

Size-Miniaturized Half-Mode Substrate Integrated Waveguide Bandpass Filter Incorporating E-Shaped Defected Ground Structure for Wideband Communication and Radar Applications

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Abstract—In this paper, a size-miniaturized bandpass filter based on the half-mode substrate integrated waveguide (HM-SIW) and embedded E-shaped defected ground structure (DGS) is presented. Two pairs of embedded E-shaped DGSs are face-to-face configured and loaded into the conventional HMSIW section to constitute a HMSIW-DGS unit cell. First of all, the HMSIW is with inherent highpass characteristic, while the embedded E-shaped DGS is with bandgap function. By integrating these two characteristics together, the proposed HMSIW-DGS unit cell will exhibit bandpass transmission response, as the cutoff frequency of the HMSIW is lower than the resonant bandgap frequency of the DGS. Utilizing HMSIW instead of SIW can help to reduce size of the unit cell. Meanwhile, the electrically small DGS is also useful for the size miniaturization. Subsequently, the stepped-impedance structure is introduced into the E-shaped DGS to decrease its electrical size, which will effectively improve the tuning flexibility of the unit cell, and can consequently make the DGS with same physical size operate lower bandgap frequency. That is to say, the stepped-impedance structure can contribute to further size reduction of the DGS. Thirdly, the proposed unit cell is systematically investigated by using the theory of guided waves, with its propagation constant and dispersion characteristic being studied in detail, from which the bandpass transmission response can be captured obviously. To verify the transmission properties of the proposed unit cell, a bandpass filter with three cascading unit cells is implemented. The fabricated prototype achieves a central frequency of 10GHz, a fractional bandwidth of 23%, an insertion loss of 1.2dB and a return loss of 20dB. As compared with some reported SIW filters, the proposed one is with smaller size and similar performance, which illustrates its suitability for the wideband communication and radar applications.

Keyword—Attenuation constant, bandpass filter, defected ground structure (DGS), half-mode substrate integrated waveguide (HMSIW), phase constant, propagation constant

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