A Compact T- Fed Slotted Microstrip Antenna For Wide Band Application

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Abstract: A simple microstrip line fed wide band printed microstrip antenna having a return loss bandwidth of 38% is presented which is mainly used in 6 to 10 GHz ultra wide band. By attaching a rectangular patch to the end of the microstrip feed line, the antenna is achieved to exhibit good radiation characteristics and moderate gain in the entire operating band. Details of the design along with experimental and simulation results in FEKO are presented and discussed. .The simulation results of proposed antenna are analyzed by using Method of Moment (MoM) from FEKO software.

Index Terms: **Broadband microstrip antenna, UWB, wide band antennas**

I INTRODUCTION

Recently there is considerable interest in developing such high data rate (500Mbps-IGbps) systems known as UWB communication systems. Now a day's UWB Technology is used for many applications such as wireless mobile communication, satellite communication, Bio- imaging systems, positioning/localization systems, vehicle radar systems, sensing/monitoring systems, broadcasting, and soon. One of the most promising solutions for future communication systems due to its high speed data rate and excellent immunity to multipath interference. In data communication UWB is used for military, government and commercial purpose Now a day's microstrip line fed antennas have many attractive features like low radiation loss , less dispersion, easy integration for monolithic integrated circuits, so these types of antennas have recently become more and more attractive, one of the main issue with line fed slot antennas is to provide an easy impedance matching to the cpw line. The total shape looks like a square-shaped with shaped feed which has a simpler geometry structure and less parameters. And the proposed antenna is successfully designed with a compact aperture area of 35 X *35mm²*. As will be seen, we designed the antenna with a bandwidth of ranging from 6.8GHz to 10 GHz .As per the UWB regulation to avoid the interference with WLAN and this frequency band is used by IEEE802.11a. Due to the rapid progress in wireless communication systems, high gain broadband antennas are of great demand. Even though microstrip antennas have a lot of advantages like high gain, low profile and ease of fabrication, their usage is limited by their inherent narrow bandwidth. Various techniques like aperture coupling [1], use of coupled parasites [2], stacking [3-4], E-shaped patch [5] and modifications in the feed [6-8] have been proposed to enhance the bandwidth of microstrip antennas.

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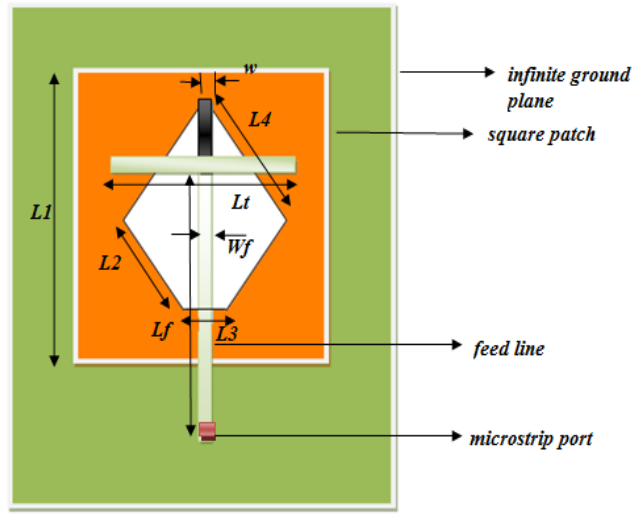
Compact broad band operation has also been implemented using microstrip ring antennas [9-10]. Ramesh Garg *et. al* has reported a single band microstrip ring antenna [11] in which impedance matching is brought about by loading a metal strip on the ring structure without affecting the cross-polarization characteristics. Implementation of wide band transmission line matching network to the end of the feed line proposed in [12- 13] increases the fabrication complexities. K. F Lee *et. al* has proposed a microstrip line fed patch antenna in which broadband matching is achieved by using an inverted L-strip fabricated on a foam substrate connected to the end of the feed In this paper a new broad-band planar impedance matching scheme is achieved by using a simple rectangular strip without any structural complexities. the shape of the microstirp line feed is also changed to T shape So more electromagnetic energy is coupled in to the patch The antenna has a bandwidth of 38% from 6 to 10GHz covering portions of C and X band

II. GEOMETRY OF THE ANTENNA

The geometry of the proposed antenna is shown in fig. 1. A square microstrip patch antenna of dimension L1 X L1 mm^2 is fabricated on a FR4 epoxy substrate of dielectric constant 4.2 with a loss tangent 0.02 and height 1.6 mm. A pentagonal slot of dimension L2=12mm,L3=8mm,L4=12.5,14mm is etched on the center of the square patch. For achieving good impedance matching characteristics a rectangular strip of dimension L3 X W mm^2 is incorporated symmetrically at the top corner of the slot. The antenna is electromagnetically coupled using a 50Ω microstrip transmission line fabricated on the same substrate. The ground plane dimension is optimized as infinite. The schematic diagram of the antenna is shown in Figure l.and its dimension parameters of the antenna consists: Dielectric constant ε_r = 4.2, loss tangent tanδ of0.02,thickness h of 1.6mm, ground plane is taken as infinite ground plane , W =2.0mm, Wf = 3mm,length L1=35mm and length L2=12.5mm,L3=4mm,L4=14mm Lf=43mm, Lt *=30mm* patch is placed exactly center with respect to Cartesian coordinate system simulations are done using microstrip port with voltage source excitation



