Analyst_Milling_Machine_Analysis

Where To Find This Example

AWR Version 14

This example was named in V14, please see Milling_Machine_Dielectric_Removal_Effects

AWR Version 13
Download Project

Understanding AWR .emz Files

Design Notes

**MICROSTRIP CIRCUITS MANUFACTURED BY MILLING MACHINE**

This example shows how to use the Analyst 3D electromagnetic simulator to study the effects of machined dielectric material for microstrip circuits. The analysis includes a study of sweeping the depth that the dielectric is machined to see the effect on simulation results.

Download

Simulating this project is time-consuming. This example, with the datasets included, is available above for download.

Overview

When you fabricate designs using a milling machine, the milling bit must extend down through the PCB metal and into the dielectric below. Due to human error or small variations in the metal thickness, you will typically extend safely into the dielectric below. You now have a dielectric for your microstrip that is not truly a microstrip configuration. The metal is sitting up on a small layer of dielectric (the full thickness of the board) and then the remaining dielectric is thinner than the full dielectric. The situation is shown in the figure below.
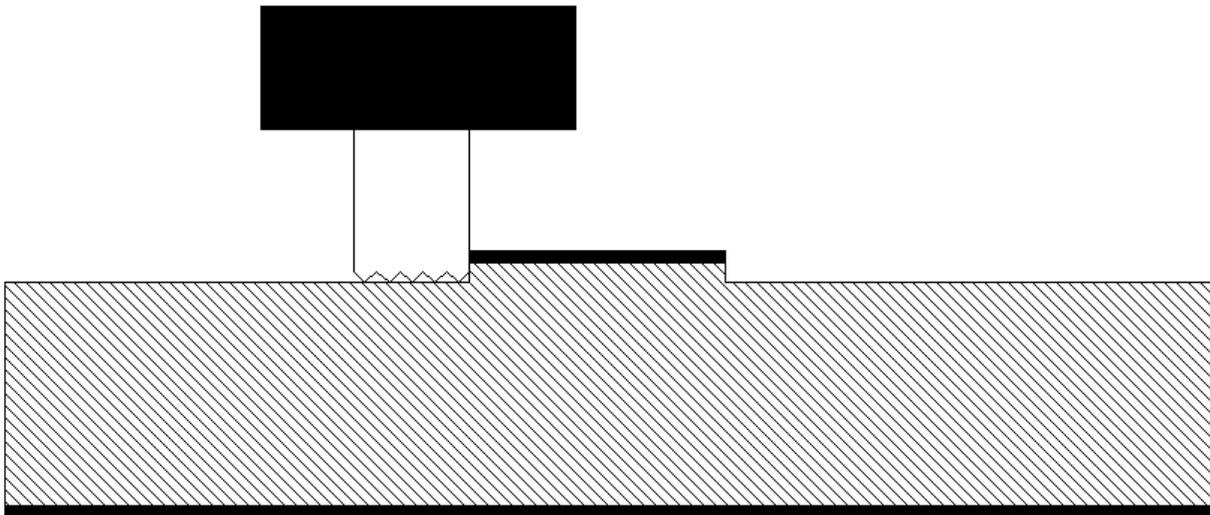
The microstrip modeling could have accuracy issues depending on how deep this dielectric is removed. This project is setup to simulate a simple microstrip open stub structure to see how much effect this dielectric machining will have on the performance of the structure. The project is parameterized so you can enter how deep the milling bit goes into the dielectric.

