

Transmit-Receive Antenna Isolation Using a Passively Tuned Balun for Simultaneous Transmit and Receive (STAR) Applications

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Spectrum congestion in the 1-6GHz band has spurred the development of architectures with greater spectral efficiency, such as simultaneous transmit and receive (STAR) transceivers. As compared with time and frequency division duplexing, STAR enables simultaneous reception with the spectrum assigned for transmission, increasing spectral efficiency and doubling data rates. To realize STAR, self-interference (SI) leakage from the transmitter to receiver must be addressed.

To cancel this SI, the following techniques can be utilized: 1) employ transmit/receive (Tx/Rx) antennas with high port to port isolation, 2) incorporate RF or analog filters to cancel duplicates of the transmitted signal from the received signal, and 3) post process the digitized signal to further remove SI using the transmitted signal modulation details. As can be understood, the most critical stage of cancellation is at the aperture level as we must ensure the receiver circuitry is not saturated by the large power coupled from the transmitter.

With the above goal in mind, in this paper, we focus on antenna port to port isolation. The goal is to achieve Tx/Rx isolation through tuning the balun's output signal using better antipodal feeding, resulting in greater isolation. This tuning is controlled via passive chip attenuators. Notably, due to the balun's symmetric design, tuning losses have a minimal effect on efficiency. Previous STAR antennas considered tuning the excitation currents to realize improved isolation. However, this approach required bulky and heavy external components (J. Ha, et. al., IEEE Trans. on Antennas and Propagation, 65, 10, 5103-5111, 2017).

For compactness and simplicity, in this paper we propose a collocated pair of antennas with the tuning components integrated in the printed circuit board (PCB) baluns to achieve greater aperture level Tx/Rx isolation. Simulations indicate that as much as a 12 dB Tx/Rx isolation improvement is possible using the proposed configuration. Notably, the transmit antenna consists of a monopole centered in the middle of a loop antenna acting as a receiver in the 1.6-2.5GHz band. The entire structure is backed by a ground plane. A fabricated prototype with measurements will be presented at the conference.