

## Rectangular Waveguide Iris-Coupled Filter

In this application note, a simulation of a band-pass, iris-coupled waveguide filter is described. Only particular case of using the irises reducing the width of the waveguide will be considered. Actually, only irises having equivalent circuit of a shunt inductance will be considered. The irises will be located on the both sides of the standard WR-90 waveguide.

### A Model of the Iris-Coupled Filter

The iris-coupled filter was created from the scratch in WIPL-D Pro CAD native editor using built-in primitives. Beside basic primitives, two symmetry planes (*Symmetry* and *Anti-Symmetry*) have been utilized to reduce the complexity of the simulated structure. Also, two *Waveguide Ports* were used as feeders. The losses in metal conductors are represented with skin effect. Conductivity is defined with  $\sigma = 19 \text{ MS/m}$ .

The WIPL-D Pro CAD model of the iris-coupled filter can be seen in Figure 1.

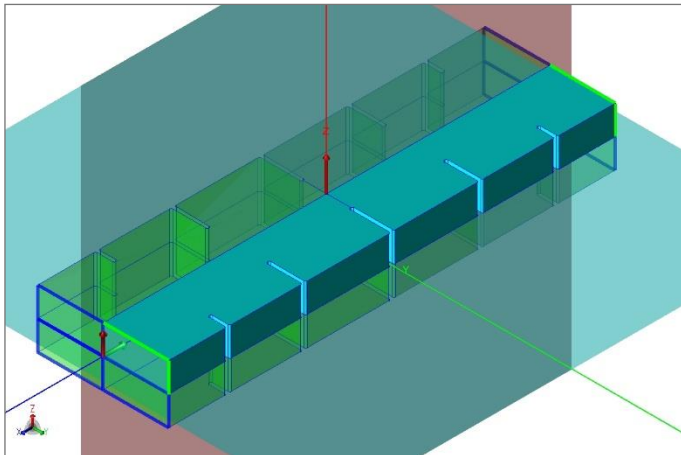


Figure 1. Iris-coupled waveguide filter in WIPL-D Pro CAD

### Simulations

The model of iris-coupled filter was simulated from 9 GHz to 12 GHz. Simulation was performed in 16 frequency points. To ensure high accuracy, the convergence of the results has been checked. It has been concluded that the convergence was satisfactory with *Reference frequency* of 20 GHz and *Max Patch Size* of  $0.5 \cdot \lambda$ . After the convergence has been confirmed, dimensions of the filter were adjusted to set values of  $S_{11}$  in the pass-band (10.19 GHz to 10.82 GHz) below -20 dB.

Computer used for these simulations is regular desktop Intel® Core™ i7 CPU 7700@ 3.60. Number of elements, number of unknowns, computer memory required and simulation time per frequency are presented in Table 1. The simulation (with ports) was performed in, so called, *S-Parameter Mode*.

Table 1. Number of elements, number of unknowns, computer memory and simulation time per frequency

Number of elements	Number of unknowns	Memory [MB]	Simulation time per frequency [sec]
848	1284	12.6	1.2

### Meshed Model

Meshed model of the quarter of the iris-coupled waveguide filter is shown in Figure 2. In the same figure, we can see port extensions which are automatically added in the simulation. The port extensions are used to model waveguide ports.

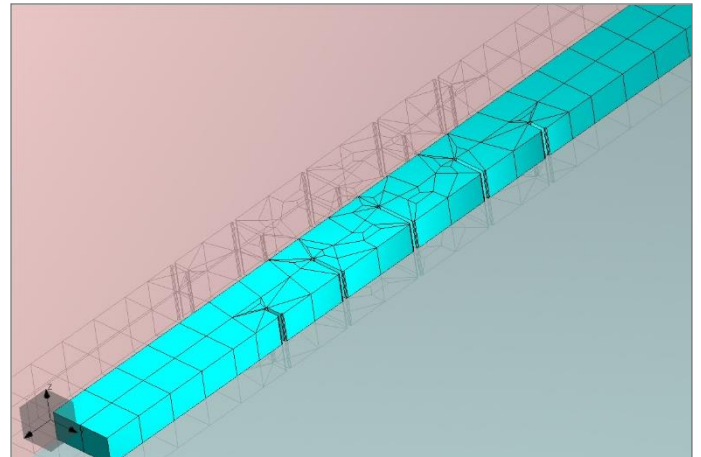


Figure 2. Meshed model of the quarter of the iris-coupled waveguide filter

### Dimensions

Meshed model of the quarter of the iris-coupled waveguide filter with indicated dimensions is shown in the Figure 3. The indicated dimensions are: thickness of the irises, lengths of the resonant cavities and lengths of the irises.

