UNIVERSITI TEKNOLOGI MARA

DESIGN OF MICROWAVE RADIATING DIPLEXER USING SUBSTRATE INTEGRATED WAVEGUIDE (SIW) TECHNIQUES

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ABSTRACT

Recently with the demand for multi-service and multi-band modern wireless communication systems, there is a growing interest in the integration of microwave modules in RF front end systems. This thesis presents new design for the integration of microwave diplexer (two bandpass filters) and antenna using multilayer planar technology. The composite diplexer/antenna configuration in one compact module offers significant advantages especially in small physical size, low weight and ease of integration without the need to use complicated external matching networks. Two novel designs namely, substrate integrated waveguide (SIW) circular cavities diplexer (SIWCCD) and integrated SIW circular cavities diplexer with microstrip antenna (I-SIWDIPTENNA) have been successfully presented with support of theory, simulation and experimental results. The working mode for SIW circular cavity was TM_{010}, whereas TM_{110} mode was chosen for the circular microstrip antenna. The design methodology was based on a filter synthesis technique proposed from the generalized low-pass prototypes Chebyshev configurations. Firstly, individual bandpass filters using SIW circular cavities were designed to operate at center operating frequencies of 2.2 GHz and 2.4 GHz, respectively and which are proposed for LTE/WiFi applications. Then, the complete SIWCCD was formed by interconnecting an appropriately designed T-junction with both lower- and upper-frequency channel filters. Subsequently, the I-SIWDIPTENNA was constructed by electromagnetically coupling the SIWCCD with circular patch antennas using multilayer configuration. All designs were fabricated using a standard PCB multilayer process with Rogers RO3006, dielectric substrate with permittivity constant ε_r = 6.15. The S-parameters were measured using a Keysight PNA Network Analyzer while the radiation measurements were performed in an RF anechoic chamber ATENLAB Model 500A. The simulation results were in good agreement with the measurement results. The SIWCCD measured return losses for both channels were better than 20 dB and insertion losses achieved were 1.30 dB and 1.72 dB, respectively. The diplexer provides isolation better than 15 dB at both channels. The I-SIWDIPTENNA measured results showed a good agreement with passband return loss greater than 10 dB in both bands and 20 MHz bandwidth with good radiation pattern and radiation gain at the two center frequencies are measured to be 5.55 dBi and 5.84 dBi.

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