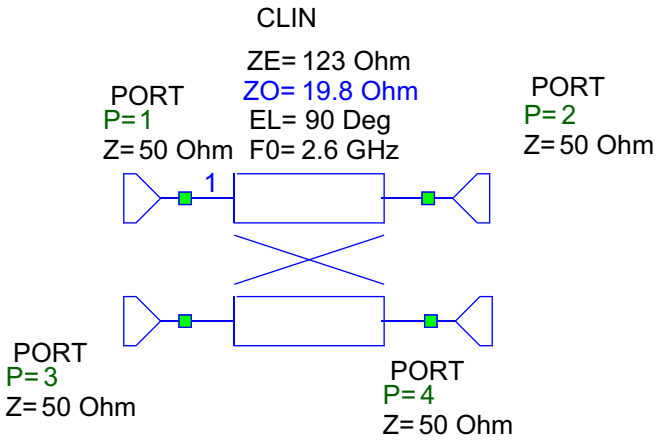
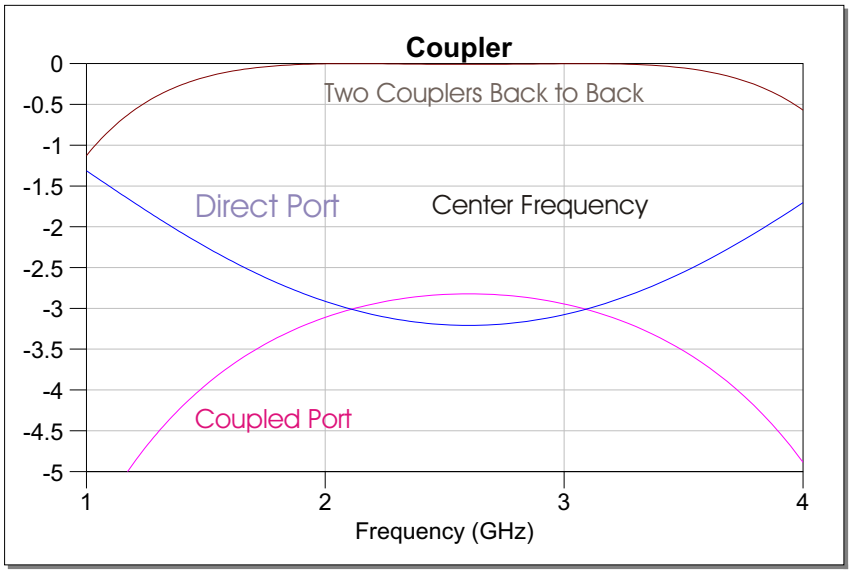
Novel Dual Balun / Coupler Is Space Saving Semi-Lumped.

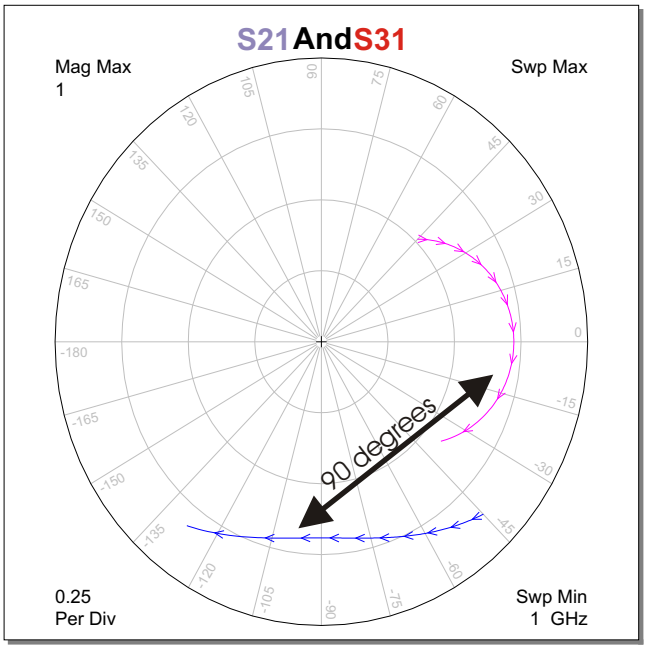
The use of a traditional coupler as a Balun has many advantageous. A single design can be adapted for both Class A applications and Push Pull applications. The method is best suited for narrow to moderate bandwidth circuits. The traditional coupler relies on a differential 90 degree signal split while the Balun is designed for a 180 degree split. The conversion of the coupler to the Balun requires an additional delay in the direct coupled leg. It is the practical application of this method that is the subject of this note.



