Perfecting Branchline Model

Michael's Work on the 90deg Hybrid

as of 1/23/2009

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Description of Technique

• The technique used to tune these models was exactly the same as was done before – it is summarized below:

- Generate the best Designer model, export for analysis in HFSS
- Analyze the exported model in HFSS and export results (using N-Port Data) back into Designer
- 'Reverse tune' the model to see how HFSS is interpreting the model…this means that if you have to tune a variable up in Designer to get the HFSS results, you should export it as tuned down

• The reason that I get different results after this tuning process *now* as opposed to last time is that I focused on different metrics. Michael Enders said that my phase could be flatter and that my return loss could be better centered. With these in mind I tuned the Designer model. To get better phase, I tuned with the variables 'mid' = 'down' (which, theoretically, should be equal…but I had tuned them separately in Designer last time to get better return loss).

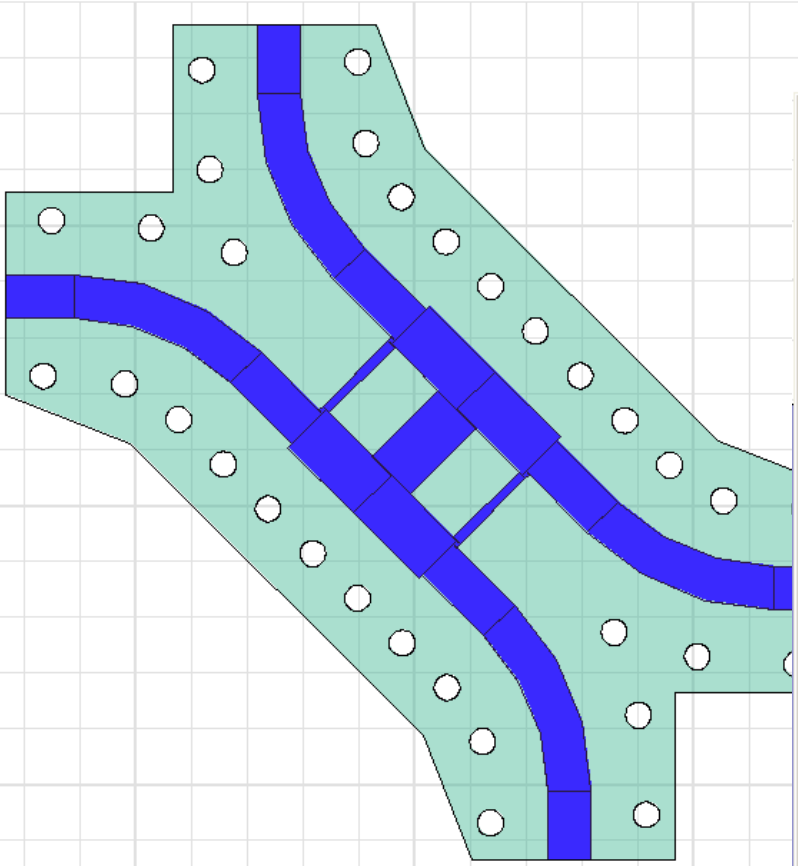
Description of Technique

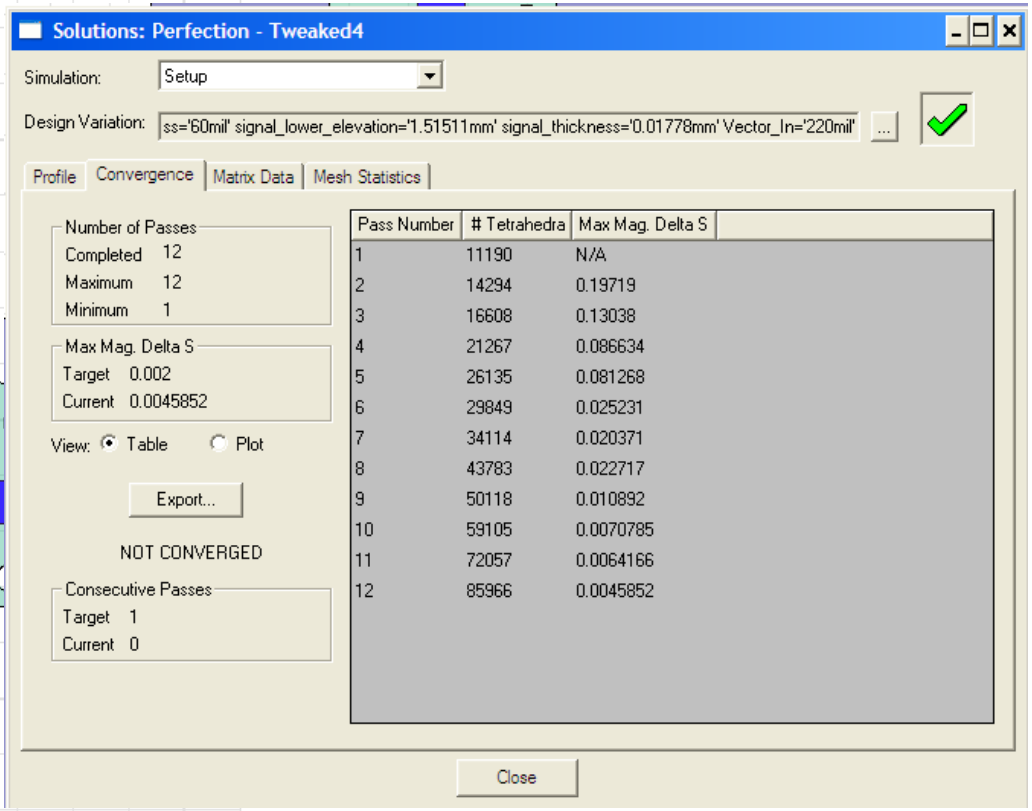
- The following table goes through the iterations that were used to get to the final models.

Variable	Best Designer Model	Tweaked 1	Tweaked 2	Tweaked 3	Tweaked 4	Tweaked 5
mid = down	4.03 mm	4.31 mm	4.16 mm	4.21 mm	4.21 mm	4.21 mm
b = c	2.6 mm	2.400 mm			2.450 mm	2.425 mm
a = d	0.43 mm					
fifty	1.97623 mm					
qwt	1.97623 mm					
radius	10.00 mm					

- The two main variables that were tuned were mid (= down) and b (= c). The variable 'mid' represents the physical length of the top and bottom striplines that connect the two branches of the branchline. The variable 'down' represents the physical length of the three vertical striplines that make up the branchline. 'b' represents the width of the 'mid' lines. 'c' represents the width of the middle 'down' line.
- Tweaking the value of mid/down shifted the center frequency of the response.
- Tweaking the value of b/c changed the power division between the output ports.
- The last three 'tweakings' are only separated by a difference of 0.05mm (approx 2mil).