(a) Top View

Side view

Figure 1: geometry of the proposed antenna

III. RESULTS AND DISCUSSIONS

The simulation and the experimental studies of the antenna are done using FEKO suit 6 which is basically a recent tool used for electromagnetic analysis involving bodies of arbitrary shape. Fig. 2 shows the simulated and experimental return loss characteristics of the antenna. Bandwidth enhancement is achieved with major resonances centered at 9.8 GHz,

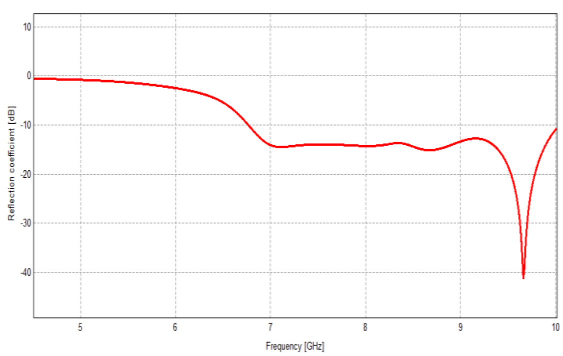


Figure 2: return loss characteristics of proposed antenna

In figure 3 return loss characteristics of proposed antenna is compared with simple micro strip line fed patch antenna , patch antenna with pentagonal slot with metal strip loaded and antenna with L shaped feed .So it is clear that proposed antenna has got bandwidth of about 3.2 GHz and moderate return loss of -42dB

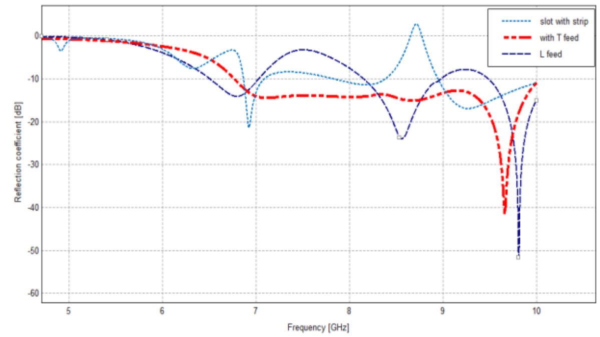


Fig 3: plot of reflection coefficient characteristics of proposed antenna with simple line, Land T shaped feed

Fig. 4 shows the return loss characteristics of the antenna with different slot dimensions. It is evident from the graph that with Pentagonal slot of higher dimension there exists only two poorly matched resonances. As length of the slot L3 increases impedance matching also increases and the maximum bandwidth is obtained when L3=4mm. Also the resonant frequencies shift towards the lower side with increase in L3.But return loss of about -65dB is obtained when L3=8mm

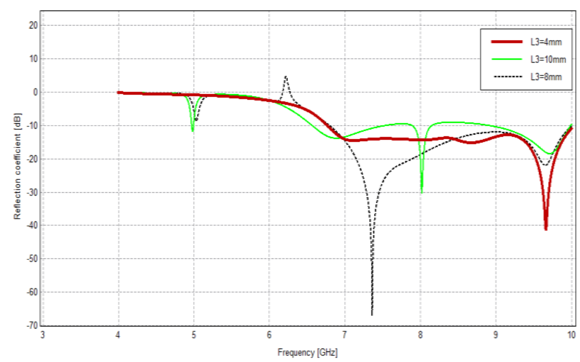


Figure.4 Return loss charactestics by varying the slot of different length

It is clear from the below figure the simulated voltage standing wave ratio (VSWR) of the UWB aperture antenna is less than 2 for entire frequency range of operation. The notch frequencies are not occur in the usable range and the voltage standing wave ratio (VSWR) is greater than two. So the proposed antenna has 2:1 VSWR of about 3.2 GHz

