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3D Directional Coupler for Impulse UWB

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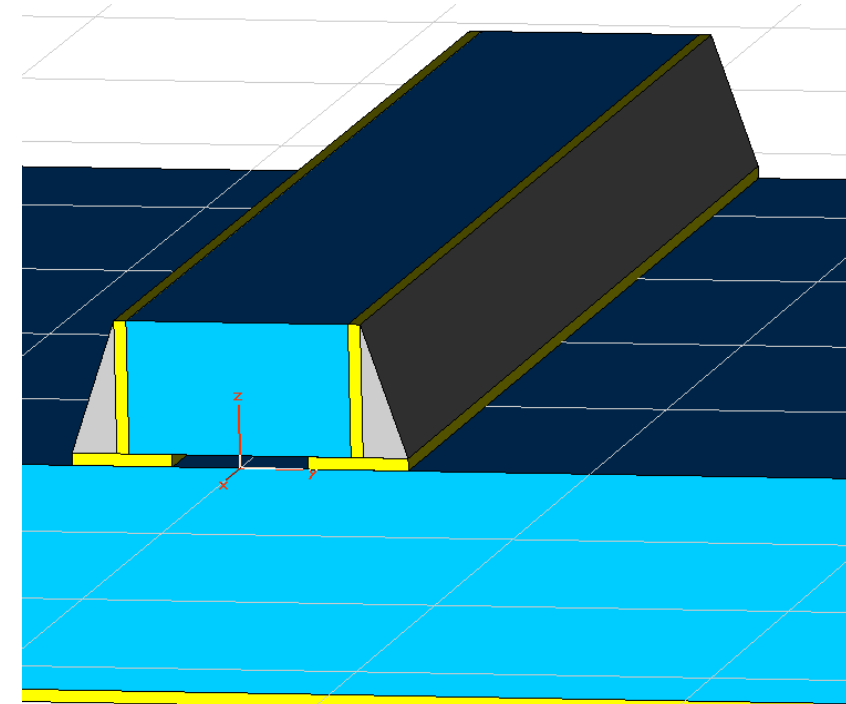
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C2I 2010

Introduction

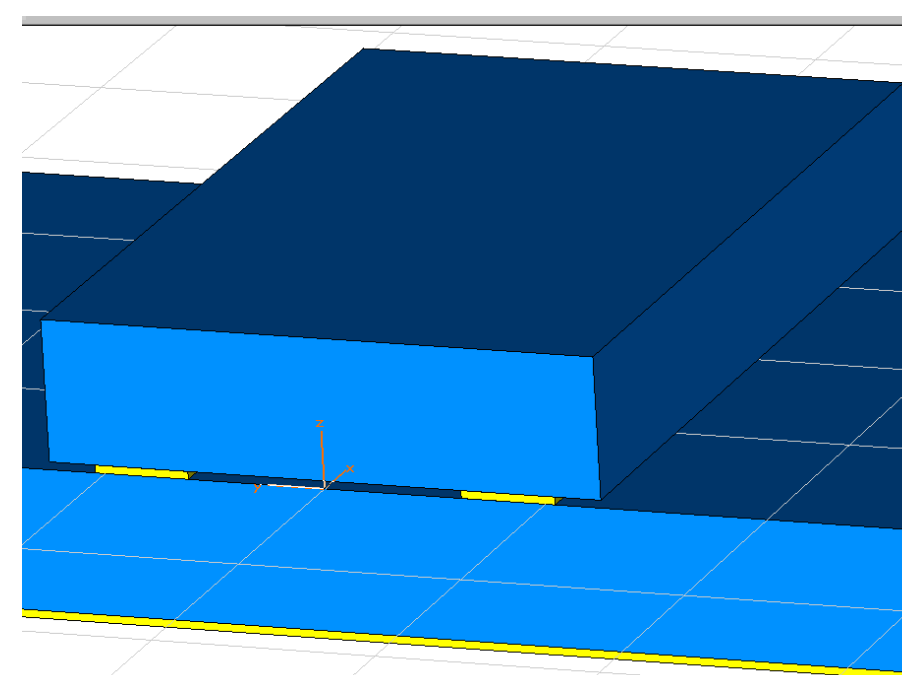
The AWS Group was developing a UWB radar and UWB transceiver for indoor people location and tracking. A radar concept has been developed. The radar is composed of a pulse generator, a channel model, a low-noise amplifier, a matched filter, two pulse shapers, a flip-flop circuit and an integrator. This 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	$\epsilon_r = 9.5$



