NEW 2GHz BROADBAND MICROSTRIP PATCH ANTENNA FOR C-BAND PERVASIVE WIRELESS COMMUNICATION

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Abstract

In this paper, broadband microstrip antenna is presented. Broadband frequency of operation demonstrated by single geometry for broadening the bandwidth gap-coupled two U-Slots loaded on patch. After IE3D^{TM} Simulation we have achieved 43 %,-10dB Bandwidth (2GHz bandwidth slot) of C-Band and analyzed maximum directional gain (4dBi - 6dBi) between 4.2GHz – 6.3GHz. We have investigated concept of strong signal coupling for higher and lower edge of frequency if S=.02λ. We achieved 43%BW for VSWR<=2. This proposed antenna is used for satellite, and wireless communication at, C- Band.

***Index Terms**: IE3DTM Simulator, slot loading, parasitic and active patch, Maximum directional gain, C- Band (4GHz - 6GHz).*

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1. INTRODUCTION

An explosive growth of the wireless radio communication systems is currently observed in the microwave band. In the short range communications or contactless identification systems, antennas are key components, which must be small, low profile, and with minimal processing costs [1-4]. The main limitations of the microstrip antennas are low gain and narrow impedance bandwidth. The bandwidth of the microstrip antenna can be increased using various techniques such as by loading a patch, by using a thicker substrate, by reducing the dielectric constant, by using gap-coupled multi-resonator etc [3-5]. However, using a thicker substrate causes generation of spurious radiation and there are some practical problems in decreasing the dielectric constant. The spurious radiation degrades the antenna parameters. Among various antenna bandwidth enhancement configurations, the two gap-coupled Circular microstrip patch antenna is most elegant one. So, gap-coupling is the suitable method for enhancing the impedance bandwidth of the antennas [6, 7]. In the con-figuration gap-coupled microstrip antennas generate two resonant frequencies and the bandwidth of the microstrip antennas can be increased [6].There exist a wide range of basic microstrip antenna shapes such as rectangular, circular and triangular patch shapes which are commonly used patches. For these patches, operating at their Fundamental mode resonant frequency, are of the dimension of the patch is about half wavelength in dielectric. At lower frequencies the size of the microstrip antennas becomes large. In this proposed antenna designed for broadband frequency operation is using a single fed, three layer, and two U-Slot loaded with gap coupled geometry. In this antenna of introducing two U shaped slot to improve the impedance bandwidth.

2. PROPOSED GEOMETRY DESIGN ANALYSIS

Proposed Rectangular Microstrip antenna Included

a. Two U-slot load on patch
b. Δ=5mil Air gap between layer
c. Whole geometry consist by three layer glass epoxy PCB and air gap(FR-4 – air- FR-4)
d. Total height of geometry is 123mil (from ground plane to top layer)
e. Spacing between U-Slot is S=50mil.
f. Top layer consists of patch dimension L x W= 700 x 800mil^2
g. Ground plane consists of patch dimension Lg x Wg= 1150 x 1200mil^2

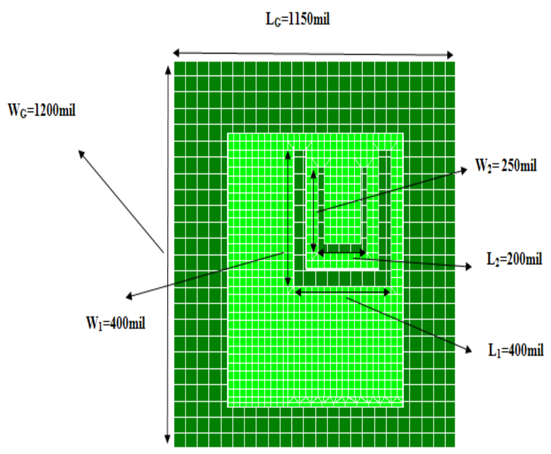

Figure 1 Proposed Models

Specification of Glass epoxy PCB has ε_r =4.3, h= 59mil and loss tangent tanδ =.0019. At h=123mil we have substituted two U-Slot have dimension L_1 x W_1 = 400 x 400mil^2, L_2 x W_2 =200 x250mil^2 respectively the spacing between two U-Slot S=50mil (.02λ).

3. RESULT AND DISCUSSION

The technique of stacked patches is based on the fact that bandwidth is in general proportional to the antenna volume measured in wavelengths but at the same time a relative large volume is a disadvantage for many applications.The utilization of additional parasitic patches of different patches of different size directly –or- gap coupled with main patch is an effective method. Superior to these methods is the techniques of slot loading on the patch ensure the small size and the low profile of the antennas. The wideband performance of the slot loaded patch is based similarly to the method of slit loading. The technique of slot cutting the surface of the printed antenna, besides the broadening of the bandwidth has been proved effective in driving the patch to multi-frequency operation. The width of the frequency band of the antenna can be controlled by slots' length and width and the slots' position. Various slot shapes have been proposed for the texturing of the patch; Embedded E-slot can be used.

In this design, small U-Slot provides impedance matching for higher edge frequency of C-Band and other U-Slot provides impedance matching for lower edge frequency of C-Band. Due to this reason we have achieved broad bandwidth slot (2GHz slot) in C-Band.

3.1 Return Loss vs. frequency: -

After IE3DTM Simulation we have investigated 43% -10dB Impendence Bandwidth of 4.22GHz -6.3GHz(C-Band). We studied when spacing between two U-Slots is S=50mil (.02λ), observed more coupling between patches so that overall loss due to surface wave , cross polarization and poor impedance matching have been reduced. And we improved results towards higher frequency and lower frequency edge. All results shown in figure-2 and Result Table.