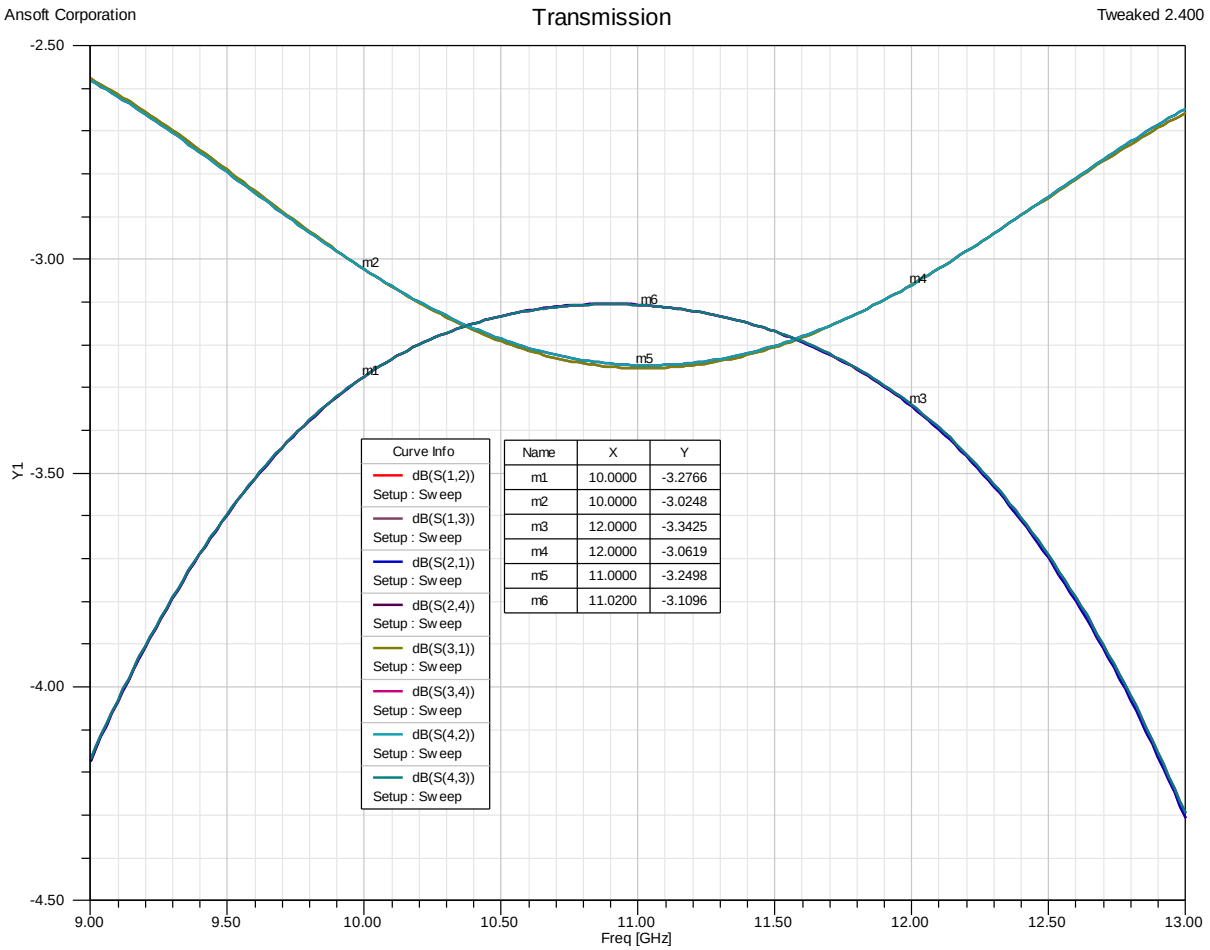
Tweaked 2.400





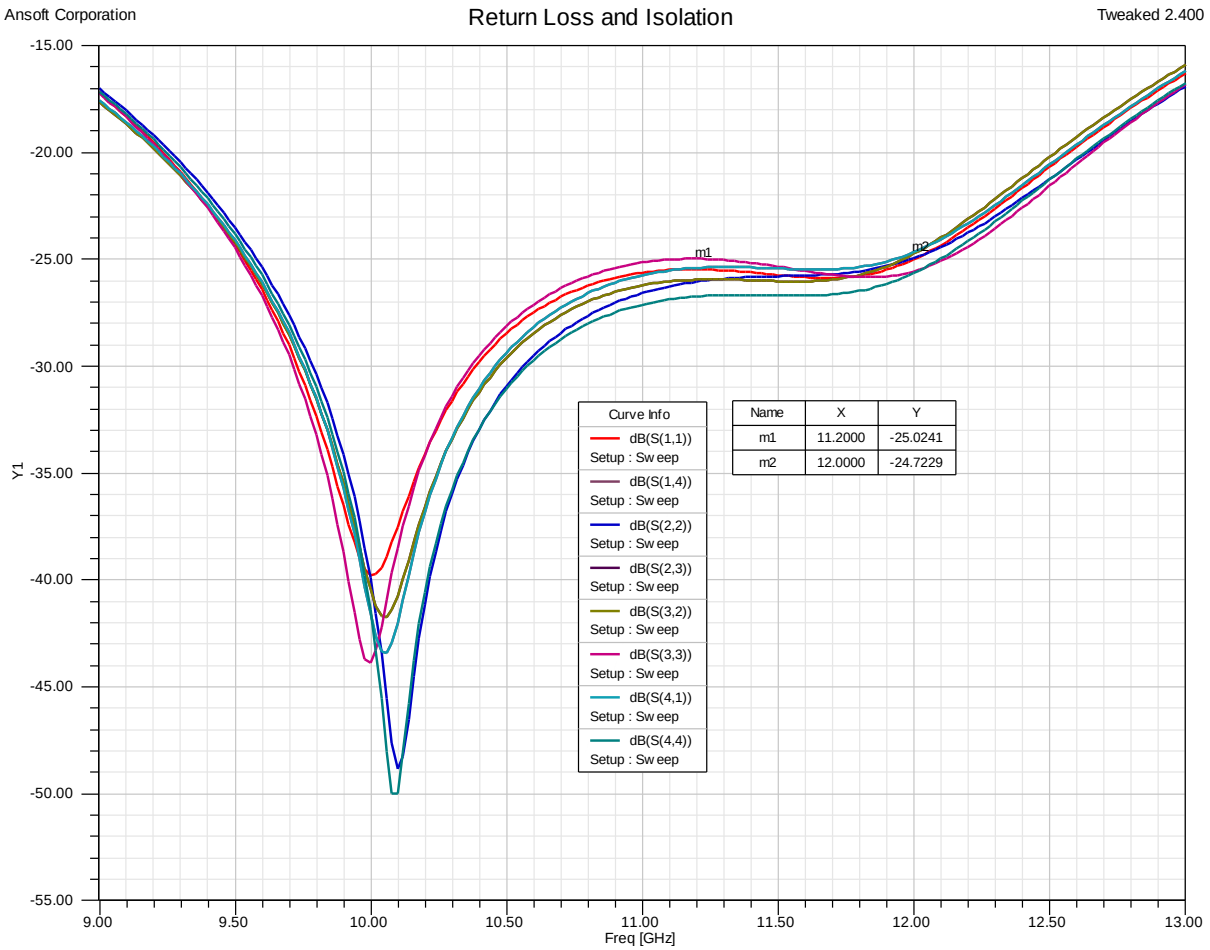
This model, with b = 2.400mm, was run on a quad core with newly expanded memory options. I was able to get 12 adaptive passes and a delta S of 0.0046-ish.

