Mutual Influence Reduction of Dual Band Reflector Backed Dipole Antenna Using Edge Folded FSR

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***Abstract* – This paper investigates the effectiveness of the edge folded frequency selective reflector (FSR) structure in reducing mutual influence between low and high band radiation patterns of a dual band reflector backed dipole antenna (RBDA), which employs FSR in the high band RBDA. As the results of the moment method analysis related to the half-power-beamwidth (HPBW) and the front-to-back ratio (FB) characteristics of the RBDA, it is confirmed that the edge folded FSR structure is effective to reduce the radiation pattern distortion in both the frequency bands.**

***Index Terms* — Frequency Selective Reflector, FSR, FSS, Dipole antenna, Base Station Antenna, Multi-Band Antenna**

1. Introduction

A multi-band base station antenna using FSR has been proposed [1]. The antenna is especially suitable to integrate RBDAs working on apart frequency bands. The FSR is applied to the high frequency band RBDA. In this configuration, the FSR influences on the other integrated antenna performance especially when operating frequencies of the other antennas are close to the FSR design frequency.

This paper considers a dual-band RBDA working in 3.5GHz and 2GHz bands, and investigates the effectiveness of folding edge of the FSR to reduce the mutual influence on each band radiation characteristics. The effectiveness is evaluated by the moment method analysis [2].

2. Analysis model

Fig. 1 shows the analysis model. FBDA using FSR working in 3.5GHz band is placed in front of the conventional FBDA working in 2GHz band. The width (x direction) and height (y direction) of a conductive reflector to λ and 2λ at 2.2GHz, respectively. The dipole element for 2GHz band FBDA is designed at 2.2GHz and is placed at the center of the reflector. The spacing between the dipole element and the conductive reflector is 27.2mm. As for the 3.5GHz band FBDA, Gang Buster (GB) type element is used for the FSR [1] and five elements are arranged in both width and height directions. In the proposed configuration, the FSR elements located at both ends in the width direction are arranged in front of the other elements as shown in Fig.1 (a). This FSR configuration is called 'FSRc' and flat FSR is called 'FSRf', hereafter. The design frequency of the dipole element is 3.6GHz, and the spacing between the dipole element and FSR is 0.2λ (@3.6GHz) at the center of the FSR. The spacing *d* is the spacing between the conductive plate for the 2GHz band FBDA and the FSR. The considering frequency range is from 2.0GHz to 2.3GHz for

