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DEVELOPMENT OF DUAL-BAND MICROSTRIP PATCH ANTENNA FOR WLAN/MIMO/WIMAX/AMSAT/WAVE APPLICATIONS

INTRODUCTION

- The design of a Microstrip patch antenna (MPA) is one of the most exciting developments in electromagnetic history because of its salient features which are not commonly exhibited in other antenna configurations. With rapid development of microstrip antenna it has been found that, study of microstrip antenna with symmetrical feed line technique are good candidates for multi-bands applications.
- To enhance bandwidth further various shapes like L-shape, U-shape etc., slots were introduced
- The features of Microstrip patch antenna includes ease of fabrication, good radiation control, low cost of production, low profile, lightweight, simple, and inexpensive to fabricate using modern day printed circuit board technology, compatible with microwave and Electric field lines millimeter-wave integrated circuits, and ability to conform to planar and non planar surfaces.
- Both the inverted L-shaped patches and -shaped ground plane play a very vital role to reject the interferences in desired frequency bands.
- defected structure embedded in the ground plane which makes it suitable to be used in various wireless communication systems, namely, WLAN/world-wide interoperability for microwave access (WiMAX)/Amateur Satellite (AMSAT)/wireless access in the vehicular environment (WAVE).
- The proposed antenna design has been studied thoroughly and fabricated, and the details of simulated and measured results are presented and discussed.

