QUAD-BAND TRI-I-SLOTTED PATCH ANTENNA FOR MOBILE & WIRELESS COMMUNICATION

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Abstract : In this paper a quad band micro strip patch antenna have been design and analysis. Paper is simulated for mobile communication mainly. In this we have used multiple I slots to increase multiple resonant frequencies, by which we can enhance radiated power and total radiation from the patch. There are many feeding technique are available but we have used micro strip feed. Four resonant frequencies created and can we used for four different applications. By slotting impedance matching and radiation increment can be done. This antenna can be used for most of the L band applications. On these four resonant frequencies value of return loss should be less than -10dB, which is achieved. Frequencies on which it can work are 300MHz, 1500MHz, 2300MHz and 2700MHz. And their respective return losses are -58dB, -36dB, -40dB and -35dB. Thickness of the antenna is 1.6mm & value of VSWR of the antenna is found close to two, which is desired. Size of the patch is 40*50 which is compact & durable due to simple design.FR4 substrate is used due to availability. Antenna is simulated & analyzed by FEKO simulation software which works on the principle of method of moment.

IndexTerms - **Quad-band, antenna, Micro strip, Slot antenna, Rectangular patch.**

I. INTRODUCTION

Antennas are metallic structures designed for radiating and receiving electromagnetic energy. An antenna acts as a transitional structure between the guiding device (e.g. waveguide, transmission line) and the free space. In order to know how an antenna radiates, let us first consider how radiation occurs. A conducting wire radiates mainly because of time-varying current or an acceleration (or deceleration) of charge. If there is no motion of charges in a wire, no radiation takes place, since no flow of current occurs. Radiation will not occur even if charges are moving with uniform velocity along a straight wire. However, charges moving with uniform velocity along a curved or bent wire will produce radiation. If the charge is oscillating with time, then radiation occurs even along a straight wire as explained by Balanis.

Low dielectric constant substrates are generally preferred for maximum radiation. The conducting patch can take any shape but rectangular and circular configurations are the most commonly used configuration. Other configurations are complex to analyze and require heavy numerical computations. A microstrip antenna is characterized by its Length, Width, Input impedance, and Gain and radiation patterns. Various parameters of the microstrip antenna and its design considerations were discussed in the subsequent chapters. The length of the antenna is nearly half wavelength in the dielectric; it is a very critical parameter, which governs the resonant frequency of the antenna. There are no hard and fast rules to find the width of the patch
.

Antenna gain is a parameter which is closely related to the directivity of the antenna. We know that the directivity is how much an antenna concentrates energy in one direction in preference to radiation in other directions. Hence, if the antenna is 100% efficient, then the directivity would be equal to the antenna gain and the antenna would be an isotropic radiator. The purpose of the inset cut in the patch is to match the impedance of the feed line to the patch without the need for any additional matching element. This is achieved by properly controlling the inset position. Hence this is an easy feeding scheme, since it provides ease of fabrication and simplicity in modeling as well as impedance matching. However as the thickness of the dielectric substrate being used, increases, surface waves and spurious feed radiation also increases, which hampers the bandwidth of the antenna. The feed radiation also leads to undesired cross polarized radiation.

Antenna is an important structure in any wireless communication system and good antenna design definitely improves the overall performance of the system. Most applications require low cost, minimum weight, low profile antennas that are capable of providing high performance over a large range of frequency.

