

Modeling Microwave Waveguide Components: The Tuned Stub

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Introduction: The waveguide device modeled demonstrates the exploration of an important microwave hardware device, a Tuned Stub, designed to facilitate the optimized transfer of power from the generating source to the consuming load.

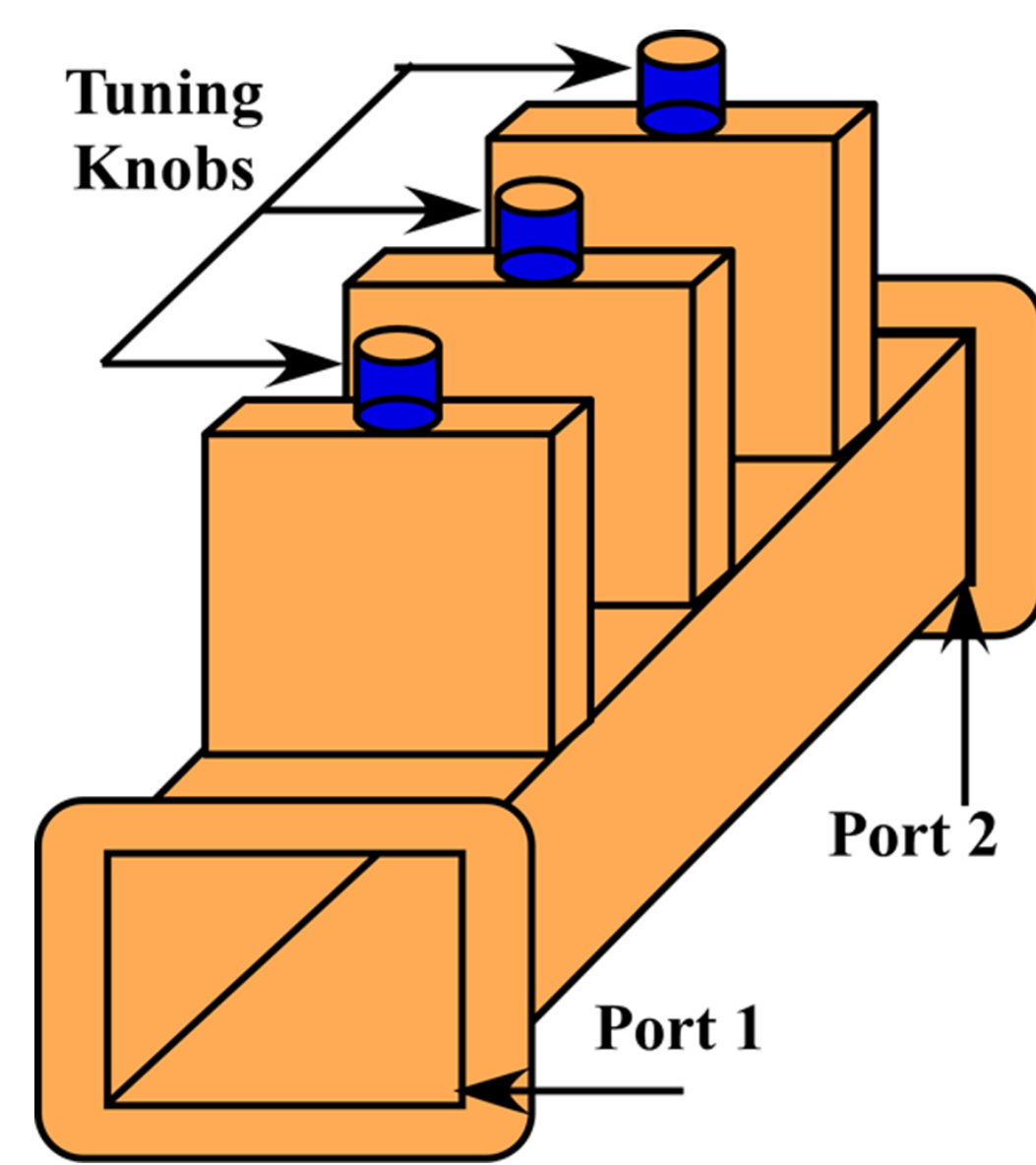


Figure 1. Three Stub Tuner

Computational Methods: The COMSOL Multiphysics RF Module software (version 4.3) is employed to perform a two-port S-parameter analysis of a Three Stub Tuner in the range of 2.2 to 3.3 GHz. It was necessary to add the equation for the calculation of the Voltage Standing Wave Ratio (VSWR), a measure of the power transfer match and indirectly of the potential signal dispersion and/or distortion.

