Abstract

The need for faster communication is constantly pushing towards the design and development of microwave components with improved performance. Moreover, with the advent of 5G standards, new design requirements for communication components to support high data transmission rate is demanded. It is predicted that by 2023 or sooner the cellular communication industry is to be adopting 5th generation (5G) standards, which would be testing the designers to produce components satisfying the stringent requirements of 5G. Microstrip technology is widely used for design of circuits as it enjoys advantages like low profile and good integration ability, but is not preferable for operation in millimeter frequency range due to radiation loss and surface wave loss at high frequency. Traditionally, bulky waveguide based components were considered for operation in millimeter-wave range. In the past decade to support millimeter-wave communication many novel technologies have surfaced in the planar form with very light weight and compact form factor. In recent years, substrate integrated coaxial line (SICL) technology has shown to gain a lot of attention due to its usefulness in design of components at millimeter wave frequency range. SICL is the planar implementation of bulky coaxial line, formed by enclosing a central conductor with substrate and conducting plate on its top and bottom, and rows of metalized via on the sides. SICL exhibits single mode TEM propagation for a large band of frequencies, similar to the conventional coaxial line with comparatively lower footprint than other technologies such as substrate integrated waveguide (SIW). The work proposed in this thesis focusses on design and implementation of various front-end microwave and millimeter-wave circuits such as transitions, filters, couplers, baluns, and power dividers, especially for microwave and 5G communication using SICL Technology. As the system design is getting more intricate and with components fabricated in different technologies, it is essential to have a low-loss broadband interconnect between them for effective working of the system. Novel wideband transition eliminating the need for blind via with DC blocking capabilities are discussed. Design of SICL based bandpass filters in compact size with wide-bandwidth, high selectivity, dual-band operation supporting enhanced flexibility in adjusting the filtering response is explored. Further, SICL based three-port and four port networks that are widely used in RF-front end architecture is formulated and validated. Finally, the proposed thesis demonstrates multi-functional components and integration of various SICL based components. SICL technology is expected to be an attractive candidate in design of circuits for RF-front end architecture where small form factor is preferred for installation in modern hand-held devices and access points.

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