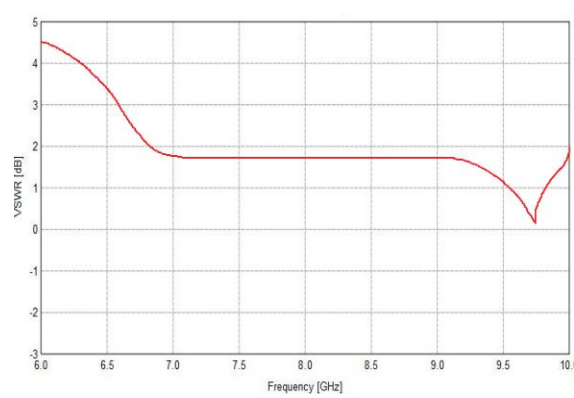
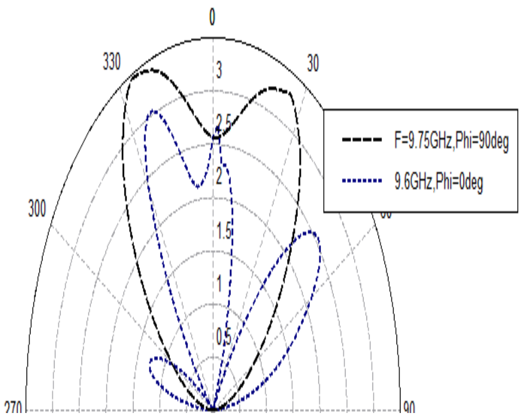
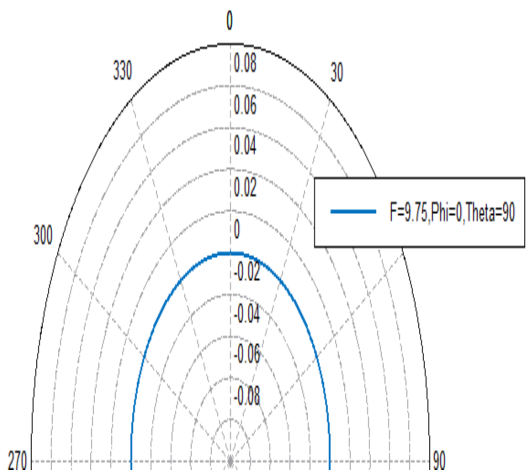


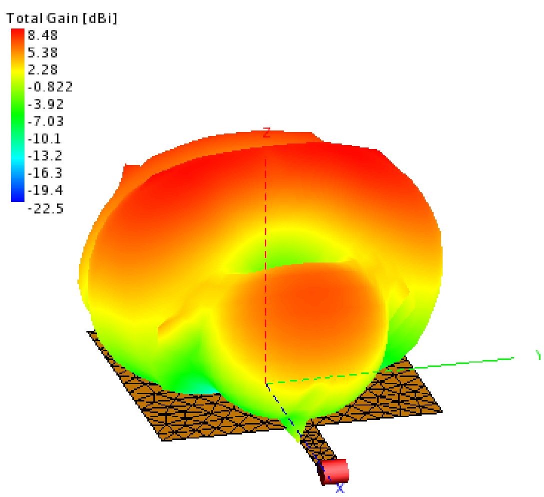
Figure 5:VSWR characteristics of proposed antenna



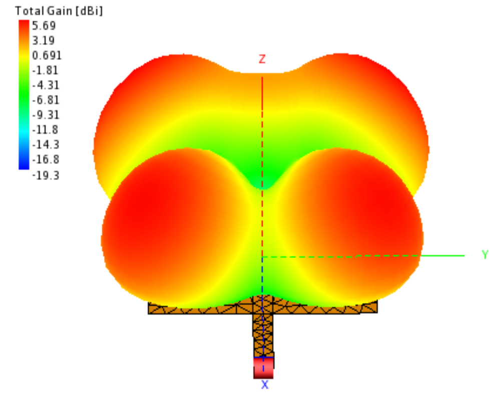
(a) Radiation pattern with elevation(theta=0,phi=90)



(b) radiation pattern with azimuthal



(c) 3D far field at9.8 GHz



(d) far field pattern at 7GHz

Figure 6: simulated far field patterns in2D and 3D

The above Figures shows the simulated radiation patterns with Elevation and azimuthal at different frequencies by using CAD FEKO software. The simulated radiation patterns of antenna in the E-plane (XZ-plane) and H-plane (YZ-plane) for two different frequencies 9.7GHz, 9.8 GHz are shown in figure.6,.it is clear that when approaches to resonant frequency it will achieve high gain The patterns and other curves are obtained at the time of simulation.

IV CONCLUSION

A broadband printed T-strip fed slotted single patch antenna is presented. The patch has a dimension of $35x35mm^2$ when printed on a substrate of dielectric constant 4.2 and thickness 1.6 mm.The proposed antenna give good radiation patterns and voltage standing wave ratio(VSWR<2),but at one particular frequency range VSWR is above 2 that frequency is known as notched frequency, these results are satisfied the WB condition The remarkable feature of the antenna is that it utilizes only a simple rectangular metal strip to achieve broadband impedance matching for the slot loaded patch without any external matching circuitry and further enhancement in bandwidth is obtained by implementing T-strip feed mechanism. The antenna has a wide bandwidth of 38% from 6.8 GHz to 10 GHz and an average gain of 3.4 dBi, which is suitable for wideband imaging applications and in radar.

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