

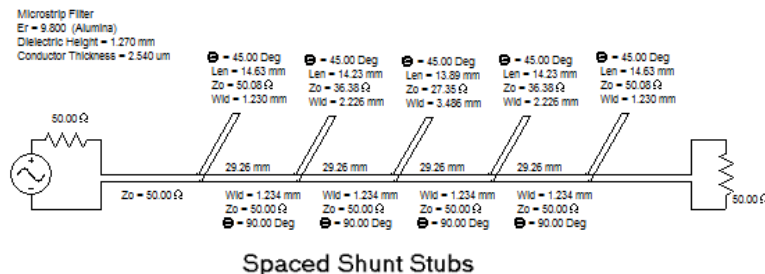
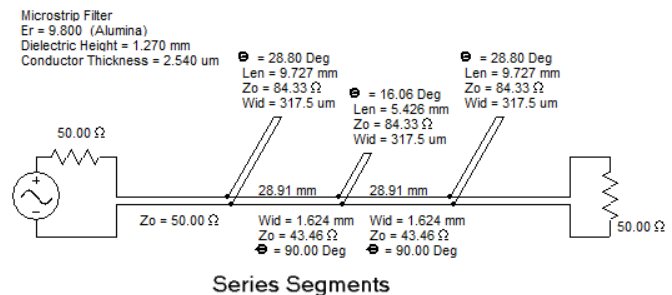
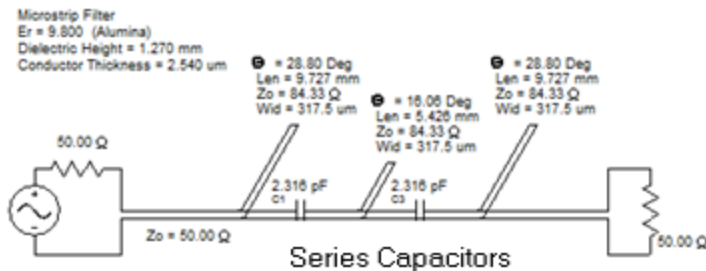


# 900% High Pass Overlay Filter Design with Axiem Port Tuning

Designed Efficiently with Nuhertz  
FilterSolutions<sup>®</sup>, AWR Microwave  
Office<sup>®</sup>, and AWR Axiem<sup>®</sup> using Axiem  
Port Tuning

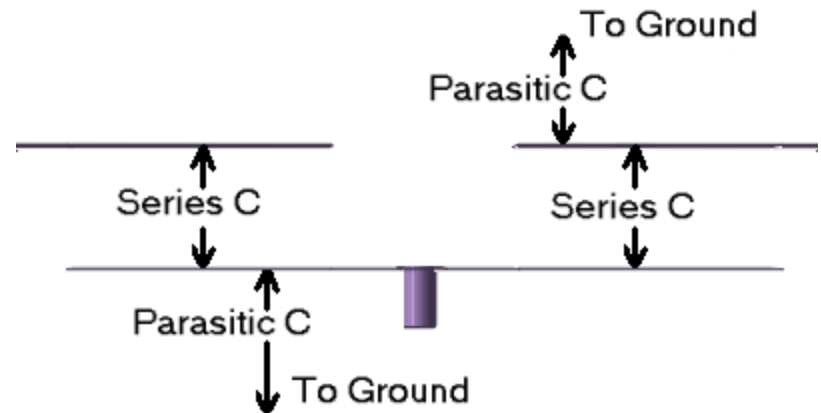
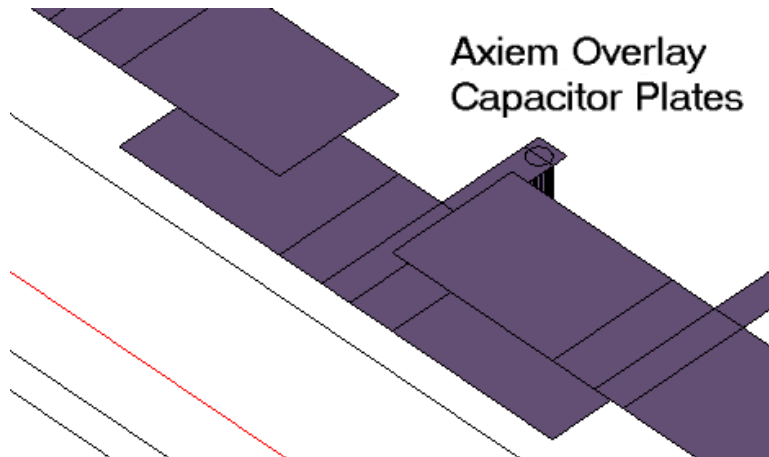
# Planar High Pass Design Problem

