

Dual Mode Circularly Polarized Feedhorn

1. Description

This example presents a validated HFWorks simulation of a high efficiency horn antenna which intended to illuminate a passive parabolic reflector. Originally, the design uses two waves with different modes and provides exceptional clean radiation pattern. We simulate the model with one wave to test return loss match. We show further results of radiation patterns as well as the inner electric field distribution.



Figure 1 :The feed with parabolic reflector used for sun noise measurement

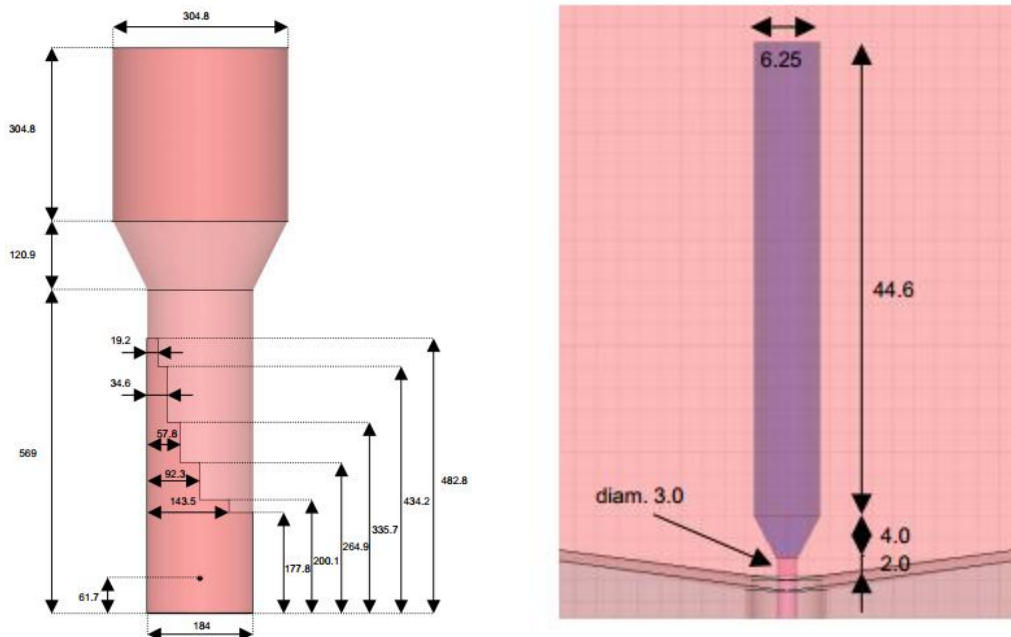


Figure 2: antenna side view (left) and probe (right) dimensions [1]

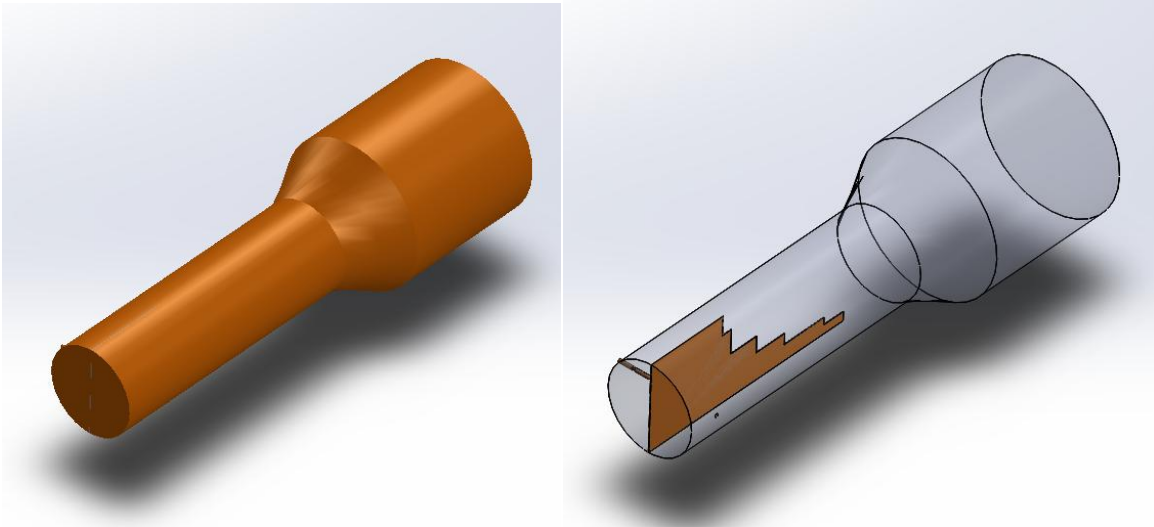


Figure 3: antenna 3D SolidWorks views (regular and transparent) [1]