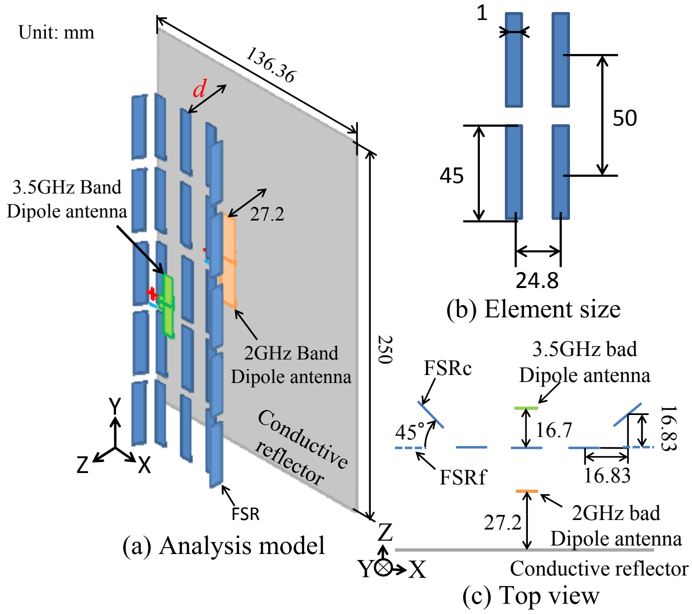

Fig.1 Antenna analysis structure and FSR element

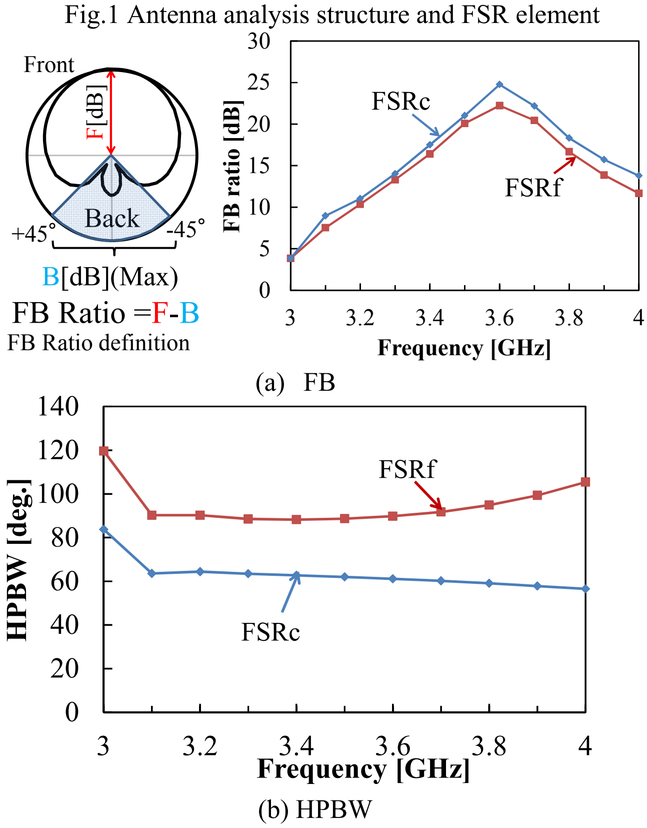

Fig.2 FB and HPBW comparison between the corner and flat FSR configurations

2GHz band and from 3.4GHz to 3.6GHz band for 3.5GHz band in this paper.

3. Radiation characteristics of 3.5GHz band antenna

Fig. 2 shows the frequency characteristic of the FB and HPBW in the H-plane radiation when only the 3.5GHz band RBDA exists. The backward radiation of FB is determined by the maximum radiated power within ±45 degrees in the backward as shown in Fig. 2(a). As can be seen in Fig. 2, both the RBDAs using the FSRf and FSRc satisfy more than 15dB FB in the considering 3.5GHz band and the FSRc configuration obtains 2.5dB more FB than that of the FSRf configuration at 3.6GHz. The HPBW of the FSRc configuration is 30° narrower than that of the FSRf configuration. The fluctuation of the HPBW of both the FSRc and FSRf configurations is 1.5° in the considering frequency range. The fluctuation increases in the wider frequency range and the increase of the FSRf configuration is larger than that of the FSRc.

4. Radiation characteristics of dual band antenna

Fig.3 shows the HPBW variations of the 3.5GHz and 2GHz band RBDAs with respect to the spacing *d* when both band antennas are integrated as shown in Fig.1(a). The solid lines in Fig.3 represent the HPBW variations of the FSRc configuration while the dotted lines represent those of the FSRf configuration. The HPBW variation is defined by the difference between maximum and minimum HPBWs within each frequency band. As shown in Fig.3, the HPBW variation of the FSRc configuration in the 3.5GHz band can be suppressed from that of the FSRf configuration when the spacing d is from 41.7 mm to 50 mm. The HPBW variations of both the configurations in the 2GHz band is largely fluctuated as changing the spacing *d*. The HPBW variation can be minimized when the spacing *d* is 50mm for the FSRc configuration and 58.3mm for the FSRf configuration. The minimum HPBW variations of the FSRc and FSRf configurations are 6.3° and 9.9° in the 3.5GHz band, and 4.5° and 4.2° in the 2GHz band, respectively. Therefore, the FSRc configuration can suppress the HPBW variation in the 3.5GHz band for 3° than that of the the FSRf configurations while maintaining the HPBW variation in the 2GHz band. The average HPBW of the FSRc configuration are 76.2° and 88.8° in the 3.5GHz and 2GHz bands, respectively. Those are 14.2° wider and 7.2° narrower than those in the case that each antenna exists alone.