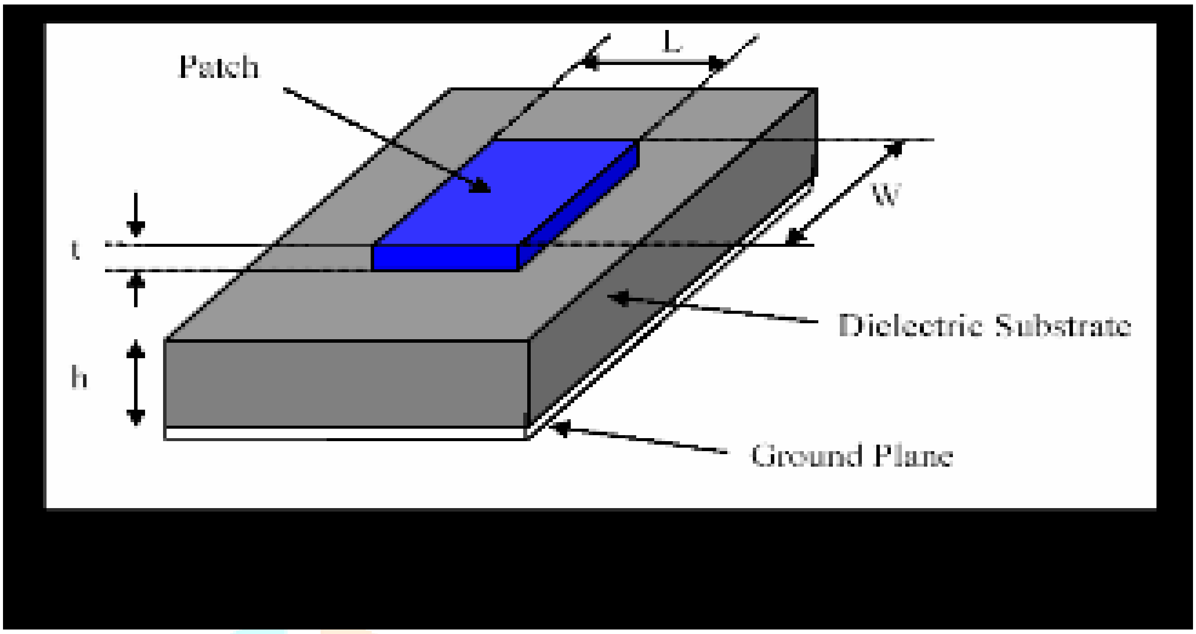

Fig. 1

As shown in Fig.1 three layers of patch radiating patch on the top, dielectric material in the middle and ground plane in the bottom.

II. ANTENNA DESIGN

Design of the antenna is represented in Fig. No. two. The design is simple and the feed used is micro strip line. The dimensions of antenna are $40 \times 50 \times 1.6\,mm^3$used for the simulation. There are three I slots in this patch to increase the bandwidth.