Response And BandWidth Of A Coupler



The coupler (Right) response with slight over coupling for increased bandwidth



Polar plot of the coupler showing the lead lag phase response

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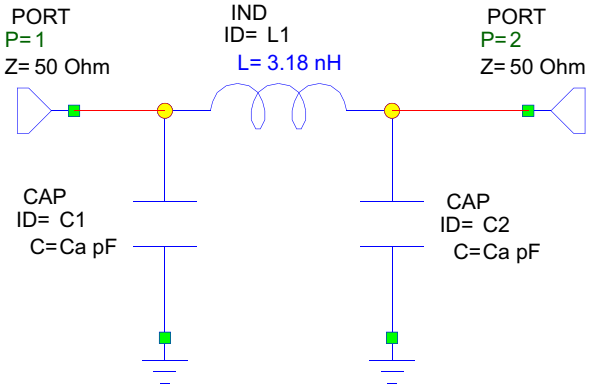
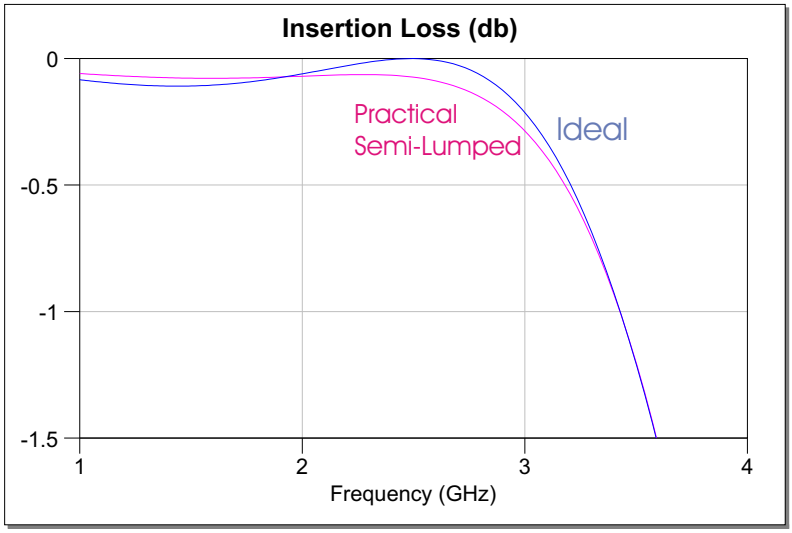
Time Delay Filter

