Radiation of Circularly Polarized Printed Antenna Composed of Slots Fed By Coplanar Waveguide

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1 Introduction

As is well known, planar antennas consisting of patches, dipoles, or slots fed by a microstrip transmission line are extremely useful to their low cost, light weight, and flexibility of design. As the popularity of the coplanar waveguide(CPW) has increased significantly in recent years, antenna elements which are suitable for a CPW-feed configuration have also become important. In comparison with other printed radiation elements, the advantages of CPW include wider bandwidth, better impedance matching possibilities, smaller mutual coupling between two adjacent lines, possibilities of obtaining bidirectional and unidirectional radiation patterns, and easier integration with solid state active devices[1]. Patch antennas[2], loop antennas[3], and slot antennas[4] fed by CPW have been reported.

In this paper, we propose the new structure of the circularly polarized printed antenna fed by CPW and show this element radiates the circularly polarized wave by using the FDTD method.

2 Configuration of the proposed antenna fed by CPW

Figure 1 shows the top view of the proposed antenna. Two antenna elements are connected to each slotline of CPW. Each element is set asymmetrically as shown in Figure 1 in order to produce the same polarization. The antenna element consists of two pairs of slots which are almost a half-wavelength long. Each pair of slots is fed by slotline in a 90° phase difference, and the element will produce the circularly polarized wave. In the Figure 1, the right-hand circularly polarized wave is produced in the broadside direction.

3 Analysis

We analyzed this antenna by using the FDTD method and calculated the near field distribution, the radiation pattern and the axial ratio. On the FDTD analysis, the super-absorbing first-order Mur boundary condition[6] is utilized. We calculated the radiation field by exciting the CPW with the Gausian pulse. The radiation field can be obtained by transforming the near field using the Equivalent theorem[5].

4 Result

The dimensions of the antenna are listed in Table 1. Figure 2 shows the distribution of the magnetic field component H_y at one instant in time, t_0, in the steady state when the CPW is fed by the sin wave of the design frequency. T represents the period. From these charts, it

Table 1: Dimensions of CP-PASS Fed by CPW shown in Figure.1(mm)

parameter	$A1$	$B1$	$A2$	$B2$	S_A	S_B	$W1$	$W2$	S
dimension	4.0	3.5	2.75	1.5	0.625	1.0	0.5	0.5	1.25

is confirmed that the proposed antenna produces the circularly polarized wave by combing two pairs of slots.

Figure 3 shows the circularly polarized characteristics. In this figure, E_r and AR represent a right-hand circularly polarized field component and an axial ratio, respectively. These results are calculated from both the electrical and magnetical current distribution on this antenna. A minimum axial ratio level of 0.5 dB was obtained at 11.7 GHz with a relative frequency bandwidth(AR$\leqq$3 dB) of 3.0%(11.6 ~11.9 GHz). -1dB bandwidth of the co-polarization $E_r$is 10.3%(11.5~12.7 GHz). The bandwidth of the axial ratio isn't very wide, but it will be improved by optimizing the antenna dimensions.

Figure4 shows the far field radiation pattern at 11.7 GHz. The radiation pattern in xy-plane isn't symmetric. It is probably caused by the generation of the even mode on CPW because of the asymmetric configuration of the antenna. In the future research, we will add an air-bridge to the CPW in order to suppress undesirable even mode, and investigate the characteristics.

5 Conclusion

We proposed the new structure of the circularly polarized printed antenna fed by CPW, and demonstrated the characteristics by using the FDTD analysis.

References

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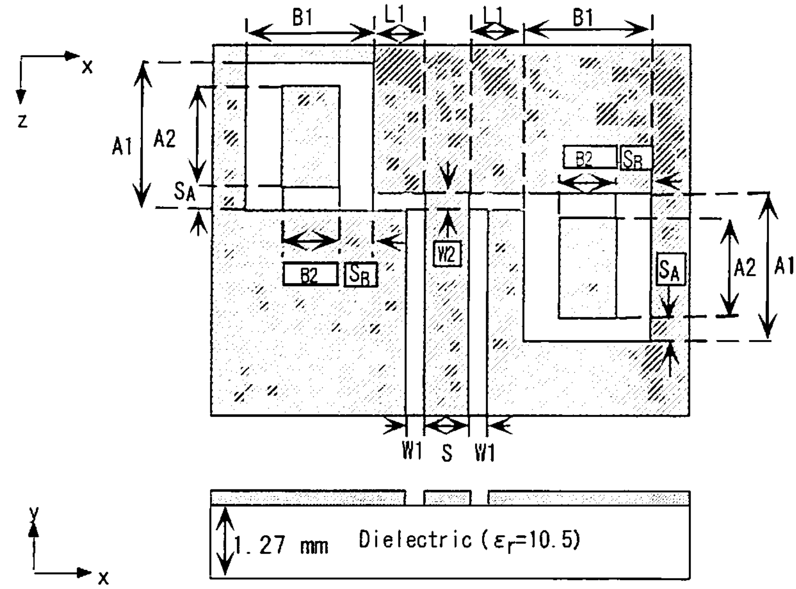

