

Broad Band Microstrip Antenna with Modified Patch and Ground Plane

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ABSTRACT

Abstract: Microstrip antenna is low cost, light weight, and easy to connect with the electric circuit, but it has some drawbacks such as low bandwidth and low gain. In this paper planar microstrip antenna is proposed to enhance gain and bandwidth. The new design has a modified ground plane and periodic patch. The bandwidth and gain are enhanced, when compared with the traditional rectangular patch microstrip antenna.

Keywords: Broadband antenna, Modified ground plane, Planar antenna, UWB antenna.

INTRODUCTION

Microstrip patch antennas have been studied extensively over the past many years because of their low profile structure, light weight, and low cost in fabrication on planar and nonplanar surfaces. However, a major drawback of these antennas is the narrow bandwidth. The most straightforward way to improve the microstrip patch antenna bandwidth is to increase the patch-ground plane separation by using a thicker substrate. Another way to improve the bandwidth of an MPA is to create several resonant structures into one antenna by adding more layers, more patches or more extra components.

Ultra-wideband and miniaturization, technique for the microstrip monopole patch antenna (MMPA) in wireless applications is presented. Ultra-wideband was achieved by using a printed modified ground plane on a dielectric substrate with 50-ohm microstrip feed line. This technique allows the bandwidth of the MMPA to be ultra-wideband with satisfactory radiation properties and reduces the antenna size. The proposed antenna with modified ground plane provides an impedance bandwidth ($S_{11} < -10$ dB) more than 5.5 GHz corresponding to 116% of the fundamental resonant frequency with a reduction in antenna size by 20% from the original size. For further improvement in antenna characteristics, an electromagnetic band-gap (EBG) structure is used. Two types of EBG are used.[1]

A slot antenna is proposed to achieve both harmonic suppression and wide bandwidth. To obtain these results, a T-shaped microstrip-line-fed slot antenna and U-shaped conductor line connected with the ground plane are applied. At the fundamental and harmonic frequencies, return loss and radiation characteristics are measured and compared with those of the conventional slot antenna. For the proposed antenna, the 10-dB return loss bandwidth could reach 1220 MHz (1730 ~ 2950 MHz), which is about 52% with respect to the center frequency of 2340 MHz, and it is observed that the second and third harmonics of the proposed antenna are effectively suppressed.[2]

Design and analysis of a line-fed, slotted diamond-shaped microstrip patch antenna is carried out. In order to prove its improvements, it is also benchmarked against a non-slotted diamond-shaped antenna and a conventional rectangular microstrip patch antenna, which are both designed for operation in the 2.45 GHz Industrial, Scientific and Medical (ISM) band. The proposed design is able to operate in at least two other frequency ranges (5.2 GHz and 5.8 GHz) satisfactorily, with broad impedance bandwidth and gain[3]. Bandwidth enhancing technique using a modified ground plane with diagonal edges, rectangular slot, and T-shape cut for the design of compact antennas. The proposed low-cost, compact-size circular patch antenna on 3 cm × 5.1 cm printed circuit board (FR-4) is designed and validated through simulations and experiments. Results show that the T-shaped ground plane with the presence of the diagonal cuts at the top corners and the rectangular slots can increase the bandwidth. Return losses of -19 and -26 dB for the first and second resonant frequencies, respectively, can be achieved when the depth of the diagonal cut is 5 mm, the dimension of each rectangular slot is 5 × 3 mm, and the T-shaped size is 8 × 4 mm, providing a 28.67% wider bandwidth than FCC standard[4].

A new design of a broad-band probe-fed patch antenna with a W-shaped ground plane is presented. The W-shaped ground plane is obtained by bending the conventional planar ground plane into an inverted V-shape, seen in the resonant direction of the patch antenna and then adding proper flanges at the two straight edges of the bent ground plane. The proposed design is applicable to the patch antenna with a planar radiating patch on a thin-air substrate.

With the use of the proposed W-shaped ground plane, the required probe-pin length in the substrate remains to be small, although the effective substrate thickness is significantly increased, resulting in a much wider operating bandwidth. Also, by choosing proper dimensions of the W-shaped ground plane, the antenna gain for frequencies over the obtained wide bandwidth is enhanced, compared to the conventional patch antenna with a planar ground plane[5]. In this paper we proposed a new patch antenna with periodic unit cell and modified ground plane to enhance the bandwidth of the of planner antenna.