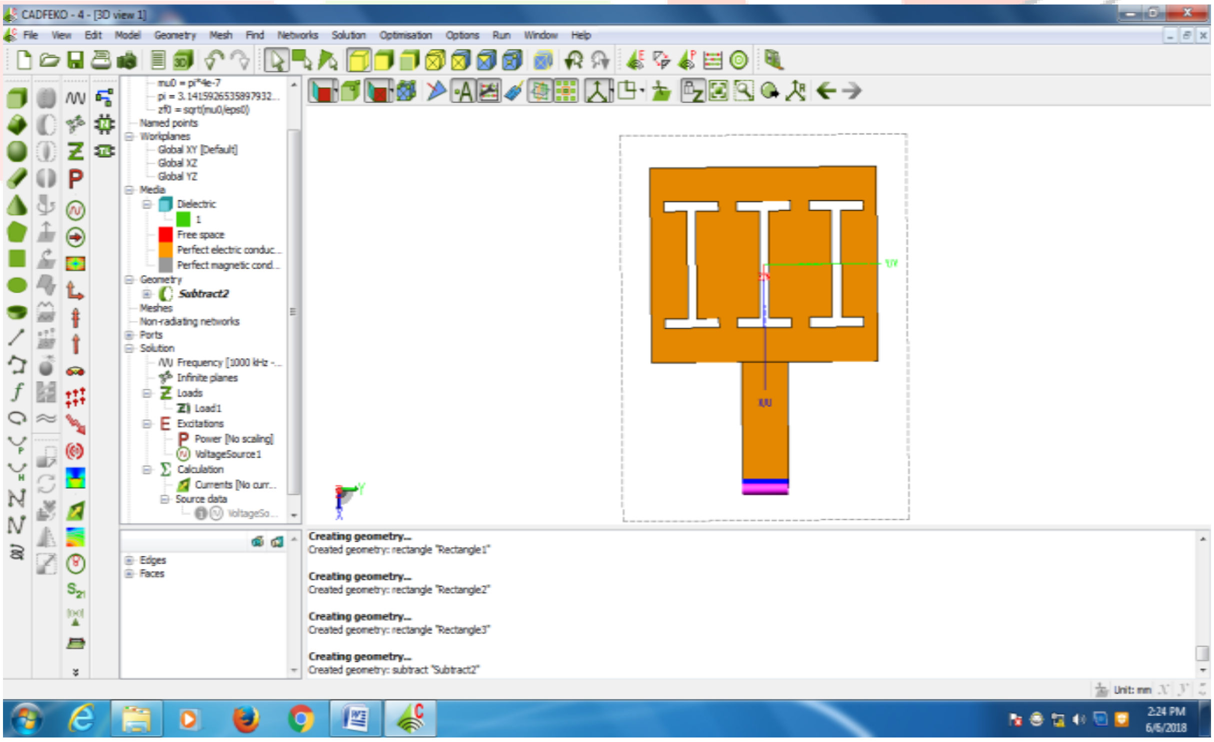

Fig.2

In the fig.2 first geometry with three I shaped slots are introduced. The dimension of the antenna is 40*50, and dimensions of slot are variable.

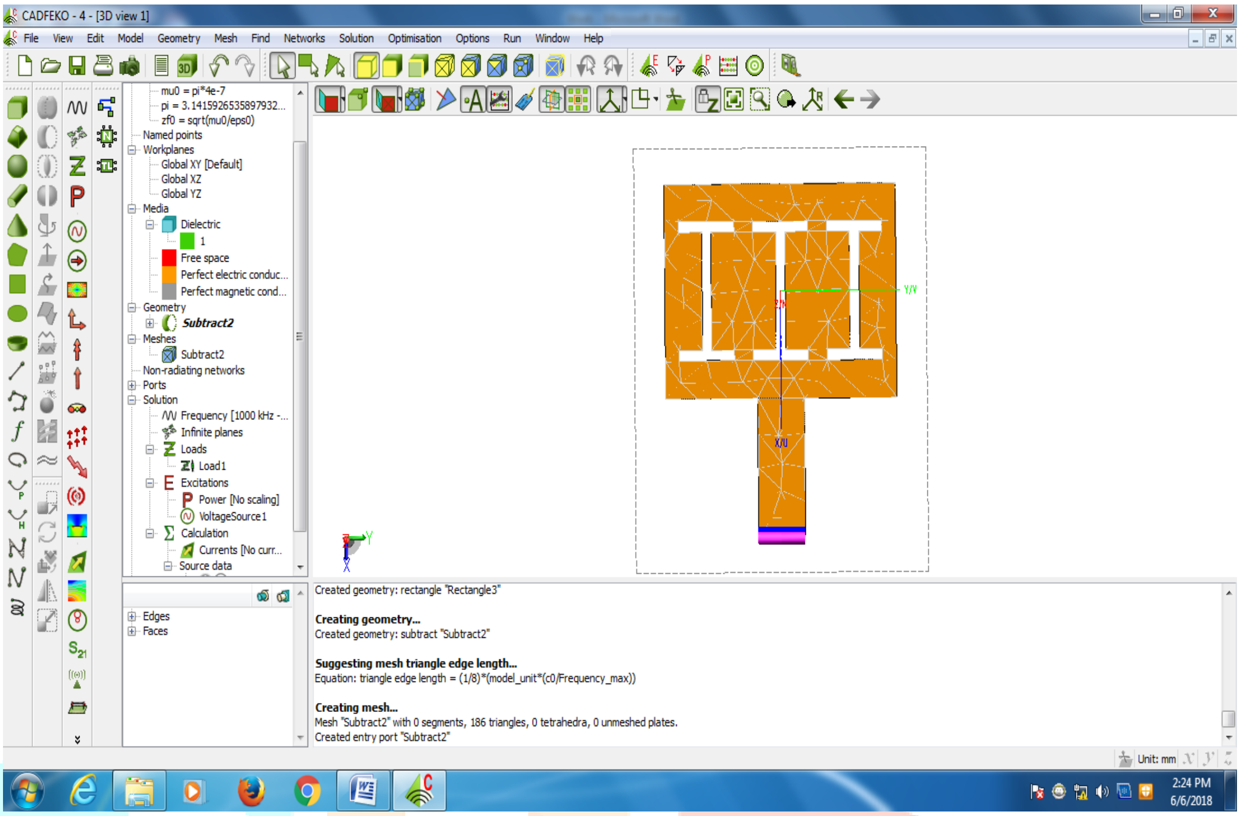

Fig.3

In the fig.3 mesh diagram is represented which shows the segmentation of the patch & feed. Geometry with three I shaped slots are introduced.