The mesh of the structure is finer on the coaxial probe. We can resort to the default mesh of HFWorks which recognizes the dimensions of the structures (bodies) and applies a pretty convenient mesh. Nevertheless, the user has total control on the mesh global size and is able to define mesh controls for areas that he assumes more relevant to the structure. A mesh element should not exceed one tenth of the a free space wavelength for optimum results. We can view a colored chart of the 3D mesh model to examine the mesh in the inner parts. The structure was discretized into a finite element mesh and the analysis was conducted with the antenna solver.

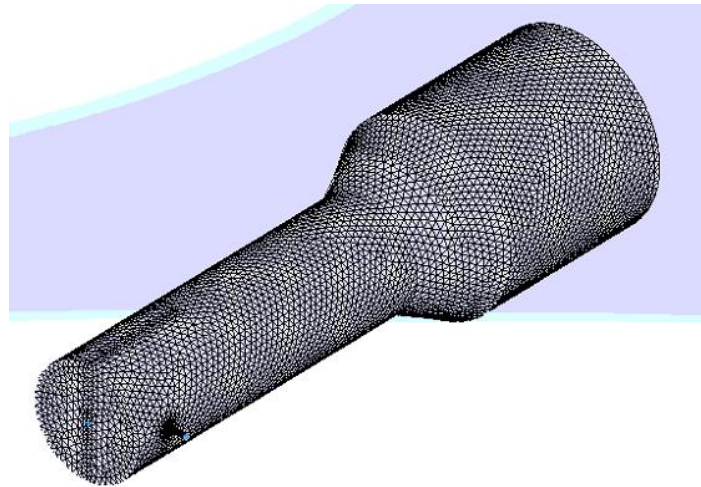


Figure 4: Mesh of the structure

2. Simulation

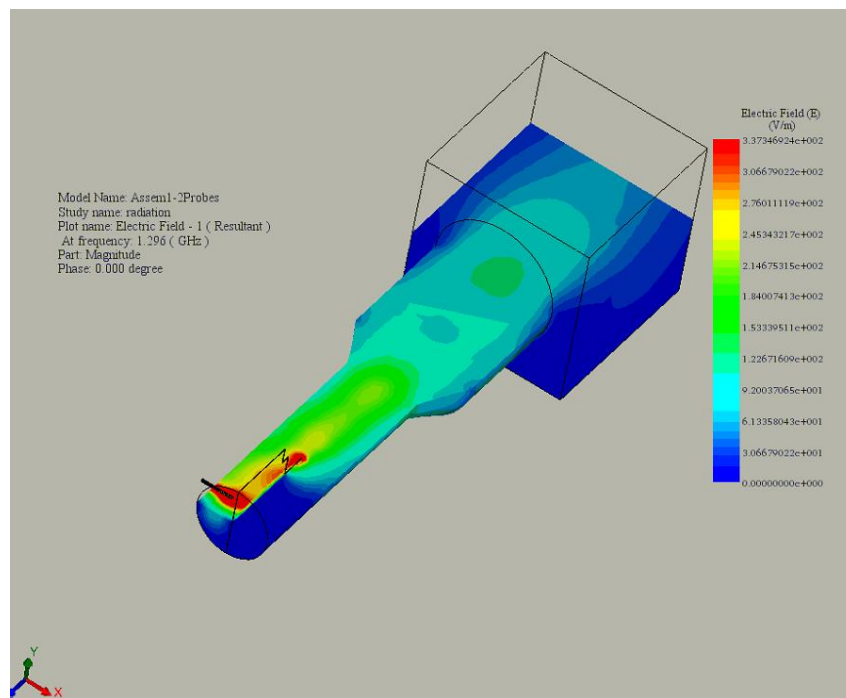
The simulation can be either an antenna study or an S-Parameter study depending on the aimed variable or plot. Predictably, the isolation between the ports is better computed in an S-Parameter study. Since we deal with an antenna's feed, we will show the results of the antenna study first (Return loss, radiation... etc). The simulated antenna study also provides 3D plots for electric and magnetic fields.

3. Load/ Restraint

We apply the port to the circular surface of the coax and check the Pure TEM check box. We signal that the septum is a PEC. The feed horn is filled with air but its surfaces are treated as PEC.

