THE CHARACTERISTICS OF CPW-FED CAPACITIVELY COUPLED MEANDER-TYPE SLOT ANTENNAS

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ABSTRACT: A meander-type slot antenna fed by coplanar waveguide is presented. By increasing the meander-section of the proposed antenna, we have studied the changes of the resonant frequency and radiation pattern. Experimental results show that this antenna has a nearly omni-directional pattern in the H-plane. Designs of the proposed meander slot antenna are described and typical experimental results are demonstrated and discussed.

KEY WORDS: meander-type slot antenna, omni-directional pattern

1. Introduction

Meander-type slot antennas have received much attention, and some researches have been presented [1-3]. The radiation patterns of these meander-type slot antennas are all broadside characteristic, which is the same as that of conventional rectangular slot antenna. In this article, we propose a new design of a meander-type printed slot antenna with CPW feed. In applications, printed slot antennas fed by coplanar waveguide have several advantages that include lower radiation losses, wider bandwidth, better impedance matching, and easier integration of solid-state devices. The resonant frequency of the proposed meander-type slot antenna is decided by the effective length of the slot. By increasing the number of meander section, the resonant frequency significantly decreases and omni-directional radiation pattern can be observed. Designs of the proposed meander-type slot antenna are described and typical experimental results are presented and discussed.

2. Antenna design

The configurations of the proposed CPW-fed printed meander-type slot antennas are shown in Figure 1(a) and (b). The proposed antenna is printed on a substrate of thickness *h* and relatively permittivity ε_r. The CPW feedline is designed to be with 50-Ω characteristic impedance in order to match the measurement system. The CPW signal strip has a width of W_c, and the gap spacing between the signal strip and the coplanar ground plane is S_c. The dimension, L_x, which is the horizontal-slot's length of the proposed antenna, is all the same in these designs for comparison. The longitudinal-slot's length of the proposed antenna is equal to $W \times 4n$, where *n* is the meander- section number per side. The distance *d* is between longitudinal-directed slots. By adjusting the width of slot S, it is found that the resonant frequency of the proposed antenna can be excited with good impedance matching.

3. Results and discussion

Some prototypes of the CPW-fed printed meander-type slot antennas are designed and constructed. These prototypes were fabricated using inexpensive FR4 microwave substrate of thickness *1.6*mm and relatively permittivity *4.4*. Figure 1(a) shows the case with one meander-section (denoted design A), and Figure 1(b) is for the case with three meander-section (denoted design B). All the distance between the longitudinal-directed slots *d* is *1*-mm in these designs. Owing to the effective length of the slot is meandered in the present designs, the obtained operating frequency is greatly lowered; thus, compact CPW-fed capacitively coupled slot antenna can be achieved for the present designs.

A conventional (without meander) CPW-fed capacitively coupled slot antenna was first constructed as a reference antenna. Figure 2 presents the measured return loss of designs A and B; the corresponding results are given in Table 1. It is observed that the impedance bandwidths are 49 MHz and 26 MHz, or about 2.3% and 1.5% with respect to the center frequencies (approximately resonant

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frequencies) at 2140 MHz and 1740 MHz, respectively. Note that the operating frequencies are lowered by about 22% and 36% compared to that (2740 MHz) of the reference antenna.

Radiation properties for the proposed designs are also studied. Measured radiation patterns are plotted in Figure 3, and nearly omni-directional radiation pattern in the H-plane can be obtained for design A or B.

4. Conclusions

The coplanar waveguide-fed capacitively coupled meander-type slot antenna has been presented and experimentally studied. The proposed antenna has the advantages of compact size and omni-directional pattern compared with conventional slot antenna. With same ground-plane dimension, the resonant frequency of the meander-type slot antenna has been decreased from 2.74 GHz to 1.74GHz. However, the disadvantages of the meander-type slot antenna compared with conventional slot antenna are lower bandwidth and gain.

References

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Table 1: Parameters and performance of the proposed meander-type slot antennas fed by CPW. The parameters are $h = 1.6mm$, $\varepsilon_r = 4.4$, $W_c = 6.4mm$, $S_c = 0.5mm$, d = 1mm, L_x = 36.3mm, W = 4.8mm, ground-plane size = $57 \times 27\ mm^2$.

