Feed structure coupling from the top of the TM_{11} and TM_{21} mode annular ring patch antennas

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1. Introduction

An antenna with annular ring patch antennas (ARPAs) in TM_{11} and TM_{21} modes collocated on a substrate has been proposed to communicate with satellites [1]. However, the antenna has a narrow bandwidth problem, with a fractional bandwidth of about 0.2 %. In order to improve the bandwidth, we proposed an electro-magnetic coupling feeding structure that feeds from the top of the TM_{11} and TM_{21} mode ARPAs [2]. The paper describes a preliminary study of the influence of coupling strip length and feeding point location on bandwidth for antennas in TM_{11} and TM_{21} modes, respectively.

2. Antenna structure and results

Figure 1 (a), (b), (c) and (d) show the antenna and feeding structures [2]. Here, for each mode, there is only one mode antenna. The design frequency f_c is 20.3 GHz. The detail structural parameters are shown in [2]. The coupling strip is made as arc along the ARPA patch, and the feed ports for the TM_{11} and TM_{21} mode patches are placed inside and outside of the patches, respectively. Each ARPA has two ports to obtain circular polarization as shown in Fig. 1(a), (b), (c) and (d). The gap between the coupling strip and ARPA patch h is 0.1 mm. The length of the coupling line along the ARPA patch is represented by the angle $W_{\theta 1}$ and $W_{\theta 2}$ as indicated in Fig. 1. The influence of collocation of both mode antennas on the feeding structure will be presented at the conference.

Figure 2 (a) and (b) show the relationship between angles $W_{\theta 1}$ or $W_{\theta 2}$ and fractional bandwidth. The results are for ports located on the y-axis, with the y-coordinate of the port for the TM_{11} mode (P_{1y}) changed from 0.8 mm to 1.1 mm and the y-coordinate of the port for the TM_{21} mode (P_{2y}) changed from 4.8 mm to 5.2 mm. As shown in Fig. 2 (a), the bandwidth of the TM_{11} mode ARPA is maximized when the angle $W_{\theta 1}$ is 60° regardless of the feeding port location. On the other hand, in the TM_{21} mode ARPA, the angle $W_{\theta 2}$ that maximizes the fractional bandwidth decreases as increasing the feeding port location, as shown in Fig. 2(b). The maximum bandwidth is not significantly affected by the set of angle $W_{\theta 2}$ and feed location. The fractional bandwidth of 1.64 % and 1.63 % are achieved for TM_{11} and TM_{21} mode ARPAs by selecting $W_{\theta 1}$ of 40° and P_{1y} of 1.0 mm for TM_{11} mode ARPA , and $W_{\theta 2}$ of 70° and P_{2y} of 4.8 mm for TM_{21} mode ARPA.

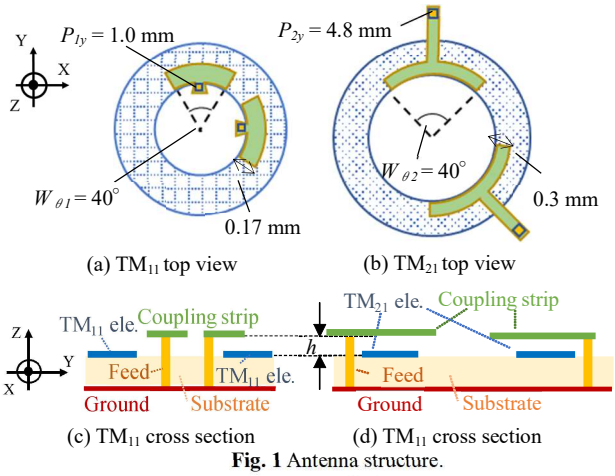

Fig. 1 Antenna structure.

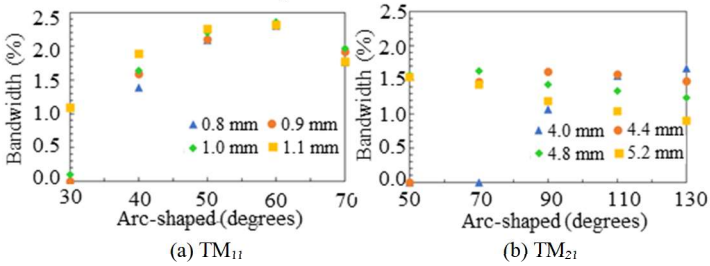

Fig. 2 Relationship between feeding strip angle W_θ and bandwidth

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References

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