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Multislot Microstrip Antenna Design in Ultra Wide Band Region Using HFSS Software

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Abstract-*The aim of this project is to design a microstrip fed multislot antenna for Ultra Wide Band (3.1 GHz to 10.6 GHz) applications. The proposed antenna consists of H-Slot on the patch and U-Slot on the feed. The rectangular patch etched on FR-4 epoxy substrate results in reduced antenna size and it has one round cut at each corner. Microstrip feed line technique is used to feed the antenna with 50Ω impedance which provides good impedance matching. High Frequency Structure Simulator (HFSS) is used to design and stimulate the antenna behavior over the different frequency ranges. The designed antenna shows a return loss of -32db besides radiation pattern and gain of antenna are also studied.*

Key Words: Patch antenna, Multislot antenna, Babinet's principle, Ultra Wide band, HFSS.

1. INTRODUCTION

The concept of microstrip antennas was first proposed in 1953, twenty years before the practical antennas were proposed. These antennas are widely used because they can be directly printed on circuit boards and are operated at microwave frequencies (300 MHz to 300GHz). Some of the main advantages of microstrip antennas are that it has low fabrication cost, light weight, low volume and low profile configurations that it can be easily be mounted on rockets, missiles and satellites. Arrays of these antennas can increase the gain of the antenna.

However, they have some drawbacks including narrow bandwidth, low power handling capability and low gain. Applications of microstrip patch antennas are mobile satellite communications, the Direct Broadcast Satellite (DBS) System and Global Positioning System (GPS). Microstrip slot antennas are operated at Frequency range of 300MHz to 25GHz.They are used as navigation radar usually as an array fed by a waveguide. Slot antennas work under Babinet's principle. They are also called as complimentary dipole antenna and dual-frequency microstrip antennas is alternate method for bandwidth enhancement. The different parameters of microstrip patch antenna which are effected by cutting slots is gain, return loss, axial ratio and size of antenna. The proposed antenna has been used in Ultra Wide Band (UWB) applications because of its low power, good noise immunity, and high immunity to multipath fading and very high data rate. To increase bandwidth of patch antennas, such as the use of thick substrate, cutting a resonant slot inside patch, use of various impedance matching and feeding techniques.

However, bandwidth and size of an antenna are generally inversely proportional to each other that is improvement of one of the characteristics normally results in degradation of the other.

2. ANTENNA DESIGN AND DESCRIPTION:

The proposed antenna consists of a rectangular patch built on FR4 epoxy substrate with €r=4.4 and thickness of 1.5. The thick dielectric substrate with more dielectric constant is required. Though it results in lesser efficiency and narrower bandwidth, it reduces the antenna size. Hence a trade-off must be realized between antenna dimensions and antenna performance.

TABLE-1:

Length of the Substrate	35(in mm)
Width of the Substrate	30(in mm)
Height of the Substrate	1.5
Length of the Patch	14.5(in mm)
Width of the Patch	15(in mm)

To improve the antenna bandwidth and matching, round steps are added to lower and upper corners of patch besides adding in ground slot. Patch antennas undergo radiation perpendicularly into the atmosphere and fringing fields present between patch and ground plane is also responsible for radiation. Capacitive coupling and inductive coupling are introduced by Cutting slots at bottom and upper corners.

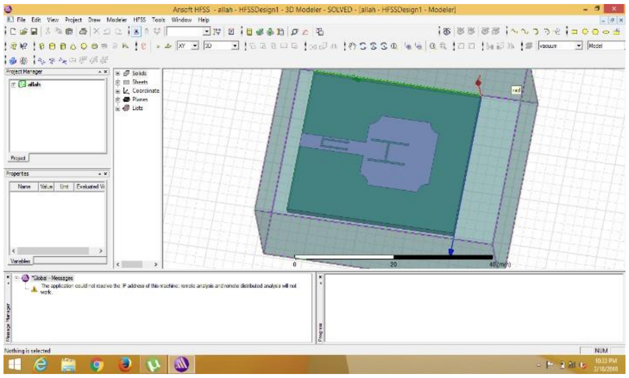

Fig-1: Proposed antenna structure

3. Simulation and results:

The simulation graphs are obtained for return loss, radiation pattern and 3d-Polar plot. The reflection coefficient (or) s11 parameter graph shows how much power is reflected from the antenna and it is obtained in negative values.

It shows that maximum power is radiated from the antenna.

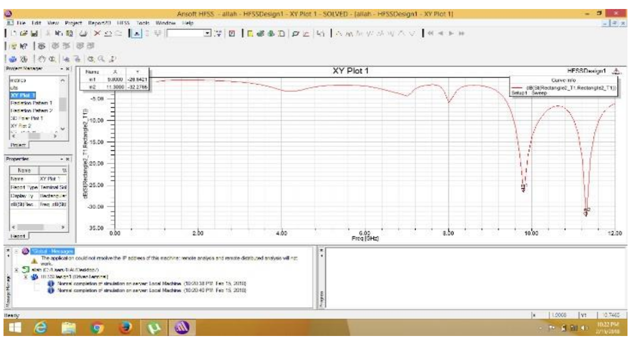

Fig-2: Return loss plot

The simulation results are operated at the multiple frequencies 4.3, 5.23 and 9.28 which are in the range of ultra-wide band.

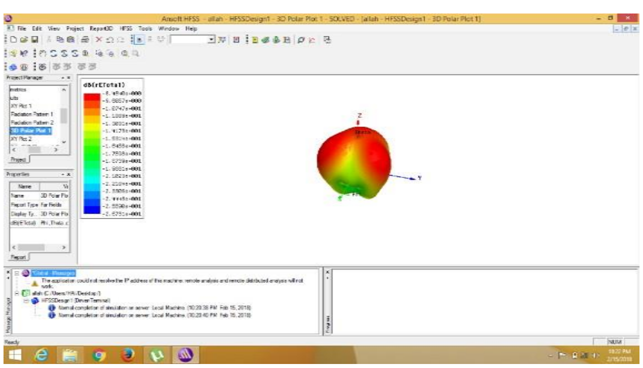

Fig-3: Polarpot

The radiation pattern with peak directivity 6.8824 is shown where side lobes, back lobes are mostly eliminated and main lobe is observed. The 3D polar plot is also shown in figure 3.

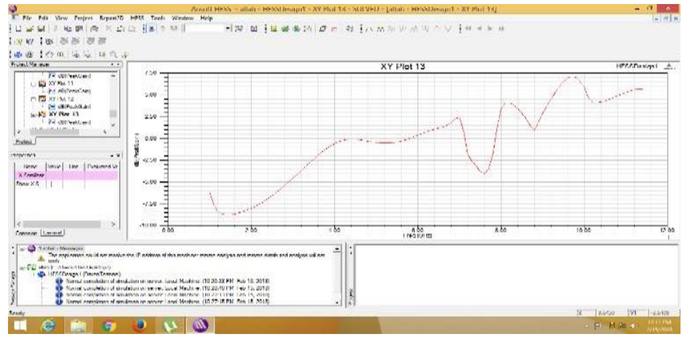

Fig.4: Peak Gain

4. Conclusion:

In this paper, a multislot rectangular patch antenna was presented with a compact size of 35 mm X 30mm. The final antenna was operated at three different frequencies which are in the range of Ultra Wide band region.

Due to the use of FR4 substrate and cutting different slots in patch and feed regions, bandwidth is increased with reduced antenna size. Finally we can say that proposed antenna is valid for Ultra Wide Band applications.

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