Ideal Lumped Element Phase Shifter

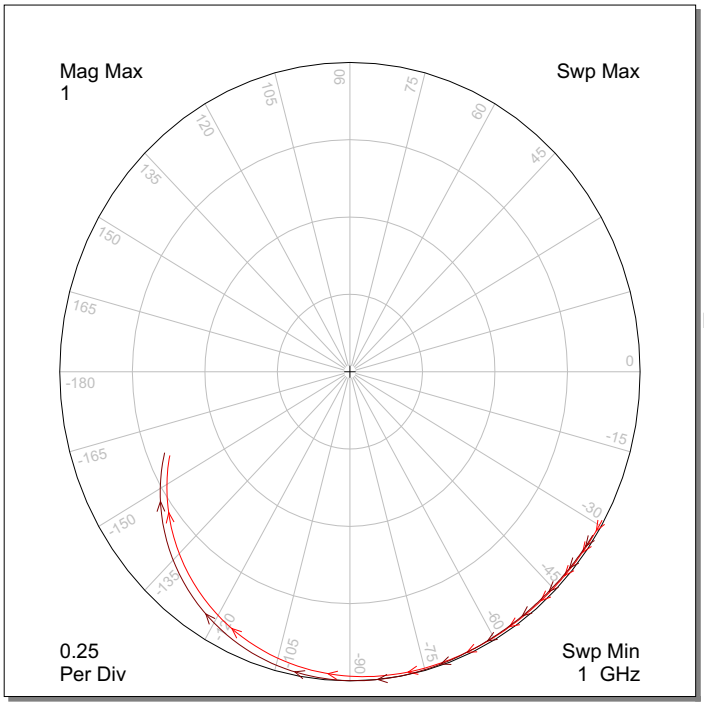
The ideal low pass filter topology offers a reasonable 90 degree phase shift and requires much less re estate than the traditional delay line. When the Low Pass transfer function pole is properly placed the insertion loss is minimum while the phase goes through 90 degrees.
The second step in the process is to convert the ideal low pass topology to a distributed semi-lumped structure.



Ca=1.165

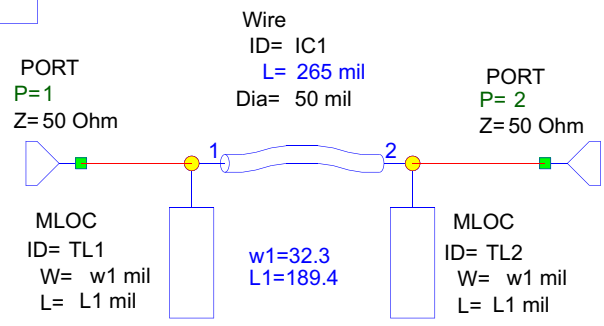


(Below) The phase andMagnatude plots for both the ideal and semi-lumped low pass phase shifters



MSUB
Er= 3.7
H= 7 mil
T= .5 mil
Rho= 1
Tand= .008
ErNom= 2.2
Name= FR4

A semi-Lumped topology derived from the ideal low pass time delay filter



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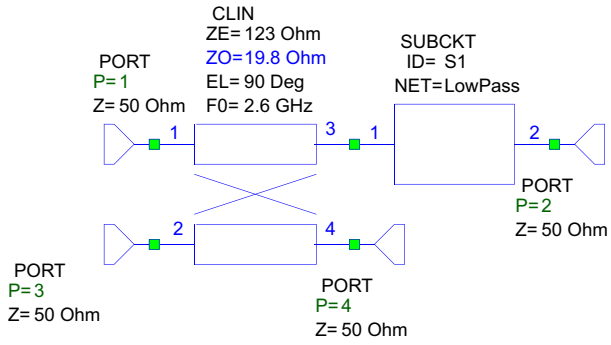
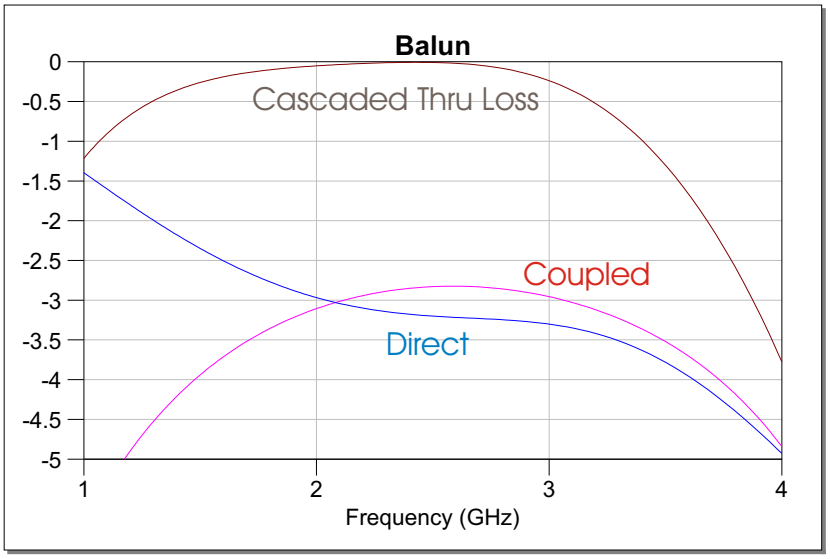
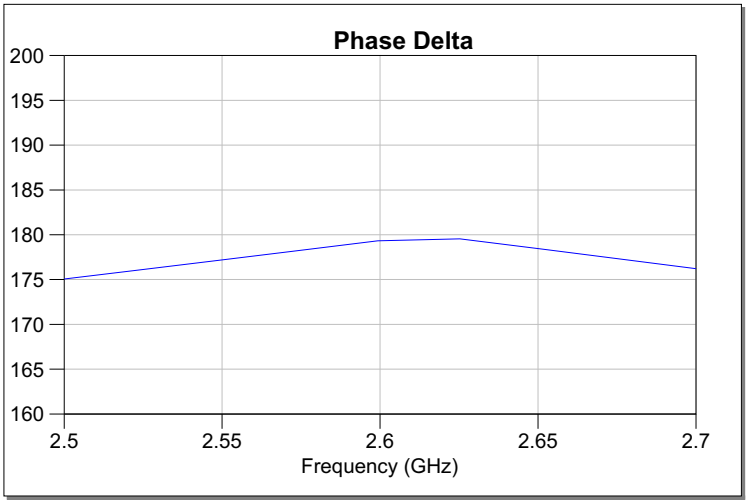