Tweaked 2.400



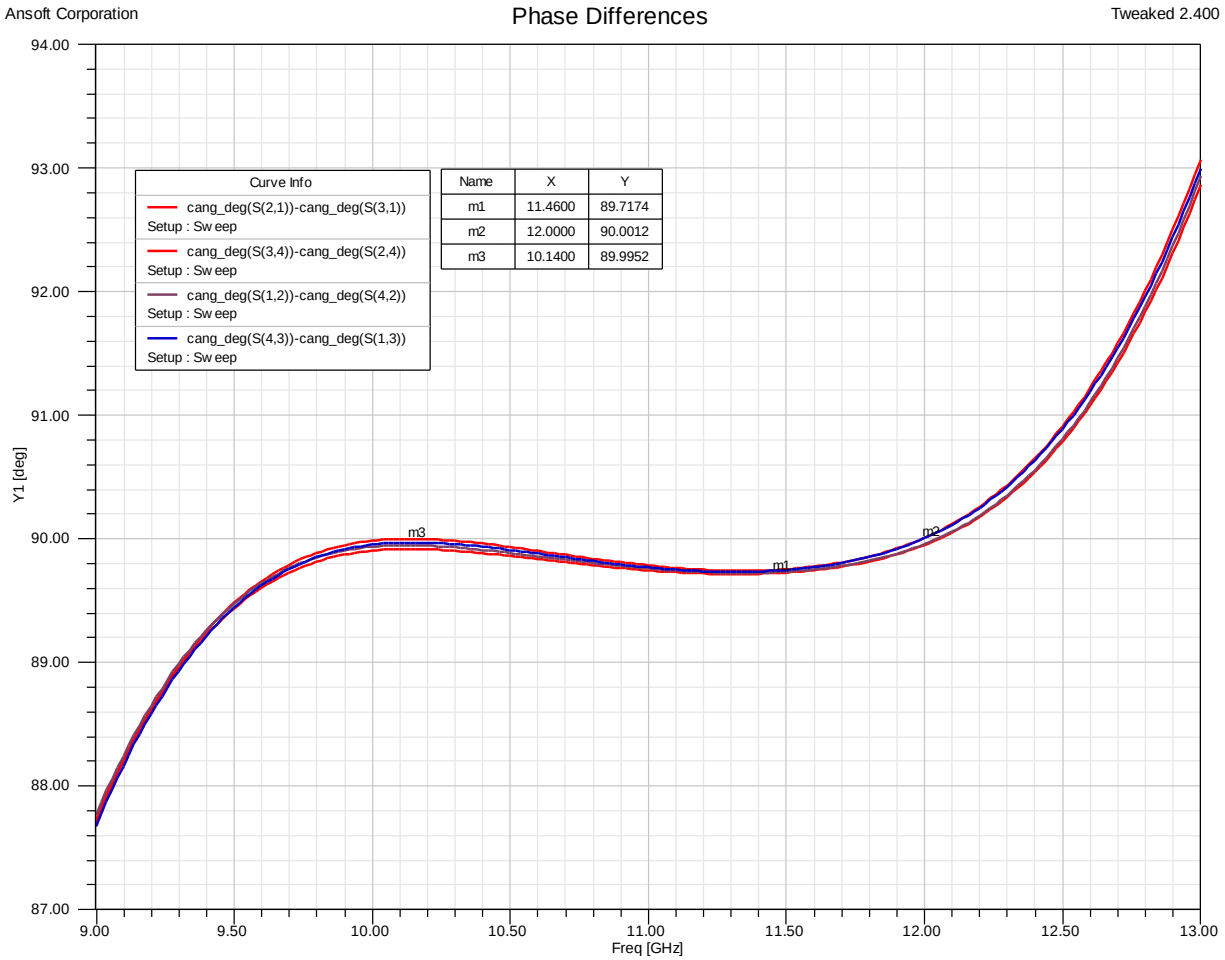
These are the transmission S-Parameters for the ‘Tweaked 2.400’ Model. Transmission is centered but seems to be uneven across the bandwidth. It could be better balanced.

