A Compact Patch Antenna with Improved Isolation for Simultaneous Transmit and Receive

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The communication spectrum is facing ever increasing demands as the number of devices utilizing wireless communications becomes more numerous. A proposed solution to this is simultaneous transmit and receive (STAR), at the same frequency rather than the traditional time and frequency division multiplexing. However, self-interference is a problem with these systems. A number of techniques have been proposed to resolve the problem of self-interference. These include antenna separation, absorptive shielding, directional antennas, polarization diversity and using 180^o hybrids. This study proposes a compact microstrip antenna design featuring high isolation, to accomplish in-band full-duplex operation.

In this work, we present isolation improvement between the transmit and receive ports of a ring hybrid fed patch antenna by the inclusion of a resonant wave-trap structure. The wave-trap acts as a filter to both prevent loss of signal strength at the design frequency of approximately 2.45 GHz, and improve port isolation. The inductive reactance of the wave-trap presents high reactance to the design frequency, this assists in the prevention of self-interference between the transmit and receive signals. Additionally, the wave-trap grounds interference outside the design frequency essentially creating a pass filter improving overall strength of the transmitted and received signal. The wave-trap structure has been designed as a parallel resonant structure whose dimensions determine its tuned frequency. The antenna consists of two substrates with the ground plane in between the two layers. A patch is printed on a double-sided substrate opposite of a ground plane defected by a wave trap structure. A second single sided substrate is printed with a 180^o ring hybrid. The signal to be transmitted is received at the ring hybrid's difference input and is fed to the patch through a VIA probe structure at the hybrid's output port, while the receive signal is taken directly from the patch. This design blocks any radiation that may be on the ring hybrid from affecting the patch. The hybrid aids in causing greater isolation, $S_{21} < -50$ dB, at a particular frequency based on dimensions. The physical separation of the receiver and transmitter in this manner also causes the ports to both be linearly polarized with the transmitter in the horizontal and the receiver in the vertical, causing high isolation and low cross polarization. The inclusion of the wave trap improves the isolation conservatively by -10 dB resulting in a total isolation of $S_{21} < -60$ dB. Results regarding critical parameters of interest will be presented.