RESEARCH ARTICLE OPEN ACCESS

Cut Slotted Microstrip Antenna for Dual Frequency Application and Analysis Using Different Optimizer Available In Ie3d

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ABSTRACT
Design of dual frequency antenna always gives the added advantages for microwave antenna applications. In this paper Fast EM and Powel method based design of a dual-frequency patch antenna using IE3D is presented. The proposed antenna is excited through the inset feed technique and the antenna design and parametric studies has been executed. The method effectively obtains the geometric parameters for efficient antenna performance. Maximum return loss obtained at 7 GHz is -36.5 dB and at 7.59 GHz is –15 dB with acceptable bandwidth at -10db.
Keywords— Microstrip Antenna, Dual frequency, VSWR, Return loss, Optimization, IE3D.

I. INTRODUCTION

Planar antenna designs, such as "microstip antennas" are often preferred for mobile and satellite communication antennas due to their added advantage of small size, low manufacturing cost and conformability. In recent years square microstrip antennas have found increasing demand in communication scenario due to their polarization diversity, particularly ability to realize dual or circularly polarized (CP) radiation patterns [1–3] Microstrip patch antennas are widely used because of there many merits such as the low profile, light weight, low cast and planar also. However patch antenna have a disadvantage of narrow bandwidth typically 1-5 % impedance bandwidth . Researchers have made many efforts to overcome this problem and many configurations have been presented to increase the bandwidth [4-6]. The most popular technique for obtaining a dual-frequency behavior is to introduce a reactive loading to a single patch, including stubs[5], notches [7], pins [8] and [9], capacitors [10], and slots [11-14]. In [6-10], by these reactive-loading approaches, one can modify the resonant mode of the patch, so that the radiation pattern of the higher order mode could be similar to that of the fundamental mode. This indicates that the use of a single feed for both frequencies on a single radiating element can be realized. In 1995, a rectangular patch with two narrow slots etched close to and parallel to the radiating edge was used to obtain the dual-frequency operation proposed by S. Maci [7]. Most of the other dual-frequency patch antennas found in the literature can be subdivided into (a) multi-patch dual frequency antennas [11], and (b) reactively-loaded dual-frequency patch antennas [11]. In_this paper, a combination of IE3D and Fast EM, Powel algorithms is used to design dual band Microstip patch antenna and simulation and optimization results are presented.

II. GEOMETRY OF MICROSTRIP PATCH ANTENNA

The antenna structure (Fig. 1) consists of a rectangular patch dimension W × L with two slots into one of the radiating edges, and is excited using an inset planar feed. The patch design consists of two stages. The first stage involves the creation of an additional TM0δ resonant mode at a resonant frequency above that of the fundamental TM01 mode, with the same polarization sense. The second stage is to simultaneously reduce the input impedance of both modes to 50Ω at resonance through the use of an inset feed

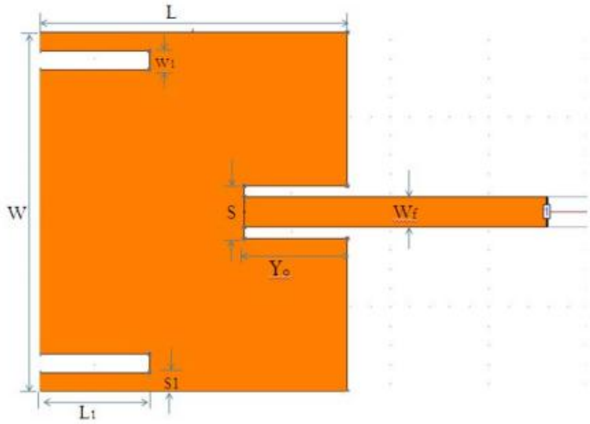


Figure 1

Width of the Patch(W)	9.999mm
Effective dielectric constant of the Patch,(*εeff*)	4.4
Length of the Patch(L)	13.0410mm
Input Resistance of the Patch(*Rin*)	243Ω
Inset Depth of the Patch (Y_o)	3.75mm
Width of Microstrip line (*Wf*)	0.5mm
Width of slots(W1)	0.5mm
Length of slots(L1)	4.25mm
Width of non-radiating edge(S1)	1mm

III. SIMULATION STUDIES

For the designing of rectangular microstrip antenna, the following relationships are used to calculate the dimensions of rectangular microstrip patch antenna [7].

