Design and Simulation of a K-band Patch antenna by using HFSS

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Abstract- **This paper present a simple patch antenna for 18 to 26 GHz K-band wireless application. The simple coplanar waveguide (CPW) is inserted to improve return loss and voltage standing wave ratio (VSWR). The center frequency of this antenna is 18.5 GHz and numerical analysis for these patch antenna dimensional parameters using Ansoft HFSS v13 is performed and presented. The proposed antenna has a small size of 12 × 10mm, and provides low VSWR level and good radiation pattern characteristics to satisfy the requirements of the current and future wireless communications systems.**

Index Terms- **Coplanar waveguide, return loss, communication system, Micro strip patch antenna.**

INTRODUCTION

Antenna is s one of the transducer that convert Radio-Frequency (RF) into the alternating current (AC) or vice-versa. Antennas play an important role in the field of wireless communications.

Some of them are simple Patch, parabolic, horn, slot, folded dipole antennas. Each antenna has their own properties and usage. In that paper we proposed patch antenna which is also called as a rectangular microstrip antenna. It is a type of radio antenna. it can be mounted on a flat surface. This antenna consists of a flat rectangular sheet or patch of metal, mounted on a larger sheet of metal called a ground plane.

ANTENNA DIMENSION

The dimension and parameters of the proposed K-band patch antenna are shown in Fig. 1.
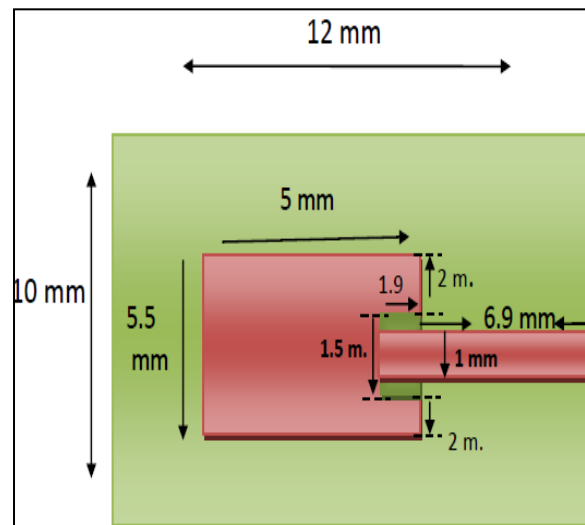

Fig. (1) Antenna Dimensions

The antenna is printed on an FR4 Epoxy substrate with a relative dielectric constant (εr) of 4.4, dielectric constant mince store electrical energy in an electric field.

A tangential loss (tan σ) of 0.02, tangential loss mince ratio of the lossy reaction to the electric field E in the curl equation to the lossless reaction. A thickness of substrate (h) 1.6mm, a width of substrate (Ws) 10mm and a length of substrate (Ls) 12 mm. The basic antenna structure Consists of a rectangular patch with a narrow slit.

SIMULATION

In that paper this antenna is simulate and obtain result on High frequency Simulation Software (HFSS) Version-13. The Fig.2 shows the simulation steps of HFSS and it create 3-D object.
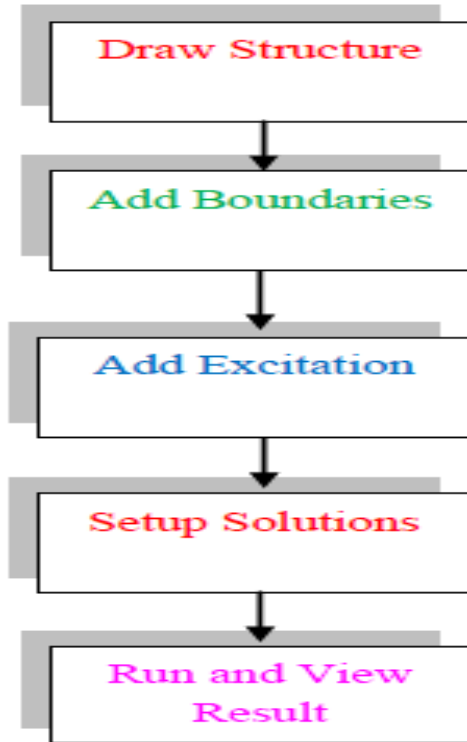
Fig. (2) Simulation flow.

Draw Structure: In that structure first take a one substrate and also assign material to that substrate (FR4 Epoxy) and then draw a sheep of antenna by using rectangular, circular or triangle sheep. In a base of antenna draw a one box named as ground. At the end of antenna draw a two cylinder name as clad and core. Assign material to clad that is air material and core that is Perfect conductor material. Finally draw a one air box and insert antenna.

Assign Boundaries: Antenna simulation in HFSS Perfect E Boundaries represents a perfectly conducting surface. In that antenna the conducting surface is as shown in fig (a). Assign Perfect Radiation to air box because of it Represents an open boundaries by means of an absorbing boundaries condition (ABC) that absorbs outgoing waves.

