Multi-hole Waveguide Coupler

Multi-hole waveguide coupler is extension of single-hole coupler, designed to increase the operational bandwidth. The performance is based on size of the coupling holes and distance between them, since it is important to achieve wave amplification in the through-direction and cancellation in the opposite direction. Typically, this type of coupler 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 (Figure 1). The waveguides are coupled through a series of rectangular cross-section holes arranged in a zig-zag order (Figure 2).

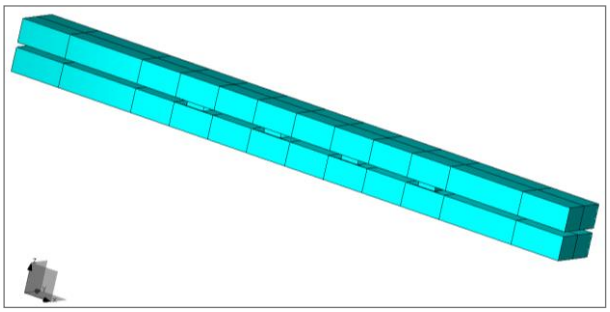

Figure 1. Multi-hole waveguide coupler

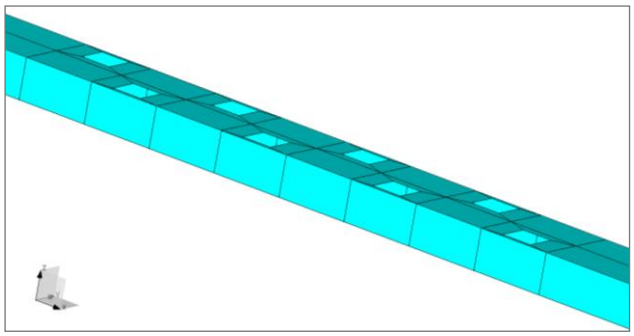

Figure 2. Part of the coupler – arrangement of holes

WIPL-D Simulation

The model displayed in previous figures is easy to create in WIPL-D Pro owing to the possibility of copying and translating few basic building blocks. 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 are given in Table 1.

Table 1. Number of unknowns, memory and simulation time

Number of unknowns	Used RAM [MB]	Simulation time per frequency [sec]
2644	56	1.5

Simulation is performed at 21 frequency points from 8 GHz to 12 GHz on a regular desktop PC Intel® Core™ i7 CPU 7700@ 3.60 GHz.

S-parameters are shown in Figure 3. We can see that we have a relatively constant characteristics of the device within the entire range of interest, where Input stays below -18 dB and Coupling is between -13 dB and -11 dB.

Fields inside the coupler are displayed in Figure 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.

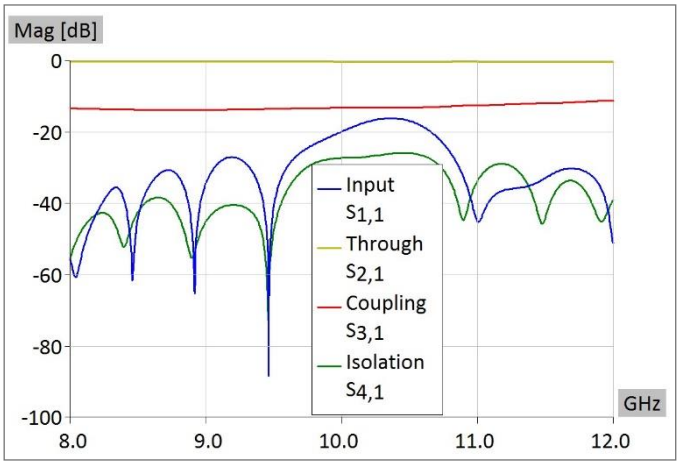

Figure 3. S-parameters of the coupler

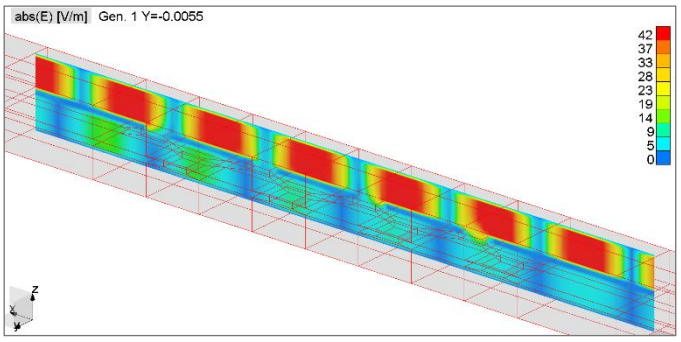

Figure 4. Electric field inside the coupler

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).