3D directional coupler for impulse UWB

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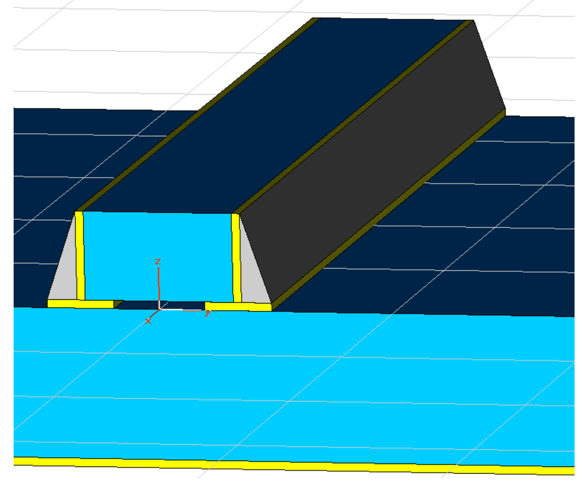
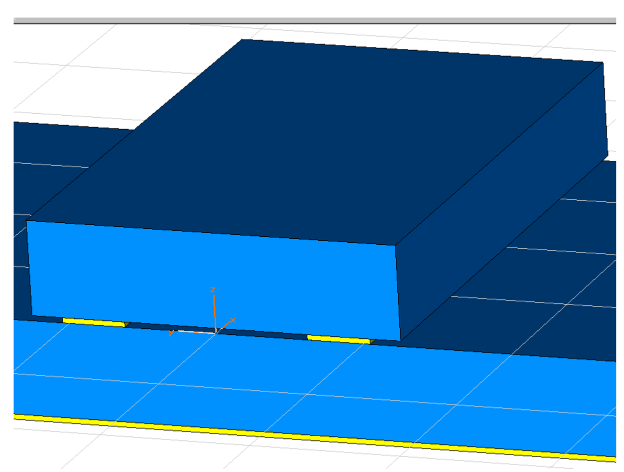
Introduction

The AWS Group was developing a UWB radar and UWB transceiver for indoor people location and tracking. A radar concept has been developed. The radar is composed of a pulse generator, a channel model, a low-noise amplifier, a matched filter, two pulse shapers, a flip-flop circuit and an integrator. This poster will focus on the design of the directional coupler. This component will provide a separation between the pulse generator and the Low Noise Amplifier. This enables the radar system to connect on the same antenna.

Design Specifications	
Frequency Band	**3.1-10.6 GHz**
Maximum Dimensions	**20mm x 20mm**
Reflection	**< -20dB**
Isolation	**< -25dB**
Coupling	**= 10dB ±0.5dB**
Transmission Losses	**< 1dB**
Constant Group Delay	**As small as possible**
CER10-250 substrate	
Dielectric coefficient	**εr = 9.5**



Vertically Installed Planar Circuit
- Reduced the effective dielectric constant for even and odd mode from 2 to less than 0.2.

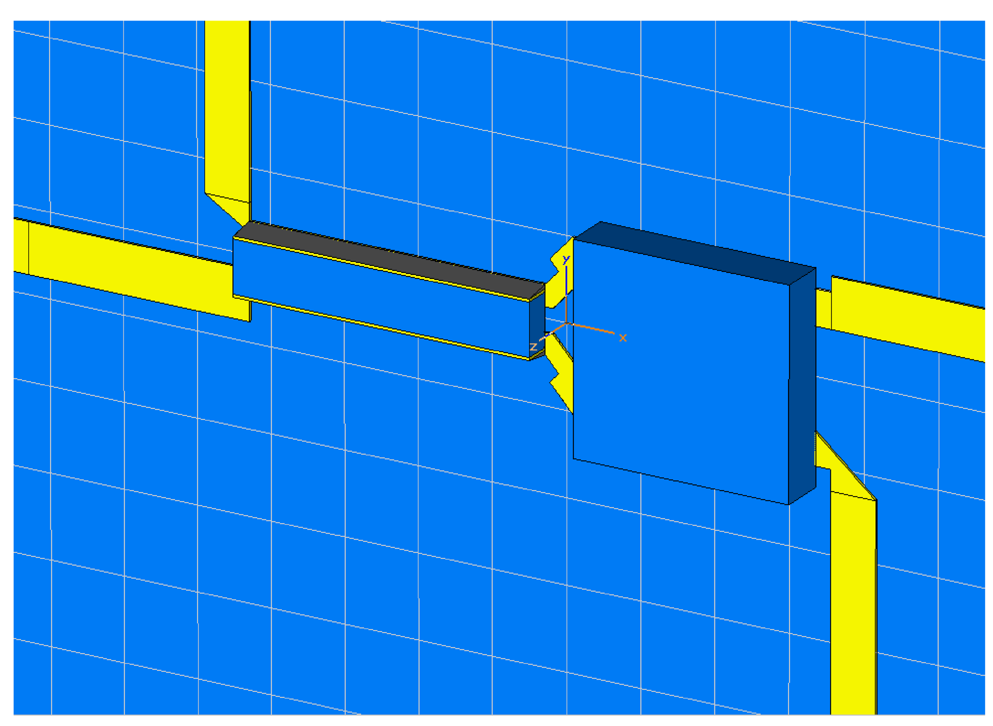


Stripline
- VIP was not feasible because the gap was too wide.
- Reduced effective dielectric constant for even and odd mode from 1.9 to less than 0.15.