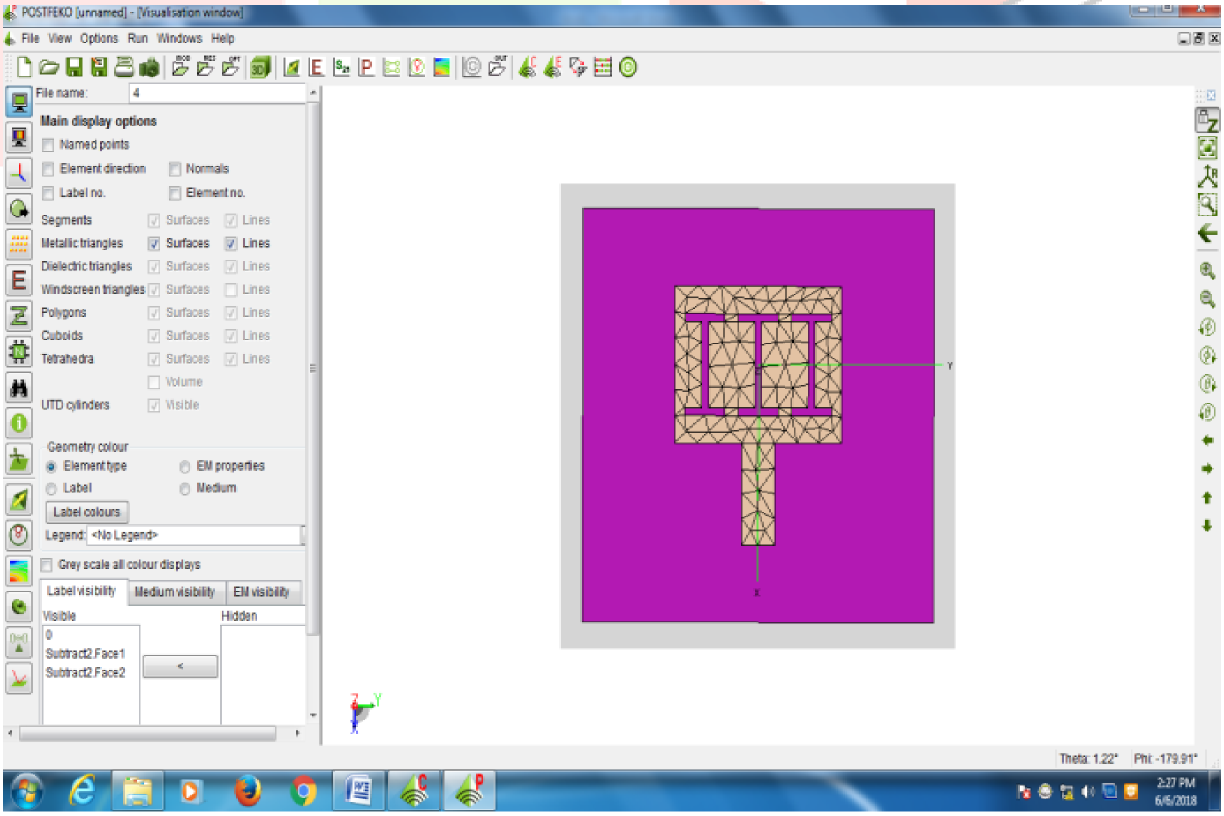

Fig.4

In the fig.4 show the simulation of the patch. The dimension of the antenna is 40*50, and dimensions of slot are variable.