- Series capacitors difficult to realize with planar elements.
- Small physical size capacitors may lead to low Q.
- Series planar elements may lead to synthesis error.
- High Pass and wide band approximations may not achieve sufficient bandwidth.



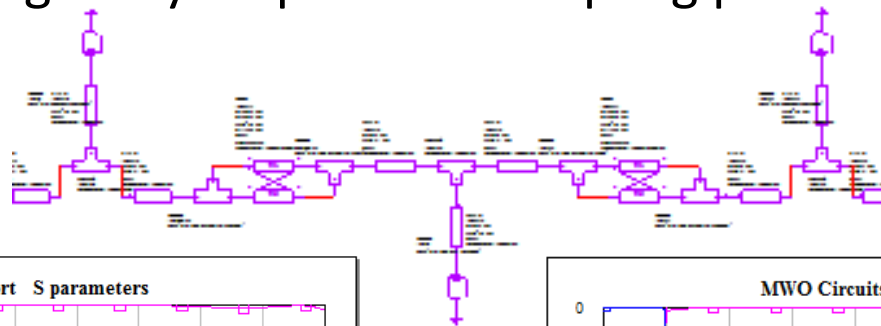
# High Pass Planar Solution

- Need a way to simulate high Q series capacitors.
- Layered boards with suspended substrate over an air layer may provide capacitor dielectric.
- Broadside coupled metal above and below said substrate may provide overlay capacitor plates.
- Still have To deal with shunt capacitor parasitic effects.

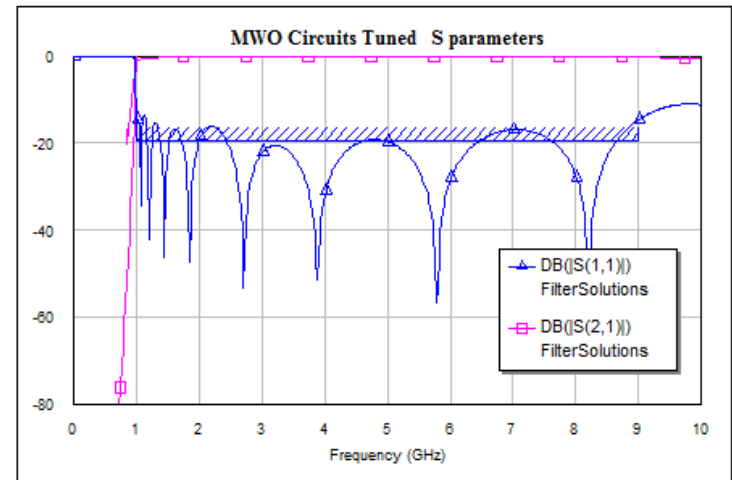
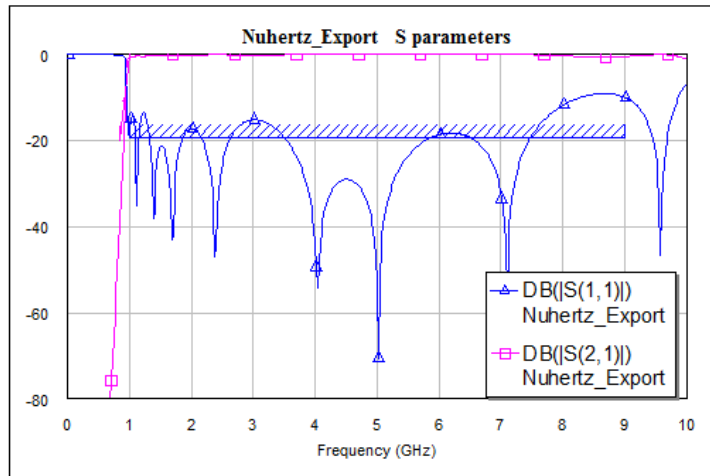


