Software for wireless broadband system design.

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PERIODICALLY LOADED WAVEGUIDE STRUCTURES

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Abstract - The purpose of this paper is to investigate a novel class of waveguide resonator structures using periodic metal septa for use at microwave, mm-wave, submm-wave and terahertz frequencies. Its aim is to show that this type of resonator can be easily realized with a single metal insert within circular, ridged and rectangular waveguide. One type of resonator which used quarter-wavelength metallic septa was employed. The simulated results for air-filled metal pipe rectangular and ridged waveguide resonator and filter structures using periodic metallic septa are presented.

Introduction

The steady growth in commercial interest in microwave and millimetre wave systems, especially in wireless communications, security and sensor applications, military and transportation electronics, and mobile and satellite communication systems has provided a significant challenge to conventional microwave circuits and their design methodologies. High performance narrow-band bandpass filters having a low insertion loss, compact size, wide stopband and a high selectivity are important for next-generation wirelss and cellular communications, and broadband microwave communication systems.

In recent years there has been a strong interest worldwide in developing advanced periodic structures for microwave, mm-wave and optical applications. We have investigated several waveguide and quasi-planar periodic structures and demonstrated their applications in high-Q resonators. One particular type of structure, the resonator with periodic metallic septa, has been developed in our laboratories and patent protection has been made. There are still serious impediments from these techniques. For example the filter insertion loss and size are still not greatly improved. Realization of extremely narrow-band filters having a low insertion loss, smaller size and a high selectivity in periodic form is seen to be an attractive alternative approach

Numerical and Experimental Results

The simulated insertion loss of the ridged waveguide E-plane resonator using periodic metallic septa at 9.2 GHz is shown in Figure 1. The dimensions of the E-plane insert are given in the same Figure. Simulated return loss and insertion loss of the rectangular waveguide two cavity filter structure periodically loaded with metal septa at 9.750 GHz is shown in Figure 2. Figure 3. shows simulated return loss and insertion loss of the conventional rectangular waveguide two cavity filter structure with metal septa at 9.75 GHz .Mode matching with 60 modes was used for electromagnetic simulation of the behavior of the waveguide discontinuities throughout design [3]. Figure 4. shows measured insertion loss of waveguide E-plane resonator at 36.80 GHz..

Conclusion

A novel class of waveguide high-Q resonator structure using periodic metallic septa for mm-wave, submm-wave and terahertz applications has been proposed. They can be easily realized with a single metal insert within a rectangular waveguide. This kind of resonators is expected to find application particularly in the mm-wave, submm-wave and terahertz range circuits, e.g. in low phase noise oscillators and highly selective filters, diplexers and multiplexers, frequency selective surfaces and antennas.

Acknowledgements

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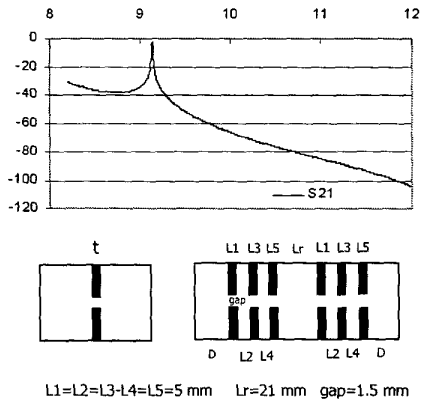

Figure 1. Shape of the ridged waveguide structure periodically loaded with metal septa and simulated insertion loss.

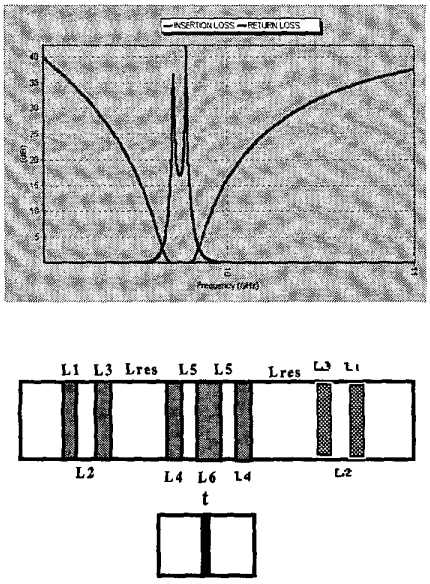

Figure 2. Simuulated return loss and insertion loss of the rectangular waveguide two cavity filter structure periodically loaded with metal septa.

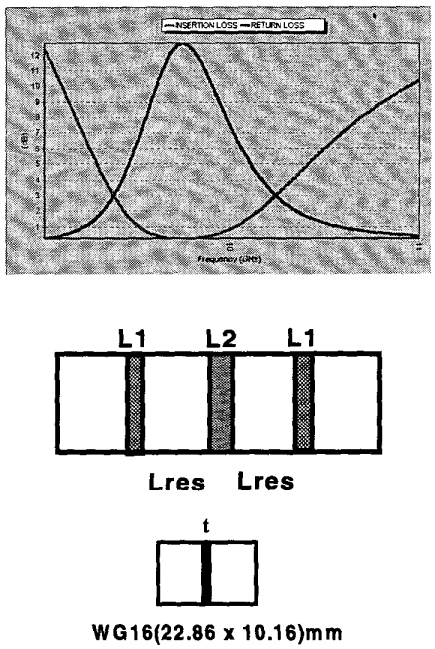

Figure 3 Simulated return loss and insertion loss of the conventional E-plane bandpass filter

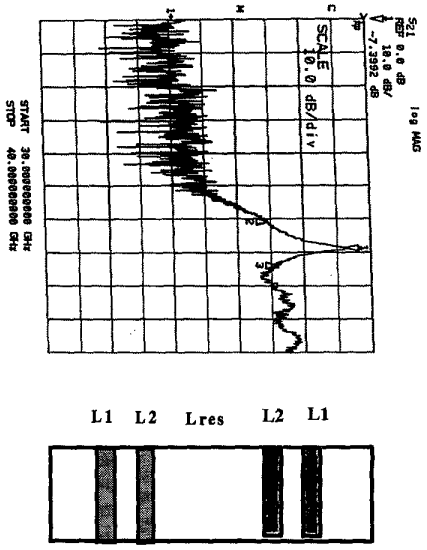

Figure 4. Measured insertion loss of the rectangular waveguide one cavity filter structure periodically loaded with metal septa.

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