

# Broadband Dual-Polarized Antenna Array For Base Station Applications

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**Abstract** - A novel broadband dual-polarized antenna array for base station applications is proposed. The single radiating element is required to perform wide band, dual-polarization and high radiation efficiency. In addition, we have integrated the structure into array and discussed the performance. The bandwidth covers from 2.6-3.8 GHz. By applying isolators and a bended reflector, high isolation and high front-to-back ratio can be achieved.

**Index Terms** — Antenna array, broadband, base station.

## 1. Introduction

In recent years, a lot of broadband antennas have been developed for base stations. One of the approaches is to use a printed dipole with an integrated balun [1]. By adjusting the position of the feed point of the integrated balun, it is possible to directly match the 50-Ω feed to the antenna. In [2], dual-polarized magneto-electric dipole antenna excited by two  $\Gamma$ -shaped strips is presented. A wideband antenna design with high isolation is obtained. Another technique is to apply a broadband planar antenna [3]. The antenna is composed of a pair of folded dipoles coupled by an L-shaped microstrip feeding line. However, the proposed structure is a single polarized antenna in [1]. The antenna design is not easy to fabricate in [2] and the size of dual-polarized structure is too large in [3]. In this paper, a novel broadband dual-polarized crossed dipole antenna element and an antenna array for base station applications are presented. Details of the proposed antenna element and antenna array are described.

## 2. Broadband Antenna Element

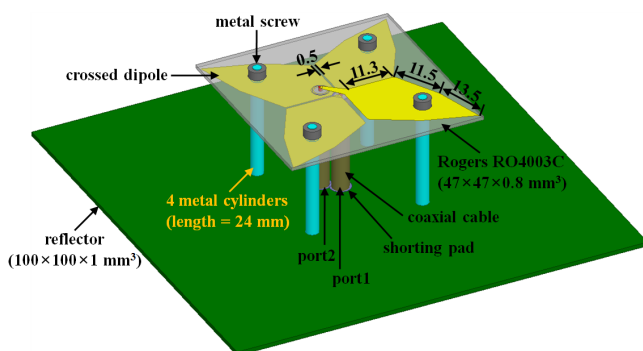


Fig. 1. Geometry of the proposed antenna element

Fig. 1 shows the geometry of the proposed dual-polarized antenna element. The antenna element consists of a pair of crossed dipoles, four metal cylinders, coaxial cables and a metal reflector. The dipoles are printed on a 0.8-mm-thick Rogers RO4003C substrate ( $\epsilon_r = 3.55$ ) with an area of  $47 \times 47 \text{ mm}^2$  and are directly fed by 50-Ω coaxial cables. The planar antenna is placed above a metal reflector with dimension of  $100 \times 100 \times 1 \text{ mm}^3$ . The height difference between the crossed dipoles and the reflector is 24 mm, which is about a quarter of wavelength at the center frequency. Besides, in order to enhance the impedance bandwidth, there are four metal cylinders electrically connected to the crossed dipole arms and the reflector, respectively.

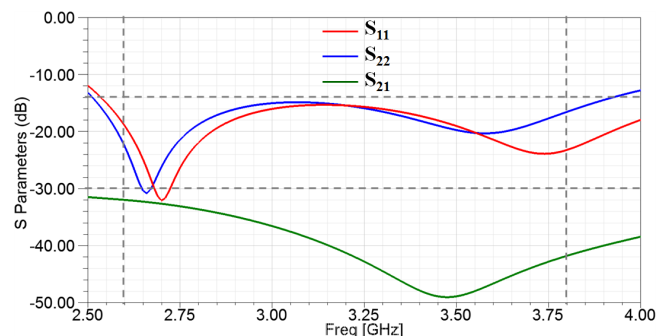


Fig. 2. Simulated S parameters for the proposed antenna

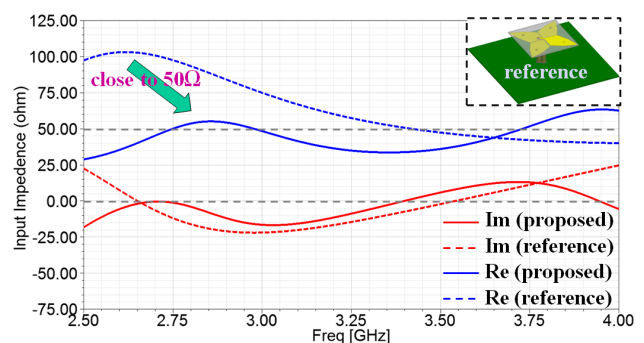


Fig. 3. Simulated results of the corresponding input impedance for the proposed and reference antenna element

Fig. 2 shows the simulated S parameters for the proposed antenna. It can be seen that  $S_{11}/S_{22}$  is less than -14 dB over 2.54–3.91 GHz and  $S_{21}$  is better than -30 dB over the operating band. Simulated results of the corresponding input impedance for the proposed and reference antenna element

are shown in Fig. 3. It is evident that the real part of the input impedance of the proposed antenna element is closer to 50 ohms than the reference one. The Simulated radiation patterns of the co-polarization and the cross-polarization for the proposed antenna at 3.4 GHz are plotted in Fig. 4. The half power beamwidths of two ports are about 65°.