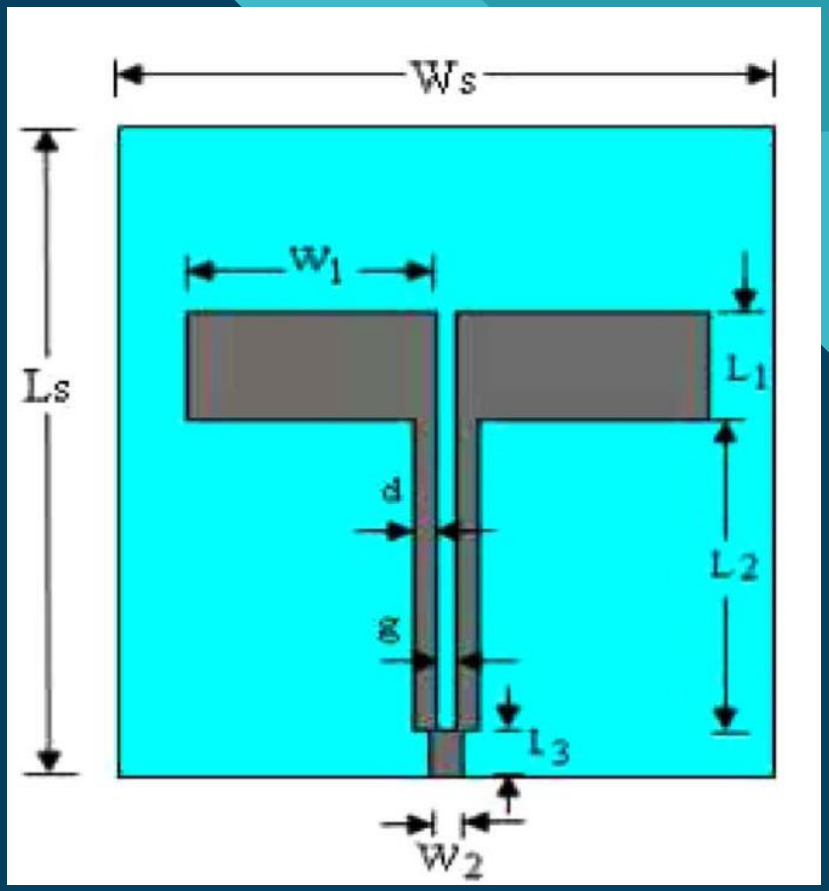
ABSTRACT

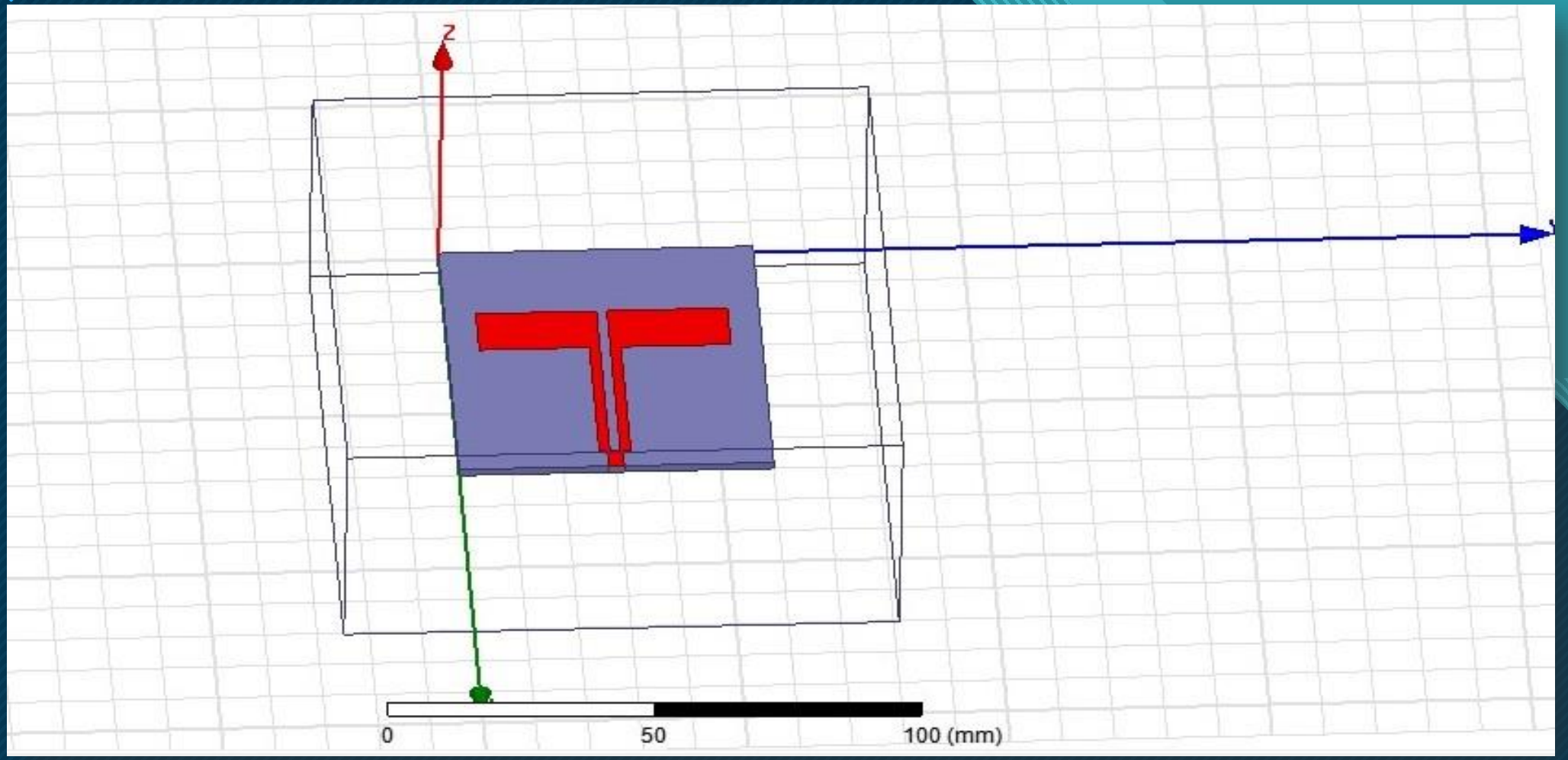
- The present work represents a dual-band microstrip-fed patch antenna in which the radiating structure is formed with a pair of inverted L-shaped patches and ground plane is being modified to a shape. Both the radiating patch and modified ground plane are perfect electric conductors. The patch is printed on a readily available Epoxy Glass (FR-4) substrate with thickness 1.6 mm, relative permittivity 4.4, and loss tangent 0.0024.
- The proposed microstrip patch antenna (MPA) design is capable of generating two distinct operating bands with 10-dB return loss as follows 3.34–3.54 GHz and 4.90–6.26 GHz with adequate bandwidth of 200 MHz and 1.36 GHz, respectively. The proposed microstrip patch antenna (MPA) design is capable of generating two distinct operating bands with 10-dB return loss as follows 3.34–3.54 GHz and 4.90–6.26 GHz with adequate bandwidth of 200 MHz and 1.36 GHz, respectively.
- Proposed MPA was simulated using HFSS high-frequency structure simulator.
- The impedance bandwidths are wide enough to cover the required bandwidths of 3.3– 3.5 GHz, 5.15–5.35 GHz, 5.725–5.825 GHz for wireless local area network, 3.3–3.5 GHz for multiple input multiple output, 5.25–5.85 GHz for world-wide interoperability for microwave access, 5.650–5.670 GHz for uplinks and 5.830–5.850 GHz for downlinks of Amateur Satellite, and 5.9 GHz wireless access in the vehicular environment

