MEMS_Phase_Shifter

Where To Find This Example

Select **Help > Open Examples...** from the menus and type either the example name listed above or one of the keywords below.

Or in Version 13 or higher you can open the project directly from this page using this button. Make sure to select the **Enable Guided Help** before clicking this button.

Open Install Example

Design Notes

MEMs Phase Shifter Example

This example shows a 3-bit, 31-35 GHz MEMS phase shifter design in the AWR Design Environment. All of the metal interconnect can be simulated using the extraction flow and Axiem as the EM simulator.

Overview

The notation used in this project is that variables that start with a lower case letter are local variables and variables that start with a capital letter are global variables and are defined on the "Global Definitions Page."

Phase Shifter Measurements are used to calculate the phase shift and phase error for all 8 phase states.

Due to the complexity of this design, the schematics and graphs has been organized under the “User Folders” node at the bottom of the design. It is much simpler to see the stages of this design using these folders.

Switches Folder

This folder contains the schematics and graphs used to design the switches. The radial stubs are tuned to show a short circuit at the switch when closed. The feed lines to the switch are tuned to show an open circuit when the switch is closed.

Individual Stages Folder

This folder contains subfolders for each stage of the design, 45, 90 and 180 degree phase shifts. See the schematics and graphs used for designing the phase shift for each stage.

Complete Phase Shifter Folder

This folder contains the top level schematic and layout for final 3 bit MEMS phase shifter design. Note that there are a swept variable **“phaseState”** that sweeps the MEMS control bits to cover the 8 possible phase states. The range over which this variables is swept is defined on the “Global Definitions” Page.

The individual phase shifter sub-circuits are labeled according to their phase shift. Note the use of the **SPDT** switch in the phase shifter sub-circuits - this switch is very handy in that it takes in an integer (**“state”**) and a significant bit (**“bit”**) and does the decimal to binary translation internally. This makes it very easy to sweep multi-state devices like a phase shifter and not have to create any equations to convert the state integer back to the necessary **“0”** or **“1”** representation.

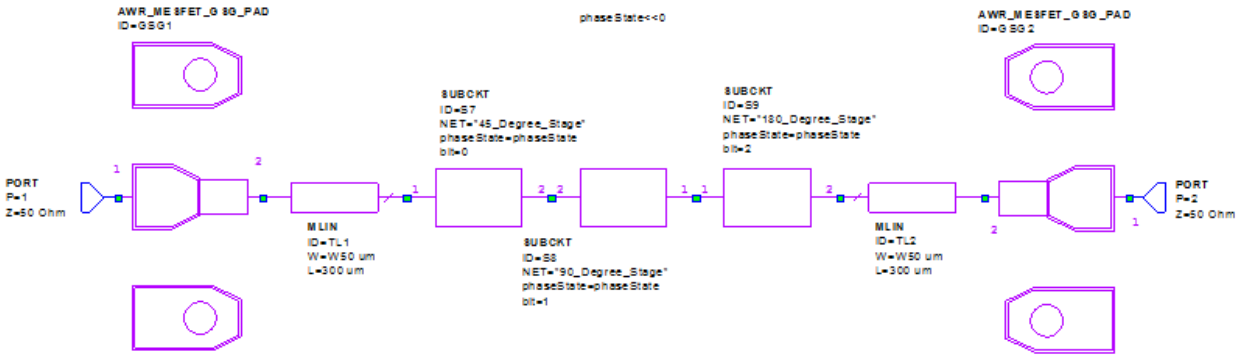
The AWRDE has many advanced measurements for doing phase shifter design. Please see all the graphs for the complete design to see what is available to the designer.