# Microwave Office(MWO) Circuits Design

- MWO effective for circuit tuning
- FilterSolutions overlay end discontinuities recommended
- Low Er value and thin dielectric layer recommended for broad bandwidth
- Alternating legs may help reduce coupling parasitic effects



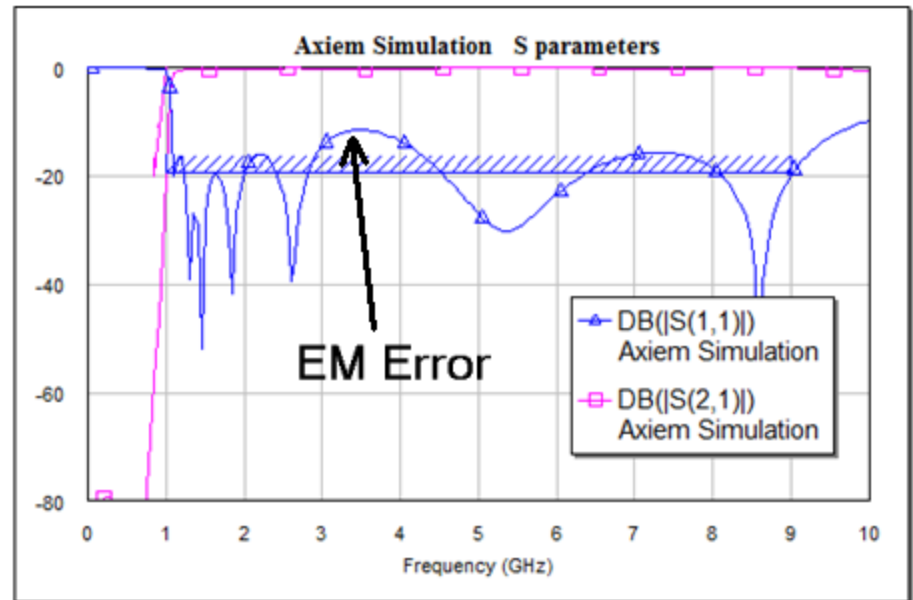
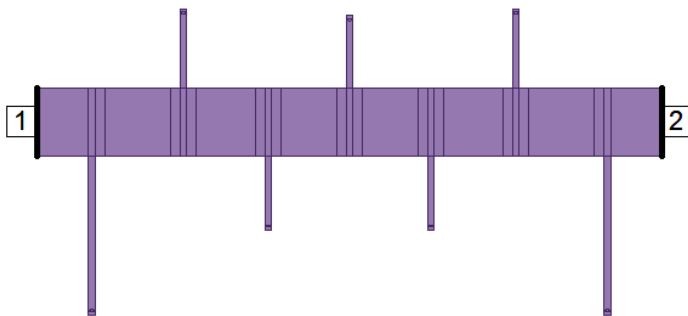
MWO Schematic  
Section



# Axiem Simulation of Circuits Tuned Overlay Filter

- EM coupling not previously accounted for in circuits simulation is now viewable
- Need a way to tune out the EM error