Tweaked 2.400



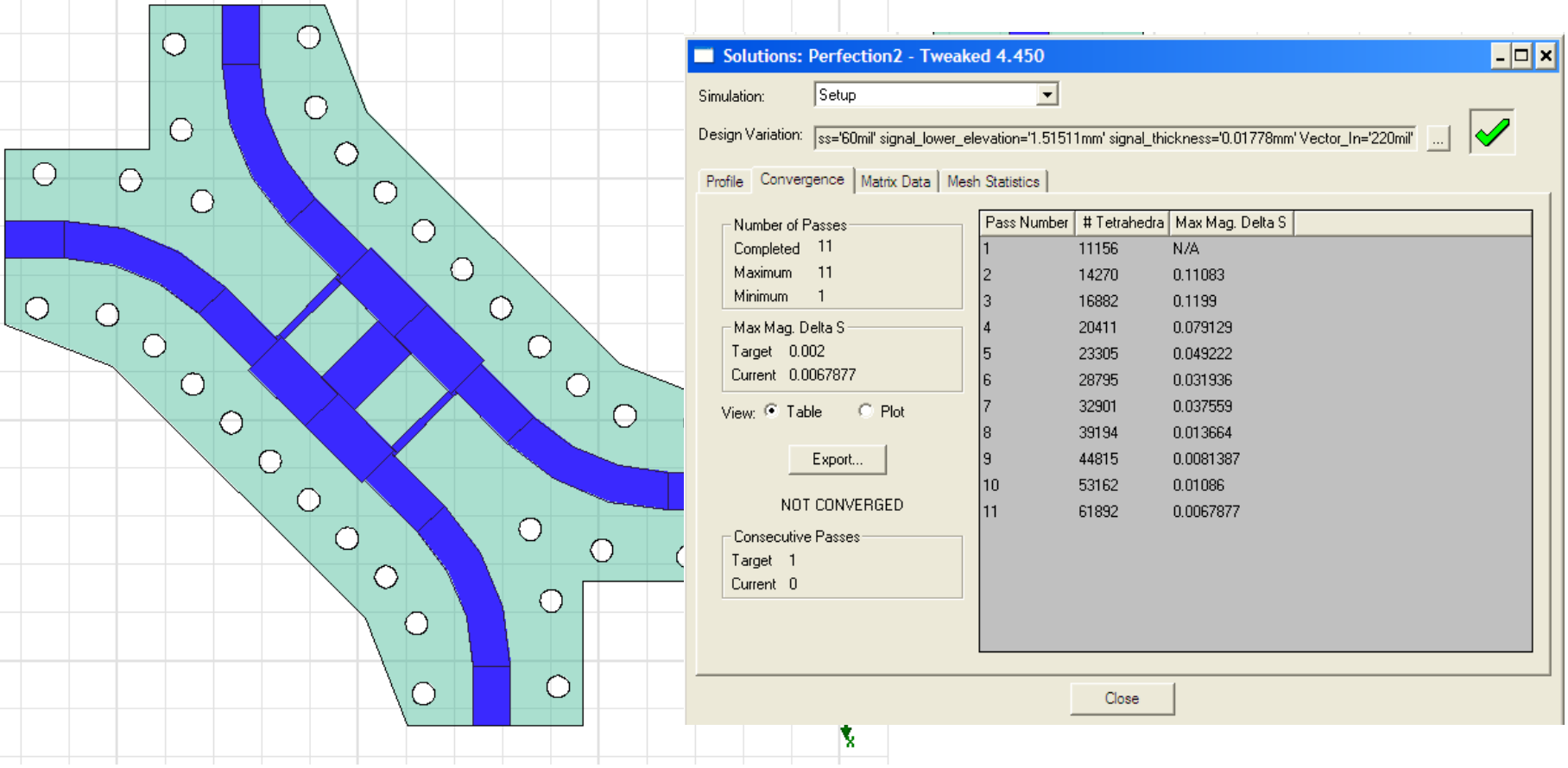
These are the return loss and isolation S-Parameters. It isn't as centered as one would like, but is very low across the bandwidth. It almost looks as if there might be a chance of the 12GHz value decreasing – there is a second dip coming on.

Tweaked 2.400



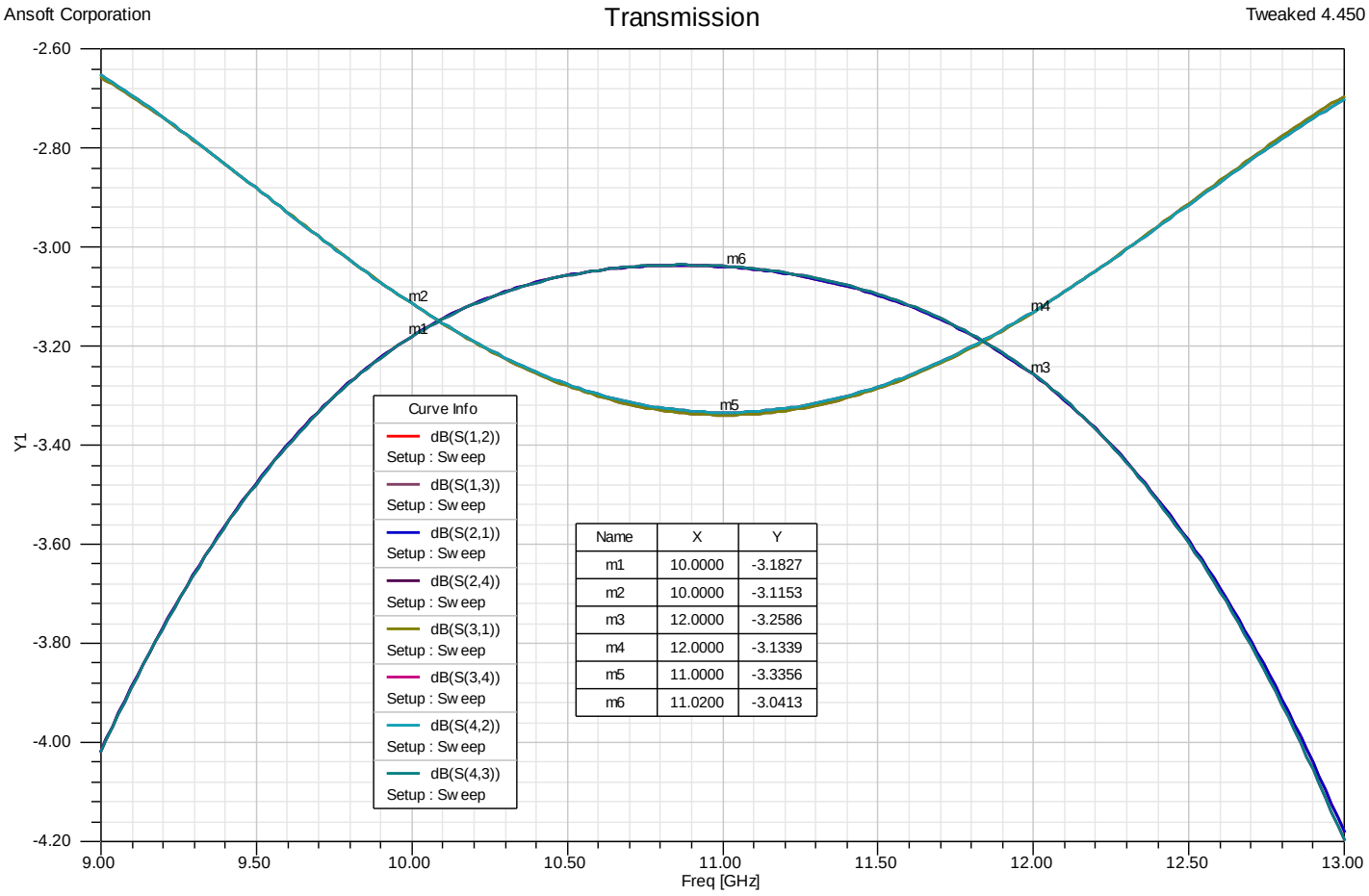
Wow! The phase differences have all of a sudden (thanks to 'mid' = 'down') converged to almost a single value. It follows the same pattern as we've seen (except for the lossless model) – we are, across the bandwidth, just below 90 degrees.

