Coax_to_Microstrip

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Design Notes

Coaxial Connector to Microstrip Transition Optimization

This example shows how optimize a coax connector to microstrip transition using a parameterized 3D EM Element connector model.

Overview

Commonly, when comparing measurement results to simulated ones, the transition from the measurement hardware coaxial cable to the signal trace of the DUT is assumed ideal. This assumption is implicitly made as soon as the simulation input/output ports are placed on the trace, e.g. on the microstrip or CPW line. There are various methods to improve the transition mismatch, and this example discusses one approach. Using a full 3D model for the connector and the transition enables analysis of the transition parasitics.

3D Element Library

Under the Elements tab, one can find a new library node "3D EM Elements". The element used in this example is found under 3D Parts > Connectors > SMA > SMA_CONFIG. It is dragged onto a parent Analyst EM structure, and its parameters can be accessed by selecting the element in the layout editor and choosing Element Properties from the right-click context menu. The parameters in this case correspond to a connector that is designed for 20mil substrates.

Connector Attached to the Board

A SMA connector attached to a PCB signal trace is drawn in the "Coax_to_Microstrip" EM Structure. The design is set up as an hierarchical design, with the 3D SMA connector modeled as a subcircuit (child) model. To set the z-position of a child document, select the child in the parent document and choose from the right-click context menu. The z-position is set on the tab of the Cell Options dialog box. Port 1 (input) of the parent document is placed on the coax end of the SMA connector subcircuit. Port 2 (output) is placed on microstrip line at the other end of the board and is defined as a wave port with the reference plane shifted to the left near the end of the tab where the SMA connector attaches to the line.

Transition Quality Without Optimization

Looking at S11 of the transition reveals that the inherent matching is good only up to about 2GHz. At the target design frequency of 10GHz the reflection is as high as -10dB, and clearly the design would benefit from an optimized transition - not only because of lost energy, but also because the mismatch is a considerable source of error for the measurement vs simulation.

Optimization Strategy

The transition model can be optimized in a schematic using the EM document as a subcircuit, as shown in the "MatchingSchematic" schematic. It is easy to find out that a series-L parallel-C matching circuit to improve the match at 10GHz. In microstrip, a series-L can be realized by a narrow segment of strip, while a parallel-C can be realized by a wide strip segment. It is straightforward to optimize for the required line dimensions.

After determining the matching circuit dimensions, the entire design including the matching circuit is modeled in the "Coax_to_Microstrip_Match_10GHz" EM Structure for a 3D EM verification simulation. Simulation results indicate a good match. It can also be instructive to view and animate the surface currents at 10GHz.

Schematic Layout - MatchingSchematic
Graph - ReturnLoss

m1: 10000 MHz -0.3363 dB