Measured Response

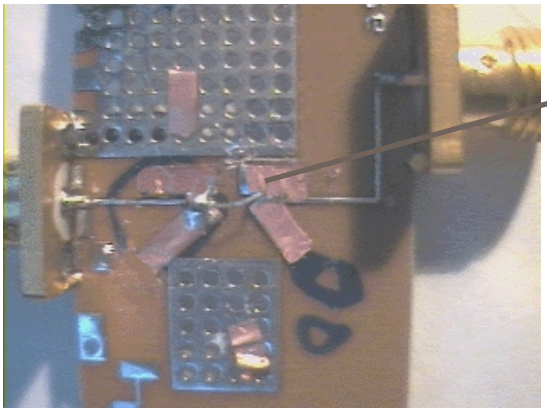


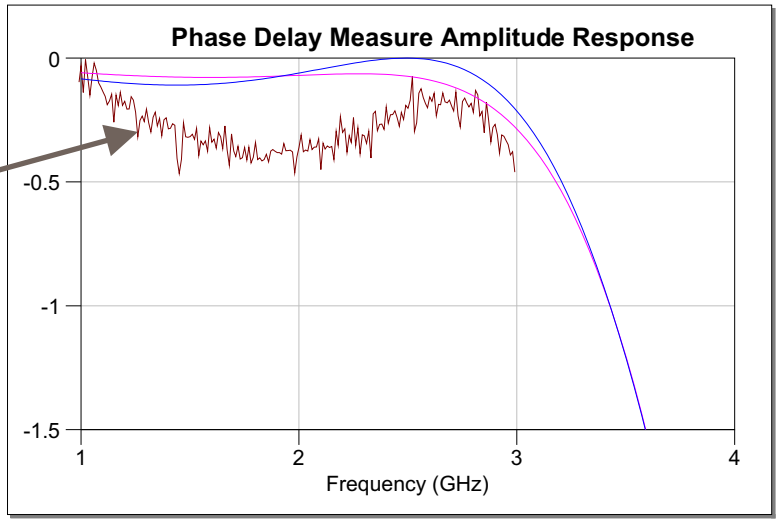
(Top Right) The simulated amplitude response for the coupler balun. The classical response is altered at frequencies beyond the coupler center frequency. The brown trace is the thru loss for a cascade of two such baluns showing the overall response band-width constriction.