AXIEM

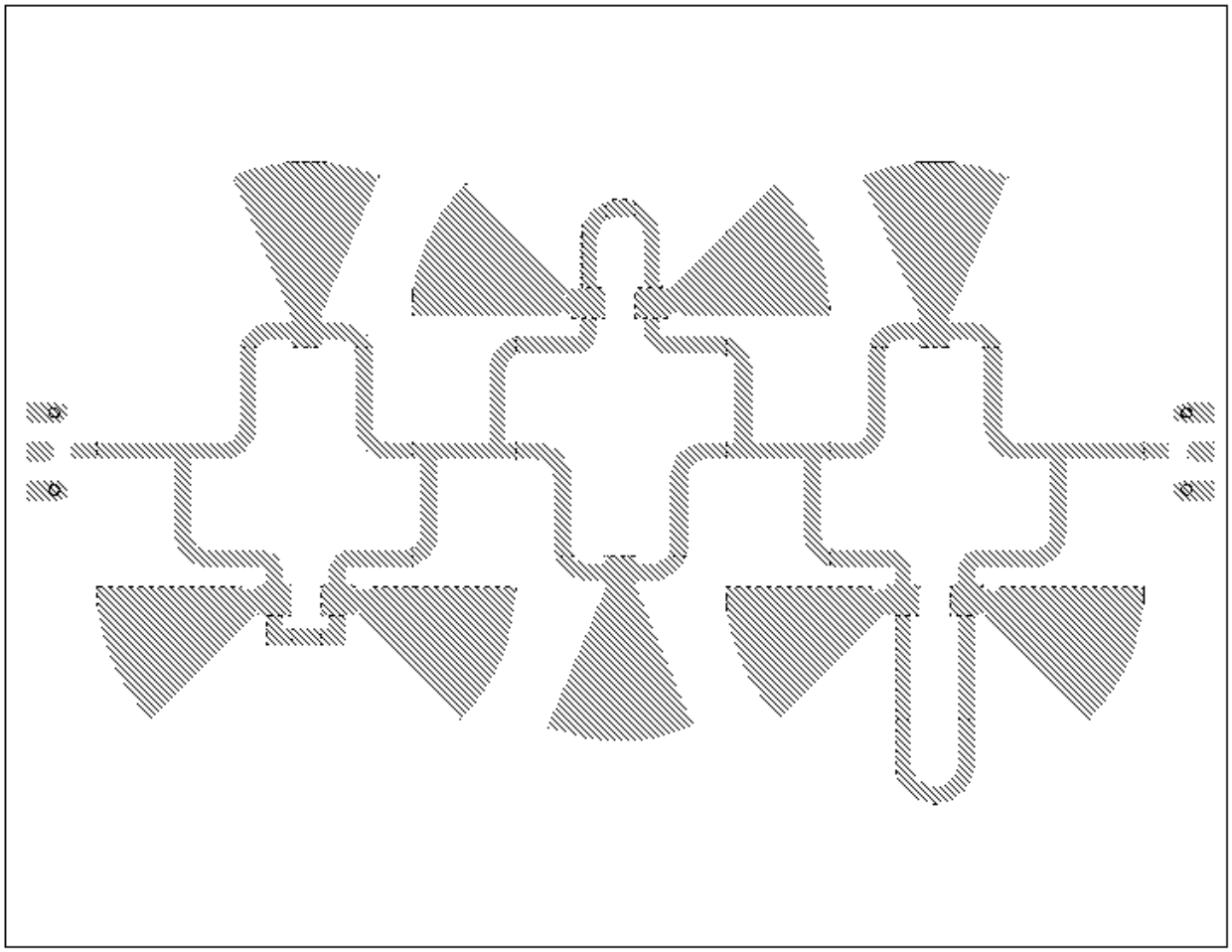
This project has been setup to use Axiem to simulate all the metal in this design. To turn this on, find the Extract block in the top level schematic and enable it. With this enabled, the layout is transferred to an Axiem EM document and simulated. The EM results are automatically merged back to the schematic to give you the results of your circuit included the EM analysis.