Tweaked 2.450



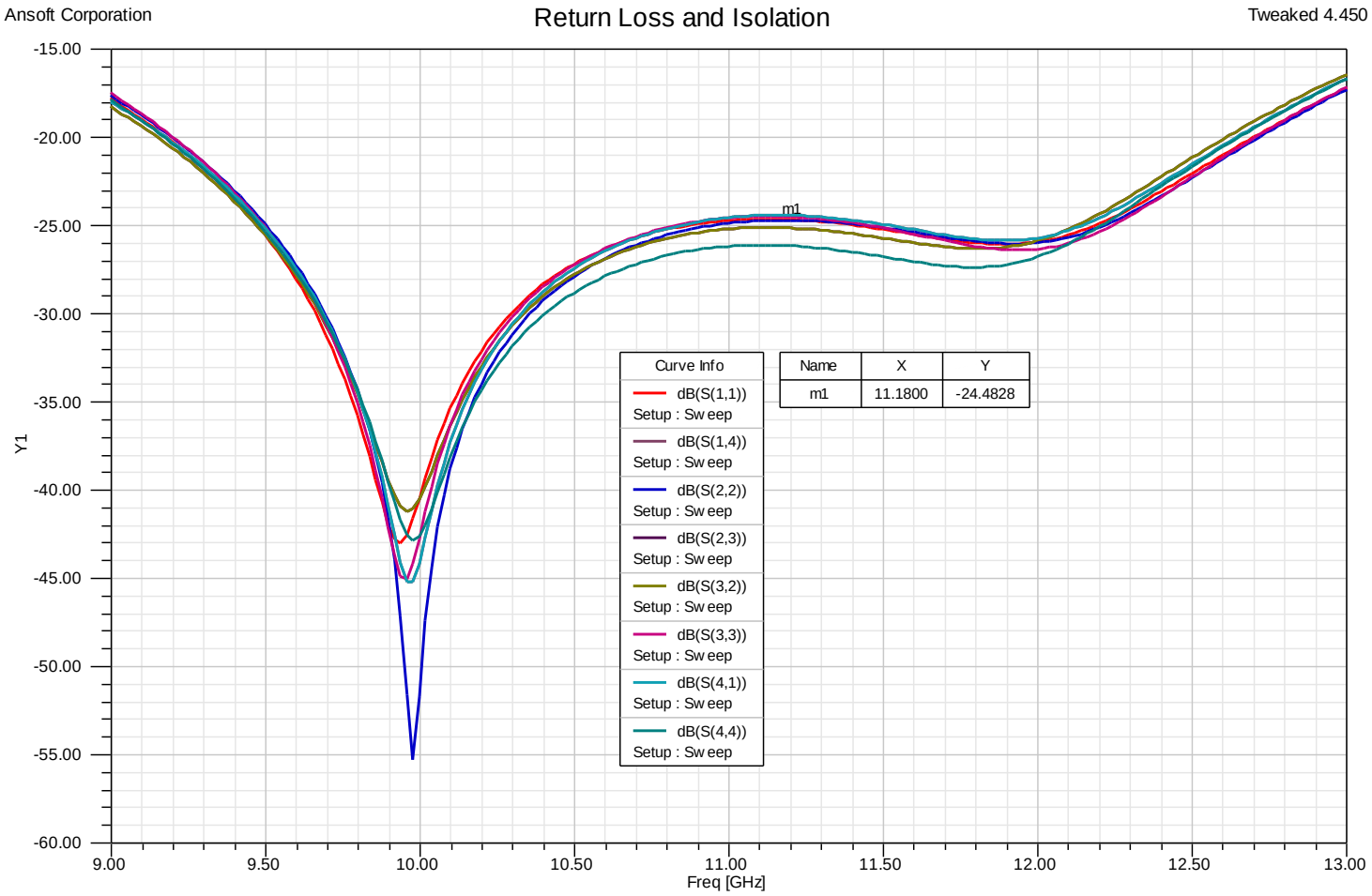
I tried to adjust to get a better power division. This meant: b = 2.450mm. This is the screenshot of the Solution Data. I was simultaneously running simulations between two Quadcores, this core did not have any memory enhancing done to Windows but it did take advantage of memory enhancing techniques (see the linear cuts, as opposed to curved cuts). 0.0067 isn't bad, though when we saw that results don't get that much better with less delta S