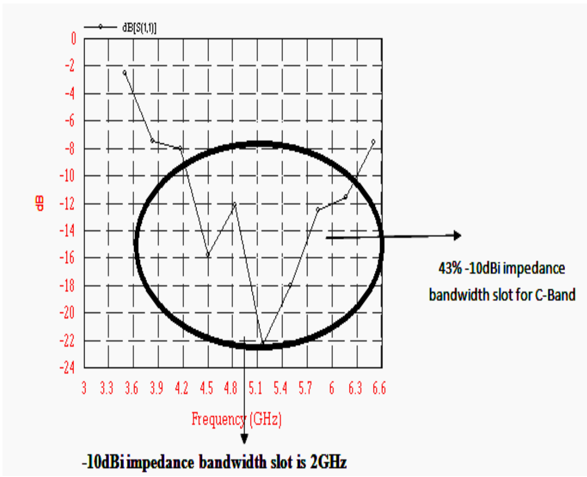

Figure 2 Return Loss Vs Frequency

3.2 VSWR vs. Frequency:-

All results shown below in figure-3 and Result Table. We have analyzed 43% VSWR<=2 over broadband.

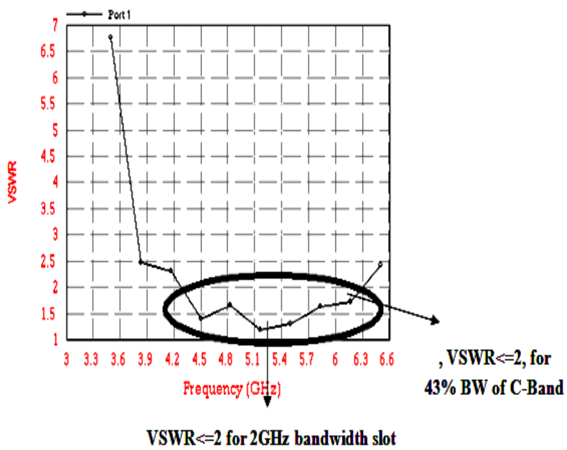

Figure 3 VSWR Vs Frequency

We investigated as per as result discussion that, S=.02λ proposed design is effectively used for lower and higher edge of frequency for C-Band.

3.3 Smith Chart:-

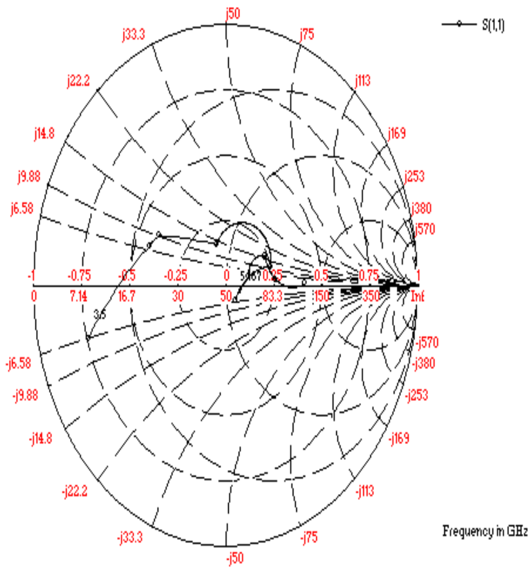

Figure 4 Smith Chart Analyses

For this design smith chart have more close to real axis so that the ratio of impedance matching is good between 4.21GHz to 6.3GHz.

3.4 **Maximum Directional Gain analysis**: -

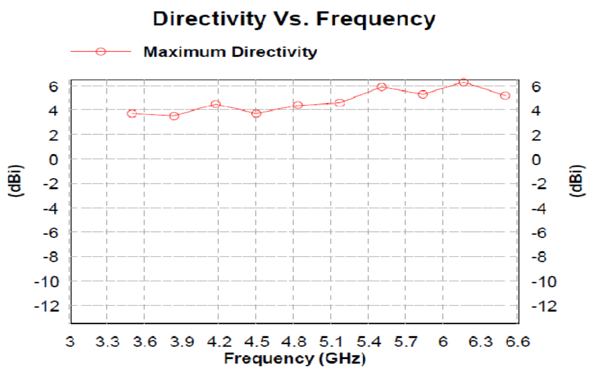

Figure 5 directivity Vs Frequency

For this graph we have achieved maximum directivity(4dBi - 6dBi) between 4.2GHz **-** 6.3GHz

4 SIMULATION RESULT TABLE

The results of proposed antenna simulated on IE3D™ Simulator. Investigated results of VSWR, and return loss shown in Result Table.

4.1 Result Table

Frequency (GHz)	VSWR	RETURN LOSS (dBi)
4.21	2	-10
4.3	1.67	-13
4.5	1.48	-16
4.6	1.5	-15
4.8	1.58	-12
5	1.25	-15
5.15	1.24	-22
5.4	1.26	-19.6
5.5	1.38	-18
6	1.6	-12
6.3	2	-10

5. CONCLUSION

In this paper, Broadband of microstrip antenna is presented. We studied broadband frequency of operation demonstrated by single geometry. We achieved 43% bandwidth (2GHz bandwidth slot) and by using gap-coupled two U-Slots loaded on patch and spacing between two U-Slots is 50mil. The simulated results are presented and discussed for proposed geometry on IE3DTM Simulator. After loading slots, we have achieved broad band operation. This proposed antenna is used for satellite, Radar, and wireless communication at, C-Band

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