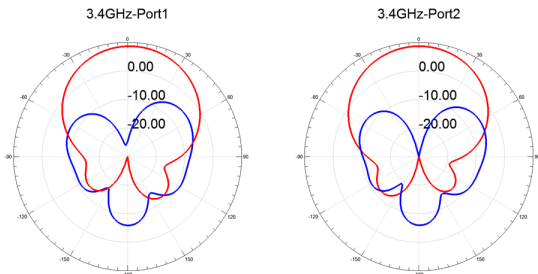


Fig. 4. Simulated radiation patterns at 3.4 GHz

### 3. Antenna Array

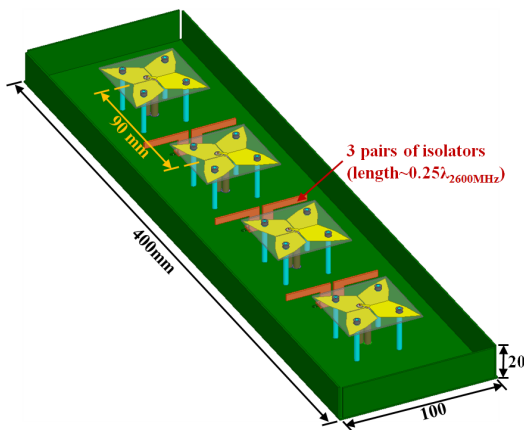


Fig. 5. Geometry of the proposed antenna array

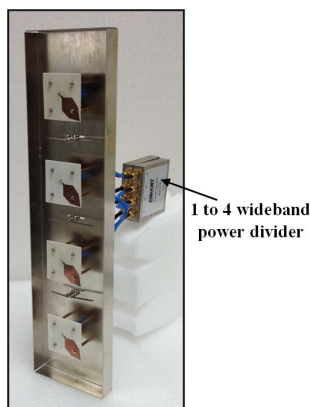


Fig. 6. Photo of the fabricated antenna array

For base station applications, a 4-element antenna array is presented. The geometry of the antenna array is shown in Fig. 5. The element spacing is 90 mm ( $\sim 0.78\lambda_{2600\text{MHz}}$ ). In order to improve the isolation, 3 pairs of isolators are located between the antenna elements. Fig. 6 shows the photo of the fabricated DIFA. The antenna array is fed by a 1 to 4 power divider. Fig. 7 shows the measured S parameters for the

antenna array. It can be seen that  $S_{11}/S_{22}$  is less than -14 dB and  $S_{21}$  is better than -25 dB over the operating band. The measured radiation patterns for the proposed antenna at 3.4 GHz are shown in Fig. 8. The half power beamwidth in the horizontal plane and vertical plane are about 60° and 11°, respectively. The front-to-back ratio is better than 25 dB, which is acceptable for base station applications.

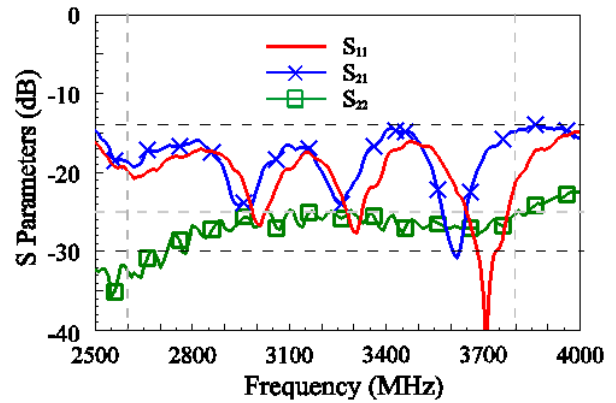


Fig. 7. Measured S parameters for the antenna array

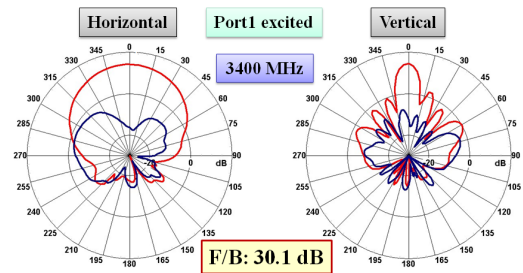


Fig. 8. Simulated radiation patterns at 3.4 GHz

### 4. Conclusion

A broadband dual-polarized antenna has been proposed for base stations. The antenna achieves a wide bandwidth of about 42% (2.54-3.91 GHz) and a high isolation of 30 dB. In addition, a 4-element antenna array is developed. The constructed prototype shows that the half power beamwidth in the horizontal plane and vertical plane are about 60° and 11°, respectively. The front-to-back ratio is better than 25 dB for practical applications.

### References

- [1] R. L. Li, T. Wu, B. Pan, K. Lim, J. Laskar and M. M. Tentzeris, "Equivalent-circuit analysis of a broadband printed dipole with adjusted integrated balun and an array for base station applications," *IEEE Trans. Antennas Propagat.*, vol. 57, no. 7, pp. 2180-2184, Jul. 2009.
- [2] B. Q. Wu and K. M. Luk, "A broadband dual-polarized magneto-electric dipole antenna with simple feeds," *IEEE Antenna Wireless Propag. Lett.*, vol. 8, pp. 60-63, 2009.
- [3] Y. H. Cui, R. L. Li and Peng Wang, "A novel broadband planar antenna for 2G/3G/LTE base stations," *IEEE Trans. Antennas Propagat.*, vol. 61, no. 5, pp. 2767-2774, May 2013.