The VSWR is defined mathematically as:

1.
$$\text{VSWR} = \frac{1 + |S_{11}|}{1 - |S_{11}|}$$

where S_{11} is the Port 1 scattering coefficient. This equation is entered in a plot group as a y-axis expression.

2.
$$(1 + \text{abs}(\text{emw.S11})) / (1 - \text{abs}(\text{emw.S11}))$$

The geometry comprises the union of four rectangular prisms. The domain was defined

as a vacuum. The conductivity of the wall material (e.g., thin sheets of silver) was used in calculating the wall losses of the tuner.

Results: The VSWR graph shows that the tuner has almost no power reflection in the 2.4 – 3.3 GHz range.

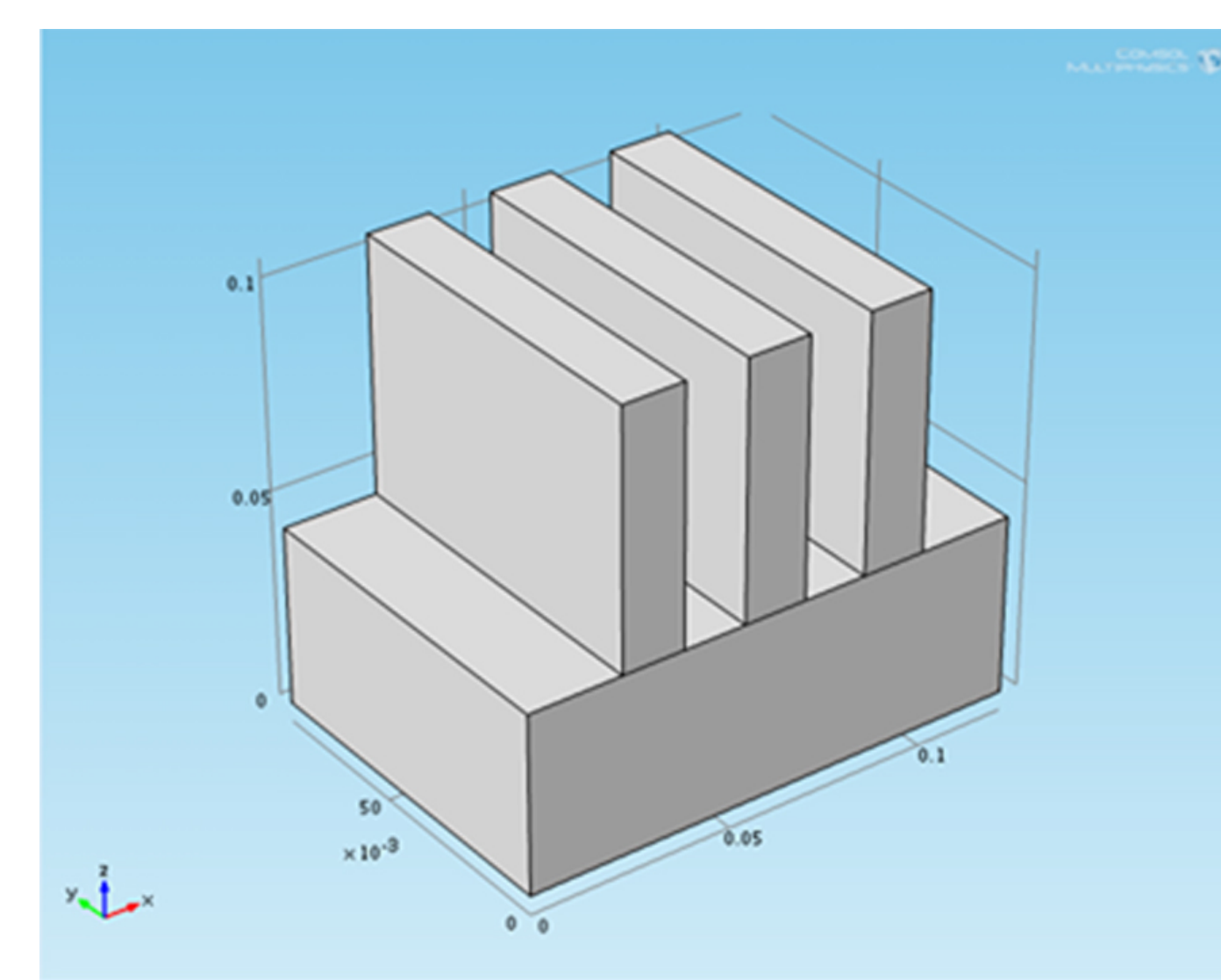


Figure 2. Tuner Geometry

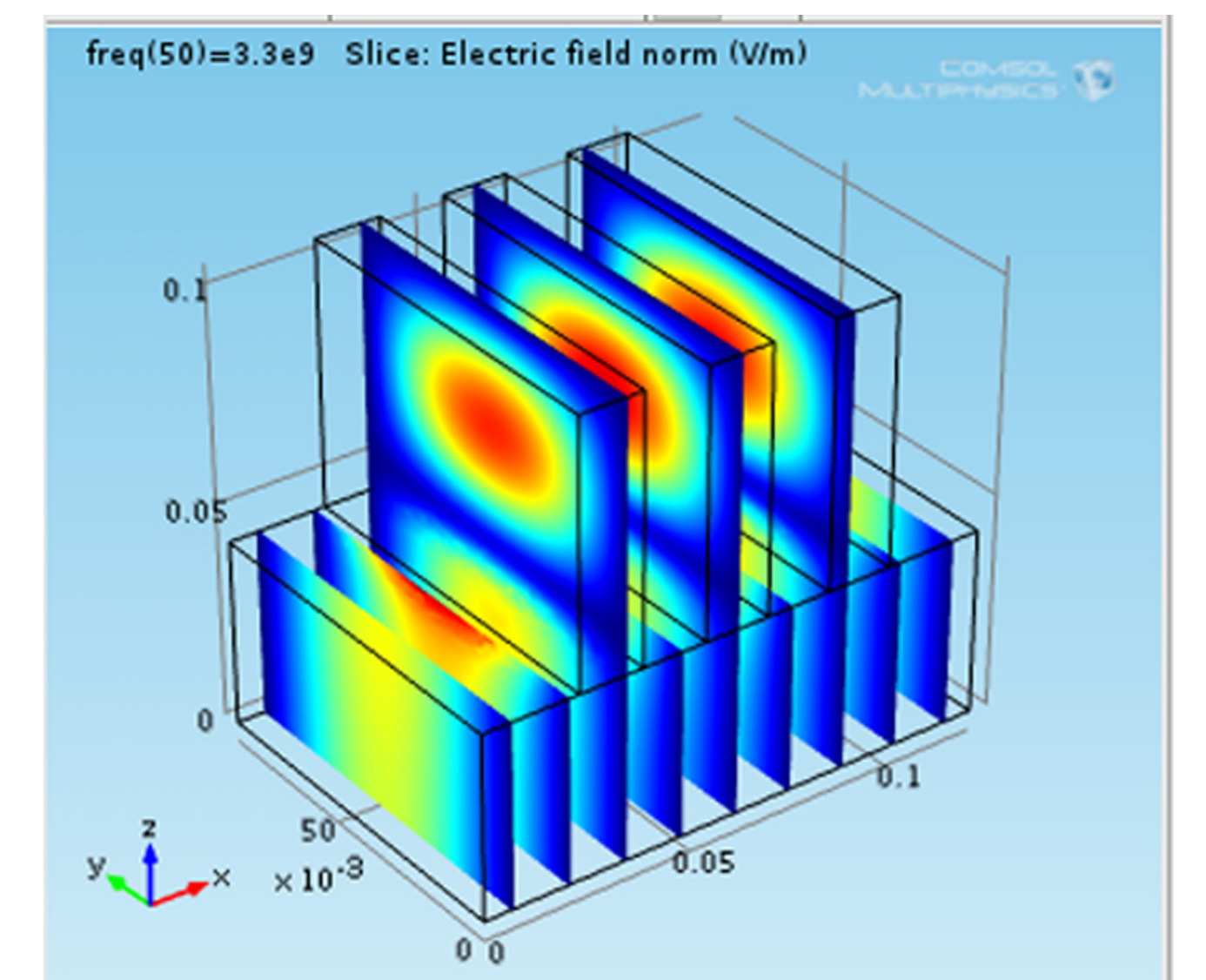


Figure 3. Electrical Field Distribution

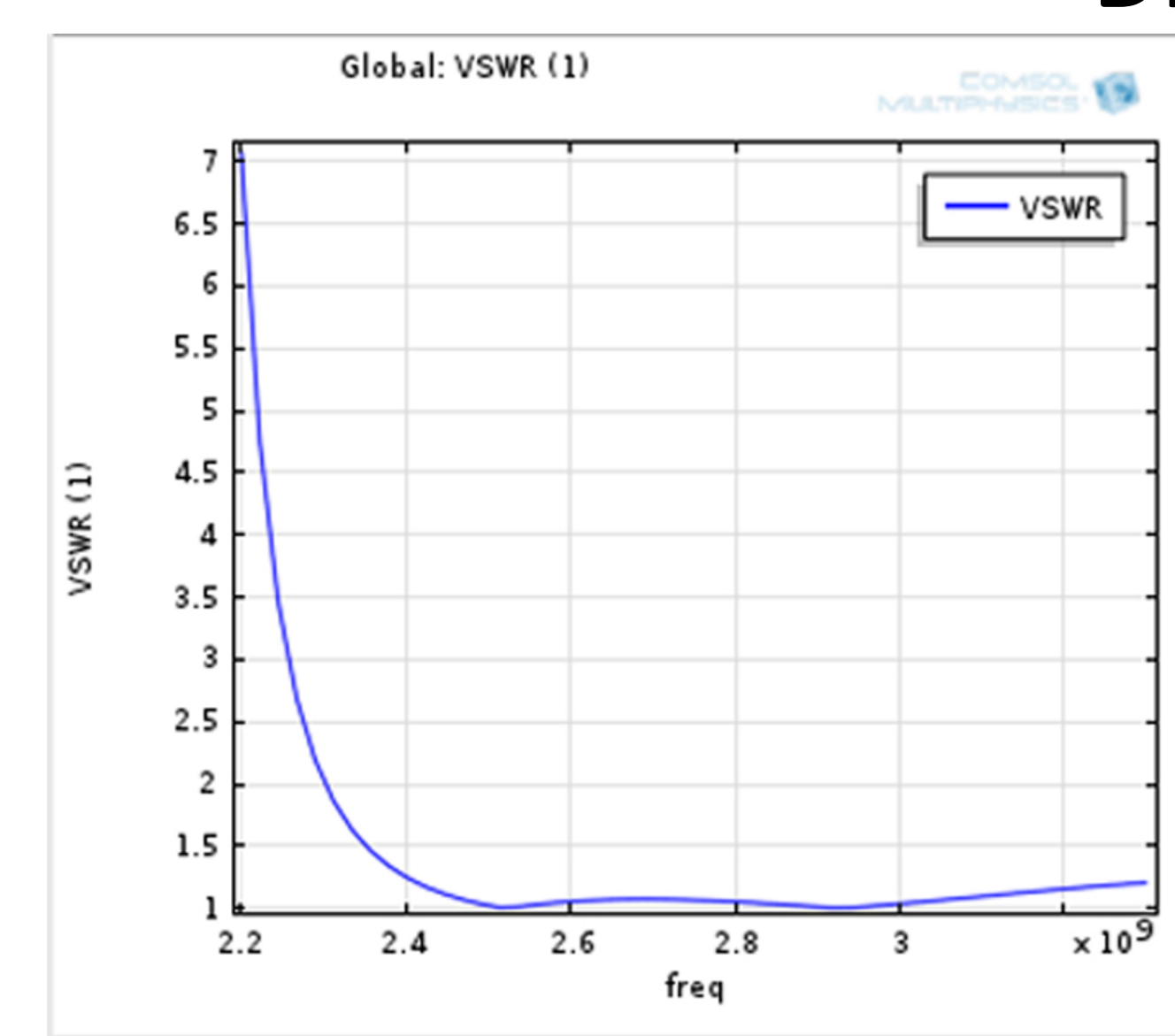


Figure 4. Voltage Standing Wave Ratio (VSWR) Plot

Conclusions: This model shows the electric field distribution and the VSWR and demonstrates that the RF Module of COMSOL Multiphysics software can be easily employed, when properly configured, to calculate microwave component power distribution and reflection analysis problems.

References:

1. Pryor, Roger W., Modeling Microwave Waveguide Components: The Tuned Stub, Proceedings of the 2012 COMSOL Conference (Boston) (2012)