Design and Comparison of a Rectangular-Slot-Loaded and C-Slot-Loaded Microstrip Patch Antenna

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Abstract
The aim of this paper is to design and compare microstrip antennas fed by coaxial probe. A coaxial feed, rectangular-slot loaded, microstrip antenna is proposed for linear polarization and compared to the C-slot-loaded microstrip antenna. The compactness of the antenna is easily obtained by inserting a C-slot. The rectangular-slot-loaded microstrip antenna and C-slot-loaded microstrip antenna is comparing their simulated value using IE3D.

Key words:
Rectangular-Slot-Loaded, C-Slot-Loaded, Microstrip, Patch Antenna

1. Introduction

Micro Strip antennas are popular for their attractive features such as low profile, low weight, low cost, ease of fabrication and integration with RF devices, allow multi-frequency operation to be achieved [1] Linearly polarized microstrip antennas (LPMAs) are widely used in many wireless communication applications. The classification of the LPMAs is based upon the single-feed or dual-feed types. Single-feed wideband LPMAs are currently receiving much attention. The single fed antenna is useful, because it can excite linear polarization (LP) without using an external polarization**.** In the resent years, radar and communication system, such as global positioning system (GPS), synthetic aperture radar (SAR) **o**ften require dual frequency patch antennas to avoid the use of two different antennas. Dual frequency is obtained by introducing the slots parallel to radiating edges of the patch co-axial [2-3]. The patch radiator was fabricated from the copper sheet and mounted on a duroid substrate. However, the patch radiator on the duroid substrate is mechanically unstable. Moreover, the coaxial feed in this antenna makes it unsuitable for a low-cost antenna array design. The slot loading allows one to strong interaction between the main patch and the slot resonant frequency. The slot loading is also a good solution to minimize and enhance the impedance mismatch and bandwidth almost similar radiation pattern for the rectangular and slot loaded patch antennas confirm that the current distributions are not much affected by the slot cut in the patch. In this paper, we propose a new compact, coaxial feed, linearly polarized, rectangular-slot-loaded microstrip antenna. The antenna consists of a rectangular-slot-loaded patch radiator and a coaxial feeding structure. The results are compared with the results obtained by EM simulator software, IE3D.

Manuscript received April 5, 2010
Manuscript revised April 20, 2010

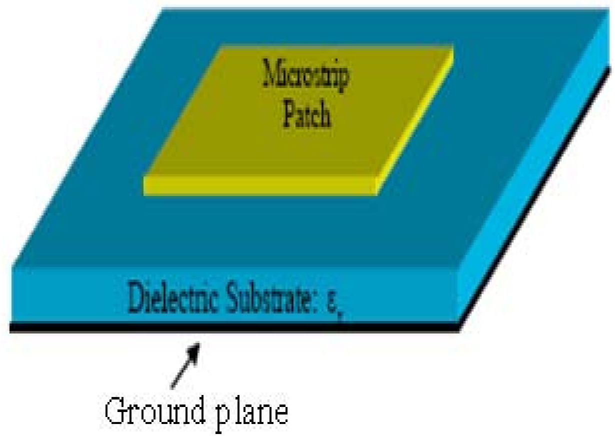

Figure 1. Rectangular Microstrip Patch Antenna

2. Proposed Antenna Geometry and Design

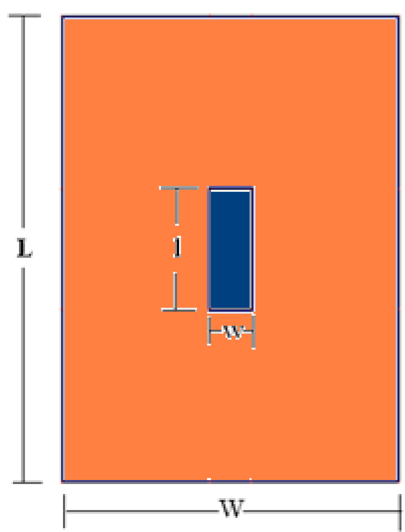

Figure 2. Geometry of rectangular-slol-loaded microstrip antenna

The proposed antenna geometry is shown in Fig. 2. The antenna is first analyzed using the method of transmission line model. The width and length of the patch are given by [4]

$$W = \frac{C}{2 f_0 \sqrt{\frac{(\varepsilon_r + 1)}{2}}} \qquad (1)$$

$$L = \frac{c}{2 f \sqrt{\varepsilon_{eff}}} - 2\Delta \qquad (2)$$

where,
C is the velocity of light,
ε_r is the dielectric constant of substrate,
f_o is the antenna working frequency,
and the effective dielectric constant ε_{eff} is given as,

$$\varepsilon_{eff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2}\left[1 + 12\frac{H}{W}\right]^{-\frac{1}{2}} \qquad (3)$$

Also,

$$\frac{\Delta}{H} = \frac{(\varepsilon_{eff} + 0.300)\left(\frac{W}{H} + 0.262\right)}{(\varepsilon_{eff} - 0.258)\left(\frac{W}{H} + 0.813\right)} \qquad (4)$$

3. Designed Parameters

For designing the proposed antennas the following parameters are used.