(Middle Right) The overall phase differential between the coupled port 4 and the direct port 2. The Balun makes +/- 5degrees balance from 2.5GHz to 2.7GHz (an 8% BW)

Prototype Time Delay Filter constructed from semi distributed and lumped elements





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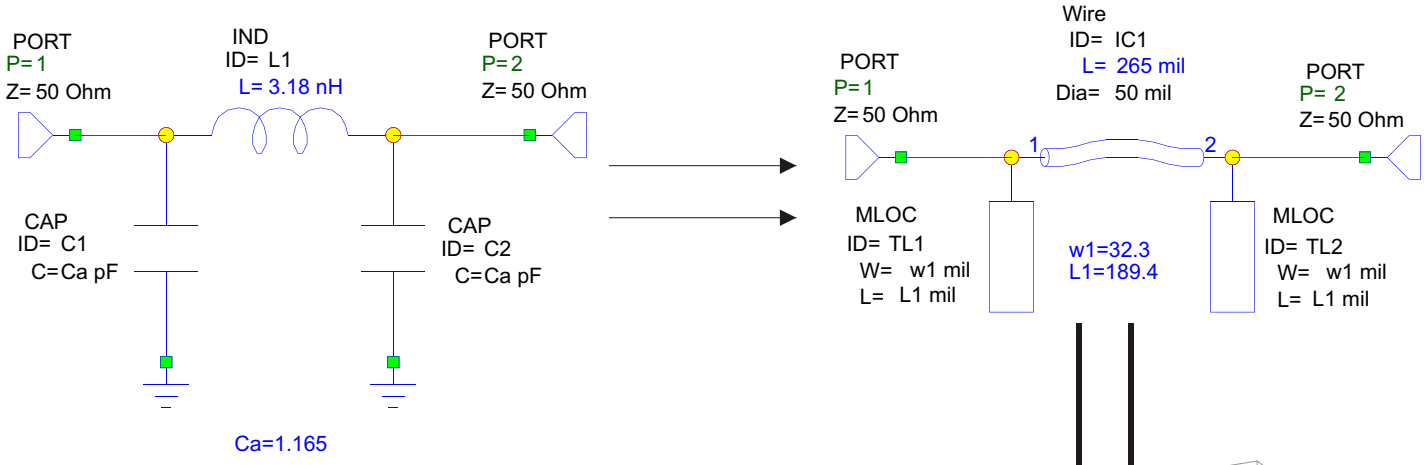
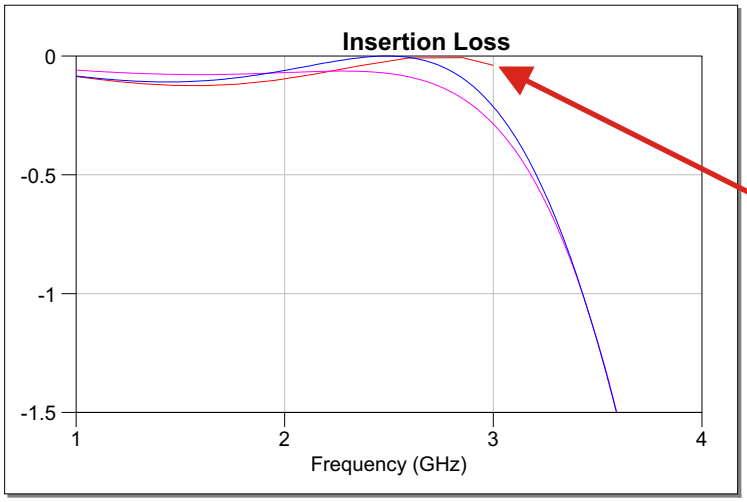
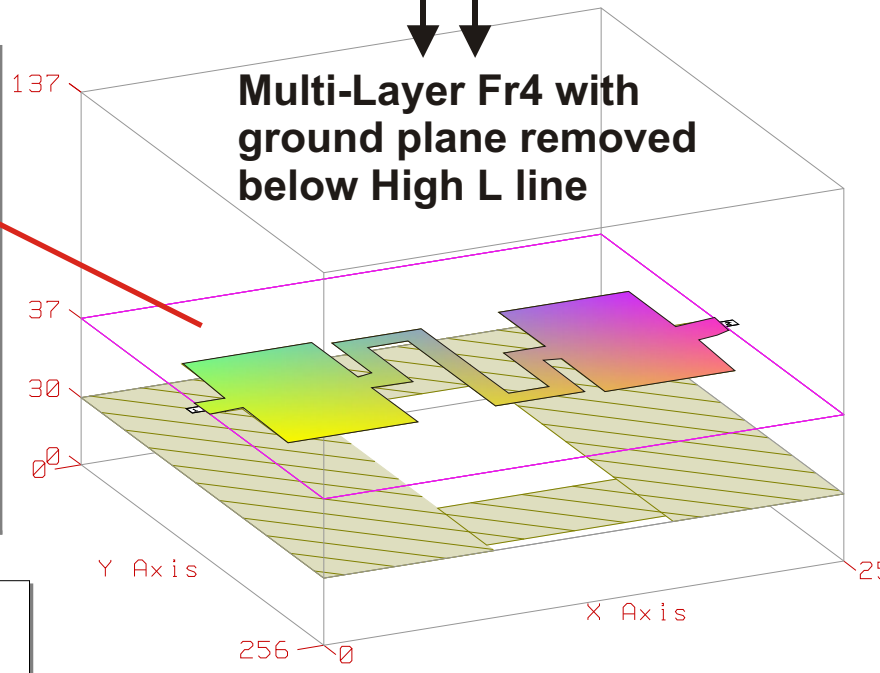
Precision Distributed Ckt.