The EM document that is simulated does not get created until you simulate. You can right click on the EXTRACT block and select “Add Extraction” to see the EM document before you simulate. You can also right click on the EM document added to the project and select “Add Annotation”. Open the 3D view and click the Show 3D Mesh button from the toolbars to see the mesh.

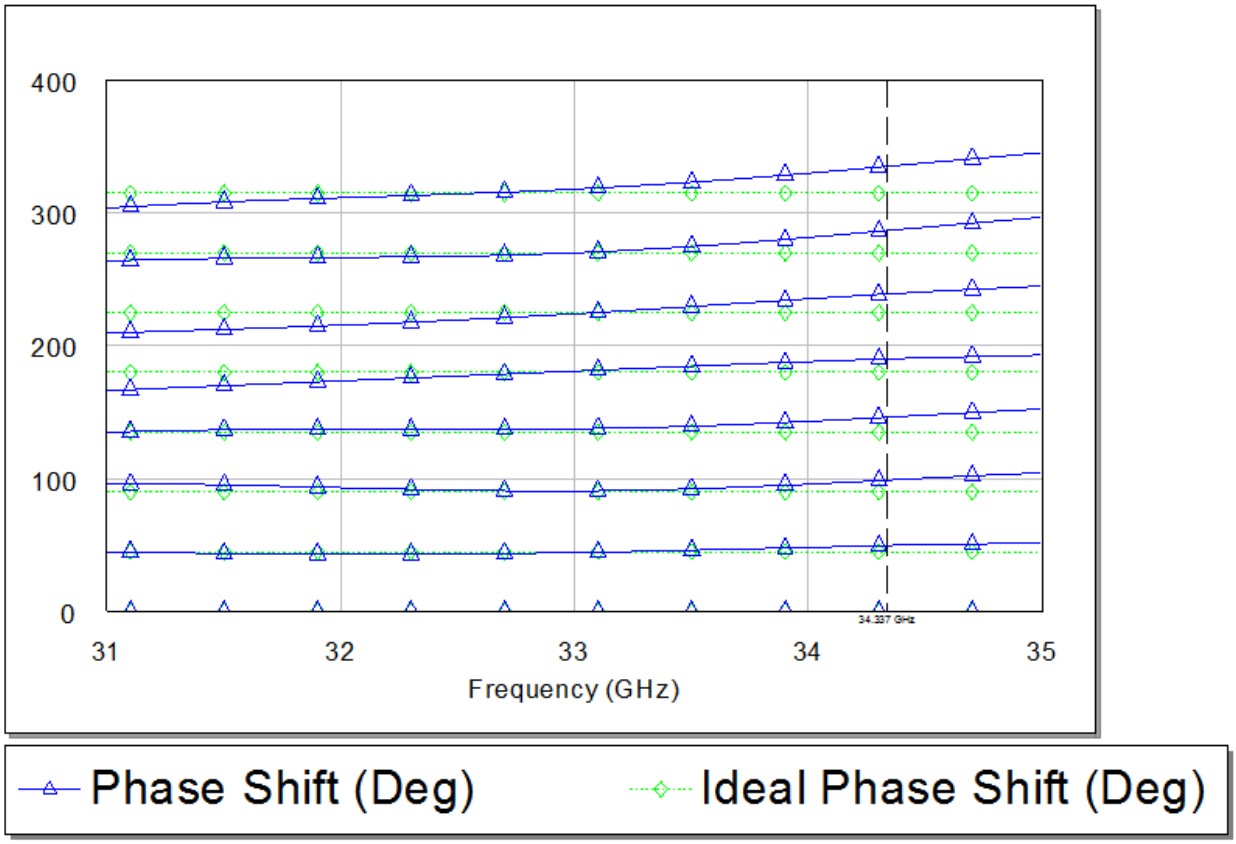
Schematic - Complete_Phase_Shifter



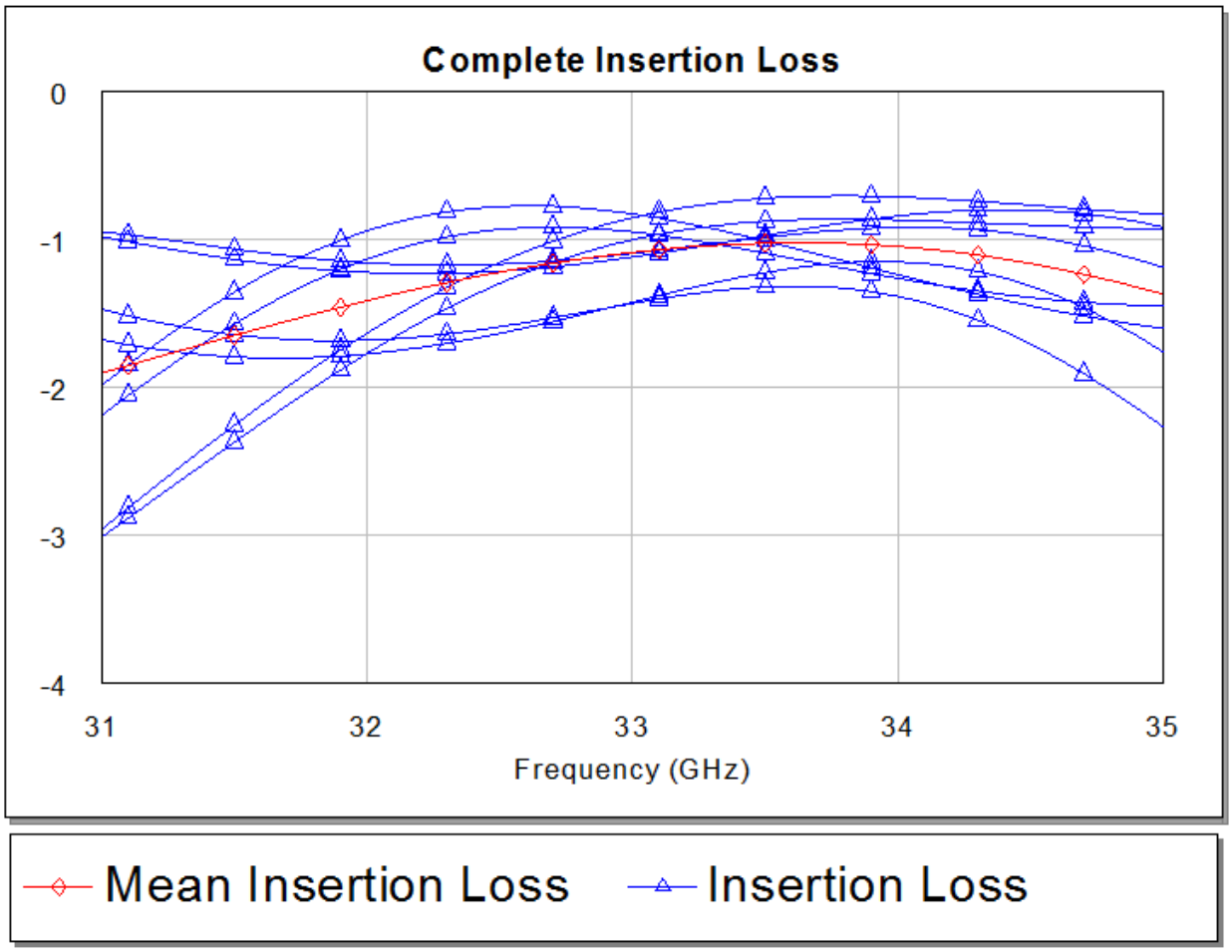
Schematic Layout - Complete_Phase_Shifter



Graph - Complete Phase Shift



Graph - Complete Insertion Loss


Complete Insertion Loss
0
-1
-2
-3
-4
31
32
33
34
35
Frequency (GHz)
Mean Insertion Loss
Insertion Loss