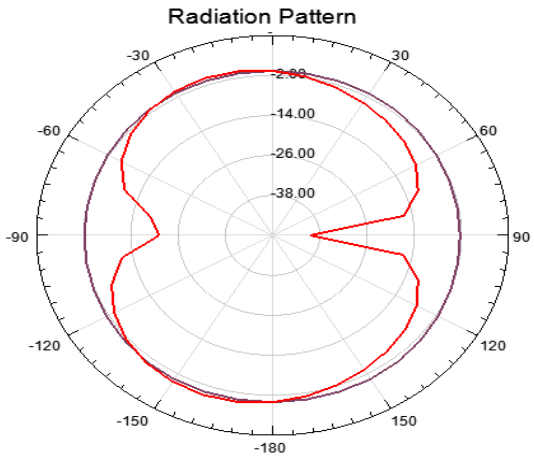

Figure6. Radiation Pattern

3.5. Smith Chart

Figure 7 shows the smith chart of proposed monopole antenna with defected ground structure (DGS).

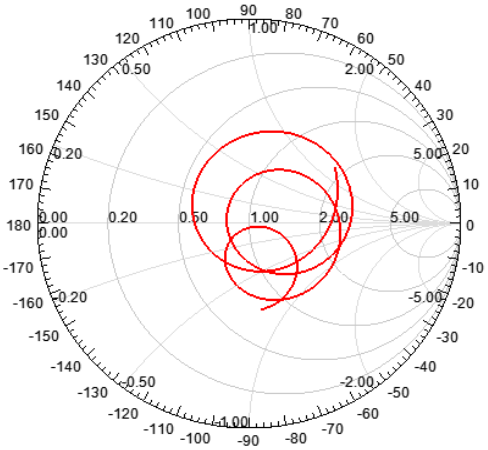

Figure7. Smith Chart

3.6. Current Distribution

Figure 8 shows the current distribution of proposed monopole antenna with defected ground structure (DGS). Red color shows that the current is maximum at particular position. It shows that the current is maximum at edges of rectangular patch and at edges.

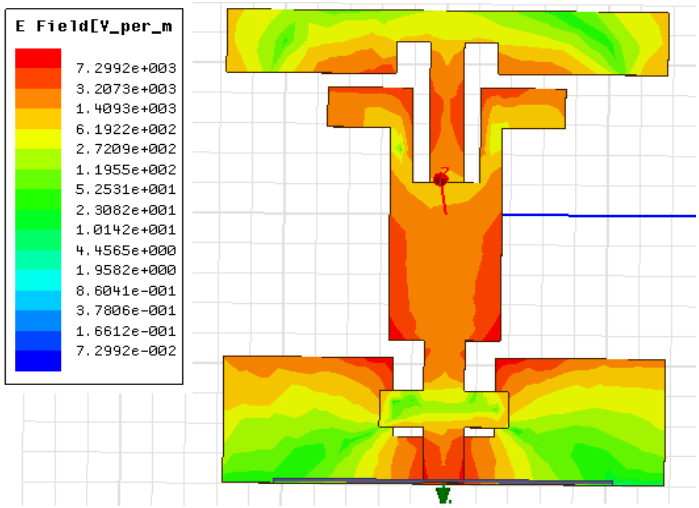

Figure8. Current Distribution

3.7. Directivity

Figure 9 shows the directivity of proposed monopole antenna with defected ground structure (DGS). It shows that antenna radiates in particular two direction.

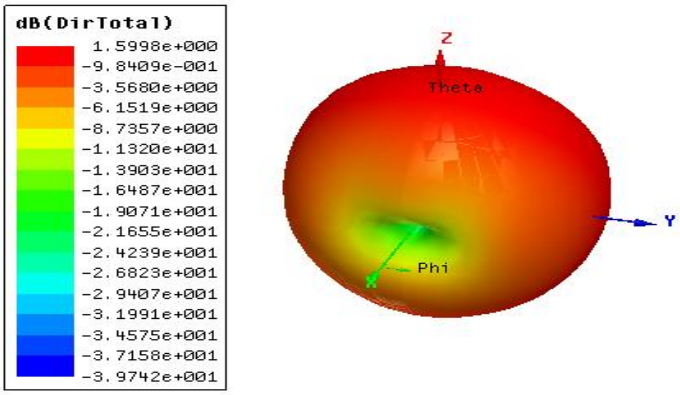

Figure 9. Directivity Plot

IV. MEASURED RESULT

4.1. Return loss and VSWR Plot

Following figure shows that the measured return loss and VSWR plot of proposed antenna. The Figure 10 shows that return loss of the proposed antenna , It shows that the proposed antenna resonant at three different resonant frequency at 2.71, 3.78 and 6.08 GHz respectively with return loss -13.45 dB, -21.5 dB, 6.0 dB respectively from this plot we will get bandwidth at last resonant mode is 720 MHz.

