Compact High Gain Multi-frequency Microstrip Antenna

S.De, P.Samaddar, S.Sarkar, S.Biswas, D.Sarkar, P.P.Sarkar

Abstract— In this paper, an antenna has been designed with some slots on the ground plane and a T slot on the radiating patch which shows five resonant frequencies. The size of the designed slotted antenna is reduced by more than 92% compared to the reference antenna. Omni-directional good radiation pattern and as well as Return Loss characteristics are done by Ansoft Designer software The gain of the antenna is also remarkable..

Index Terms— microstrip antenna, compactness, high gain, multfrequency.

I. INTRODUCTION

Microstrip patch antennas are widely employed in many practical applications because they have advantages of low profile, light weight, low cost, conformability, ease of fabrication, integration with RF devices, etc. [1]–[4]. Multi-frequency microstrip antennas with a single feed are required in various radar and communications systems, such as synthetic aperture radar (SAR), multi-band GSM/DCS 1800 mobile communications systems, and the Global Positioning System (GPS)[5]. Generally, the multi-frequency Microstrip antennas found in the literature may be divided into two categories: multiresonator antennas and reactively loaded antennas. In the first kind of structure, the multi-frequency operation is achieved by means of multiple radiating elements, each supporting strong currents and radiation at its resonance. This category includes the multilayer stacked-patch antennas using circular, annular, rectangular, and triangular patches [6], [7]. A multiresonator antenna in coplanar structures can also be fabricated by using aperture-coupled parallel microstrip dipoles [8]. As these antenna structures usually involve multiple substrate layers, they are of high cost. Large size is another drawback of the multiresonator antenna, which makes it difficult for the antenna to be installed in hand-held terminals. In this paper a simple slotted rectangular, single layered, defecting grounded and inset fed Microstrip patch antenna has also been presented. This compact patch antenna can radiate three frequencies i.e 1.18GHz, 1.51GHz, 3.35GHz, 5.4GHz and 9.58GHz with return loss of about 12.2dB, 17.3dB, 13.9dB, 21.2dB and 16dB respectively This antenna can be used in WiMAX and WLAN application and more than 92% size reduction has been achieved by cutting the unequal slots in patch and ground plane. The resonant frequency ratio of third to second band is 2.22GHz.

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II. ANTENNA DESIGN

Fig 1: shows the geometry of the patch of the designed compact linearly polarized antenna.

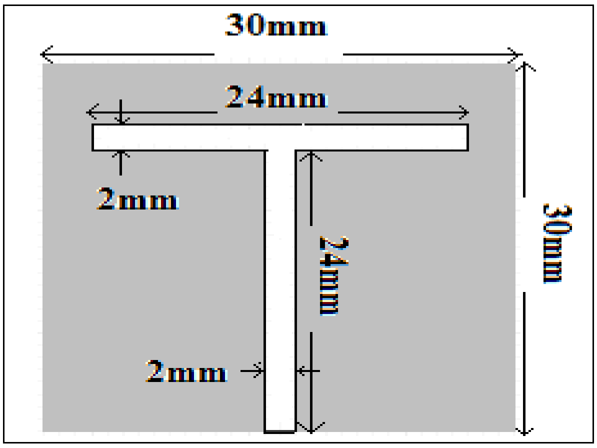

Fig 1:- Design of the patch of the antenna

A rectangular patch of size 30mm*30mm is fed through a coaxial feed. The feeding point is so positioned to obtain better impedance matching. For better matching of input impedance, the radiating patch is positioned at the centre with respect to ground plane of the antenna. A T shaped slot of width 2mm and length 24mm is embedded on the patch.