Figure-1: configuration of CP-PASS fed by CPW

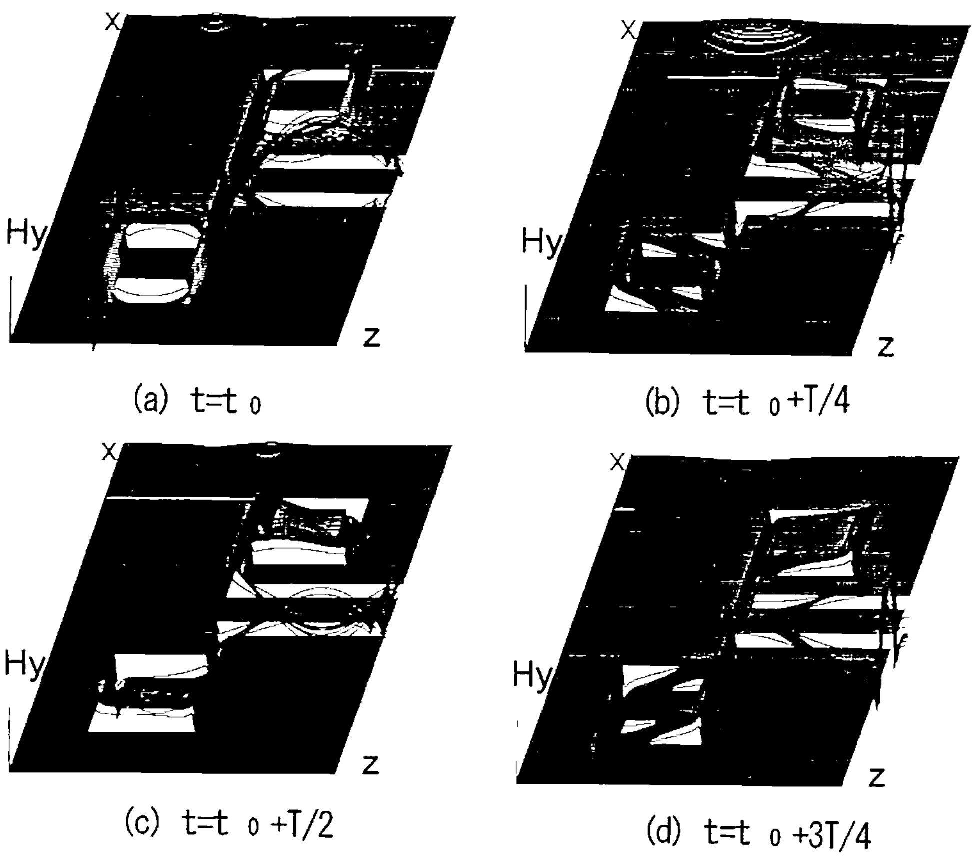

Figure 2: The steady-state magnetic field distribution(y component)

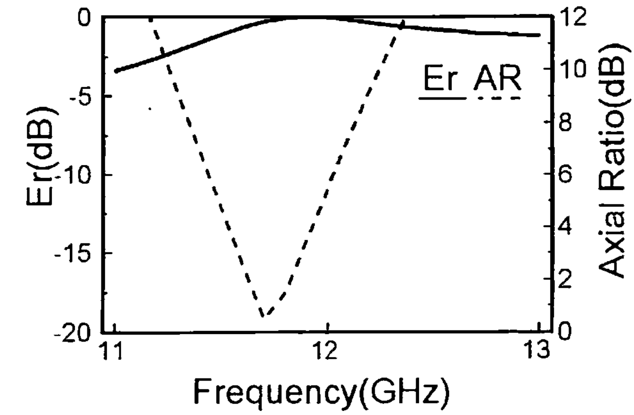

Figure 3: Axial ratio and relative power versus frequency

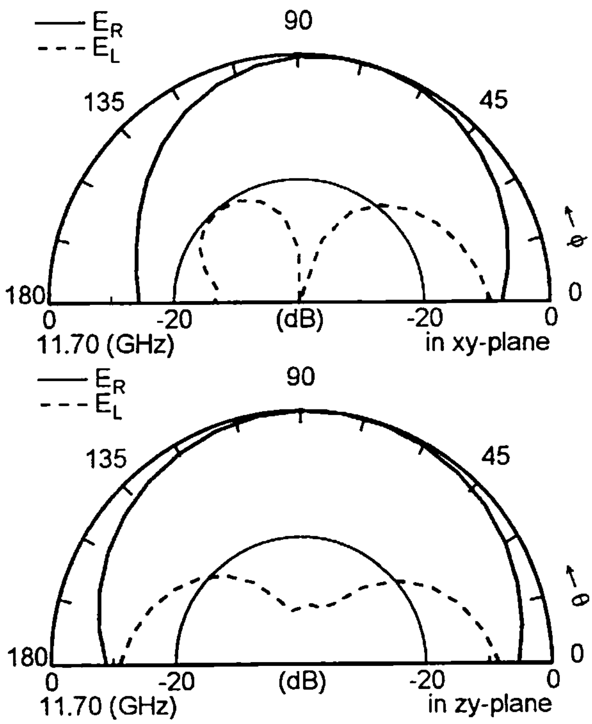

Figure 4: The far-field antenna pattern