	Design A Fig. 1(a)	Design B Fig. 1(b)	Reference (no meander)
L_x (Length of horizontal-slot, *mm*)	36.3	36.3	36.3
L_y (Length of longitudinal-slot, *mm*)	19.2	57.6	0
$(L_x+L_y)/\lambda_s$	0.51	0.69	0.42
S (mm)	0.8	0.5	1.2
f_r, *BW(MHz, %)*	2140, 2.3	1740, 1.5	2740, 3.7
Gain (dBi)	0.2	0.3	3.2

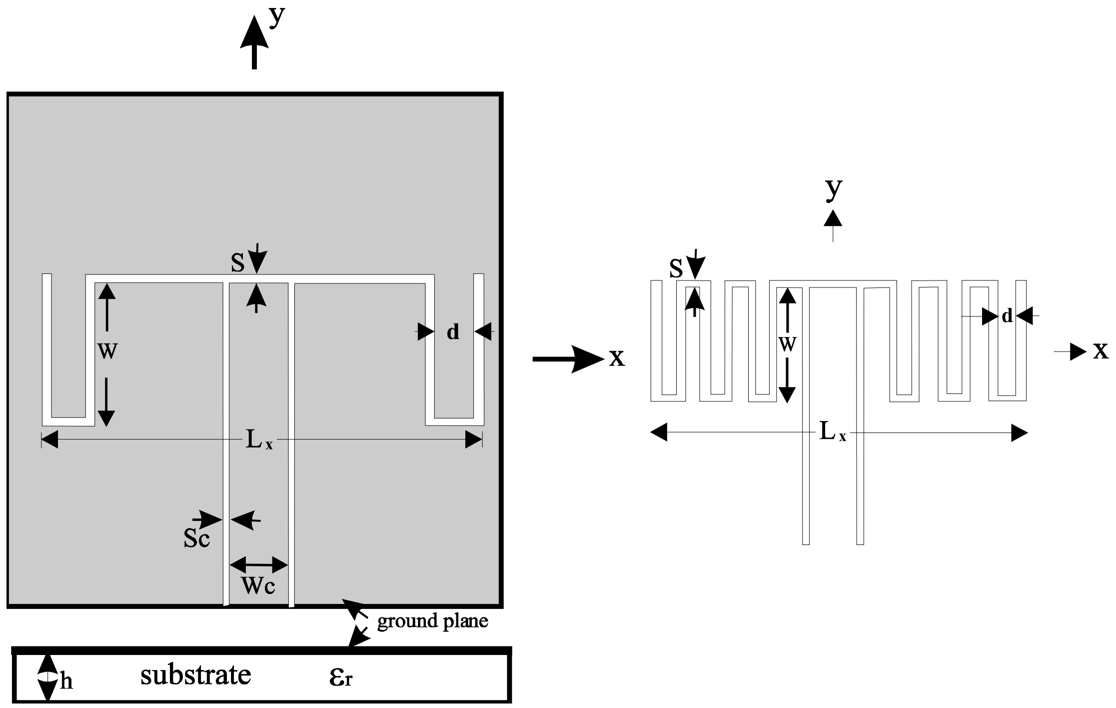

Fig. 1 Geometry of the proposed meander slot antenna. (a) one meander section, (b) three meander sections.