Circuit Model

A network is modeled using schematic elements in "Schematic_Open_Stub". X-models are used to give the highest accuracy from this linear simulation network.
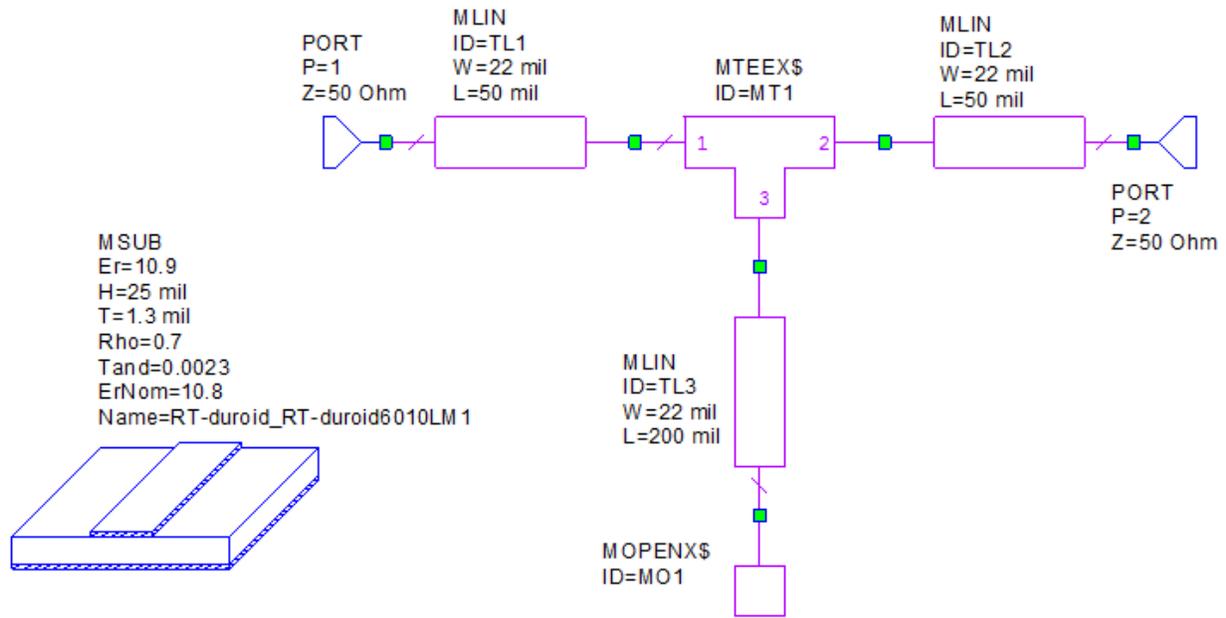
EM Model

The same network is modeled an Analyst 3D EM document in "Analyst_Open_Stub". The general setup procedure is discussed below. Refer to **Help** docu menation for more details.

1. The EM schematic is used to build the stub network using schematic elements, the same way the schematic is built.

2. A line type for the microstrip lines is defined to draw with two layers, one for the metal and one for the dielectric brick to draw exactly under the metal.

3. Equations are used to set the machining thickness to control the thickness of that layer and subtract from the full substrate thickness.