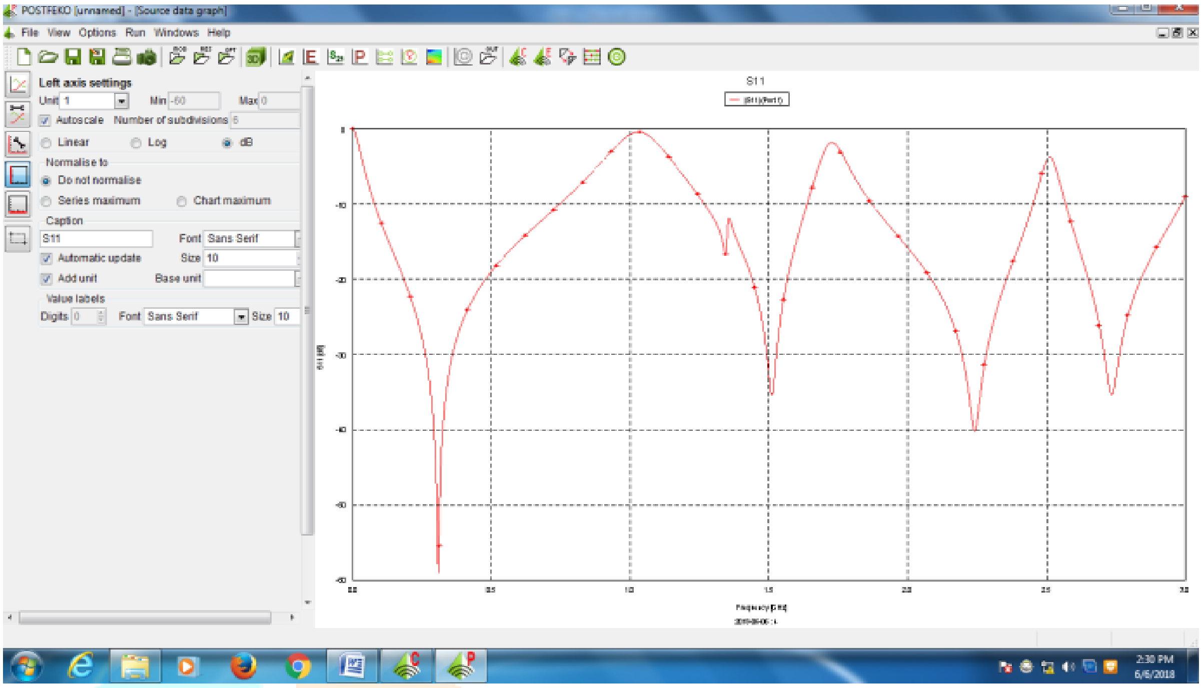

Fig.5

In the fig.5 shows the return loss with respect to frequency is shown where antenna is resonating on four different frequencies which exist in L & S band of IEEE standard.