Design frequency	= 1.5 GHZ
Free space wavelength	= 100 mm
Dielectric constant	= 4.2
Loss tangent (tan δ)	= 0.0013
The thickness of the substrate	= 1.6 mm
Length of the patch	= 49 mm
Width of the patch	= 62 mm
Location of feed point	= (32, 10)

4. Antenna Fabrication and Results

After designing and comparison it has been found that the result obtained by rectangular slot loaded antenna is better than C slot loaded antenna at the same designing parameters. It is mounted on a RT duroid substrate of dielectric constant 4.2. The resulting data are presented in Figures.4, & 6.

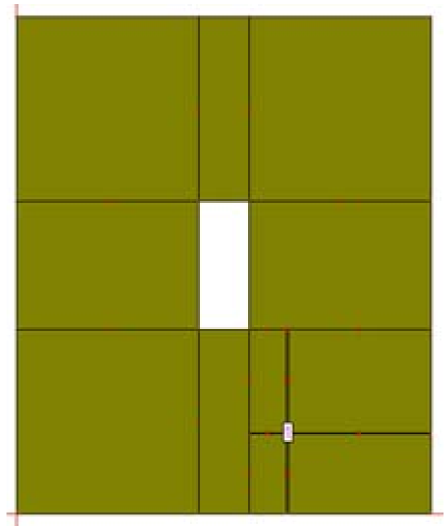

Figure 3. Rectangular-slot-loaded microstrip antenna on IE3D

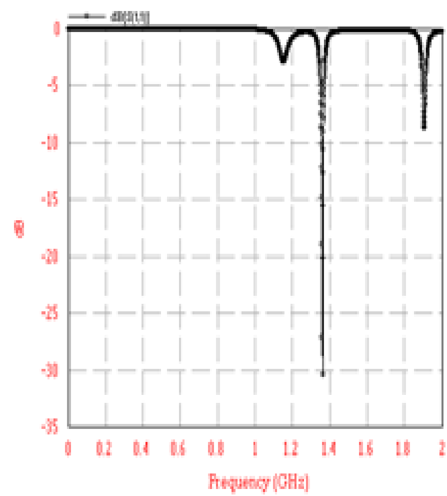

Figure 4. Return loss Vs frequency plot of rectangular-slot-loaded microstrip antenna on IE3D.

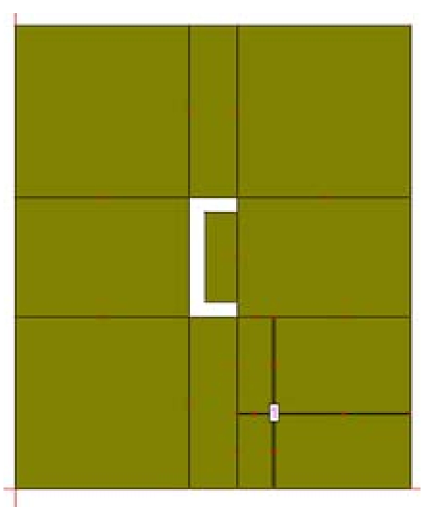

Figure 5. C-slot-loaded microstrip antenna on IE3D

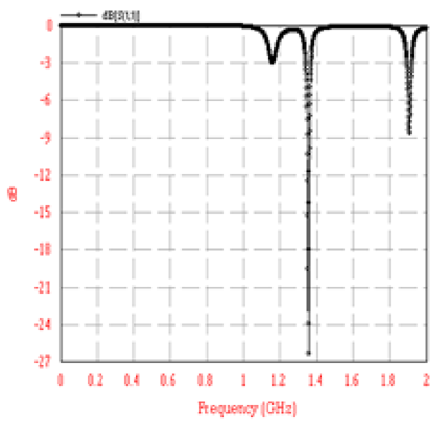

Figure 6. Return loss Vs frequency plot of C-slot-loaded microstrip antenna on IE3D.

Conclusions

It is observed that a coaxial feed, linearly polarized, C-slot loaded and rectangular slot loaded microstrip antenna has been designed, and simulated. After comparison the rectangular slot loaded antenna gives better results as compared to C slot loaded microstrip antenna. The both the microstrip antenna is suitable for implementing compact arrays, thus achieving even higher gain over specified bandwidth.

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