Advancements in Integrated Passive Circuits and Filters: A Decade of Technological Evolution

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ABSTRACT

Integrated passive devices, circuits, and filters play vital roles in signal conditioning and processing across electronic systems. Over the past decade, there has been remarkable component miniaturization driven by the demand for smaller, faster, and more energy-efficient devices. Novel solutions to Maxwell's equations have disrupted traditional space-time symmetry, easing constraints on RF/microwave systems. A prime example is achieving non-reciprocity without magnetic materials, enabling broadband miniaturized circulators and integrated full-duplex radios to potentially double network capacity.

Furthermore, the emergence of extremely fast switching has paved the way for rapidly tunable filters, while switches based on phase change materials (PCM) have been seamlessly integrated with high-volume semiconductor processes, enabling reconfigurable architectures. Novel time-folding power combiners have also been successfully demonstrated. Additionally, an inverse design approach for synthesizing filters on integrated circuit substrates, alongside matching network design using machine learning, has been developed. This presentation delves into advancements that have transformed passive circuits and filters, overcoming long standing limitations through innovative techniques.