INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 6.078
(Volume 6, Issue 3)
Available online at: www.ijariit.com

Improving the performance of patch antenna using microwave frequency bands

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ABSTRACT

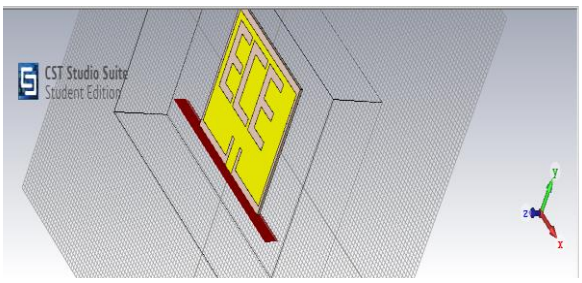
The microstrip patch antennas have a limited gain and bandwidth performance. In this paper, an enhancement in the gain, bandwidth, VSWR, return loss and directivity this will make antenna more compact and low profile and this parameter are achieved by slotting an ECE radiating patch and using a defected ground structure and by using proximity feeding and also by techonicCER-10 substrate respectively. The proposed antenna design with design frequency of 2.45 GHz, (4 to 8) GHz, (8-12) GHz, (26-40) GHz has been evolved isometrically in different design stages (design iterations). The work of single band antenna with a slotted patch geometry offering an improved gain but limited in its bandwidth. The change in the widths of the ground, substrate and the patch along with the addition of addition of slots into this design results into a completely different geometry featuring multiband operation with an improved parameter performance and the use of defected ground structure in the final stage counters the limited bandwidth operability. All the involved iteration designs have been simulated over CST 2019 for the performance parameters of the reflection coefficient, bandwidth, radiation pattern and gain, VSWR, return loss. The measured results have been found to be in close approximation to the simulated ones.

Keywords— *CST-2019, Microwave band frequency, Microstrip patch, Performance parameters, Design equations, Feeding techniques, Substrate*

1. INTRODUCTION TO MICROSTRIP PATCH ANTENNA

Microstrip patch antennas have many advantages such as light weight, low profile, low cost, easy fabrication. However, it suffers of low efficiency and narrow bandwidth. Multiband has been playing a very vital role for wireless communication system. The interest in multiband antenna is increasing, especially in order to reduce the number of antennas embedded in combining multiple applications on a single antenna. To achieve the multiband characteristics many efforts has been made by the researchers in recent years. By introducing these different of methods and techniques in the geometry of microstrip patch antenna and proper selection of feeding technique helps to achieve the multiband characteristics easily. There are different types of multiband antenna which can be categories as printed dipole, loop antenna, slot antenna and printed inverted F antenna. There are lots of researches for designing antennas with different numbers of bands. This paper presents a microstrip patch antenna with ECE shaped slots etched in the radiating patch, which is designed to provide 4 resonant frequencies. The first one is for S-band applications (2-4 GHz). The second resonant is for the C-band applications (6.24-6.75 GHz). The third resonant one is for X-band applications (7.25-7.75 GHz). The fourth resonant (28-30) GHz one is for Ka-band applications. The CST-2019 software is being used for the analysis and design of the proposed antenna.

2. ANTENNA DESIGN AND SIMULATION RESULTS



The schematic diagram of the proposed antenna is illustrated in Figure. The deign parameters and diminutions are tabulated in Table. 1. The proposed antenna is printed on the cheaper substrate FR4 epoxy with relative permittivity of 4.4 and thickness of 1.575 mm and loss tangent 0.035. A 50ohm microstrip line is used to feed the antenna for better impedance matching.

$$W = \frac{v_{\circ}}{2f_r}\sqrt{\frac{2}{\epsilon_r + 1}}$$

Where,
W= Width of the patch
$v_{\circ}$= Speed of the Light
ϵ_r= value of dielectric substrate
f_r= Resonant Frequency