Calculation of the Width *(W):* The width of the MSA is given by equation

$$W= (c/2f_r)\ \sqrt{2/(\varepsilon_r+1)}$$

Calculation of Effective dielectric constant *(ε_{reff}):* Equation that gives the effective dielectric constant is $\varepsilon_{reff} = (\varepsilon_r+1)/2 + [(\varepsilon_r-1)/2]*[\ 1+ 12\ (h/W)]^{-1/2}$ for W/h > 1.

Calculation of the Effective length *(L_{eff})*: Equation that gives the effective length is:

$$L_{eff} = c/2f_r\sqrt{\varepsilon_{reff}}$$

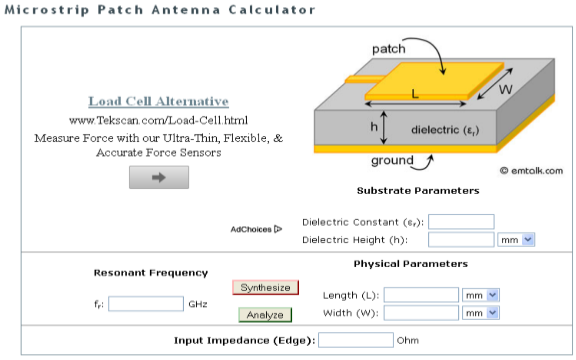
Calculation of the length extension (*AL*): Equation that gives the length extension is:

$$\Delta L= 0.412h[(\varepsilon_{reff} + 0.3)*(W/h+0.264)] / [(\varepsilon_{reff} -0.258)*(W/h+0.8)]$$

Calculation of actual length of patch (L): The actual length is obtained by the equation:

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

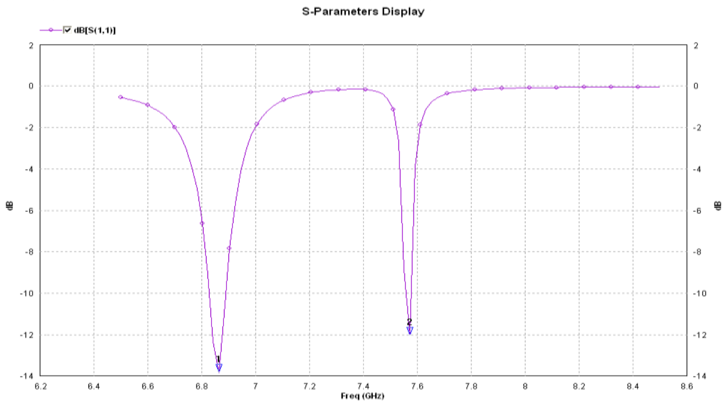
For calculating the actual length and width of the antenna we also use Microstrip Calculator available in the wave site http://www.emtalk.com/mpacalc.php .



IV. RESULTS AND DISCUSSION

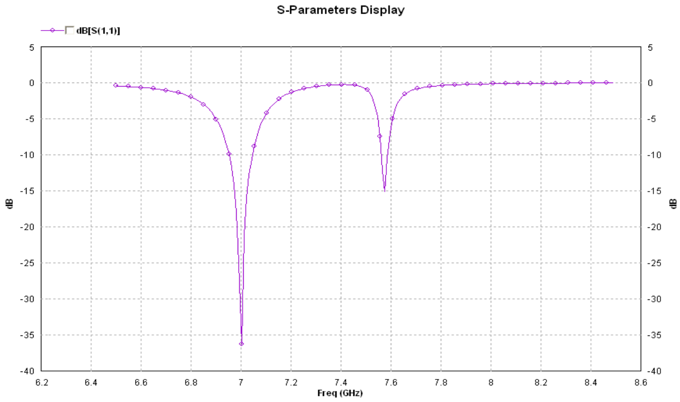
The bandwidth of the antenna for this dual frequency point location using IE3D at fast EM optimization is seen to be ***f_1*** = 7GHz and due to slots the second frequency is ***f_2*** =7.59 GHz. The frequency ratio is 1.29 for using these dual slots. with acceptable bandwidth at -10dB The plots of radiation pattern in Polar form are shown in Figure also. We analysis the following parameter for our antenna