ANTENNA DESIGN

A new antenna has be design and simulate using the High Frequency Structure Simulation HFSS of Ansoft® ver. 14. The proposed antenna is shown in Fig. 1. The dimension pf the antenna is illustrated in the Table 1, the substrate material is Roger RT/5870 with $\epsilon_r = 2.33$ and $\tan \delta = 0.0012$.

RESULTS AND DISCUSSION

A new antenna has be design and simulate using HFSS and compared with the traditional planner microstrip antenna to study the effect of the new design, improvement in antenna characteristics, electromagnetic band-gap (EBG) structure is used.

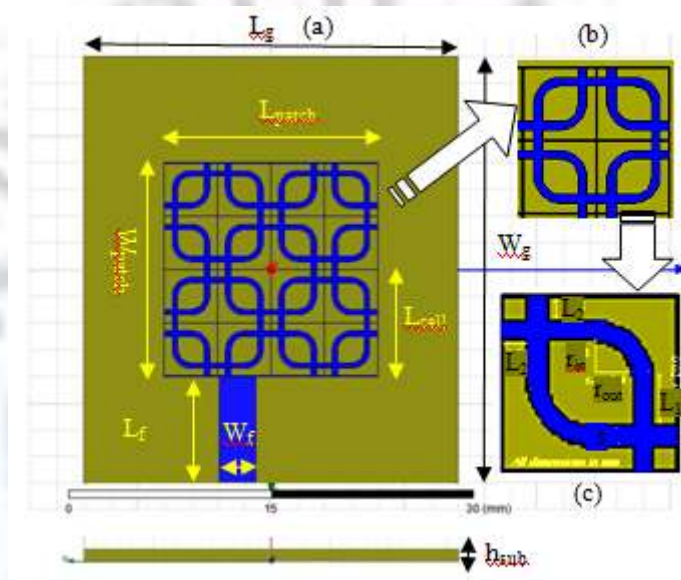


Fig. 1: Proposed microstrip antenna dimensions; (a) proposed antenna, (b) unit cell, and (c) sub unit cell

TABLE 1: Propose Antenna Dimensions (ALL IN mm)

Symbol	value	Symbol	value	Symbol	Value
W_g	32	L_f	8	L_{cell}	8
L_g	28	W_f	2.74	W_{cell}	8
L_{pach}	16	W_{patch}	16	h_{sub}	1
r_{in}	1	r_{out}	1.4	L_1	1
L_2	0.58	S	0.4		

Parametric study has been done to determine the best offset feed location.

Figure 2 depicted the compared results between the traditional antenna (narrow band; blue) and the proposed antenna (broad band; grey).

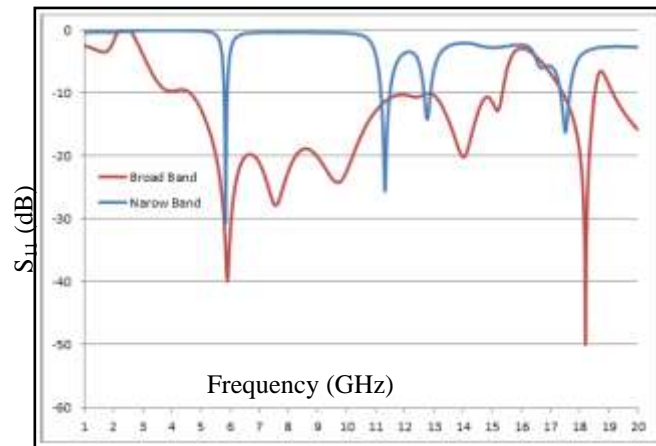


Fig. 2: Return Loss vis. frequency of tow antennas

CONCLUSIONS

A new antenna has been designed and simulated using HFSS and compared with the traditional microstrip, the new antenna show as the ultra wideband behavior when compared with the traditional one. This antenna provide many microwave bands such as WLAN, satellite, radar etc.

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