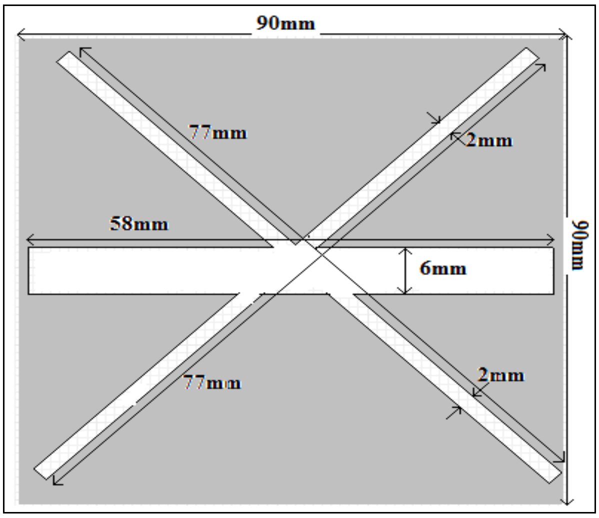

Fig 2:- Design of the ground plane of the antenna

The unequal slots are embedded in the ground plane at the centre position. The crossed slot has equal lateral lengths of 77mm with a slot width W=2mm. They are crossed each other at 45^0 angle. A rectangular slot of length 58mm and width 6mm is embedded at the centre position of the ground plane. These patches are printed on glass-PTFE substrate, of permittivity €=2.4 and thickness 1.6 mm.

III. RESULTS & DISCUSSIONS

For the conventional Antenna structure, the return loss vs frequency plot is shown in Fig 3. From this Figure it is shown that there are Three resonant frequencies at 6.06GHz, 6.88GHz and 9.1GHz with return loss of about -22.1dB, -13.3dB and -11.5dB respectively. The simulated resonant frequencies of the slotted antenna are 1.18GHz, 1.51GHz, 3.35GHz, 5.4GHz and 9.58GHz with return loss of about 12.2dB, 17.3dB, 13.9dB, 21.2dB and 16dB respectively is shown in Fig 4. From these two figures it has been shown that the number of resonant frequencies is increased and shifted to the left side for slotted antenna than reference one. The omnidirectional Radiation pattern of this antenna is also shown in Fig: 5, Fig 6 and Fig 7 for the resonant frequency 1.18GHz, 1.51GHz and 3.35GHz respectively. The VSWR value of this antenna is also good which is shown in Fig 8.From Fig 9 it has been shown that the gain of the antenna is 5.45dBi.

