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The evolution of mobile communication technologies from GSM to 5G has demanded Base Station Antennas (BSA) to support multiple frequency bands. Some very common bands include 617 MHz-960 MHz (Low Band), 1695 MHz-2180 MHz (High Band 1), 2490 MHz-2690 MHz (High Band 2) and 3300 MHz – 3800 MHz (High Band 3). The current BSA designs cater for multiple bands in a single antenna system as it provides greater cost saving in terms of utilized real estate. However, this requires multiband antenna arrays sharing a single aperture. Designing such antennas can present many challenges such as poor cross band isolation, degradation to patterns in terms of increased squint, variation in beamwidth, high side lobes etc..

Cross-Band isolation of a BSA provides a measure on the coupling between arrays of different bands. For example, cross band isolation from High Band (HB) to Low Band (LB) is measured as $S_{21}$ between HB (port 1) and LB (port 2) at HB frequencies and vice versa. BSAs require the cross-band isolation to be at least 30dB or more. Conventional technique is to physically separate the antenna arrays in the same aperture to minimize coupling. This defeats the purpose of multiband antennas, i.e., to build compact antennas to save on real-estate. In a compact BSA antenna arrays are interspaced. However, the close proximity of LB and HB elements significantly increases the coupling between these bands. Different techniques, such as providing filtering antenna elements [1], cloaking surfaces [2], and decoupling network [3] have been used. While these techniques have their merits, they often have limitations in terms of narrowband operation, complexity involved in implementation or costs.

In this paper, we present an easy to fabricate and cost-effective low pass filter implementation to improve cross-band coupling. In particular, the microstrip implementation of the filter makes it of low-cost and practical to integrate in the LB feed network. The low-pass filter reduces the coupling from HB elements to LB at HB frequencies. The filter is designed to provide very low insertion loss covering the frequency band up to 960 MHz (upper end of the LB) and high insertion loss in the HB regions, resulting in reduced coupling between elements at HB frequencies. The simulated filter response is shown in Figure. 1. The return loss of the filter in the LB is greater than 15 dB in the proposed design.

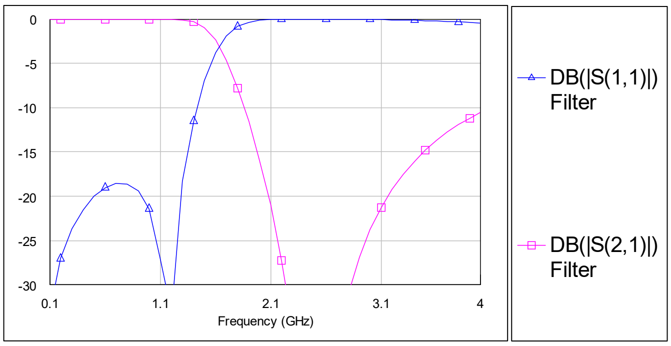


**Figure 1.** Simulated scattering parameters of proposed low-pass filter

1. Y. Zhang, X. Y. Zhang, L.-H. Ye, and Y.-M. Pan, “Dual-band base station array using filtering antenna elements for mutual coupling suppression,” IEEE Trans. Antennas Propag., vol. 64, no. 8, pp. 3423–3430, Aug. 2016.
2. H. M. Bernety and A. B. Yakovlev, “Reduction of mutual coupling between neighboring strip dipole antennas using confocal elliptical metasurface cloaks,” IEEE Trans. Antennas Propag., vol. 63, no. 4, pp. 1554–1563, Apr. 2015.
3. L. Zhao, K.-W. Qian, and K.-L. Wu, “A cascaded coupled resonator decoupling network for mitigating interference between two radios in adjacent frequency bands,” IEEE Trans. Microw. Theory Techn., vol. 62, no. 11, pp. 2680–2688, Nov. 2014.