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.

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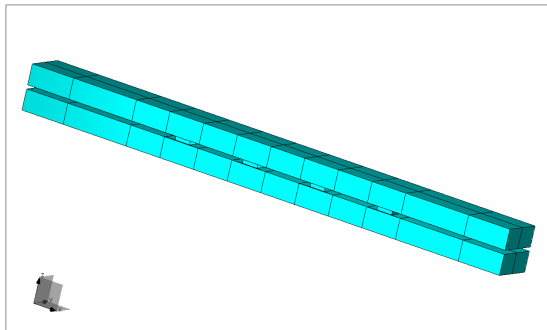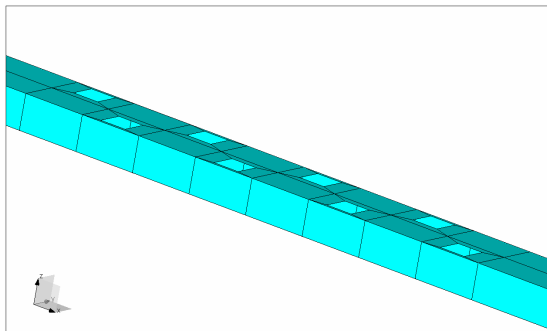

Figure 1. Multihole waveguide coupler

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 or the performance of the coupler can be automatically optimized.

Number of unknowns, memory usage and simulation time 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 range are obtained in just 6.5 minutes, which is excellent. Computer used for these calculations is Intel ® Core2 Quad at 2.5 GHz clock.

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.
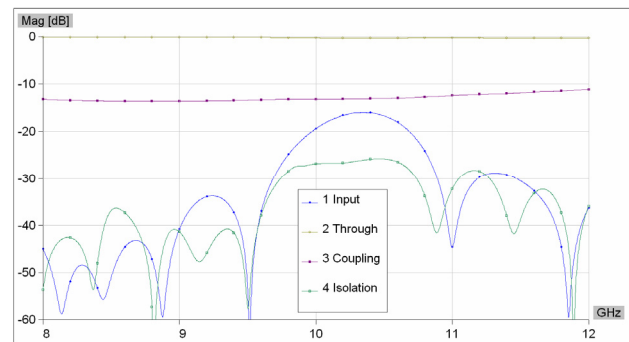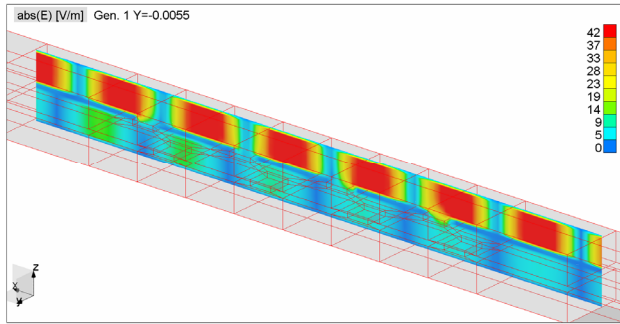

Figure 3. S-parameters of the coupler

Figure 4. Electric field inside the coupler

Conclusion

Modeling this structure is easy thanks to the fact that a basic building block consisting of several plates can be copied and translated in order to form the coupler model. Simulation is fast and requires a small amount of computer memory thanks to the application of advanced numerical techniques such as higher-order MoM.

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).