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A Miniaturized Multiband CPW-Fed Microstrip Antenna with Modified Ground Structure for Wireless Applications

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ABSTRACT: In this paper, a CPW-fed Microstrip antenna is proposed with modified ground structure for various wireless applications. The rectangular patch has four symmetrical circular slots in the patch for improved antenna characteristics. The proposed antenna has been designed with miniaturized dimensions of 30x 38x 0.7 mm^3 , using Rogers RT5880 substrate. It is a multiband antenna radiating at different frequencies wit bandwidth of 0.65 GHz (1.08 GHz-1.74 GHz), 0.54 GHz (4.12 GHz-4.66 GHz) and 1.18 GHz (11.80 GHz-12.98 GHz). The VSWR is calculated to be less than 2 throughout the bandwidth and the return loss upto -42.289 dB has been obtained. The antenna is designed and analyzed using CST Microwave Studio software through which all the important antenna parameters like VSWR, gain, return loss, radiation pattern are discussed.

KEYWORDS: CST Microwave studio, Coplanar waveguide (CPW), Multiband antenna, Modified ground structure (MGS).

I. INTRODUCTION

In the present era of wireless communication, there is a rising need for compact size antennas with improved radiation characteristics and enhanced bandwidth. The Microstrip antennas are nowadays used for various wireless applications like WLAN, Wi-MAX and RFID as it exhibits wider bandwidth, lower radiation loss, ease of fabrication, lighter in weight, low cost and smaller in dimension. In order to achieve these results different kinds of feeding techniques are used. However the results show that out of all the conventional feeding techniques CPW feeding technique proved to be most promising. The CPW structure has resulted in ease of fabrication of patch and ground both on same plane (MGS) for reduced complexity [1].

A CPW-fed antenna [2] with operating bandwidth of 2.6 to 13.04 GHz is presented for UWB applications. A Microstrip antenna protruded with pair of L-strips and inverted L-strips on either side resonating at 3.6 GHz and 8.1 GHz for Wi-Fi applications is formed using CPW feeding technique [3]. The ground is modified to form two UWB antennas radiating across 2.9-11.5 GHz and 2.9-11.89 GHz respectively [4].

is observed that by cutting slots in the patch of Microstrip antennas the bandwidth can be enhanced [5]. The multiple slots can increase the bandwidth of an antenna up to 70.8%without affecting resonant frequency, and radiation pattern [6].A multiple circular slots Microstrip antenna is formed which works in four frequency bands applicable in C-band, X-band, Ku-band and K-band [7].

A trapezoidal CPW fed antenna shows omnidirectional radiation pattern across the whole bandwidth of 2.3-9.7 GHz [8] applicable in ultra wideband applications. An antenna is formed with 56 similar radius circular slots for operation in ISM band [9]. A rectangular patch [10] with two symmetrical steps like slots modifies the patch to give omnidirectional radiation pattern and ultra bandwidth region.

In this paper, a miniaturized coplanar waveguide fed antenna has been proposed with a modified ground structure. It has four symmetrical circular slots in the patch and a rectangular slot in the ground plane. The results show the proposed antenna can be used in multiple applications like GSM, RFID, IMT and Bluetooth.

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II. ANTENNA DESIGN

The geometrical specifications of the proposed antenna for multiband applications are illustrated in figure 1. The given antenna is made of Rogers RT5880 substrate with permittivity 4.4. The length and width of substrate are 60mm and 80mm respectively and the thickness of substrate is measured to be 0.5mm. As shown in figure 1, the radiating patch of the antenna has four symmetrical circular slots of radius (r) 3.2 each.