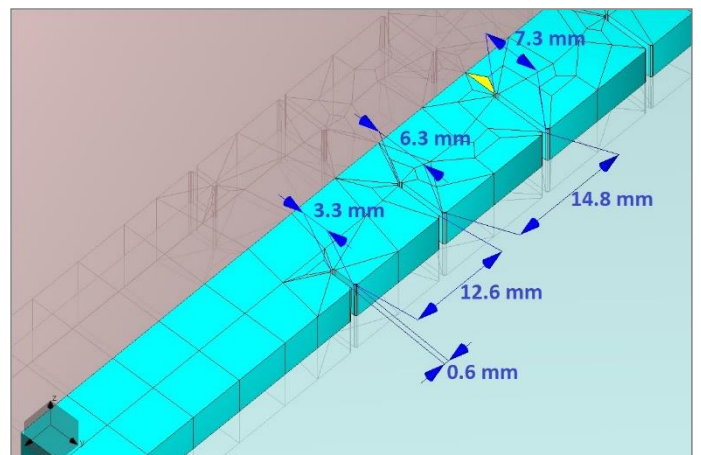


Figure 3. Meshed model of the quarter of the iris-coupled waveguide filter with dimensions of interest

## Results

Results obtained in simulations are shown in Figure 4 and Figure 5.

$S_{11}$  and  $S_{21}$  parameters of the simulated iris-coupled waveguide filter can be found in Figure 4. These indicate that the filter has the performance as required. The passband is 10.19 GHz to 10.82 GHz with the return loss higher than 20 dB (see markers in Figure 4).

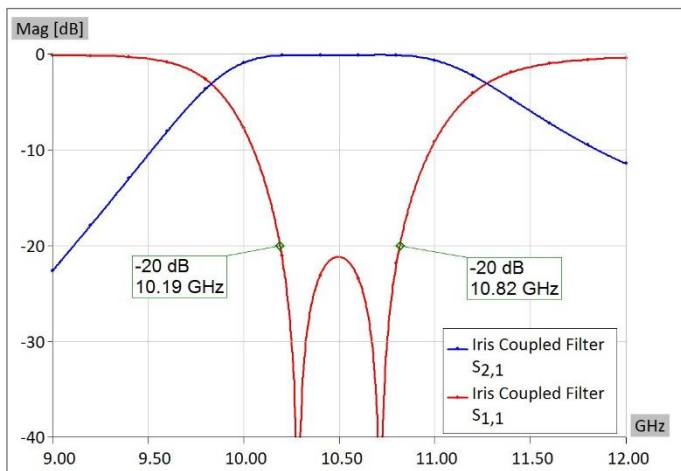


Figure 4.  $S_{11}$  and  $S_{21}$  parameters- simulated iris-coupled waveguide filter

In addition, near field within the filter was calculated at 10.50 GHz. The resolution was set to 100x40 uniformly distributed points. The result is shown in Figure 5.

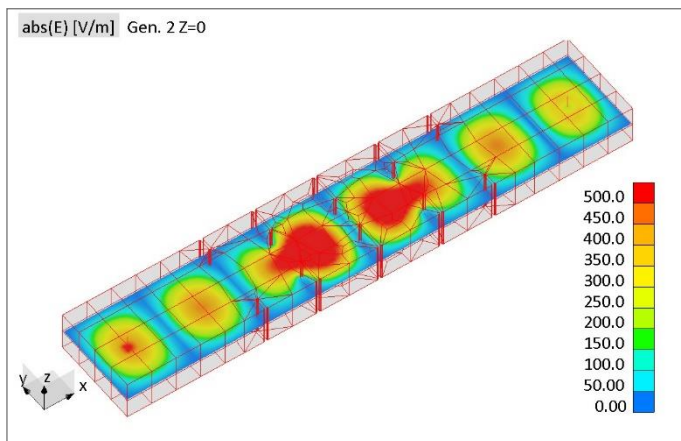


Figure 5. Near field calculated at 10.50 GHz.

## Conclusion

This application note presented a 3D EM model of an iris-coupled waveguide filter. Also, simulations of the iris-coupled waveguide filter, carried out using WIPL-D Pro CAD, a full wave 3D EM Method of Moments based solver, were presented.

All of the simulations (convergence check and simulations where S-parameters and near field results were obtained) have been performed relatively fast. The simulations have required a small

amount of computer platform memory. Finally, an inexpensive computer platform was used.

This application note outlined utilization of waveguide ports and automatic de-embedding of final results. The similar approach can be applied to the other classes of filters.