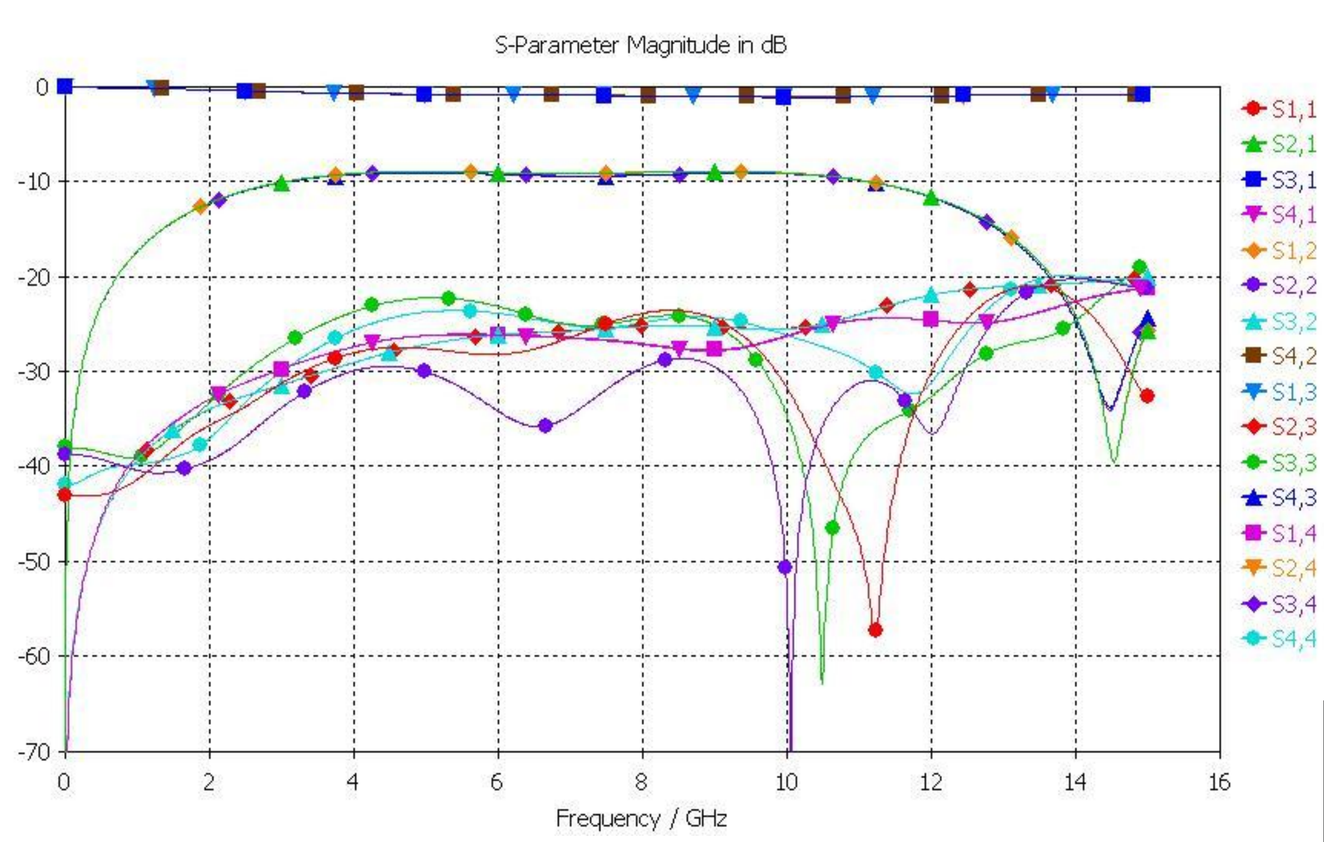
First Approach

broadband Chebyshev equal-ripple coupling response

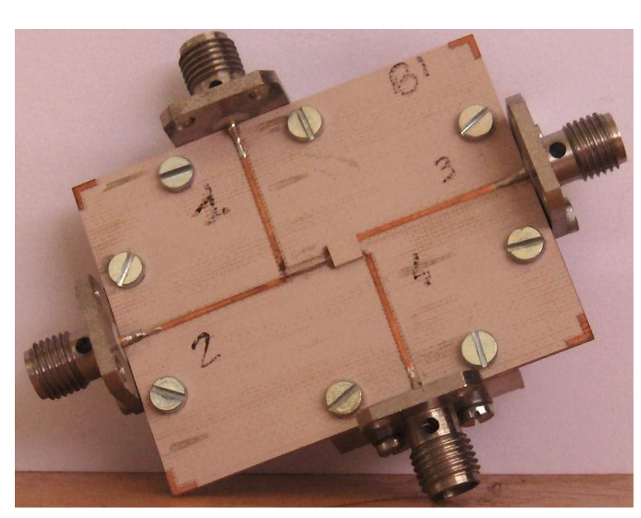
- S-parameters: simulated ≠ theoretical
    - Stronger transmission losses
    - Stronger reflections
    - Strong isolations
    - Uneven Band pass ripple
- Cause:
    - frequency dispersion of the effective permittivity
    - Two propagation medium (air+substrate)
- Effects: even and odd mode differences in
    - Impedances
    - phase velocities



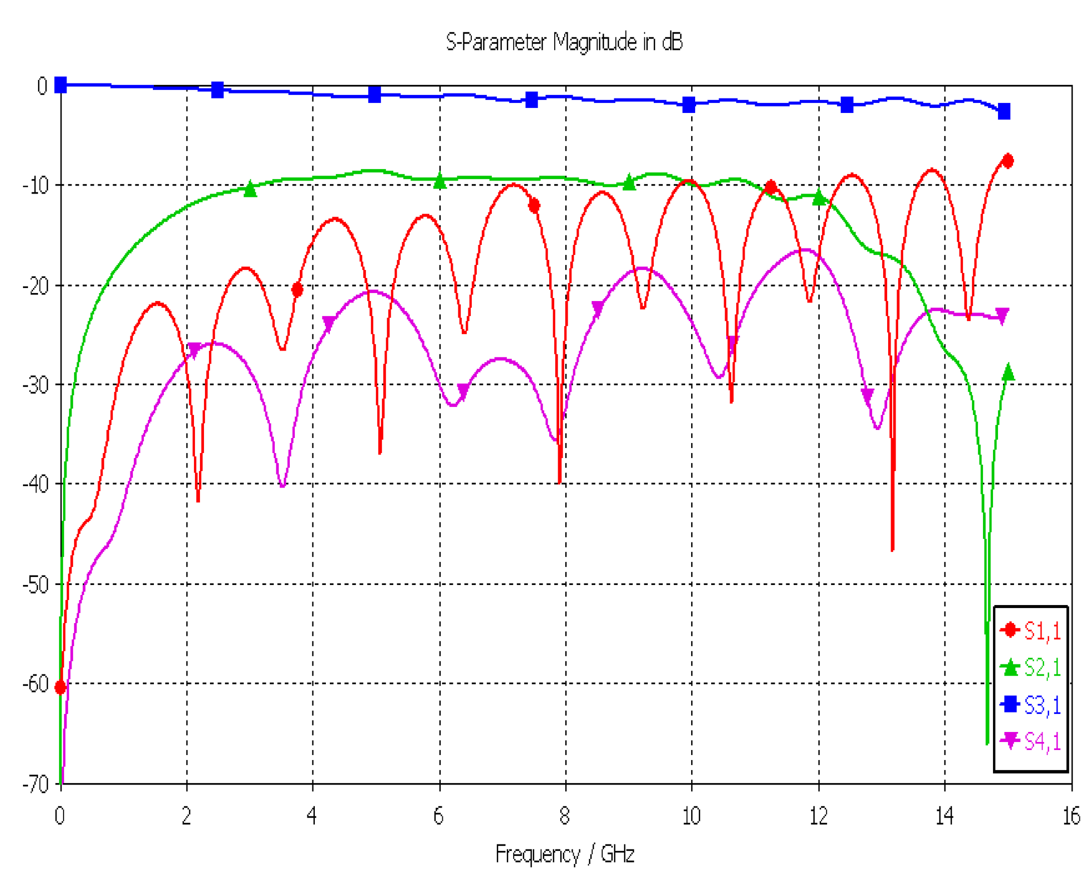
Final Layout
- stronger coupling to compensate for the precision of the manufacturing
- all the transitions were designed to reduce coupling and transmission losses.



Final Layout Simulated S-parameters



Prototype
- precision milling machine
- dicing saw
- flip chip bonder aligner.



Final Layout Simulated S-parameters

Conclusions

- Unsatisfactory experimental results
    - New simulations with the SMA connectors and the extra microstrip length
        - Results matching the measurements for reflections
    - the substrate probably has a higher loss tangent of dielectric than its model
        - Explains the higher transmission losses of the real directional coupler
- An improved model of the substrate has to be incorporated to the model and some modifications to decrease overall losses, insertion losses and increase isolation before this 3D architecture can be considered viable.

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