Grounded Coplanar Waveguide

1. Description

Coplanar waveguide (CPW) was invented for the first time by Cheng P. Wenin 1969. Basically, a coplanar waveguide (CPW) consists of a conductor separated from two ground planes, and everything is etched on one side of a dielectric on the same plane. The dielectric should be thick enough to damp the electromagnetic fields inside the substrate. There is also a different type of coplanar waveguide which has a ground plane on the opposite side of the dielectric, which is called finite ground-plane coplanar waveguide (FGCPW), or more simply, grounded coplanar waveguide (GCPW). This kind of waveguide is preferred to microstrip when we are dealing with thick substrates. However, using microstrip, will cause impedance variation over the frequency because of dispersion effect. On the other hand there will be non-negligible radiation loss for high frequencies. When using the grounded coplanar waveguide for such structures, the mentioned drawbacks will be addressed. In this study, we analyze the performances of a grounded coplanar waveguide, etched on a thick (0.030") isotropic substrate, using HFWorks.
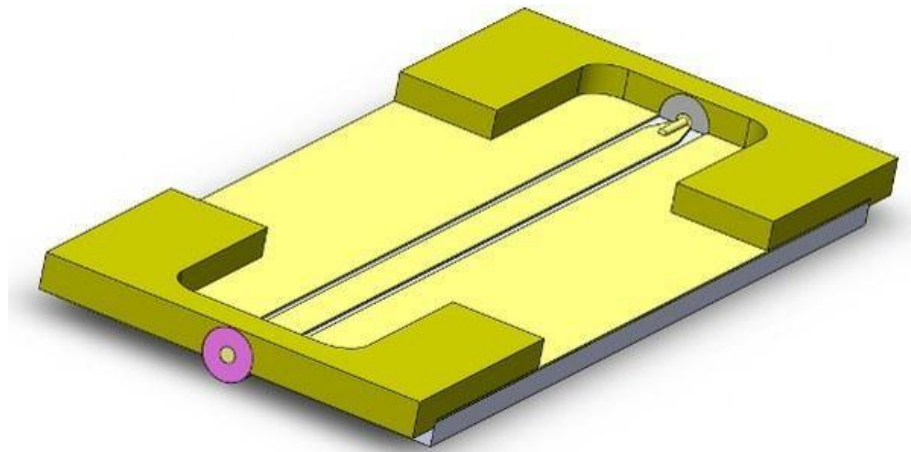

Figure 1: the structure's 3D view in SolidWorks

The mesh of the structure is more accurate in the areas of the via and ports. We can resort to the default mesh of HFWorks which recognizes the dimensions of the structures and applies a pretty

convenient mesh. Nevertheless the user has total control on the mesh global size and is able to define mesh controls to areas that he assumes more relevant to the structure.
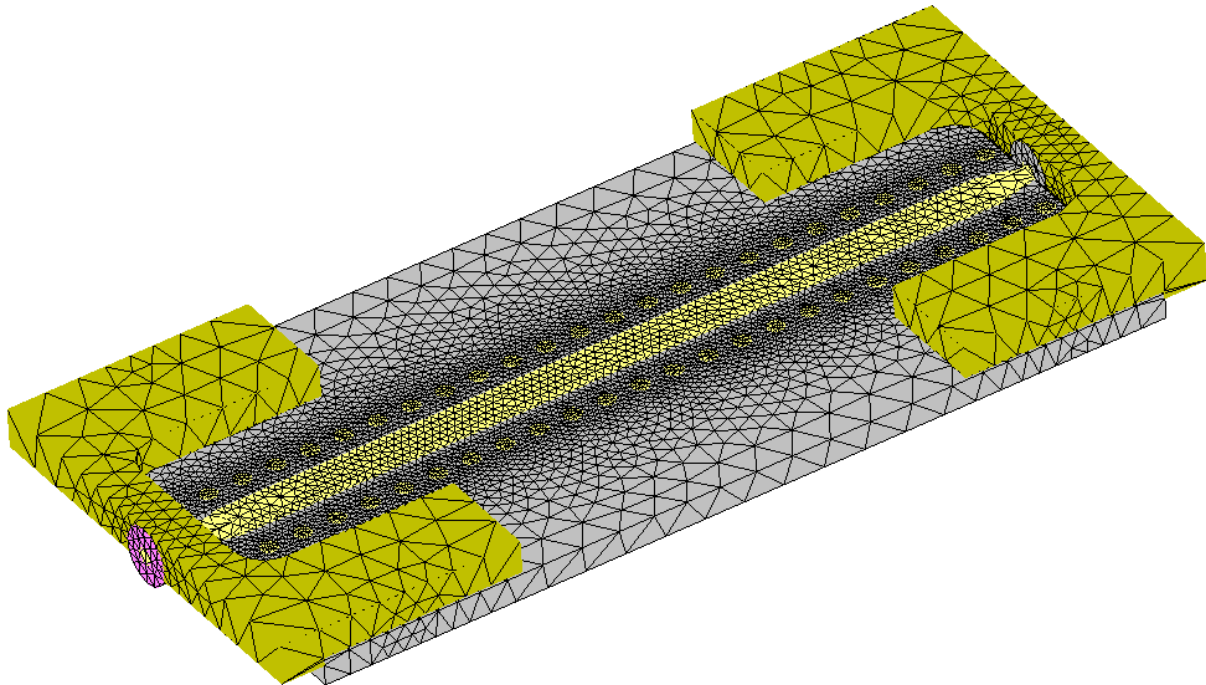