Tweaked 2.450



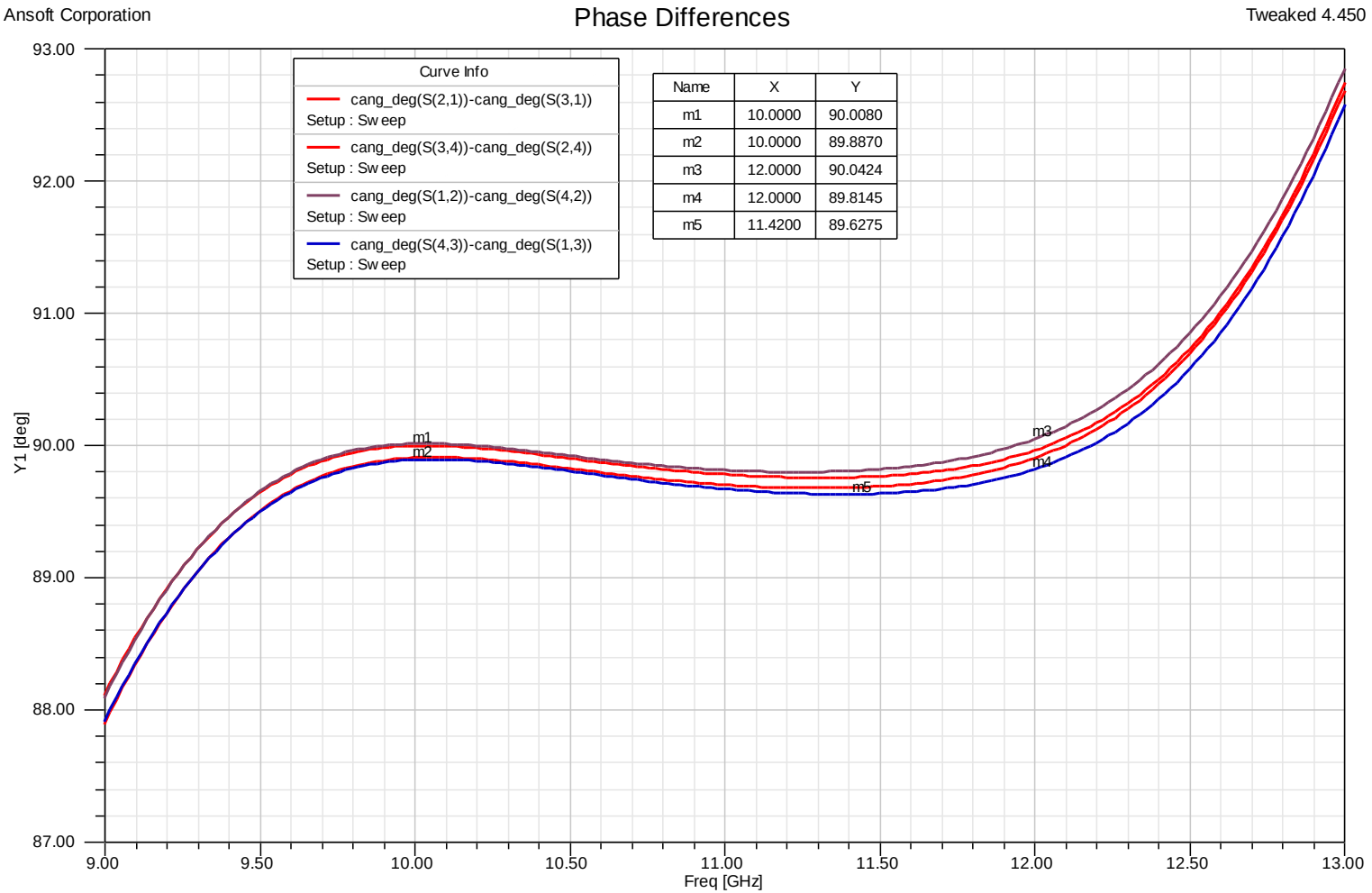
These are the transmission S-Parameters for the Thru-Holes 2 model. The higher order modes are gone. However, there is the problem that these results are STILL not centered around 3dB down…

Tweaked 2.450



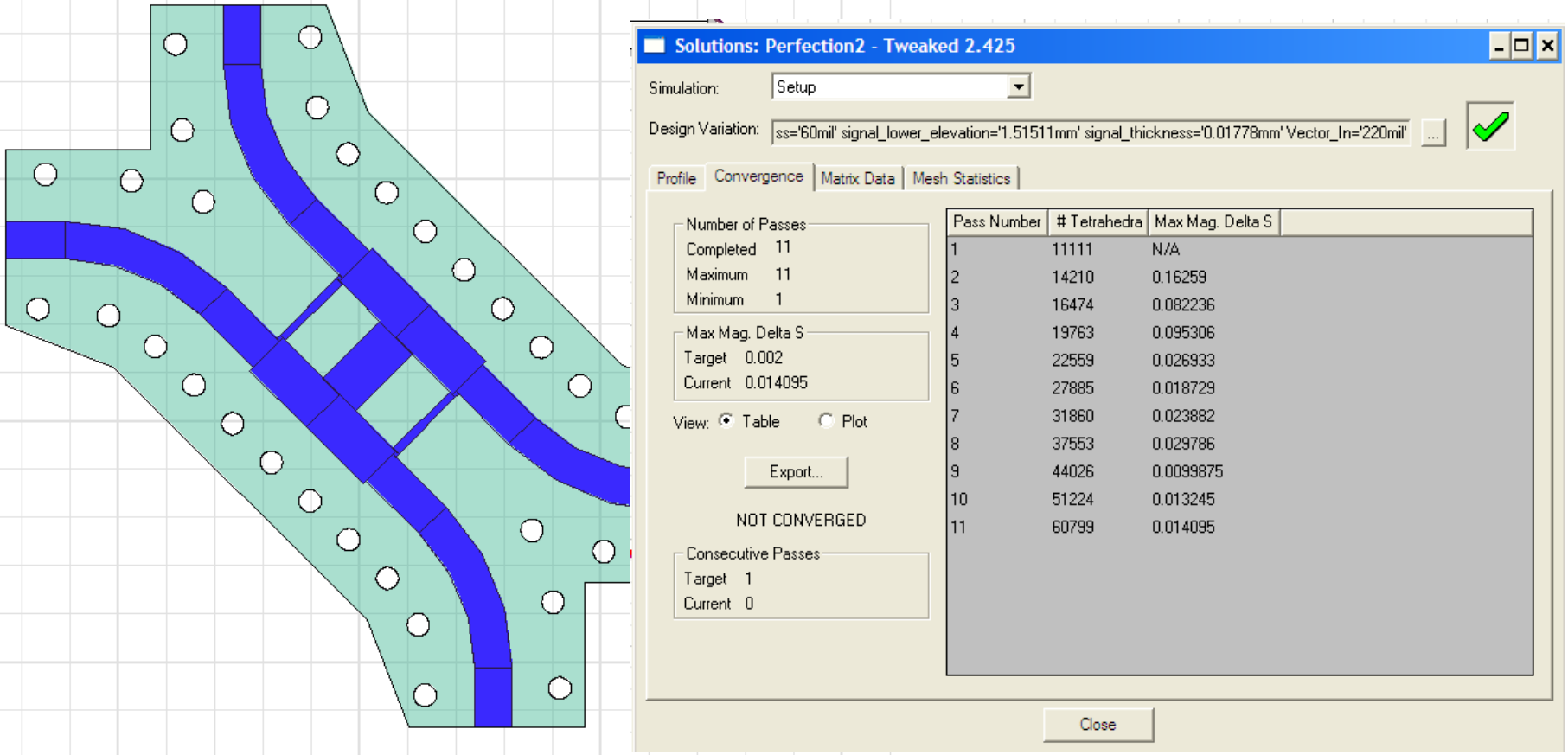
These are the return loss and isolation parameters for the Thru-Holes 2 model. Again, the higher order modes are no longer manifested.