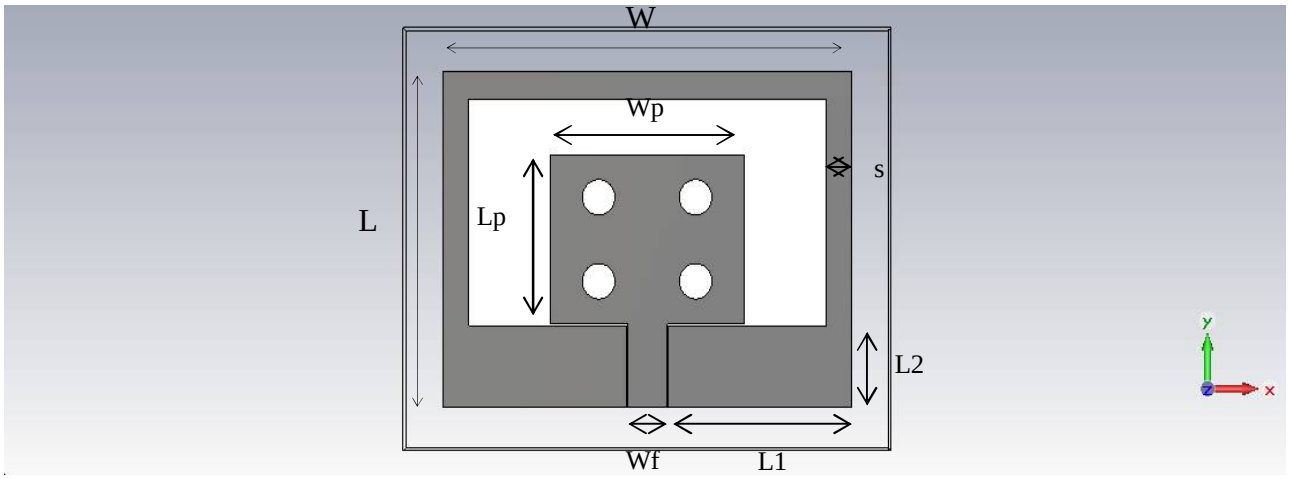

Fig1: Design of proposed antenna

Parameter	Description	Dimension (mm)
W	Width of substrate	80
L	Length of substrate	60
Wp	Width of patch	38
Lp	Length of patch	30
Wf	Width of feed	7.8
L1	Width of ground plane	36
L2	Length of ground plane	14.5
s	Width of stub	5
h	Height of substrate	0.5
hp	Height of patch	0.2
r	Radius of circular slots	3.2
Wp	Width of patch	38

Table 1 Dimensions of the proposed antenna

Thus, the proposed antenna has an advantage that it is very compact in size. On the basis of the given parameters, the antenna is analysed and simulated using CST simulation software whose results are discussed in the next section.

III. SIMULATION RESULTS

The simulated return loss result of the proposed microstrip multiband antenna is shown in figure 2. The plot clearly shows that the antenna resonates effectively at three different frequencies of 1.37 GHz, 4.41 GHz and 12.45 GHz with return loss of -42.289 dB, -15.09 dB and -20.38 dB respectively which shows that the proposed antenna exhibits

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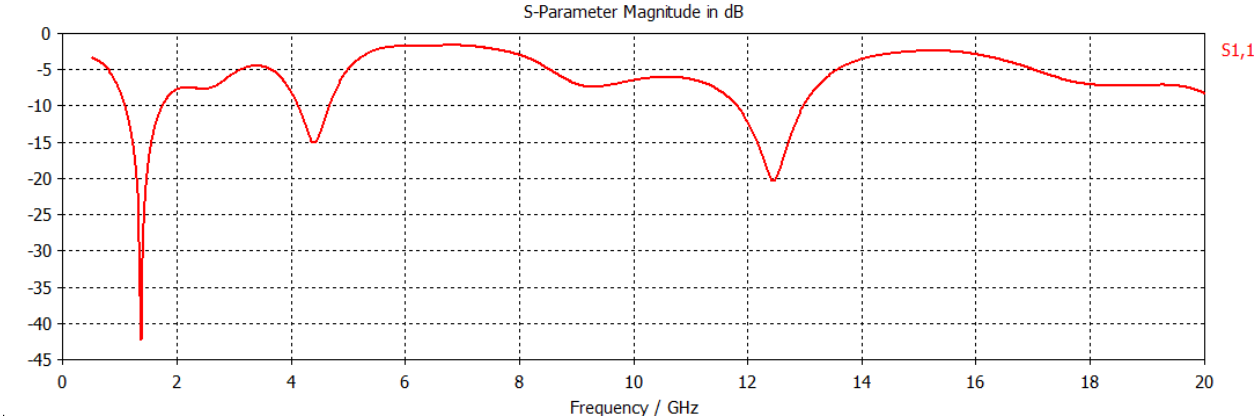


Fig 2 Simulated return loss of proposed antenna

Also, the proposed antenna satisfies the VSWR characteristics i.e. the VSWR throughout the resultant resonant frequencies of the multiband antenna is less than 2 as shown in figure 3.