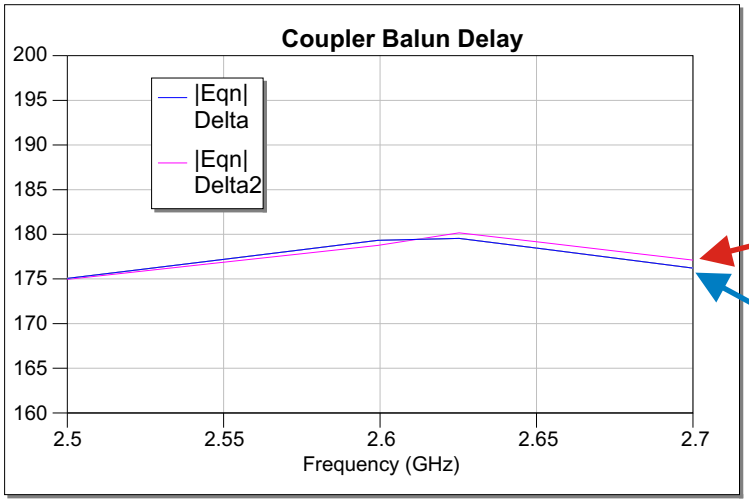
EVOLUTION OF THE TIME DELAY LOW PASS FILTER







Multi-Layer Fr4 with ground plane removed below High L line



All Distributed CouplerBalun

Semi Distributed CouplerBalun

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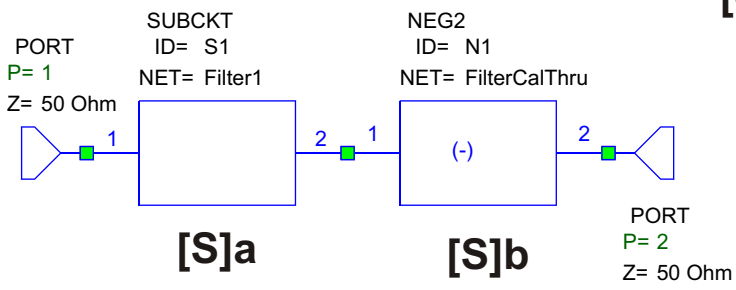
Precision Distributed Ckt.Measured Response