Figure 2: Mesh of the structure

2. Simulation

To simulate the behavior of this transition (insertion and return loss at the desired frequency band; input and output matching), we will create a scattering parameters study, and specify the frequency scheme(in our case 20 frequencies in a fast sweep plan from 0.2 GHz to 20 GHz; the center frequency being chosen 10 GHz). In an antenna simulation, radiation boundaries which are peculiar features of such a simulation have to be assigned to the radiation surfaces. These surfaces truncate the air surrounding the antenna and somehow minimizes the reflection on these surfaces and define the extent of radiation measurements.

The simulated study provides multiple choices and options to plot and to adjust the outputted results according to the user's desire. They also offer the exploitation of electrical parameters calculated in Scattering parameters simulations (insertion, return losses...etc).

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3.   Load/ Restraint

The coplanar waveguide is composed of signal and ground conductors. Each one could be assigned Signal and PEC materials during the step of assignment of solids and materials.

4.   Results

Various 3D and 2D plots are available to exploit, depending on the nature of the task and on which parameter the user is interested in. As we are dealing with a filter simulation, plotting the insertion and return losses sounds like an intuitive task. The following figure shows both the insertion and return losses of the considered filter:
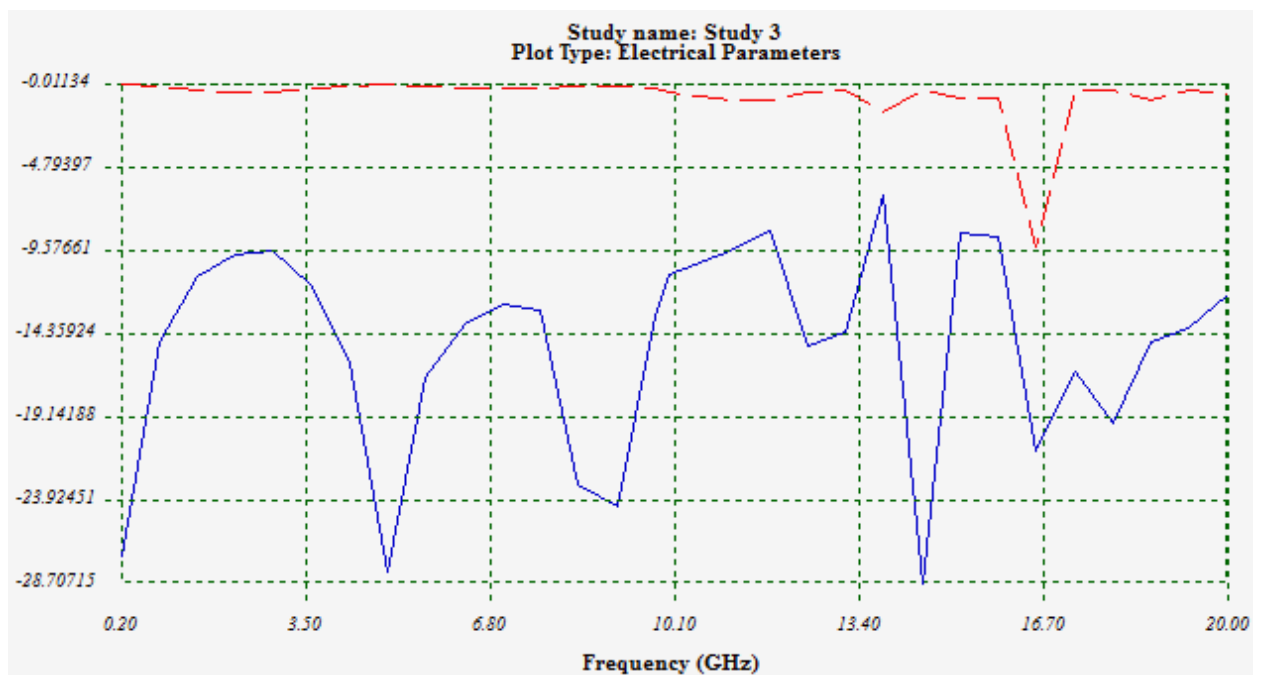

