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Single –Layer Single Patch Quad band Antenna for S &C Band Application

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Abstract

In this paper, A quad band Lange shape micro strip patch antenna for S & C band application is presented, which is incorporated by Lange shaped slot structure in square patch antenna. The proposed antenna has the resonating frequencies at 3.18 GHZ with return loss -26.88 db, 3.62 GHZ with return loss -12.61 db, 4.86 GHZ with return loss -20.92 db and 6.94 GHZ with return loss -27.26 db .The Bandwidth is increased with better return loss when compared to a conventional micro strip patch antenna without slot. The theoretical simulated return loss and VSWR at each resonant frequency are obtained using SONNET lite software.

Keywords:. *S and C Band, Quad frequencies, Voltage standing wave ratio (VSWR), Radar*

1. Introduction

In modern telecommunication systems, a Multi band antenna has been widely required in satellite, radar, Aerospace vehicles, missiles and mobile communication to meet the continual system complexity. The shape and size of radiating patch can be changed depend upon the application [1-3]. The importance of patch antenna has been discussed in the literature [1-7].Multiband Micro strip patch antenna have some special properties.

- The bandwidth is directly proportional to the substrate thickness and width
- It is extremely low profile, light in weight, structurally robust and low cost antenna.
- Resonance frequencies and its return loss can be varied by varying feeding position.
- Bandwidth can be also changed by changing the position of feeding point.

But its major drawback is its narrow bandwidth and low gain. This is one of the problems that researchers have been trying to overcome. In this project, we have tried to increase the gain and bandwidth of the patch antenna

2. Antenna Structure.

The antenna is a 23 mm x 23 mm square patch in which lange shape slot is created (as shown in figure-1& fig-2). The substrate selected for this design is an Arlon AD450 with dielectric constant (ϵ_r) =4.5 and height of substrate (h) =4.2 mm with dielectric loss of .0035. To feed the suggested antenna, co-axial probe of characteristic impedance (Z_0) 50 ohms is used.

The conventional square patch antenna (as shown in fig-3) with same parameters is also designed to compare their results.

3. Tables, Figures and Equations

3.1 Tables and Figures

The geometry of proposed antenna with its dimension is shown in table1

Table-1 Geometrical dimension of proposed lange slot patch antenna

Parameters	***Units(mm)***
No of fingers	4
Finger width	3
Finger spacing	2
Finger length	15
Feed width	3
Feeding point	41,38

The used Dielectric material, Radiating materials and their thickness are same for proposed as well as conventional antenna. As per the tabulated dimension of the proposed

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antenna, its 2-D and 3-D geometry are shown in fig-1 and fig -2 respectively.

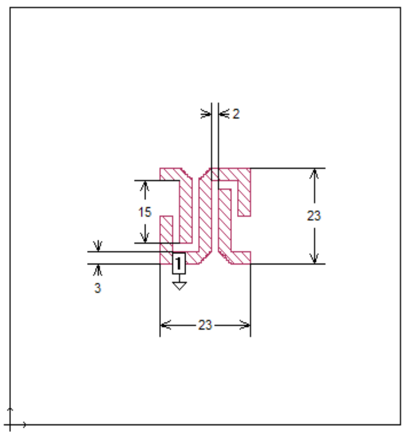

Fig-1- 2D geometry of proposed antenna

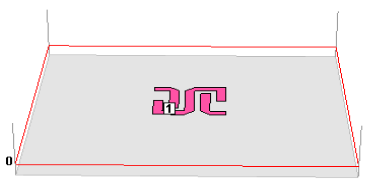

Fig-2- 3D geometry of proposed antenna

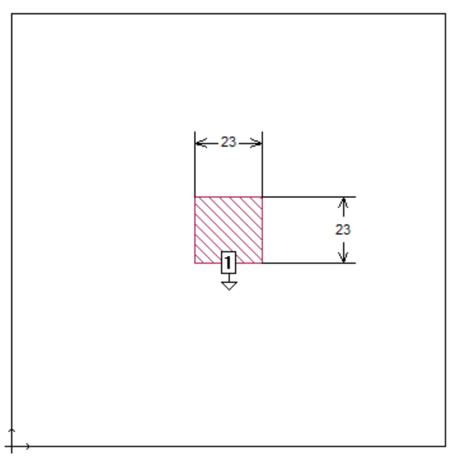

Fig-3-2D Geometry of conventional antenna

The simulation and analysis is completed for quad band Lange slot micro strip patch antenna by sonnet lite software. In this paper return loss, VSWR and current density is simulated and analyzed which is shown in fig-4,fig-5,& in fig-6 respectively. For proposed antenna resonant frequency is 3.18 GHZ,3.62 GHZ,4.8 GHZ,6.96 GHZ and their corresponding simulated return losses are -26.88 db,-12.61 db,-20.92db and -27.26 db respectively . Simulated 10 db bandwidth at each resonance frequencies are 60 MHZ (3.14-3.2), 20 MHZ (3.16-3.63), 140 MHZ(4.74-4.88) and 860 MHZ(6.14-7.0) respectively. Almost all microwave applications are designed with input impedance of 50Ω.so matching the antenna to 50Ω is desire .Fig -7 shows the impedance plot