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{\frac{-1}{2}}$$

ϵ_{reff}= Effective dielectric constant
ϵ_r= Value of dielectric substrate

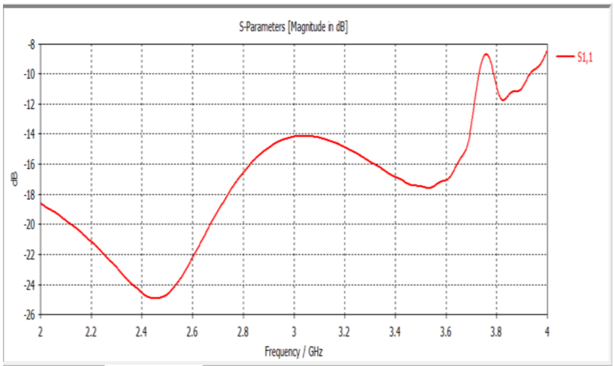
$$\frac{\Delta L}{h} = 0.421\frac{(\epsilon_{eff} - 0.3)\left(\frac{w}{h} + 0.8\right)}{(\epsilon_{eff} + 0.3)\left(\frac{w}{h} + 0.264\right)}$$

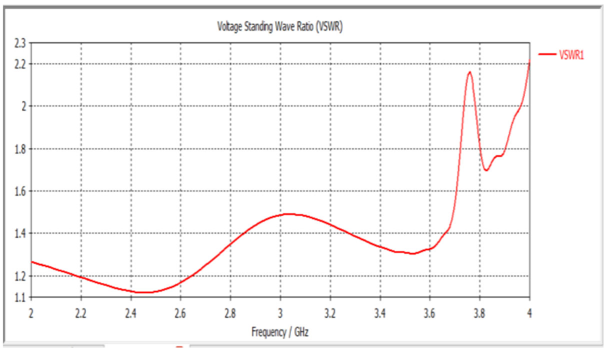
ΔL= Actual increase in length of the patch due to fringing effect.
H= Height of the substrate.

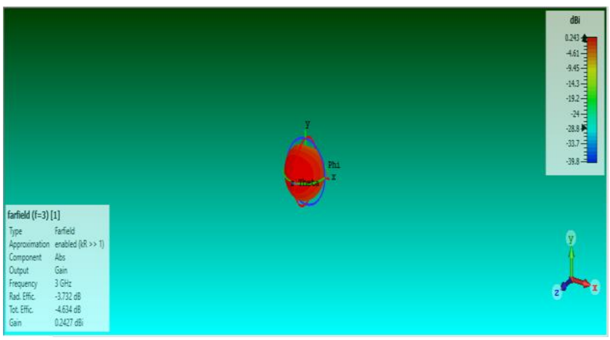
$$L = \frac{1}{sf_r\sqrt{\epsilon_{eff}}\sqrt{\mu_{\circ}\epsilon_{\circ}}} - 2\Delta L$$

L=Length of the patch

The proposed antenna is designed with three steps. First, the antenna is optimized to operate at 3.4 GHz with return loss (S11) less than -25dB for s-band applications. Fig illustrates the designed antenna with the corresponding return loss, VSWR, directivity and gain.







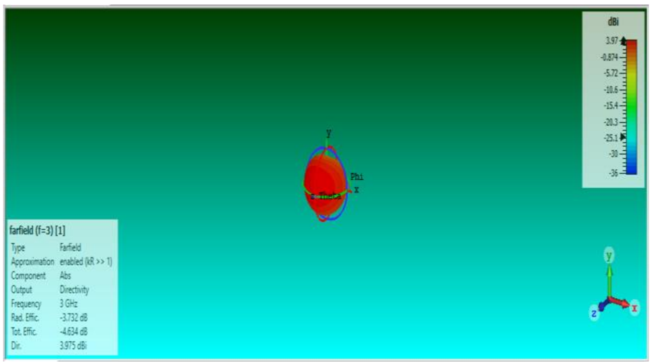
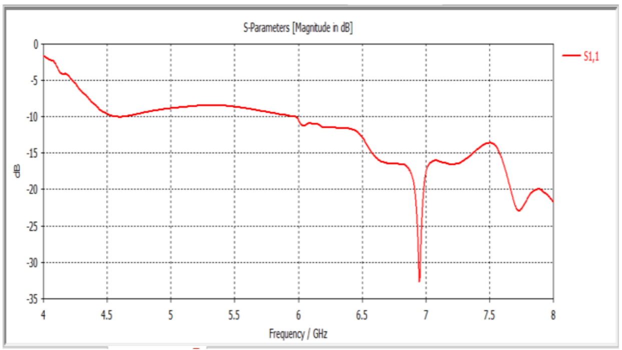
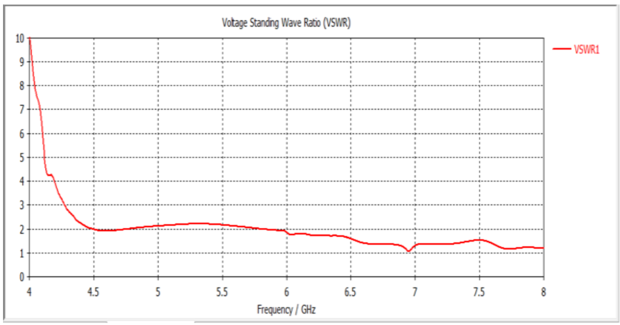
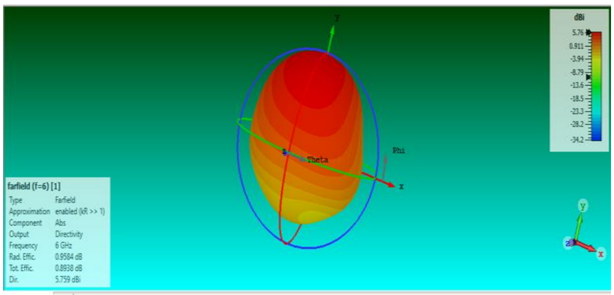


