Multihole Waveguide Coupler

Multihole waveguide coupler is an extension of a singlehole coupler designed with the intention of increasing the operational bandwidth. The performance is based on size of the coupling holes and distance between them as it is important to achieve wave amplification in the through-direction and cancellation in the opposite direction.

Typically, this type of couplers demonstrates frequency selectiveness in its directivity response while its coupling response is less frequency-dependent.

The waveguides used correspond to standard X-band WR-90, with dimensions of 22.86 mm by 10.16 mm (Fig. 1). The waveguides are coupled through a series of rectangular cross-section holes arranged in a zig-zag order (Fig. 2).

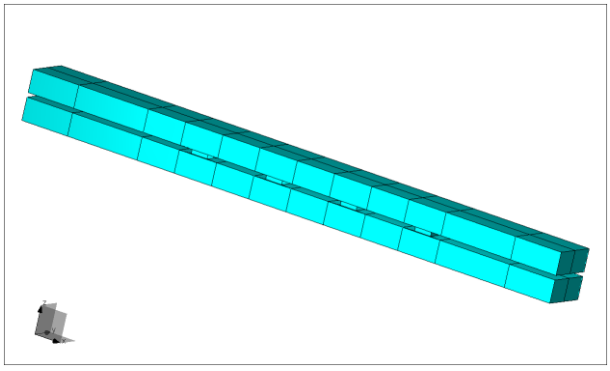

Figure 1. Multihole waveguide coupler

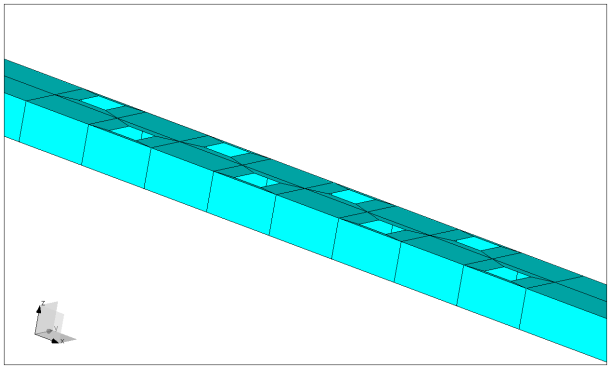

Figure 2. Part of the coupler – arrangement of holes

WIPL-D Simulation

The model displayed in previous figures is easy to create in WIPL-D Pro thanks to the possibility of copying and translating few basic building blocks multiple times to form the coupler. Moreover, the entire model can be parameterized so influence of parameter changes (such as the size of the holes or their distance) on model performance can be easily investigated.

Number of unknowns, memory usage and simulation time of simulation are given in Tab. 1.

Table 1. Analysis characteristics

No. of unknowns	RAM used [MB]	Time [sec]
2644	56	201

Simulation is performed in 21 frequencies in the range from 8 to 12 GHz. The results for the entire are obtained in just 3 minutes, which is excellent. Computer used for these calculations is Intel Core(TM) i7 CPU 950 @3.07 GHz.

S-parameters are displayed in Fig. 3. We can see that we have a relatively equal behavior of the device within the hole range of interest, during which Input stays below -18 dB and Coupling is between -13 and -11 dB.

Fields inside the coupler are displayed in Fig. 4. A strong standing wave is present in the excited upper guide, while a part of the energy is transferred into the lower guide through the holes. As a result, we can notice a weaker standing wave in the lower guide.

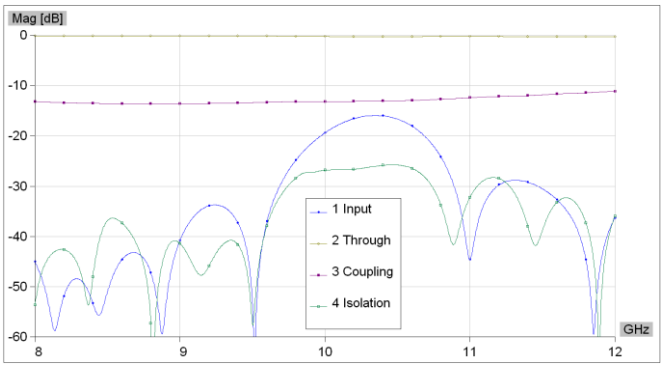

Figure 3. S-parameters of the coupler

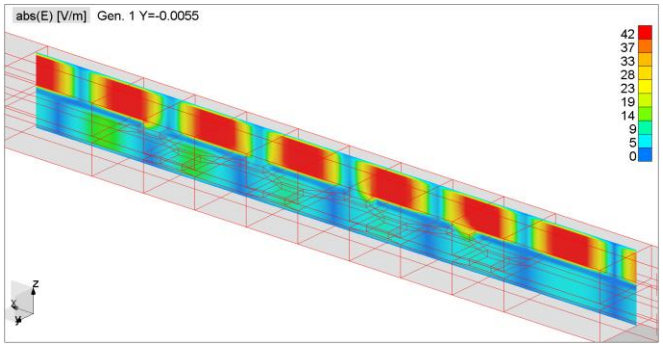

Figure 4. Electric field inside the coupler

Conclusion

WIPL-D Pro provides very fast and accurate simulation of waveguide structures, whether radiating (such as slot arrays on waveguides) or closed-region (such as the presented coupler).