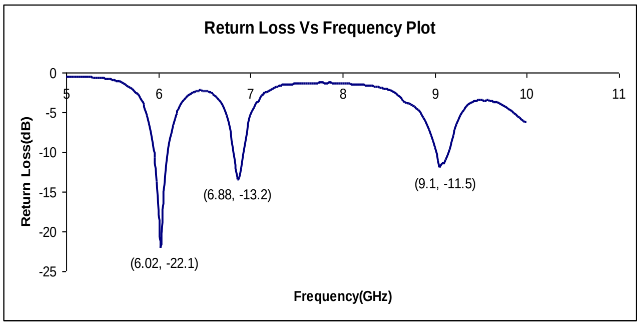

Fig 3:- Return Loss Vs Frequency plot for reference antenna

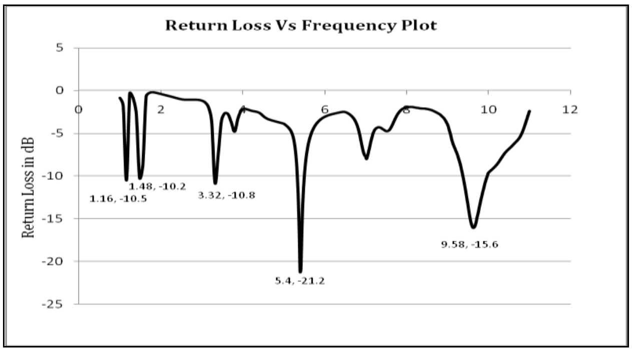

Fig 4:- Return Loss Vs Frequency plot for slotted antenna

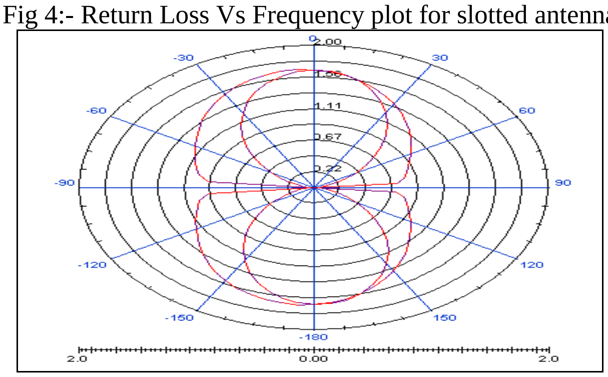

Fig 5:- Radiation pattern of the slotted antenna at 1.18GHz

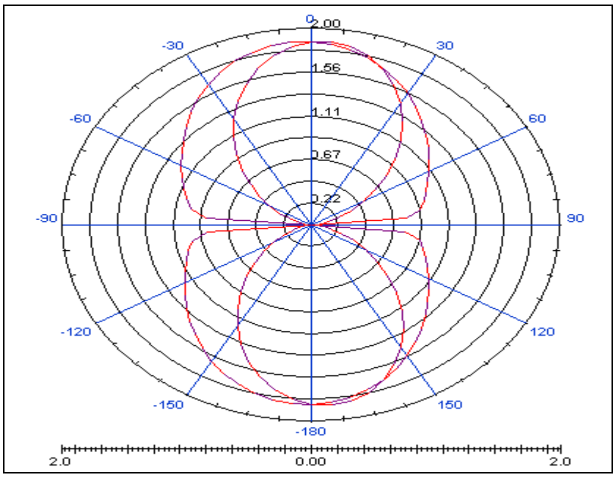

Fig 6:- Radiation pattern of the slotted antenna at 1.51GHz

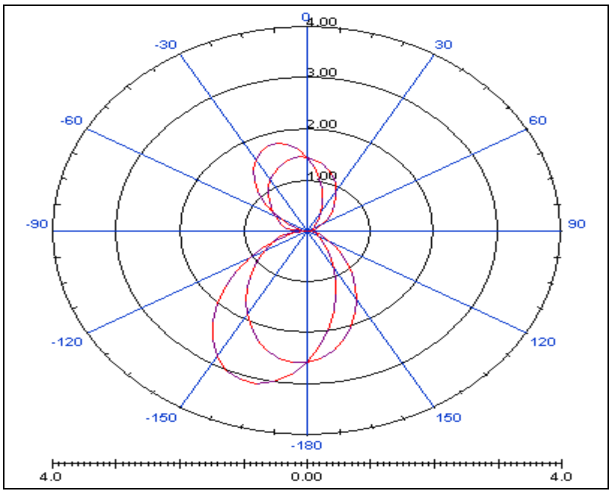

Fig 7:- Radiation pattern of the slotted antenna at 3.35GHz

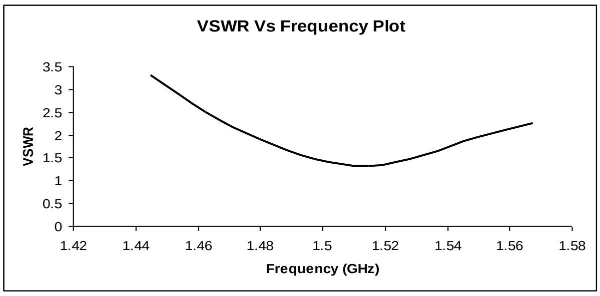

Fig 8:- VSWR curve for the slotted antenna

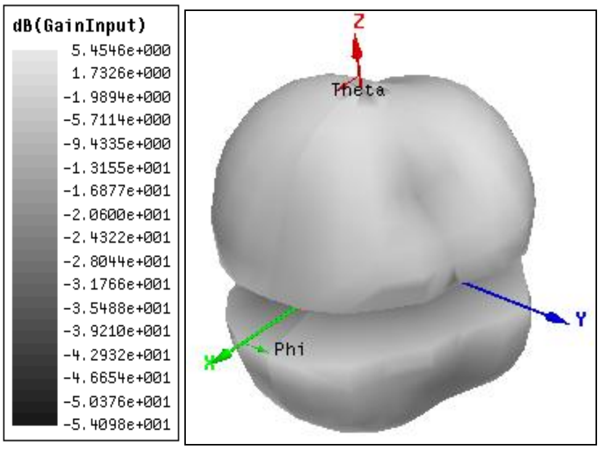

Fig 9:- Gain for the slotted antenna

IV. CONCLUSION

For the antenna without slot the resonant frequencies are 6.02GHz, 6.88GHz and 9.1GHz. It is also found that the resonant frequencies for the slotted antenna are 1.18GHz, 1.51GHz, 3.35GHz, 5.4GHz and 9.58GHz with return loss of about 12.2dB, 17.3dB, 13.9dB, 21.2dB and 16dB respectively.So, resonant frequencies are significantly decreased and also the number of resonant frequencies is increased for the slotted antenna. Theoretically if we want to design the antenna to operate at first resonant frequency 1.18 GHz then size of the antenna will be around $360mm^2$.So around 92% size reduction is achieved. The gain of this antenna is 5.45dBi,which is also a good result.

V. ACKNOWLEDGEMENT

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