Fig. 4 (a) and (b) show the area in which the 3.5GHz and 2GHz band antennas satisfy more than 15dB. The blue and red shaded areas correspond the areas of the FSRc and FSRf band antennas, and the blue and red lines represent the boarder of the area, respectively. As can be seen in Fig.4, both FSRc and FSRf configurations achieve more than 15dB FB in the considering 3.5GHz and 2GHz bands when the spacing *d* is the spacing minimizing the HPBW variation.

5. Conclusion

This paper focused on a dual-band RBDA high FSR was used for high frequency band antenna, and investigated the effectiveness of the edge folded FSR configuration to suppress the mutual influence between the low and high frequency band antenna radiation patterns. As the results of the moment method analysis, it is shown that the edge folded configuration can reduce the radiation pattern distortion in both high and low frequency band antennas.

Acknowledgments
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References

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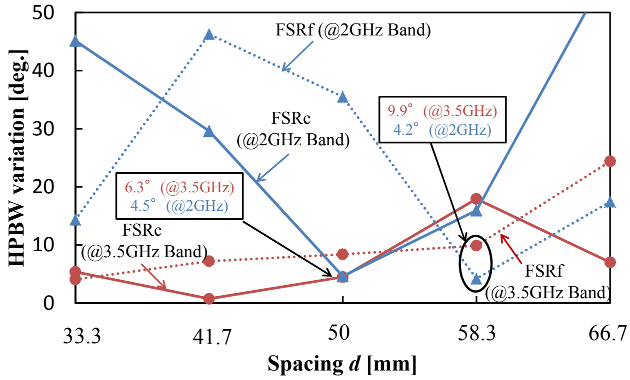
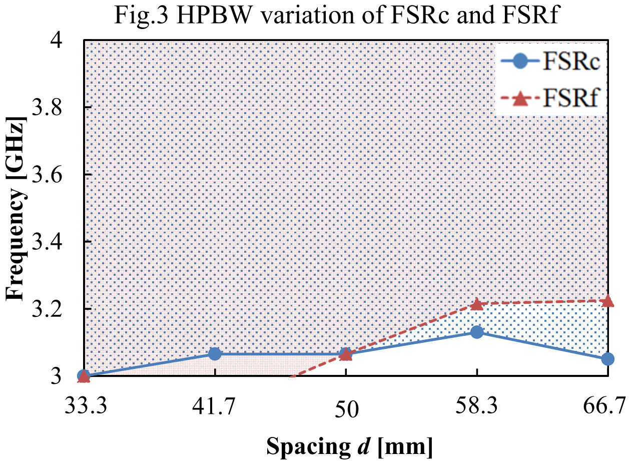
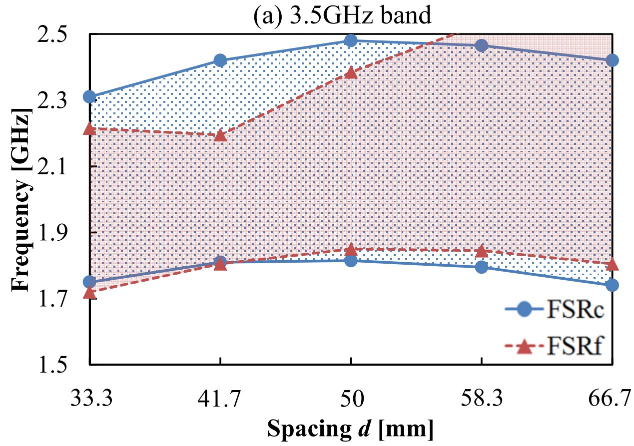


Fig.3 HPBW variation of FSRc and FSRf



(a) 3.5GHz band



(b) 2GHz band

Fig.4 Frequencies satisfying FB of more than 15dB in the H-plane pattern