Literature Review

- Today wireless communication has become more of a dire necessity in various applications. In many scenarios where the wired systems are impractical or almost impossible to be implemented, wireless systems have readily replaced them. Many systems are actually required to actually transmit a message and receive it with minimal error in a wireless systems. Such blocks like transmitter, receiver, coders etc. are required to pass information both over short and long distances.
- Now-a-days with the advent of Internet of Things (I.O.T) applications, wireless networking has increased manifold both in terms of number and complexity. Take the example of the unlicensed spectrum of 2.4 GHz for interconnecting Wi-Fi devices such as connecting laptops or mobile devices for people in transit. This spectrum in small range is used for communicating multiple devices in various networks thereby generating requirement of various kinds of specialised antenna for the suitable purpose.
- One more use for wireless systems is one that connect the mobile network to connect to the satellites. Take the example of GPS systems where devices need to be within the range of three or more satellites. The location is transmitted from the satellites in range via the communicating channels. So practically the antenna needs to be designed in such a manner that the signals can be detected in any orientation. So a circularly polarised antenna is the requirement for such an application which overcomes the orientation problem
- With embedded systems in use at large, antennas have to be integrated into small, portable systems. Small antenna at a particular resonant frequency can be made feasible with various design techniques in the microstrip patch antenna. Recently with the use of metamaterials and dielectric resonators, the antenna size have been drastically reduced to very small sizes for actual practical applications.