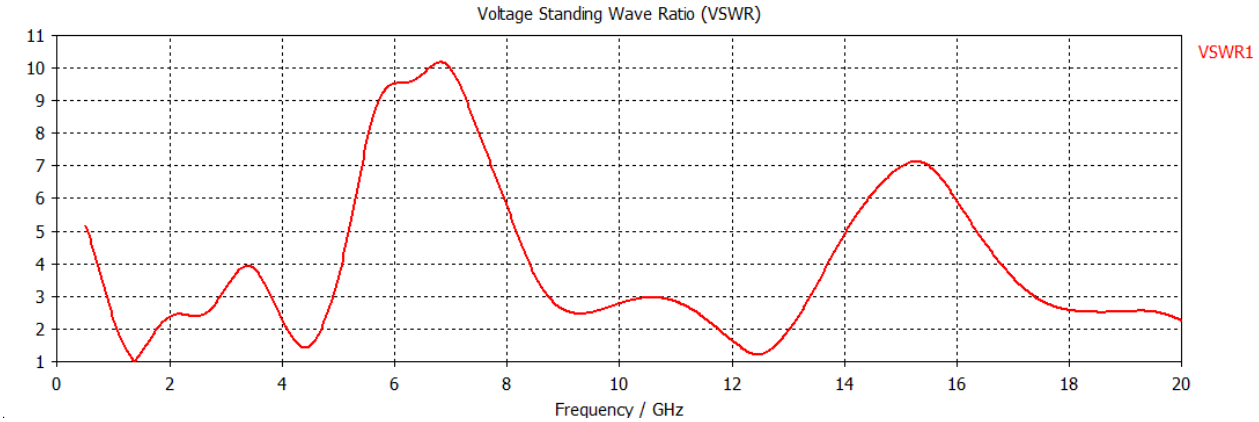
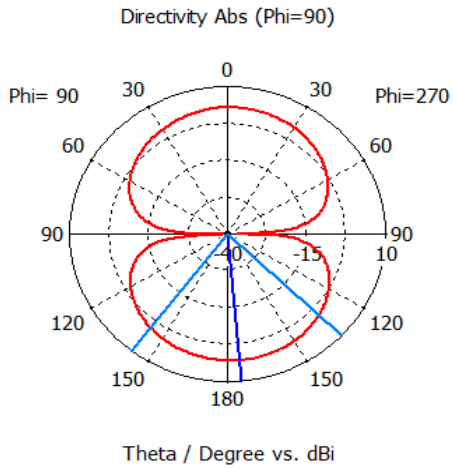


Fig 3 VSWR plot for the proposed antenna

The simulated radiation pattern of the proposed antenna in E-plane is presented in figure 4 at different radiating frequencies of 1.37 GHz, 4.41 GHz and 12.45 GHz.



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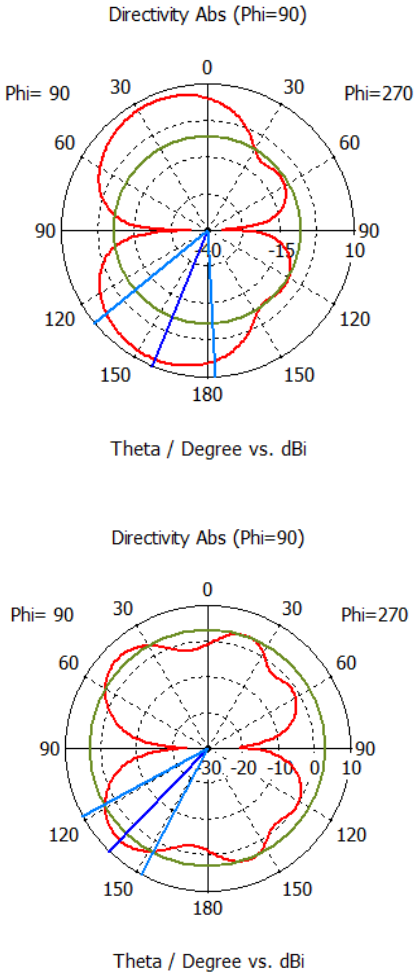

Fig 4 E-plane radiation patterns at different resonating frequencies

It shows that the directivity of the antenna at 1.37 GHz, 4.41 GHz and 12.45 GHz is 2.8 dBi, 7.4 dBi and 5.5 dBi respectively.

IV. CONCLUSION

The proposed antenna consists of a rectangular patch element with four symmetrical circular slots and modified ground structure resulting into a multiband antenna. The return loss value of less than -10 dB has been obtained upto -42.89 dB which shows that there is a good impedence matching in the proposed antenna. Various other important parameters like bandwidth, gain, directivity, VSWR have been discussed. Thus, the proposed antenna is good enough for different wireless applications.

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