Axiem 2D Layout





# Axiem EM Tuning and Optimizing

- Axiem Extraction Optimizations
  - Easy and straightforward
  - May be computer time consuming
- Axiem Port Tuning Optimization
  - Fast and accurate, as little as 5 minutes required
  - Requires more know-how

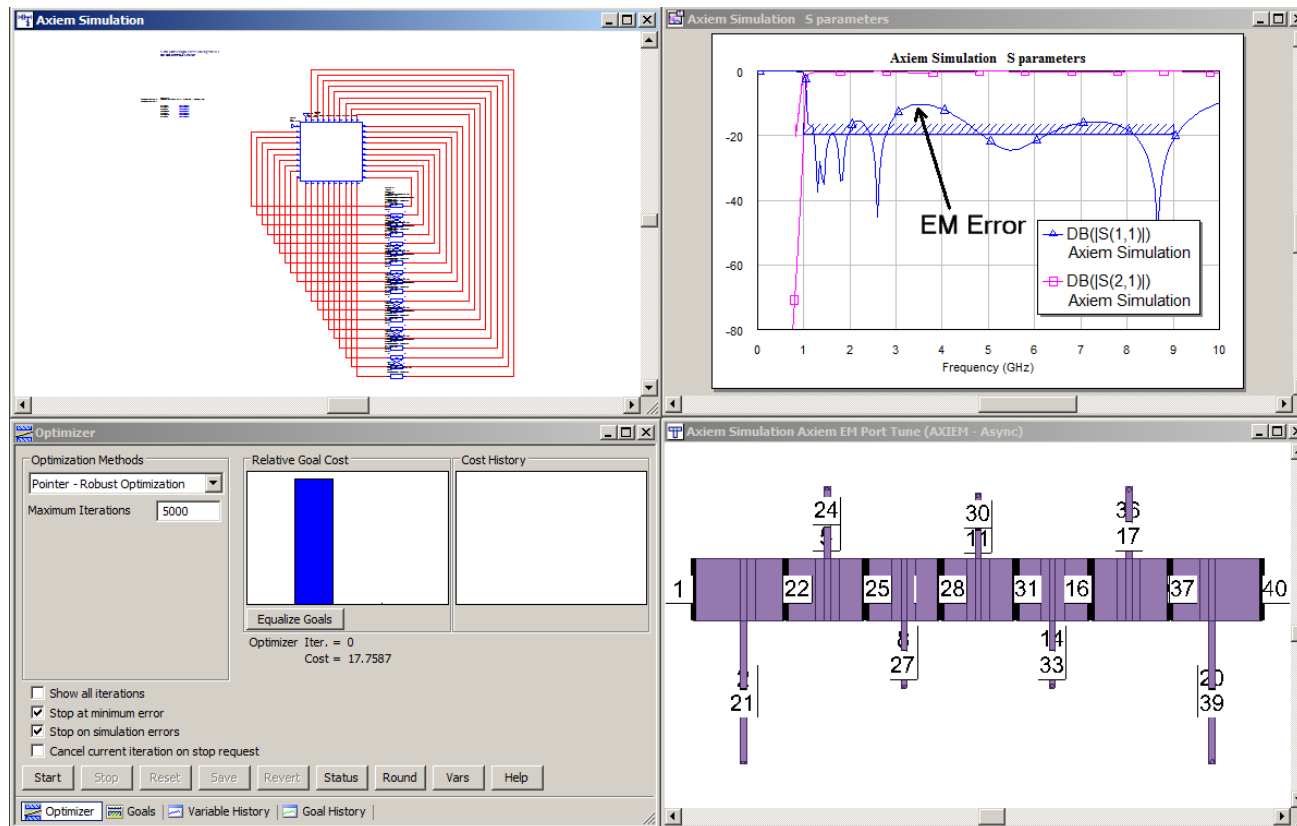


# Port Tuning the Axiem EM Response

- Tuning ports inserted into Axiem EM Structure
- Port Tuning schematic created with tuning elements
- Only the length tuning need be considered for overlay filters
- Port tuning simulation relies on small perturbation adjustments.
- Generally, two tuning passes are required: one to rough out and one to fine tune.