Add Excitation: Excitations in HFSS is used to specify the sources of electromagnetic fields, charges, currents, or voltages on objects or surfaces in the design. In that antenna assign a wave port as an excitation because it represents the surface through which a signal enters or exits the geometry.

Setup solution: It is Specify how HFSS will compute a solution by adding a solution setup to the design. We can define more than one solution setup per design. Each solution setup consist of general data about the antenna that is solution frequency (19GHz), maximum number of passes (20) and value of delta (0.02).

Run and View Result: After the completion of all designing part, check the designing antenna validity. If it is correct then go to analysis all. To use this command, either click HFSS>Analyze All or right-click on the Analysis icon in the Project tree and select Analyze All from the popup menu. The Analyze All command applies to all enabled setups, dependent setups, and sweeps at the level invoked in the Project tree.

RESULT

In this Research, presented microstrip patch antenna with various design parameters was constructed, and the numerical and experimental results of the input impedance and radiation characteristics are presented and discussed.The simulated results are obtained using the Ansoft simulation software high-frequency structure simulator (HFSS) [13]. The configuration of the presented antenna is shown in Fig. (1). Voltage standing wave ratio (VSWR) for the microstrip patch antenna shown in Fig. (3).
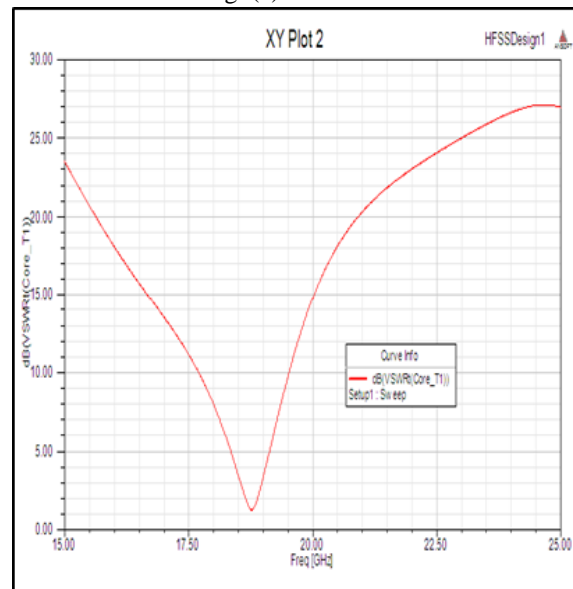

Fig. (3) VSWR of patch antenna.

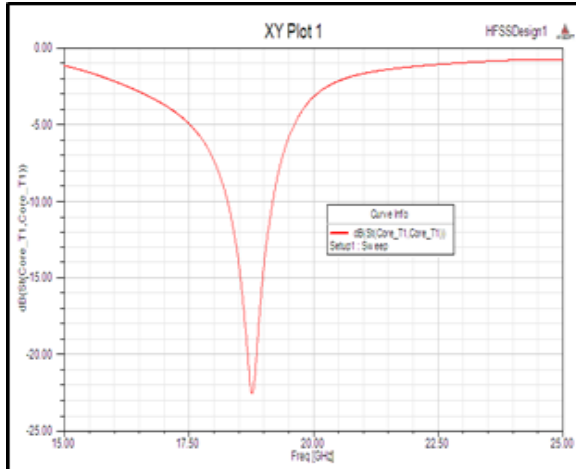S- Parameter for the microstrip patch antenna shown in Fig. (4).

Fig. (4) S-parameter of patch antenna.

The radiation pattern for the microstrip patch antenna shown in Fig. (5).
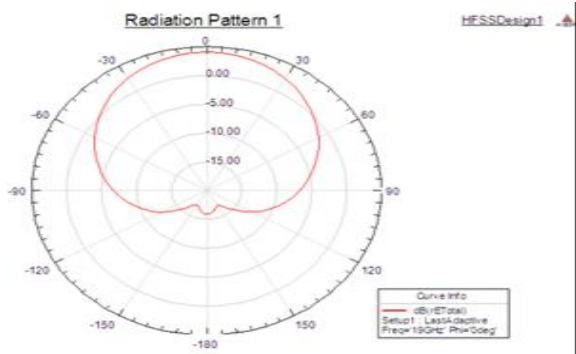

Fig. (5) Radiation pattern of Patch antenna.

CONCLUSION

In this paper, we presented the design of a Microstrip Patch antenna covering the 18GHz–26 GHz frequency spectrum. It has been shown that this design of the Microstrip patch antenna produces a bandwidth of approximately 3% with a stable radiation pattern within the frequency range. The design antenna exhibits good impedance aching of approximately 50 Ohms at the center frequency. This antenna can be easily fabricated on substrate material due to its small size and thickness. The simple feeding technique used for the design of this antenna make this antenna a good choice in many communication systems.

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