Tweaked 2.450



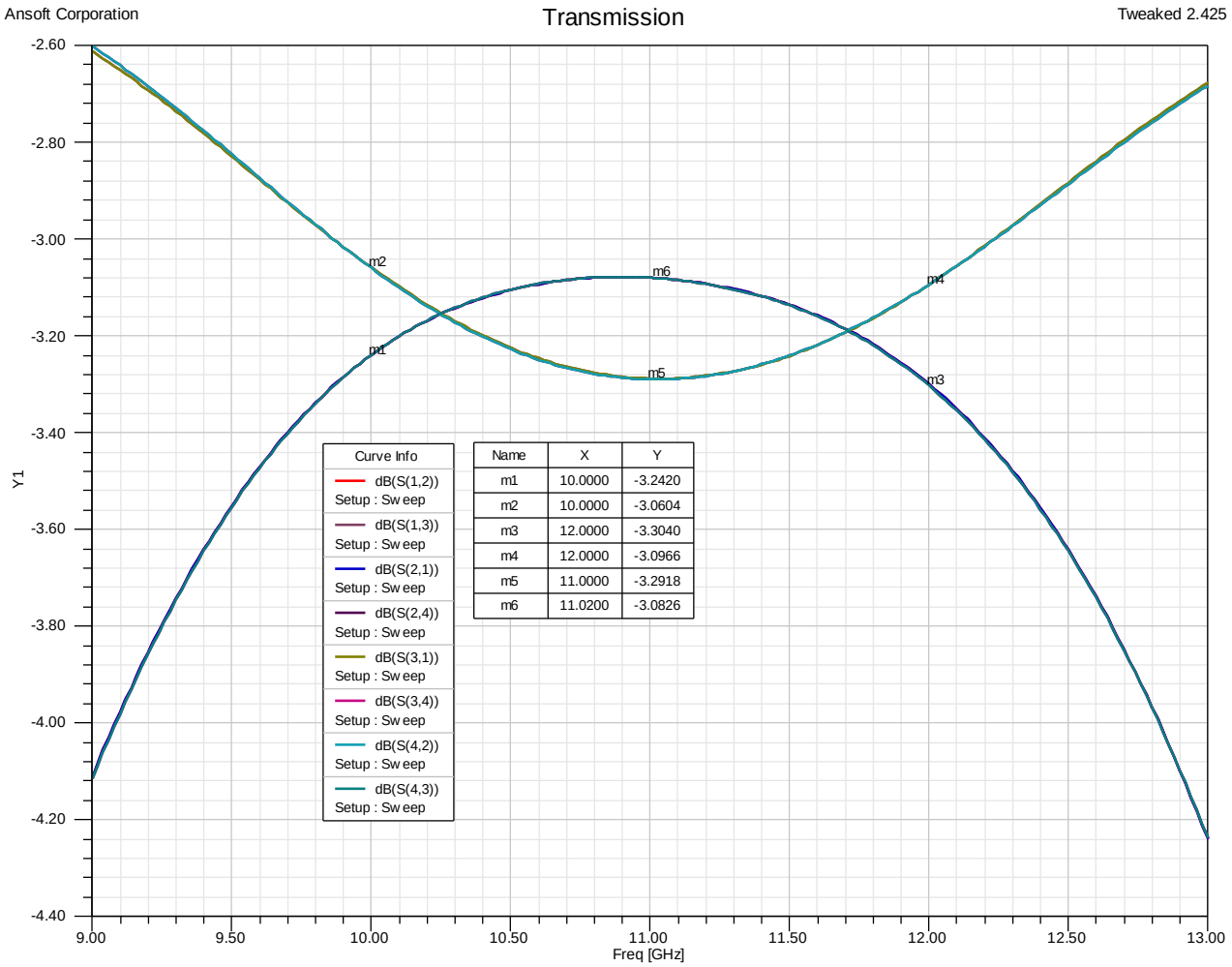
Phase Differences for Thru-Holes 2 are shown. The 13 adaptive passes got down to a delta S of 0.008-ish. The phases are all around 90. Through all of my tweaks, the phase hasn't changed much. It seems to continually be just below 90 degrees until the sharp upturn from 11 to 12GHz.

Tweaked 2.425



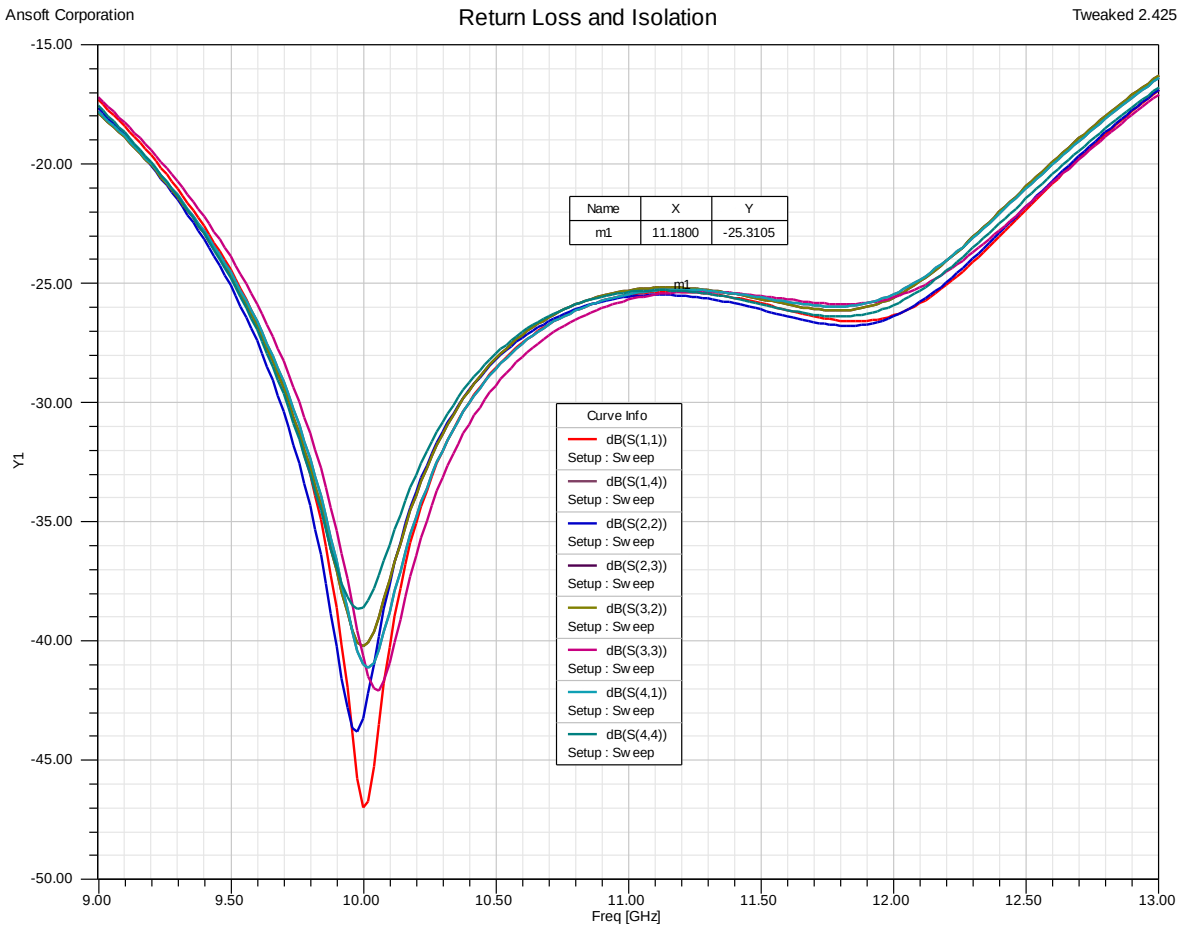
Lastly, I averaged the b values for a b = 2.425mm. I was having problems with 'Missing Edges' in HFSS that caused a ridiculous number of extra tetrahedrons to be used. I solved this by not uniting the stripline rectangles/curves when they were imported from Designer. The max magnitude of delta S was the largest of all the sims.