4. Results

After the model is meshed and analyzed, we can have a look at the electric field distribution. We can animate the field in both its fringe and vectors formats. We can make section clipping view in order to see the distribution in the inner parts.



This plot shows the return loss plot from 1.1 GHz to 1.5 GHz. We can see the minimum is attained at approximately 1.29 GHz. We can run another study from 1.25 to 1.32 GHz for more accurate results (See further figure).

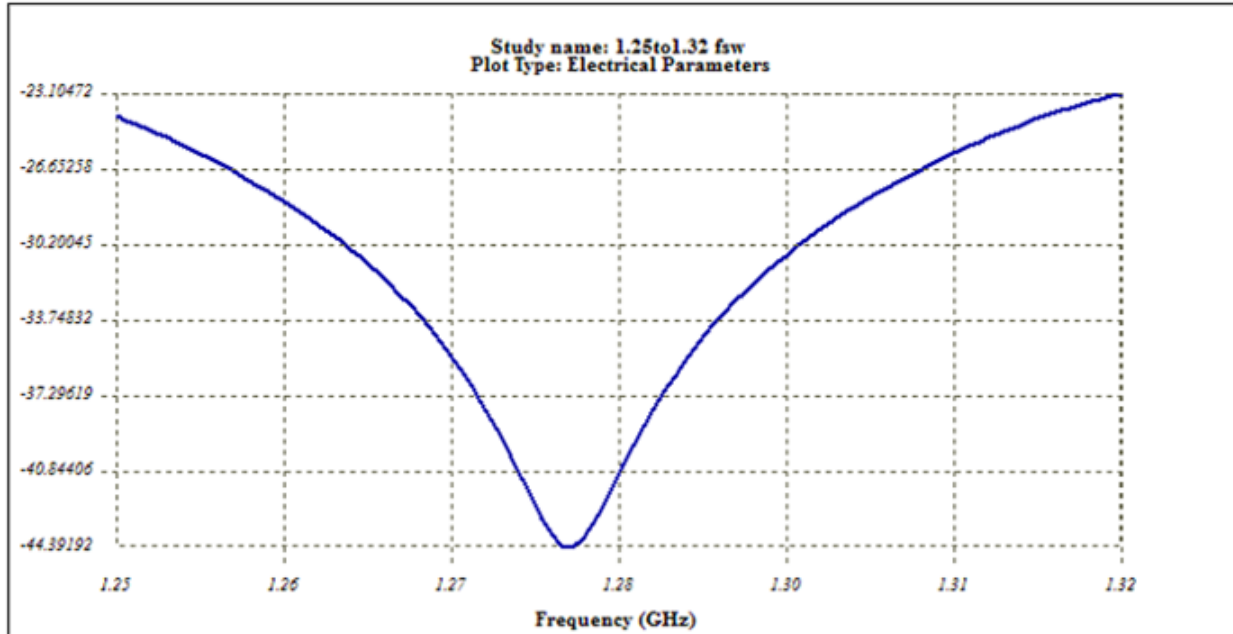
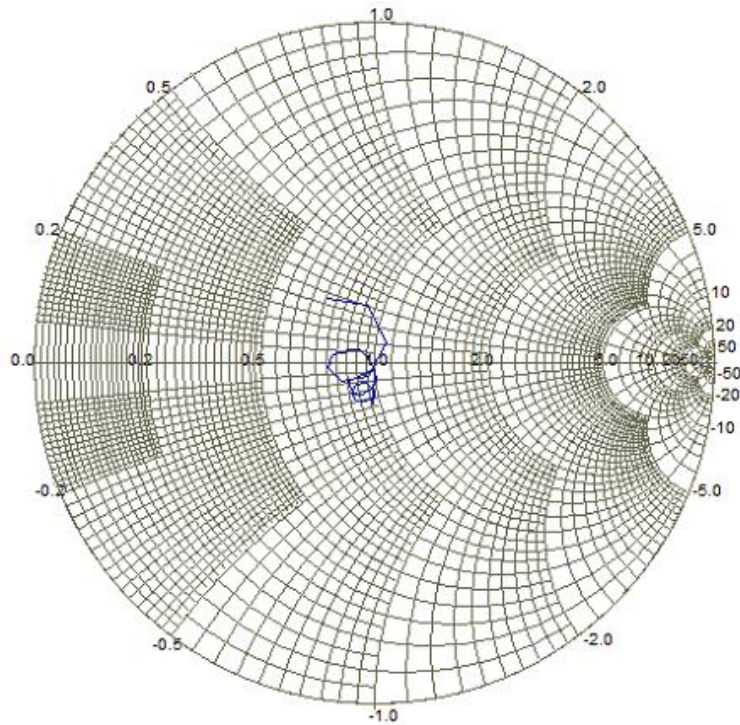