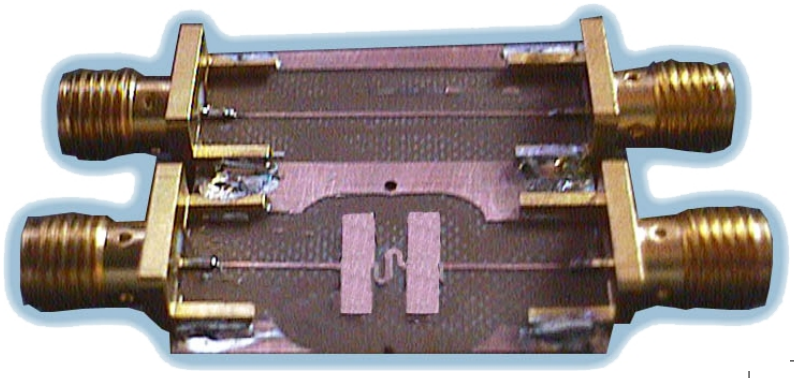
Circuit Layout For Time Delay Filter With Reference Line

Correction Scheme For Precision Differential Phase And Amplitude S-Parameter Extraction



[S]a

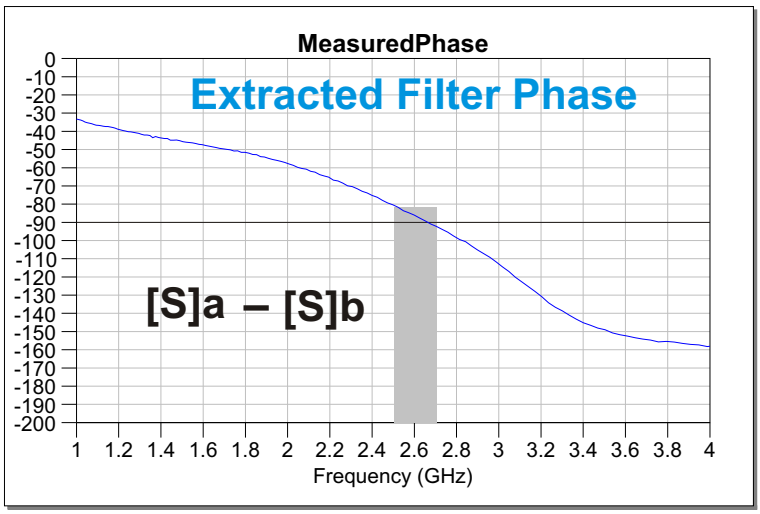
[S]b

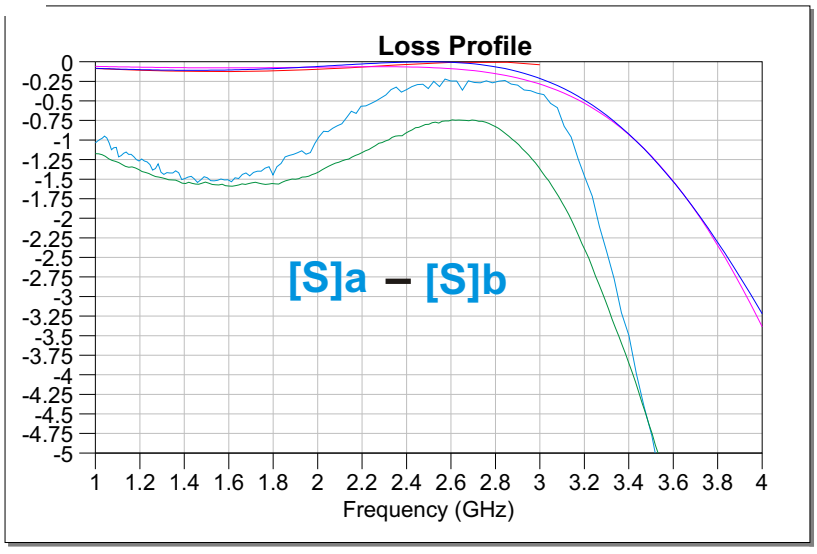


Simulations

Raw Measured

Extracted





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