(a) Return loss: Theoretical result (IE3D)



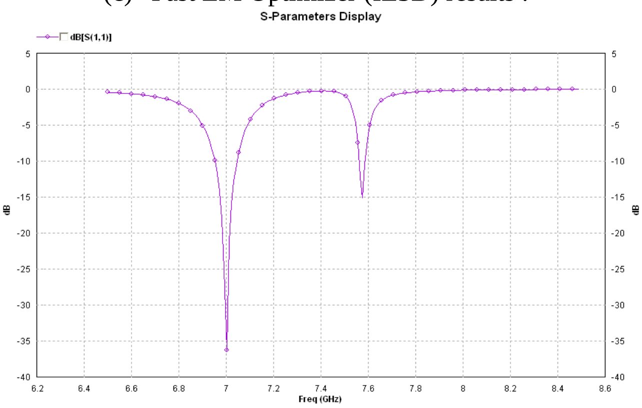
Return loss is -13.78 dB (6.84 GHz) and Return loss is -12.006dB (7.59 GHz)

(b) Powel Optimizer (IE3D) results:



Return loss is -36.5 (7 GHz) and Return loss is –15 (7.59 GHz)

(c) Fast EM Optimizer (IE3D) results :

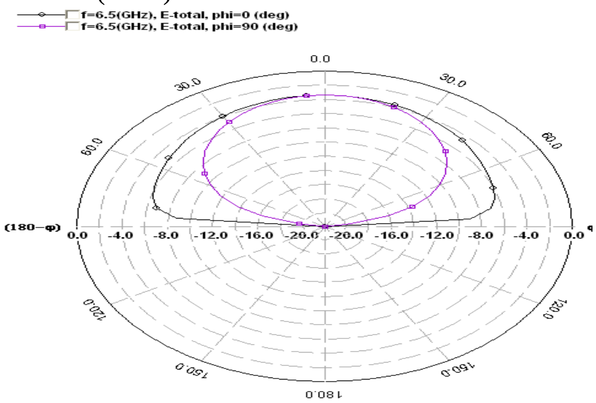


Return loss is -36.5 (7 GHz) and return loss is -15 (7.599 GHz)

Radiation pattern plot

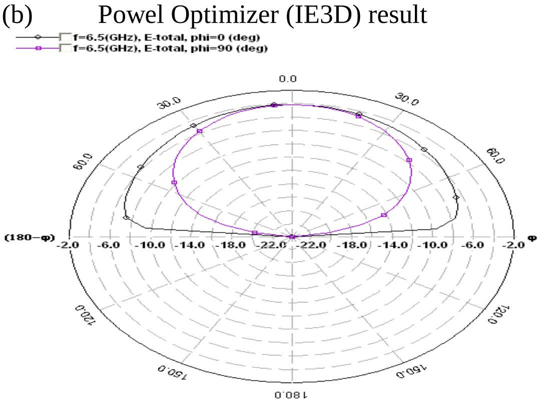
A Microstrip patch antenna radiates normal to its patch surface. The elevation pattern for Φ=0 and Φ=90 degrees would be important. Figure below show the 2D radiation pattern of the antenna at the designed frequency for Φ=0 and Φ=90 degrees

(a) Radiation Pattern Plot: Theoretical result (IE3D)



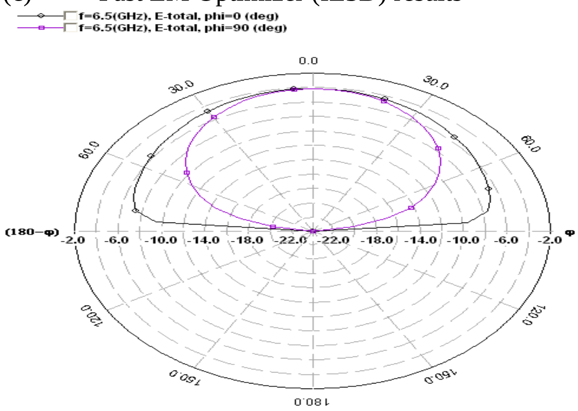
Elevation Pattern for Φ=0 and Φ= 90 degrees at f=6.84 GHz & 7.59GHz.