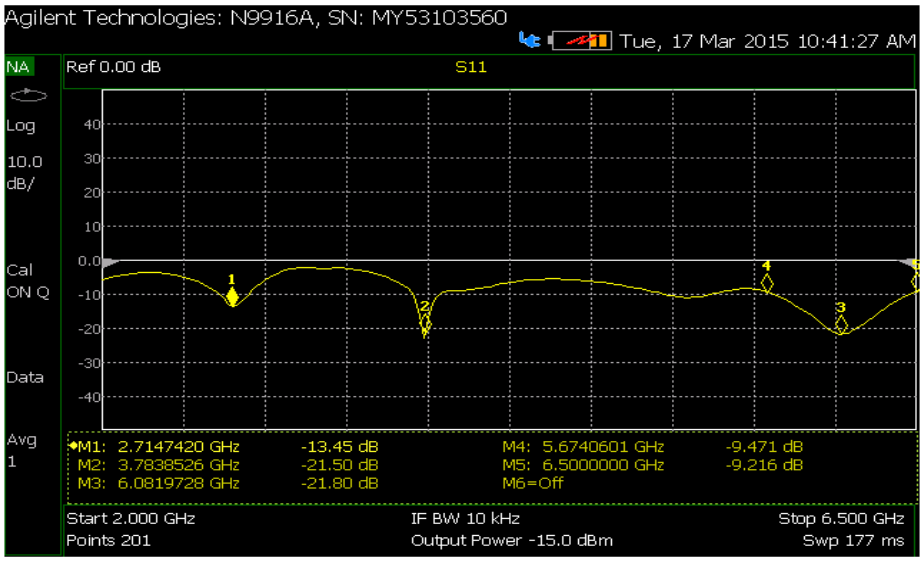

Figure10. Measured Return loss of the proposed antenna

Figure 11shows that the measured VSWR plot of proposed antenna and it shows that the value of VSWR is less than 2.The value of VSWR at resonant frequency are 1.51,1.16 and 1.12 respectively and bandwidth at first resonant frequency is 230MHz.

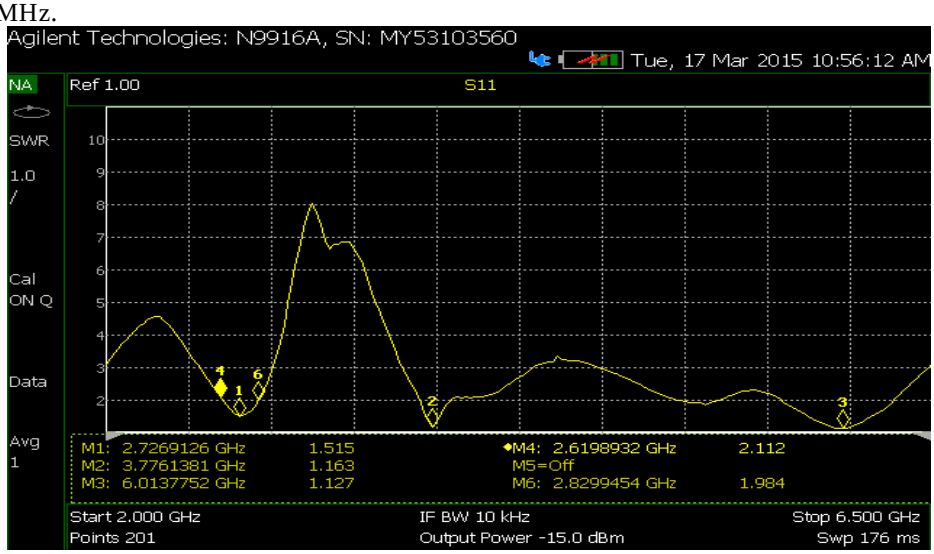

Figure11. Measured VSWR of the proposed antenna

Figure 12 shows that the VSWR of the proposed antenna from this plot we will get the bandwidth at second resonant mode is 180 MHz.

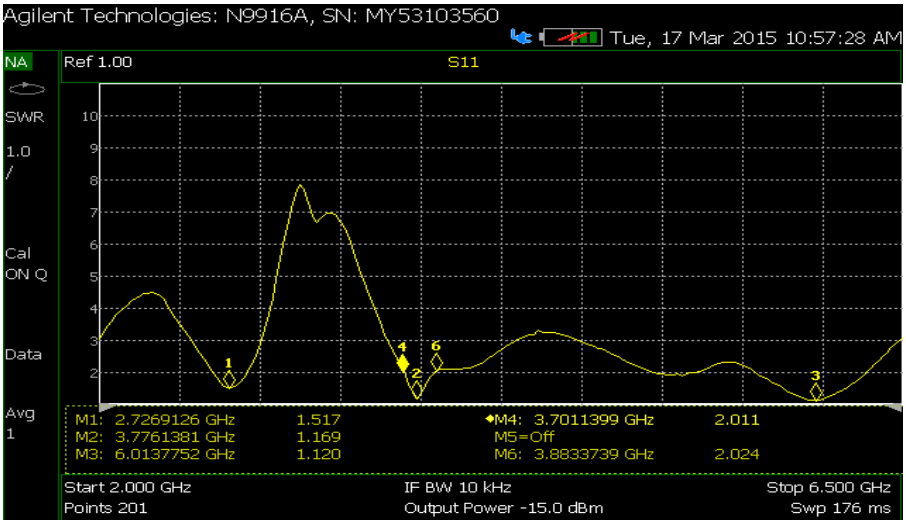

Figure12. Measured VSWR of the proposed antenna

V. CONCLUSION

A Compact Multiband Cross-Shaped Microstrip- Fed Monopole Antenna Using Defected Ground Structure for WLAN and WiMAX application has been design. The simulation is carried out with the help of HFSS software. From the simulation result it shows that proposed monopole antenna operates over the three different frequency rages 2.48 to 2.76 , 3.66 to 3.90, 5.86 to 6.42 GHz with return loss -10.52, -19.65 and -23.41 dB respectively. The VSWR are 1.84, 1.23,1.14 at resonant frequency 2.6, 3.7,6.1 GHz respectively. There is good agreement between simulated and measured result.

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