# Axiem Port Tuning AWR Project

- Raw port tuning simulation nearly identical to full Axiem simulation

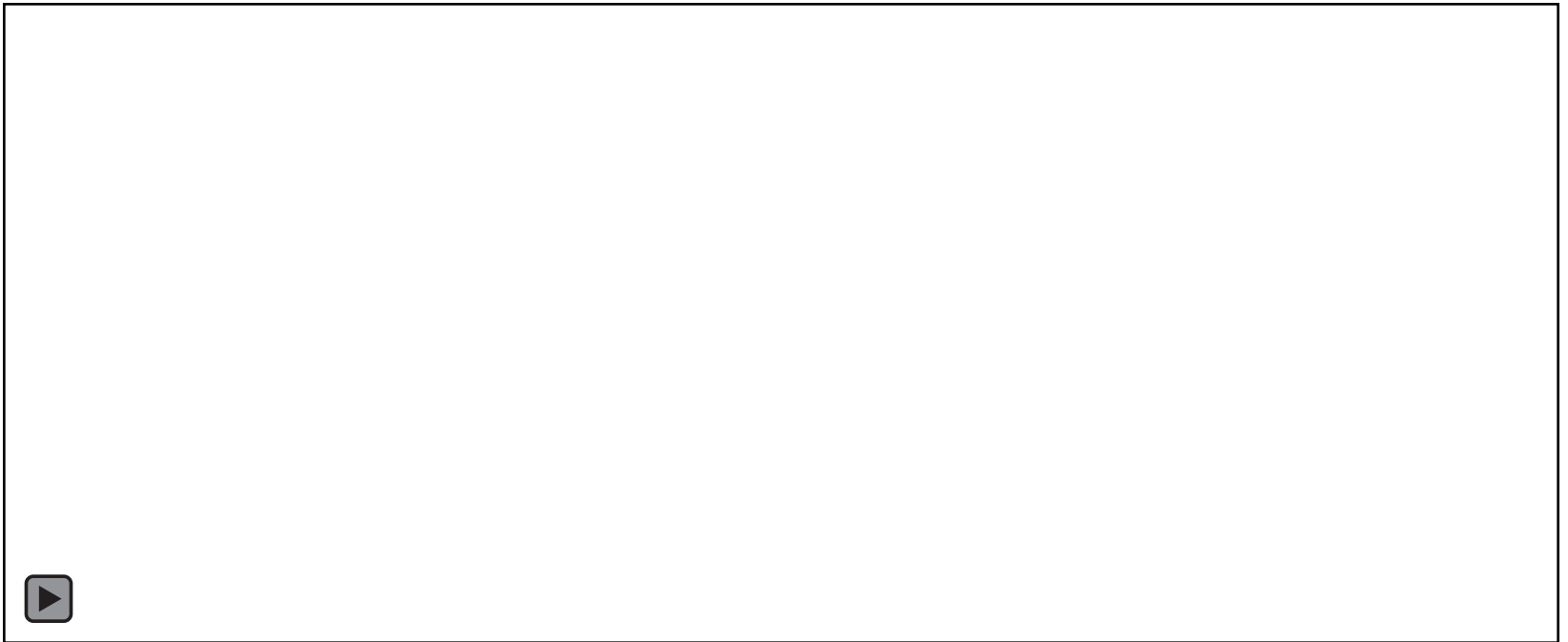






# Axiem EM Port Tuning Optimization in Real Time

- Double Click Image to Start Optimization Video



# Final Axiem Port Tuned Filter

- First port tuning optimization pass restores pass band
- Only a few minutes are required
- Vias normally replaced with a box wall or grounding plane.