Tweaked 2.425



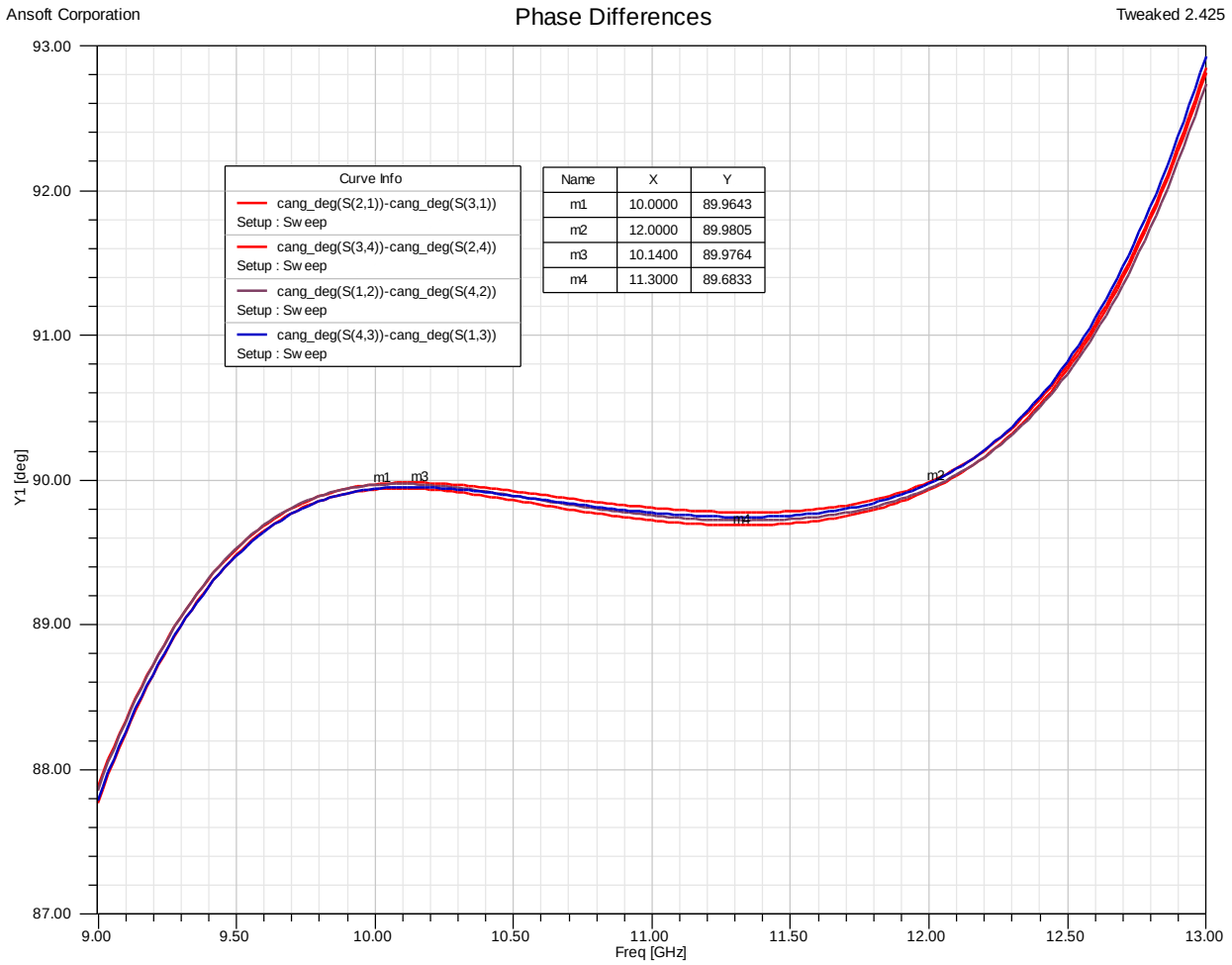
These are the transmission S-Parameters for the ‘Tweaked 2.425’ model. The transmission is well centered and distributed. It has a maximum difference of approximately -3.19 +/- 0.10dB.

Tweaked 2.425



These are the return loss and isolation S-Parameters. The dip that I though might occur at the 12GHz mark seems to have occurred. Also note that we have seen no higher order modes for any of these simulations. The thru-holes have been placed, approximately, 67mils away from each other and 250mils across from each other.

Tweaked 2.425



These are the phase differences for the ‘Tweaked 2.425’ model. Very similar to the previous phase differences for 2.400mm and 2.450mm. I think that this model, the ‘Tweaked 2.425’ model, is the final model. Even if it can get better – the connector launch still must be made and there is little time left.