4. Swept variable control is used to sweep the machine depth.
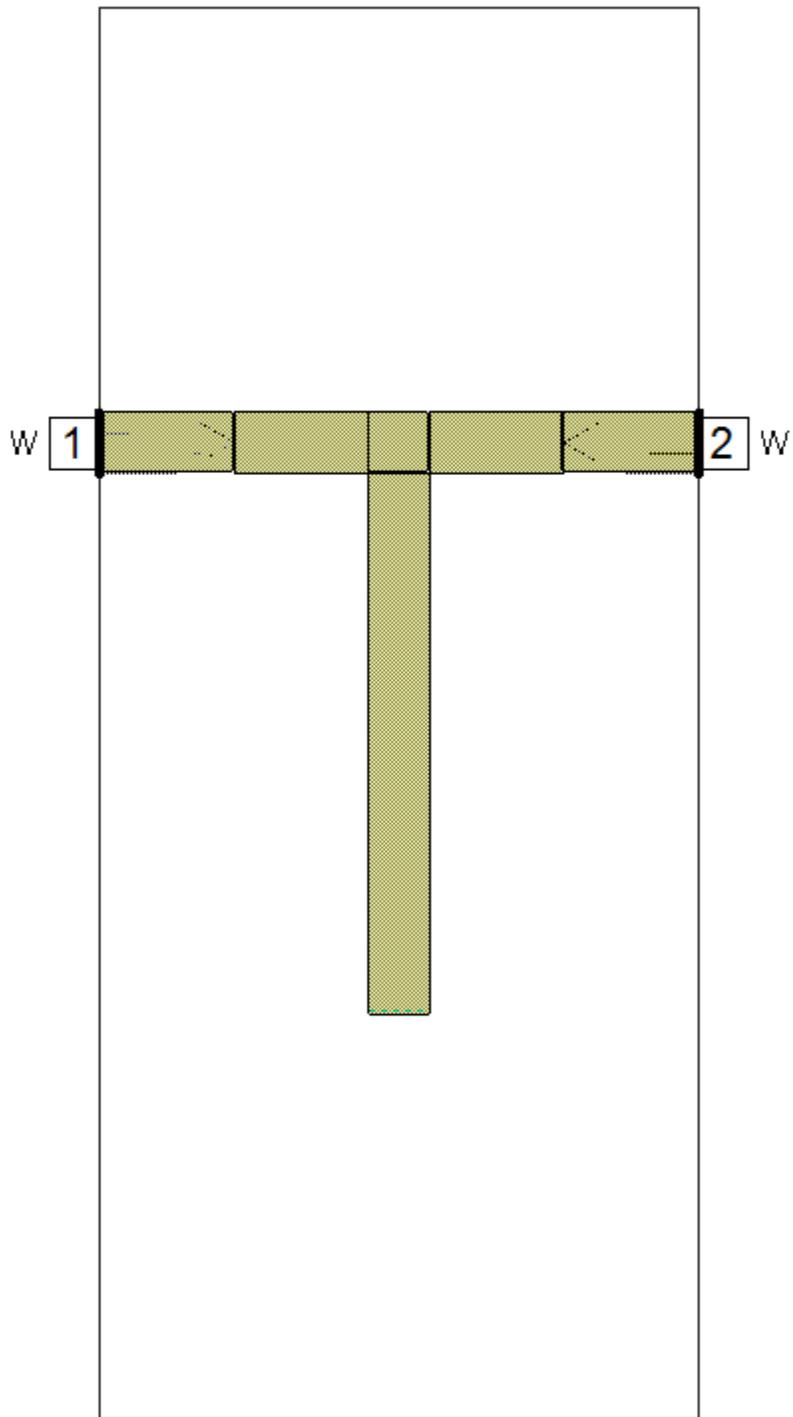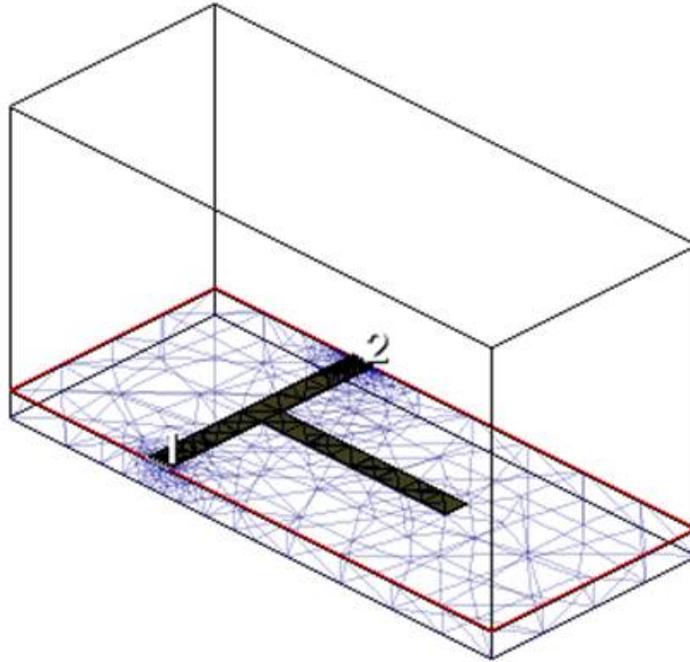
Results

The rectangular graph "S21" clearly shows the effect of removing this dielectric material. The blue curve shows the schematic results and then the three red curves are different depths of dielectric removed. Note that from this structure, you can approximate the effective dielectric constant of the substrate. These equations are written in the "Global Definitions" section of this document, you just need to enter the frequency of the null of S21 and the length of the stub to calculate the effective dielectric constant. This approach was validated using the results from the microstrip model and using TXLine (**Tools > TXLine**) to calculate the effective dielectric constant.