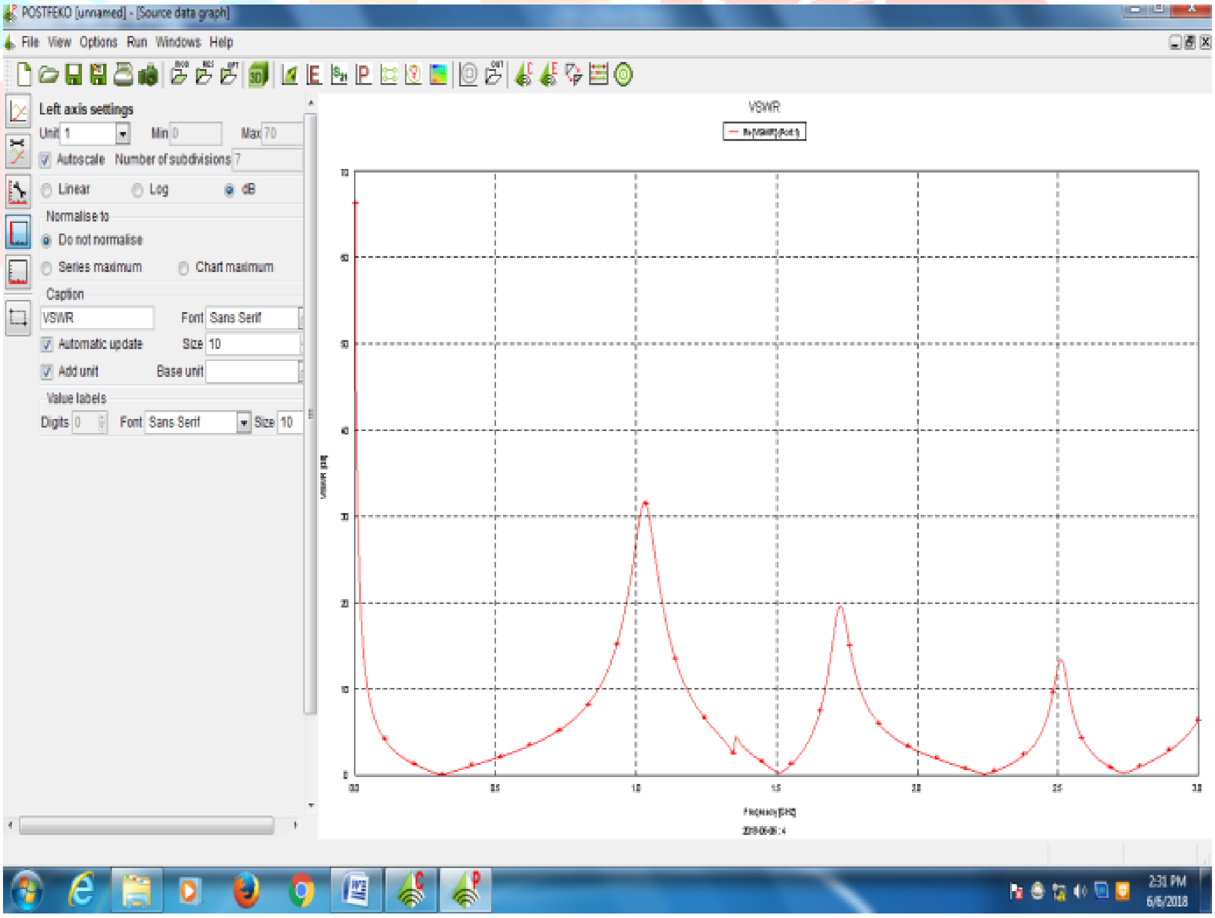

Fig.6

Table 1 Designed parameters of the proposed antenna

Frequency → / Parameter ↓	F1(300MHz)	F2(1500MHz)	F3(2300MHz)	F4(2700MHz)
S11(RETURN LOSS)	-58	-36	-40	-35
VSWR	Close to Two	Close to Two	Close to Two	Close to Two
Band Width	1300Hz	900Hz	1200Hz	700Hz

III. RESULT

This is simulated and analyzed by feko simulation software, has been used which work on method of moment generally called mom. The return loss which is called s-parameter of the proposed antenna is shown in the fig. 5. It can be seen that resonant frequencies are 300mhz, 1500mhz, 2300mhz and 2700mhz. their respective return losses are -58db, -36db, -40db and -35db. This is useful for most of the application like radio telecommunications, wi-fi, cordless communications and radar. The antenna is thin and compact which makes it portable. the vswr parameter is found to be less than two for all frequencies.

IV. CONCLUSION & FUTURE SCOPE

A tri-I slotted quad band rectangular micro strip patch antenna is presented in this paper. Structure of this antenna is simple and compact size of $40 \times 50 \times 1.6\, mm^3$ which makes it easy to be incorporated in small devices. Results show that the frequency bandwidth covers L band like telecommunications, cordless telephones, some Wi-Fi devices, weather radar systems. In this paper we have analyzed the parameter like gain, directivity, VSWR, impedance bandwidth of antenna can be further improved. Antenna miniaturization can be possible by different technique. Multi layer dielectric may be used for bandwidth enhancement. Different combination of material can be used for substrate layer and modify thickness to increase the bandwidth of antenna. The antenna can also be manufactured for its result measurement and verification. Additionally, Defected ground structure is a new concept which has great scope in future development of micro strip patch antenna. DGS is very easy to implement as it does not involve any complexity. The antenna array can be designed for the further work.

V. REFERENCES

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