Fig. 1: The performance parameters characteristics of s-band

The second resonance frequency, which is 4 to 8 GHz for C-band applications, is achieved by etching a slot on the patch. While got a second resonance at 6.67 GHz which better than -25 dB, degradation is occurred in the first resonance but it will be enhanced soon.







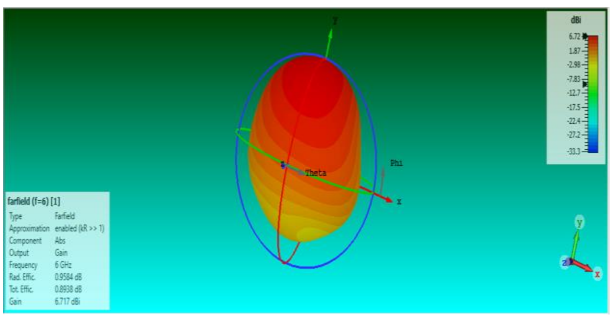


Fig. 2: The performance parameters characteristics of c-band

A third resonance frequency of 7.39 GHz for X-band applications is created by etching near by the slot based on the current distribution along the batch as illustrated in the figure. The S-parameters is demonstrated in second resonant better than 40 dB return loss at the desired frequency is obtained without any negative impacts on the other resonances after creating the third resonance.