(b) Powel Optimizer (IE3D) result



Elevation Pattern for Φ=0 and Φ= 90 degrees at f=7 GHz & 7.59GHz

(c) Fast EM Optimizer (IE3D) results

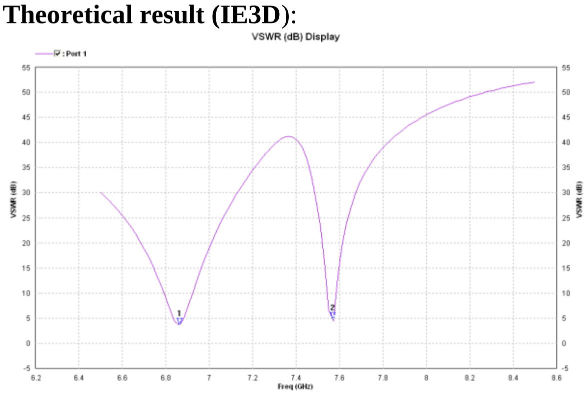


Elevation Pattern for Φ=0 and Φ= 90 degrees at f=7 GHz & 7.59GHz

VSWR

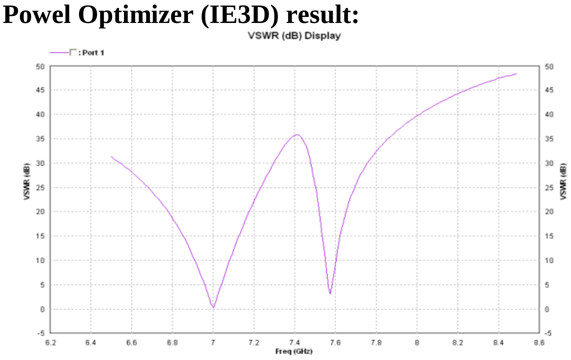
Voltage standing wave ratio (VSWR) of Microstrip antenna shown in figure bellow respectively shows the theoretical result, Powel optimization and the Fast EM optimization of the patch. In the case of Microstrip patch antenna the value of VSWR is always less than 2. At f_1 = 7 GHz the value of VSWR is 1.08 and at the value of VSWR is 1.3 using the Fast EM Optimization.

Theoretical result (IE3D):



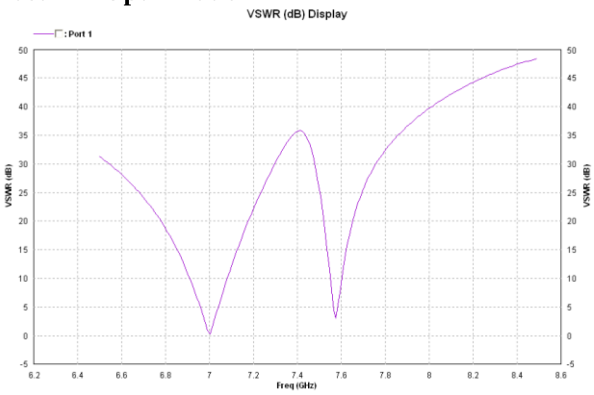
VSWR of Microstrip patch antenna is 3.60 at f_1 =6.86 GHz and 4.75 at f_2=7.59

Powel Optimizer (IE3D) result:



VSWR of Microstrip patch antenna is 0.15 at f =7 GHz and 3.12at f=7.59 GHz

Fast EM Optimization



VSWR of Microstrip patch antenna is 0.15 at =7 GHz and 3.01 at =7.59 GHz

V. CONCLUSION

In this paper microstrip line fed dual frequency microstrip patch antenna has been designed for satellite communication and simulated using IE3D software. Our designed antenna also optimized using Powel & Fast EM optimizer and we done comparative studies among them. We found the best result for Fast EM Optimization technique.

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