Figure 3: Return loss curves. (Smith Chart from 1.1 to 1.5 GHz)

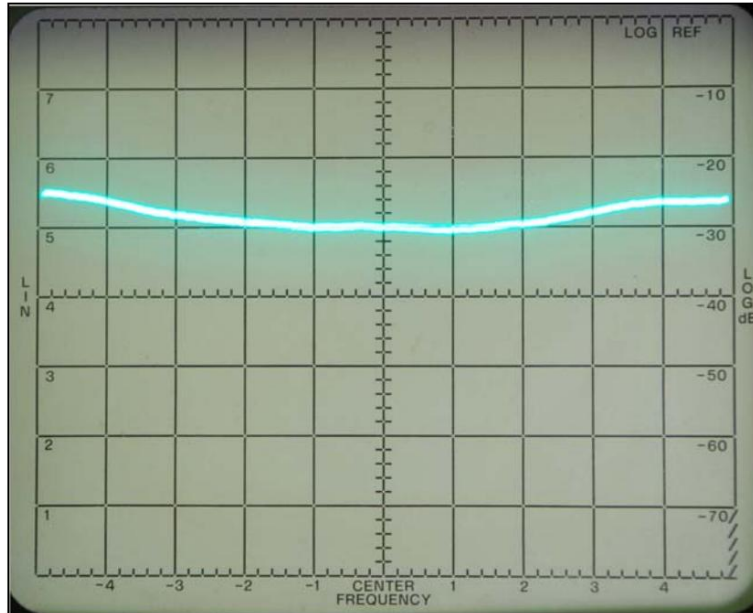


Fig. 20 – Feedhorn return loss
Vertical scale: 10 dB/DIV
Horizontal scale: 5 MHz/DIV, centered at 1296 MHz
Measurement results from [1]

For radiation pattern viewing, the electrical parameters folder incorporates two types of polar plots (2D and 3D). After deciding which type to use, you have multiple variables to plot. Usually, we choose Total Electric Field to show the radiation pattern of the antenna. We also have other choices such as the different components of the electric field, the gain and axial ratio of the antenna... etc. The following figure shows the radiation pattern of the antenna, showing perfect agreement with the measured results in [1].

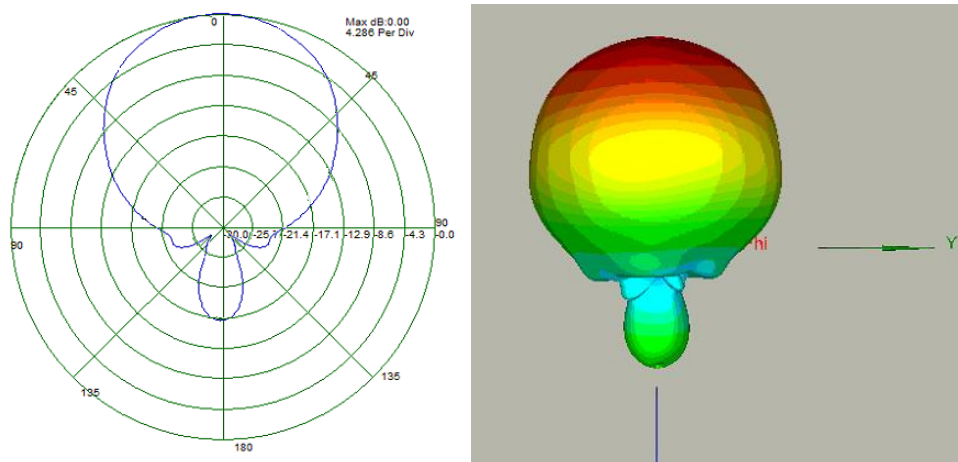


Figure 5: Radiation patterns at 1.296 GHz



5. Conclusion

In this example, we were able to discover how to set up an antenna study for a feed horn in pre and post simulation steps in HFWorks. The simulation shows great agreement with the measured results of [1].



Figure 4: The feed after realization [1]

6. References

[1] Computer Optimized Dual Mode Circularly Polarized Feedhorn Marc Franco, N2UO