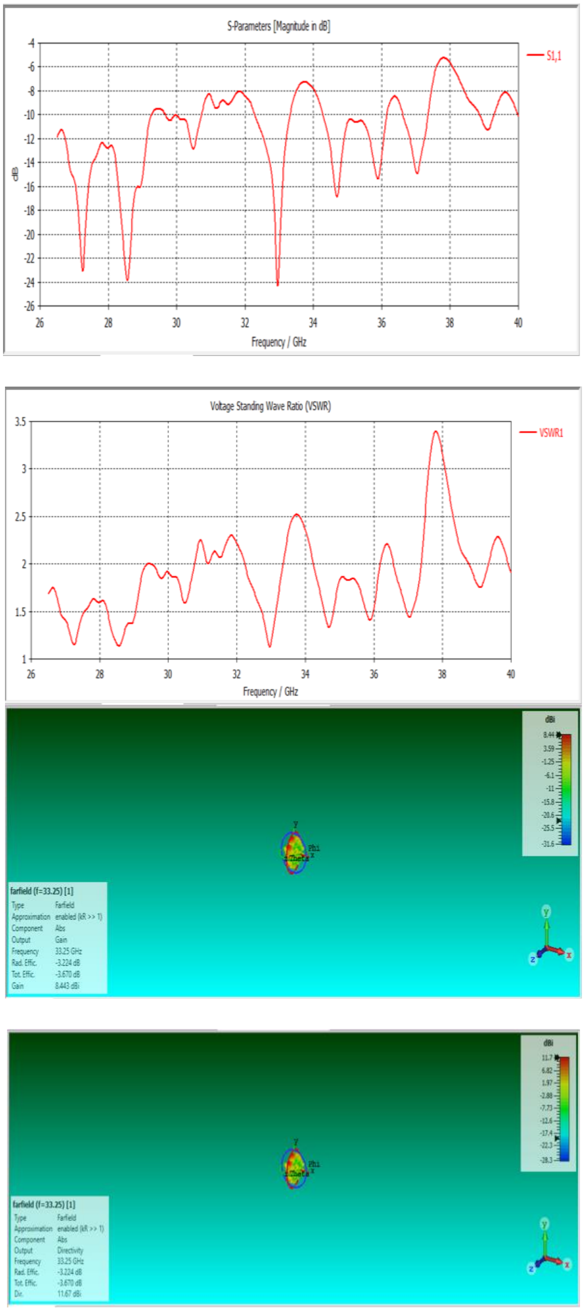


Fig. 3: The performance parameters characteristics of ka-band

The prototype model is fabricated and measured at the Electronic Research Institute. HP Hewlett Packard Agilent vector network analyzer (VNA) standard calibrated is used to measure the Sparameters of the antenna. The comparisons between the simulated and measured return losses (S11) for proposed antenna are demonstrated. The return loss values for the measurements are less than -15 dB at 3.46 GHz, 7.05 GHz and 7.83 GHz. It could be observed that there is not perfect matching between simulation and measurements which may be due to fabrication tolerance or measurement errors. Observed that the measured voltage standing wave ratio which is less than 2 at all resonances, which satisfies good matching impedance.

Table 1: Comparison results of performance parameters

Parameters	S-Band	C- Band	X-Band	Ka-Band
Gain	0.243	6.72	7.52	8.46
Directivity	3.97	5.76	7.24	11.7
VSWR	1.12	1.04	1.015	1.13
Return Loss	-24.95	-32.61	-42.31	-24.38

3. CONCLUSION

In this project, using the 3D simulation tool Computer Simulation Technology (CST) the performance of the Micro-strip line feeding and Proximity Coupled Micro-Strip Patch Antenna is measured. After the complete analysis, we can conclude that the Direct Coupled and Proximity Coupled MPA with ECE path shape gives Low Return loss, High Directivity, High Gain and Low VSWR which gives better performance for microwave frequency applications and Satellite communication transmissions.

4. FUTURE SCOPE

The proposed Direct coupled ECE shaped micro-strip patch antenna Operates in S band of frequencies and it is also effective in X Band. The proposed Proximity coupled ECE shaped micro-strip patch antenna Operates in C band of frequencies and it is also effective in Ka Band. So, for further Applications of Direct coupled ECE shaped micro-strip patch antenna in S, X bands the selection of Suitable material for substrate and increasing the height of the substrate, or by employing Defected Ground Slots Technique We can also use this Direct coupled ECE shaped micro-strip patch antenna for S, X bands. Similarly, for further Applications of Proximity coupled ECE shaped micro-strip patch antenna in C and Ka bands the selection of Suitable material for substrate and increasing the height of the substrate, or by employing Defected Ground Slots Technique We can also use this Proximity coupled ECE shaped micro-strip patch antenna for C and Ka bands

5. REFERENCES

[1] Ch.Rama Krishna & Naga Ganesh.A & D.Durga Prasad, "Design of Elliptical Shaped Micro-Strip Patch Antenna for Ka Band," International Journal of Research and Analytical Reviews, Volume 5, Issue 3, Sept 2018.

[2] X.-X. Zhang and F. Yang, "The study of slit cut on the micro-strip antenna and its applications," Microwave Opt. Technol. Lett., vol. 18(4), 1998.

[3] S. Rawat, and K. K. Sharma, "A compact broadband micro-strip patch antenna with defected ground structure for C-band applications," Central European Journal of Engineering, Springer, 2014, 287-292.

[4] Alok Kumar, Nancy Gupta and P. C. Gautam, "Gain and Bandwidth Enhancement Techniques in Microstrip Patch Antennas - A Review", International Journal of Computer Applications (0975 – 8887) Volume 148 – No.7, August 2016

[5] Samah Badr1 and Ehab K. I. Hamad2, "Design of multiband microstrip patch antenna for WiMax, C-band and X-band applications", Aswan Engineering Journal (AswEJ), Aswan University, Aswan 81542, EGYPT.

