A Dual-Polarized Four-Port In-Band Full-Duplex Antenna Array Based on A Novel Common-Mode and Differential-Mode Combination Method

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A four-port IBFD antenna system is developed based on a novel common-mode (CM) / differential-mode (DM) combination method. By exciting the CM and DM of a dual-polarized subarray, the intrinsic orthogonality of the two modes leads to low coupling between ports. Further, to deal with the inconsistency of radiation patterns caused by different phase outputs between CM and DM, two subarrays are combined into an array in which each port always simultaneously excites the CM of one subarray and the DM of the other one. This way, the beam-spilt in DM pattern can be mitigated and the beamwidth of CM pattern can be improved, thus resulting in consistent broadside radiation patterns of each port. To verify the proposed method, an IBFD array system is designed, fabricated, and measured to realize the consistent and stable radiation patterns from the four ports. Differential feed and decoupling structures are employed to further increasing the isolation between any two ports, which is greater than 38 dB within the bandwidth of 3.3 - 3.8 GHz (14.1%). The gains of all four ports are greater than 8 dBi with more than 20 dB cross-polarization discrimination (XPD). The excellent simulation and experimental results demonstrate a great potential of this work in the 5G and beyond sub-6 GHz IBFD systems.

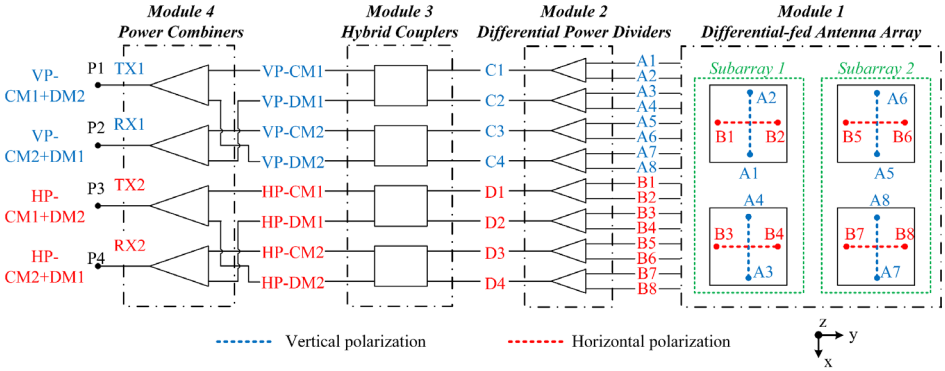
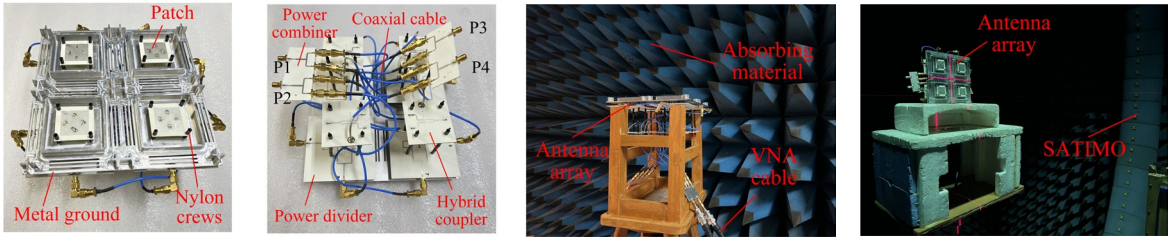
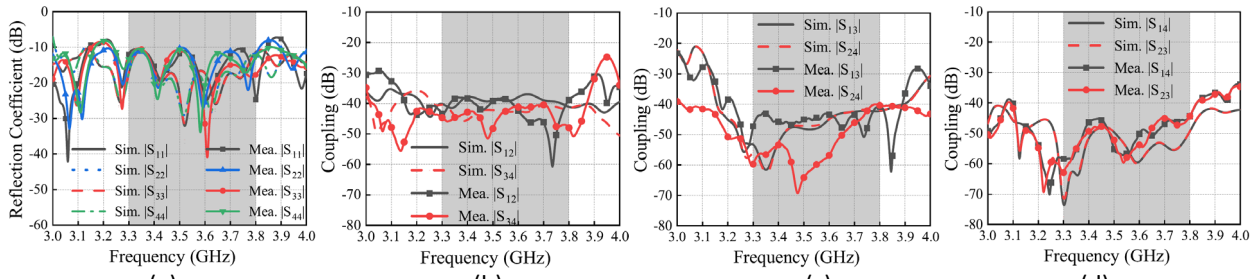


Fig. 1: Schematic diagram of four-port IBFD array system based on CM and DM combination method.



(a) (b) (c) (d)

Fig. 2: Prototype and testing environment of the fabricated IBFD antenna array system. (a) Top view. (b) Bottom view. (c) S parameters testing. (d) Far-field testing



(a) (b) (c) (d)

Fig. 3: Simulated and measured S parameters of proposed IBFD antenna system. (a) Reflection coefficients. (b) Couplings between co-polarized ports. (c) and (d) Couplings between cross-polarized ports.

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[2] Y. -N. Chen, C. Ding, H. Zhu and Y. Liu, "A ±45°-polarized antenna system with four isolated channels for in-band full-duplex (IBFD)," I*EEE Trans. Antennas Propag.*, vol. 71, no. 4, pp. 3000-3010, Apr. 2023.