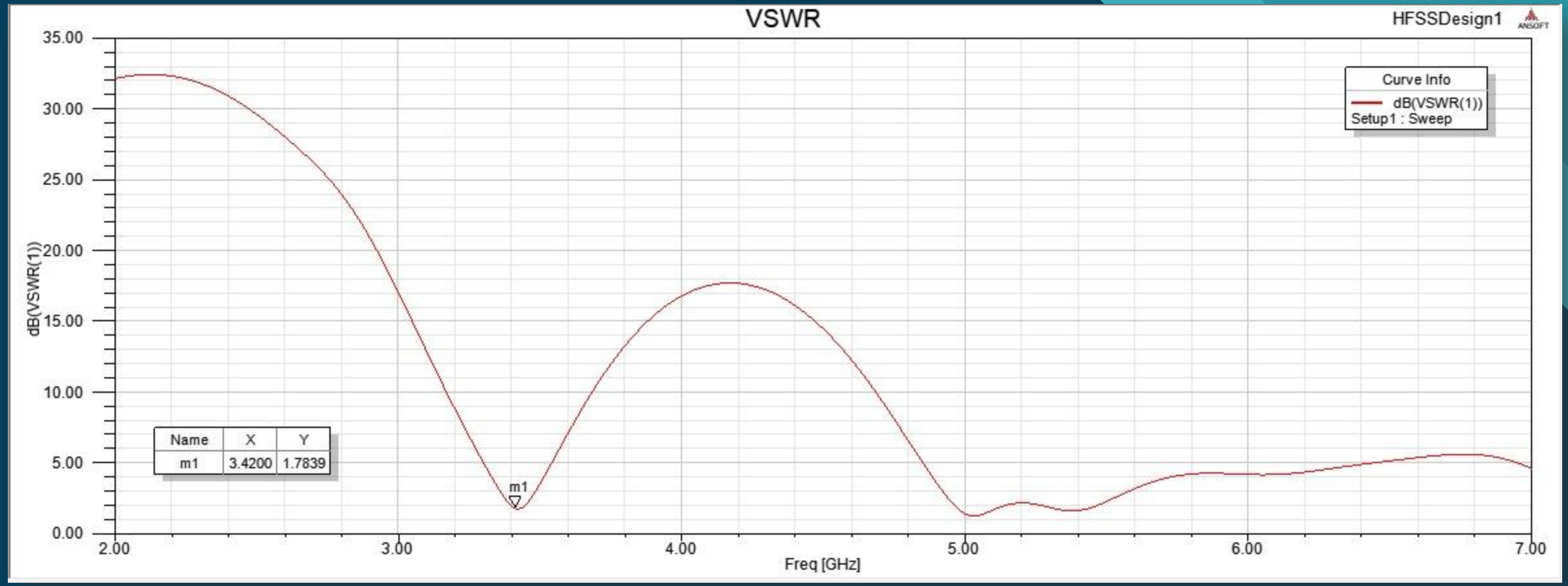
Inverted L-shaped Design



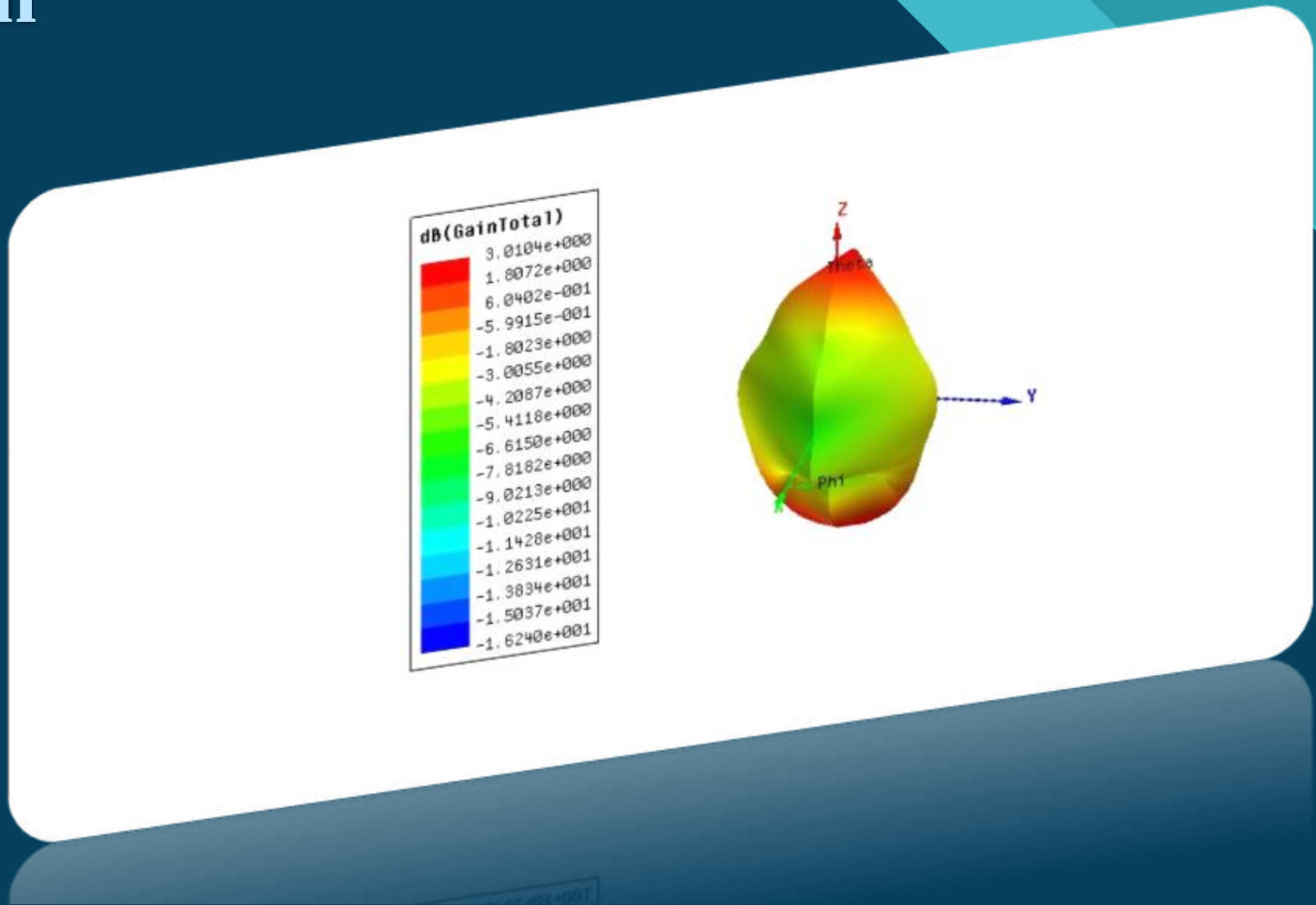


ANTENNA DESIGN OF SOFTWARE

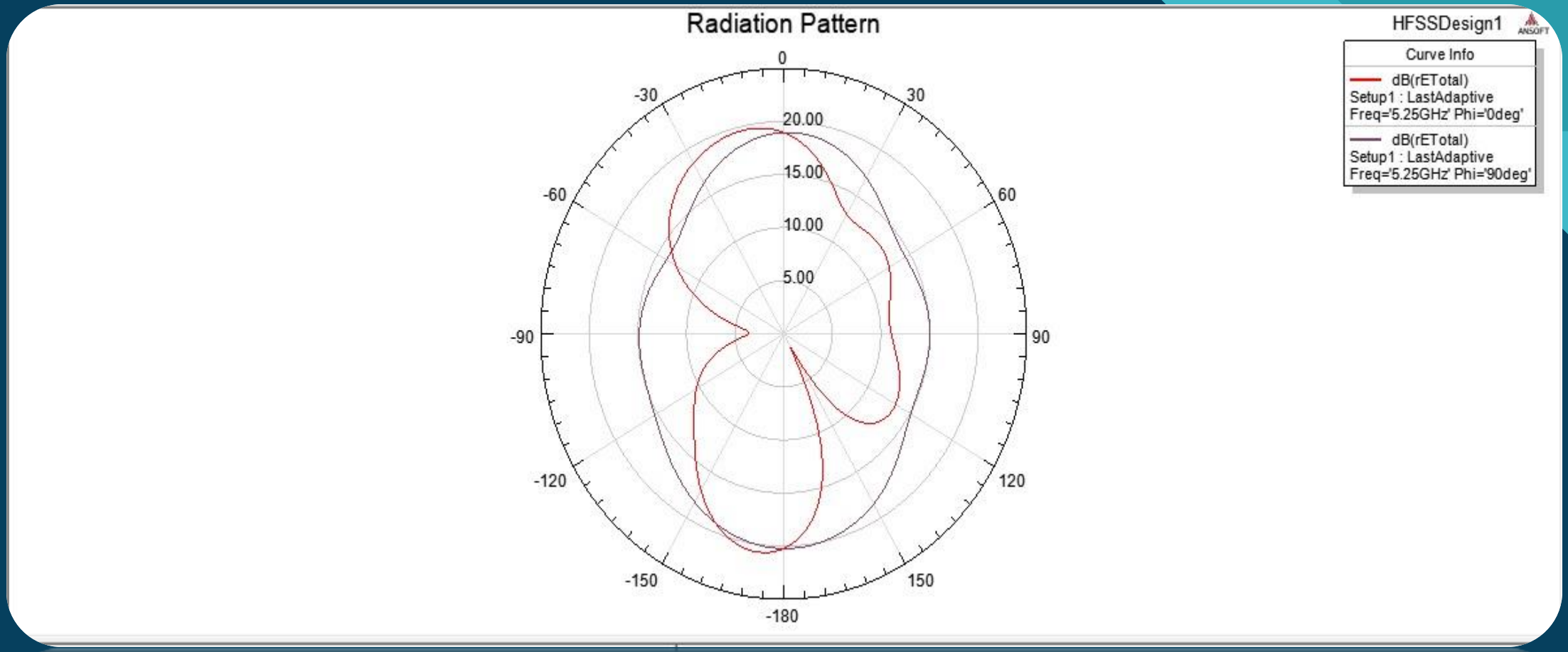
VSWR (Voltage Standing Wave Ratio)



3D Radiation graph



2D Radiation Pattern



Simulated return loss curve of proposed Antenna

RESULT ANALYSIS

- After the simulation all the parameters were analyzed to check for the desired output of the antenna design. As we can see in figure 6, the S11 curve has been plotted. As we can see the curve just crosses below -10 db at the resonant frequency marked on the plot.
- The E-plane and H-plane has also been shown. The E-plane is bi-lobed in nature keeping axial angle constant and varying the equatorial angle whereas the H-Plane is circular for a constant equatorial angle and varying axial angle. We can also visualize the 3-D radiation pattern where the areas in red represent directions having higher antenna gain as compared to area having green color. The areas having blue color have no directivity in the direction indicated.

APPLICATION

Some communication-based applications of microstrip patch antenna are :

- radio altimeters, command and control systems, remote sensing
- environmental instrumentation, feed elements in complex antenna
- satellite navigation receivers, mobile radio, integrated antenna
- biomedical radiators and intruder alarms
- Doppler and other radars, and satellite communication and direct broadcast services.

CONCLUSION

- ✓ In this article, a compact, high-gain and dual-band MPA formed with a pair of inverted L-shaped patches and -shaped ground plane is presented that is suitable for WLAN/MIMO/WiMAX/ AMSAT/WAVE and other long-distance communication applications.
- ✓ The frequency bands with return loss below 210 dB cover 3.34–3.54 and 4.90–6.26 GHz with maximum gain values of 6.1 and 8.0 dB in the lower and higher frequency bands, respectively, thus making the proposed antenna appropriate for high-gain applications.
- ✓ the performance of the antenna meets the desired requirements in terms of return loss, high gain, and VSWR at the two operating frequencies. From this article, it can be concluded that the performance of the microstrip antenna depends heavily on the dimensions of the inverted L-shaped patches and DGS been used. The type, thickness, and dielectric constant of substrate also contribute in the antenna performance.
- ✓ The proposed antenna production costs are reduced because of using a FR-4 substrate. It is seen that the proposed antenna having simple structure achieved very good performance and can be constructed with a lower cost.

Thank You