Figure 3: Insertion (Blue) and return (Red) loss

The insertion loss appears to be very low within the frequency band and gives acceptable levels on most parts of the band; As for the return loss, it seem fluctuating but keeps good matching performance; Plotting the return loss on a Smith chart plot is more relevant when we deal with matching issues.
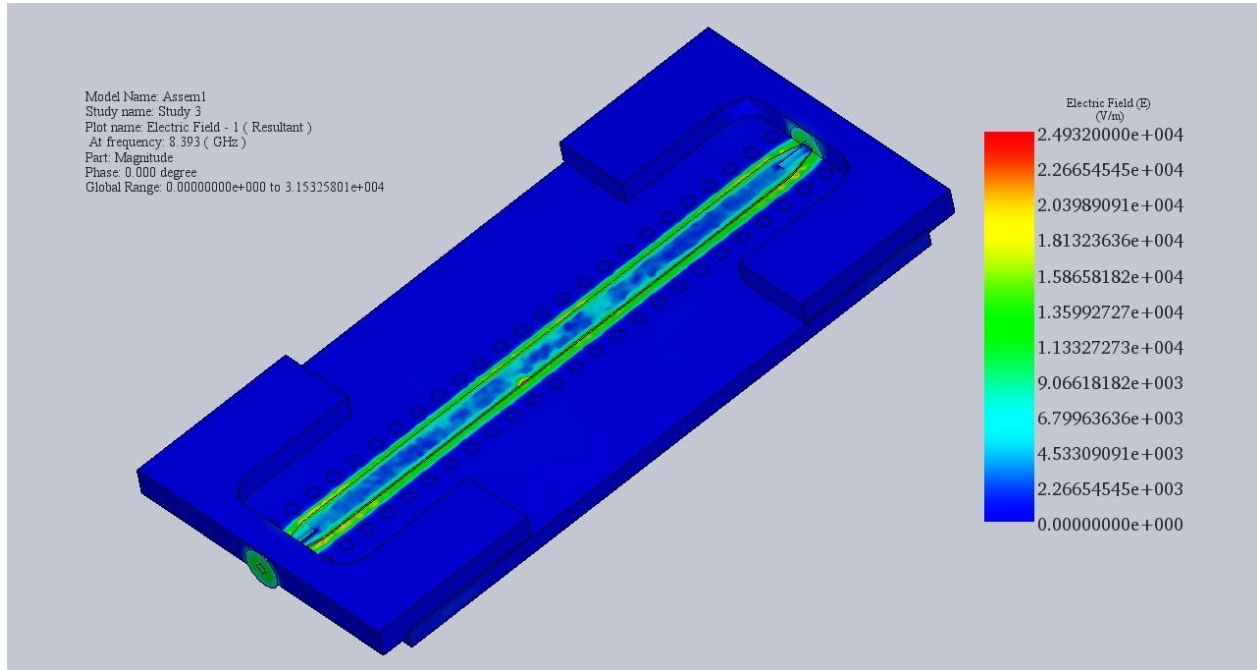
Figure 5: Electric field vector distribution on the circuit at the aimed frequency (8.3 GHz)

The electric field distribution at 8.4 GHz has been spotted on the this figure; when animated, we can see clearly electromagnetic waves going through the circuit and reaches the second SMA port.

5.   Conclusion

In this example, we were able to discover how to arrange a study in pre and post simulation steps in HFWorks. The model being simulated in an S parameter simulation, shows the inner details of wave propagation. It also outputs different electrical parameters in 2D, 3D plots and Smith charts. The transition between different types of RF signal carriers has always been an interesting issue in the RF community; thus, getting an optimized result for your application can be in the origin of great amelioration of your system performance.