Design of Millimeter Wave Substrate Integrated Waveguide Diplexers

J. Ross Aitken* (1), Jiasheng Hong(1)
(1) Institute of Sensors, Signals and Systems, Heriot-Watt University, Edinburgh, UK
E-mail: Ross.Aitken@theIET.org

In recent years, the use of substrate integrated waveguide (SIW) has increased: there has been a flood of papers in the literature focusing on both passive and active devices, such as filters and amplifiers. In terms of passive devices, a lot of work has been done on filters. However, only a limited amount of work has been carried out on diplexers where experimental validation has been limited to below K band.

Diplexers are essential components in communication systems that allow an antenna to transmit and receive signals simultaneously. They are generally constructed by matching two filters (upper and lower frequency channels) to a power divider of some sort, as this provides the best trade-off between size and performance.

Above 30GHz, component sizes are on the order of a few millimeters. This makes fabrication very challenging, especially when considering that most SIW circuits use a substrate with a dielectric constant of 2 or more, making the structure even smaller when compared to the equivalent waveguide using air.

To fabricate circuits above 30GHz within a given set of specifications, tight fabrication tolerances must be imposed. As fabrication tolerance is related to the time required to make the circuit, and subsequently related to cost, this is far from ideal. One solution is to redesign the circuit so that the fabrication tolerance can be relaxed.

A circuit previously proposed by the authors showed that fabrication tolerances can be relaxed by replacing the upper channel bandpass filter of a conventional diplexer circuit with a highpass filter (J.R Aitken and J. Hong, *IET Microw. Antennas Propag*., 2015, doi:10.1049/iet-map.2014.0552). That circuit was realized using waveguide technology and experimentally validated at Ka band.

In this paper, we continue on from this work by realizing the circuit in SIW technology for use at Ka band. The intended use of the diplexer is mobile backhaul communications, where it is thought that SIW can provide a low cost alternative to the more expensive waveguide design.