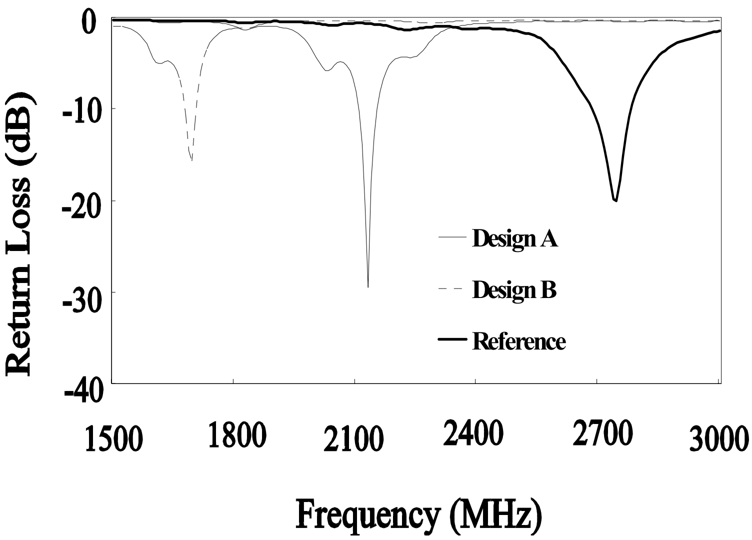

Fig. 2 Measured return loss against frequency for the proposed meander- type printed slot antenna; antenna parameters are given in Table 1.

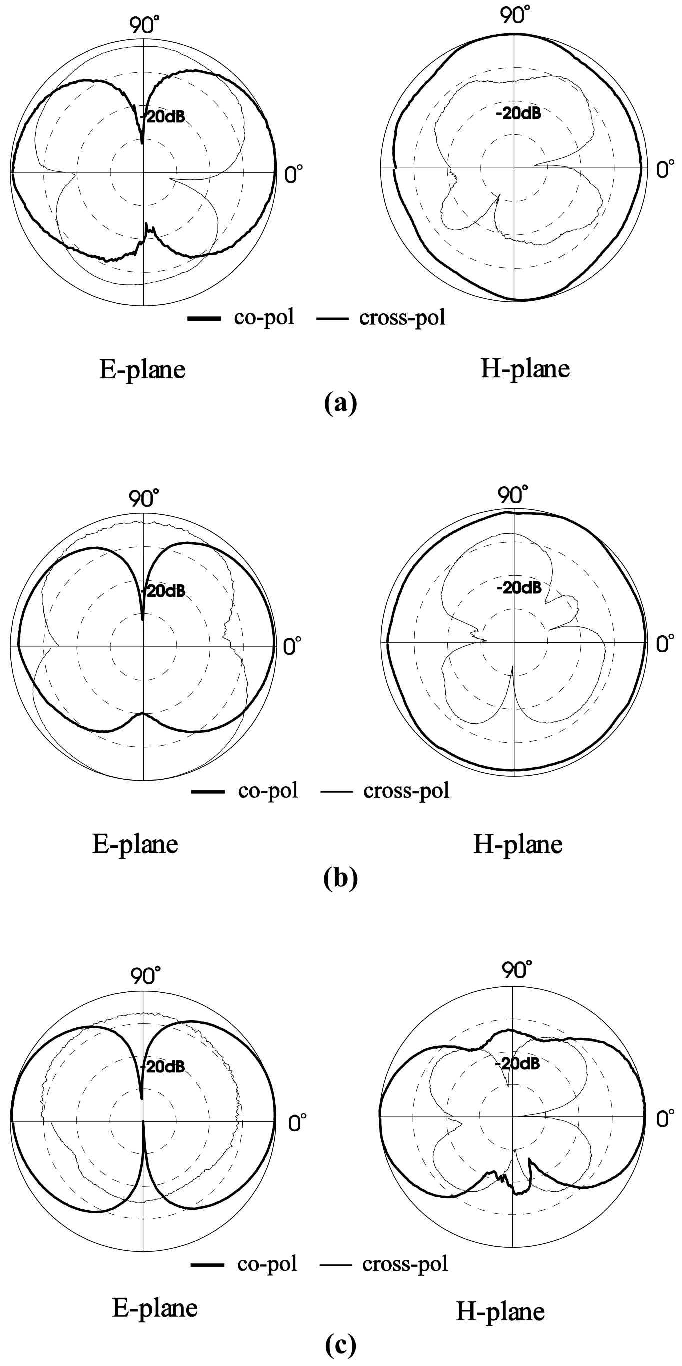

Fig. 3 Measured radiation patterns in two principal planes for antenna studied in Fig. 2. (a) Design A, (b) Design B, (c) Reference antenna.