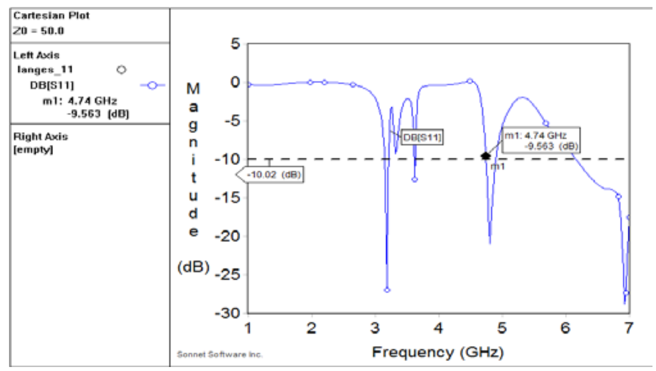

Fig-4 simulated return loss of proposed antenna

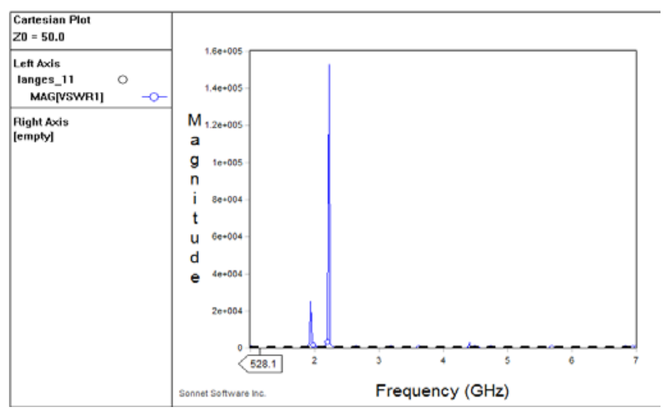

Fig-5 simulated VSWR plot of proposed antenna

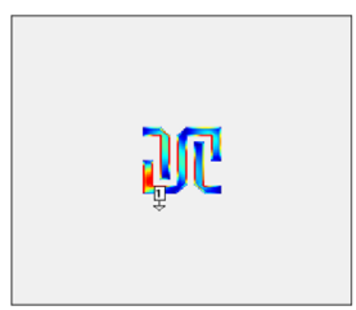

Fig-6 Current distribution of proposed antenna.

The best matching is found at all resonance frequency including at 5.9 GHZ at which Z_{IN}=49.97 Ω

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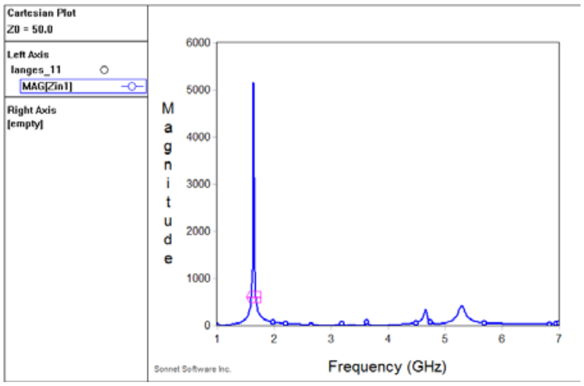

Fig-7 input Impedance vs frequency for proposed antenna

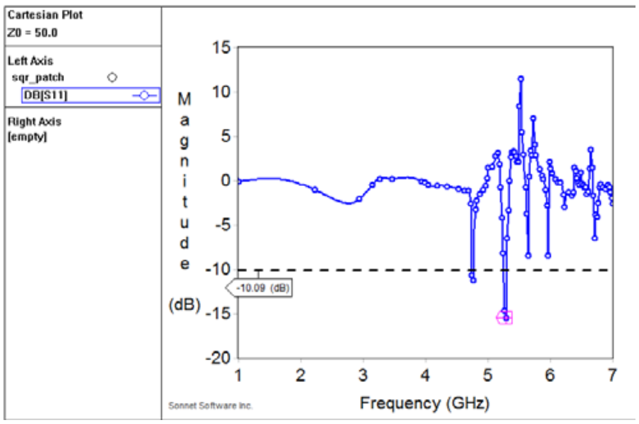

Fig-8 simulated return loss of proposed antenna

The return loss output of square patch is shown in fig-8

3.2 Equations

The effective dielectric constant has values in the range of 1 <$\in r_{eff}$ .Where the dielectric constant of the substrate is much greater than the unity ($\in r \gg 1$), the value of $\in r_{eff}$ will be closer to the value of the actual dielectric constant $\in r$ of the substrate. The various design equation for the conventional patch antenna is hereunder.

3.2.1 Value of effective dielectric constant (ε_{eff}) is calculated as

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{-\frac{1}{2}} \qquad 1$$

3.2.2 The effective length (L_{eff}) of the antenna is given as

$$L_{eff} = C/2f_o\sqrt{\epsilon_{eff}} - 2\Delta L \qquad 2$$

3.2.3 The length extension (*ΔL)* is calculated by the equation

$$\Delta L = 0.412h\frac{(\varepsilon_{eff} + 0.3)\left(\frac{w}{h} + 0.264\right)}{(\varepsilon_{eff} - 0.258)\left(\frac{w}{h} + 0.8\right)} \qquad 3$$

3.2.4 Calculation of the actual length of the patch (*L*):

$$L = L_{eff} - 2\Delta L \qquad 4$$

In above equations, f_0, C and h are central resonant frequency, c is speed of light and h is the substrate thickness

4. Conclusions

The Simulated results of proposed antenna exhibits good performance for S and C band application with enhanced bandwidth.Proposed shaped antenna provides wide bandwidth and also very low return loss when compare to the square patch antenna for the same dielectric and its parameters. The performance of the proposed antenna can be further improved for WLAN application by doing certain modification in its feeding technique and in its feed position

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