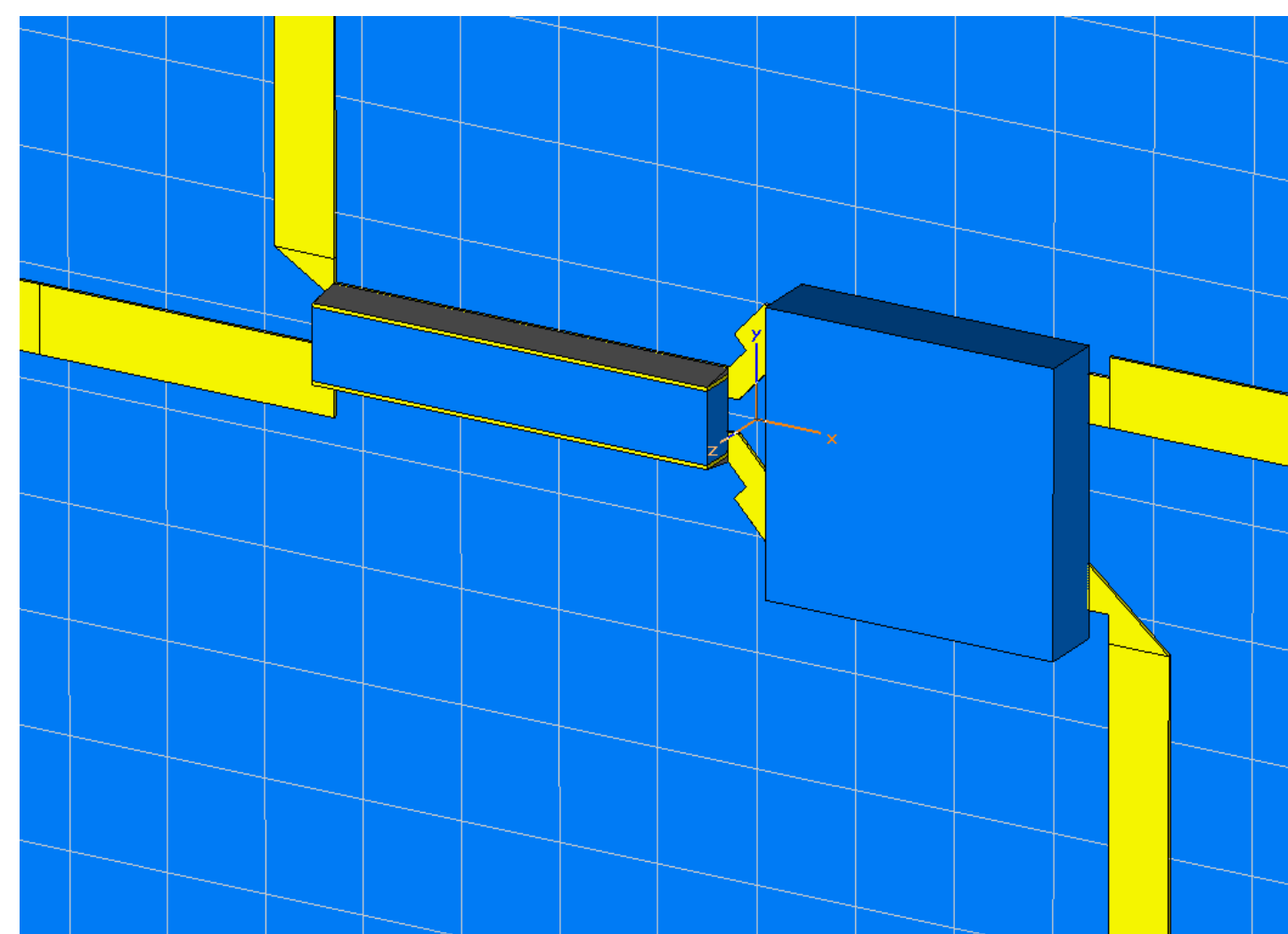
Vertically Installed Planar Circuit

- 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.



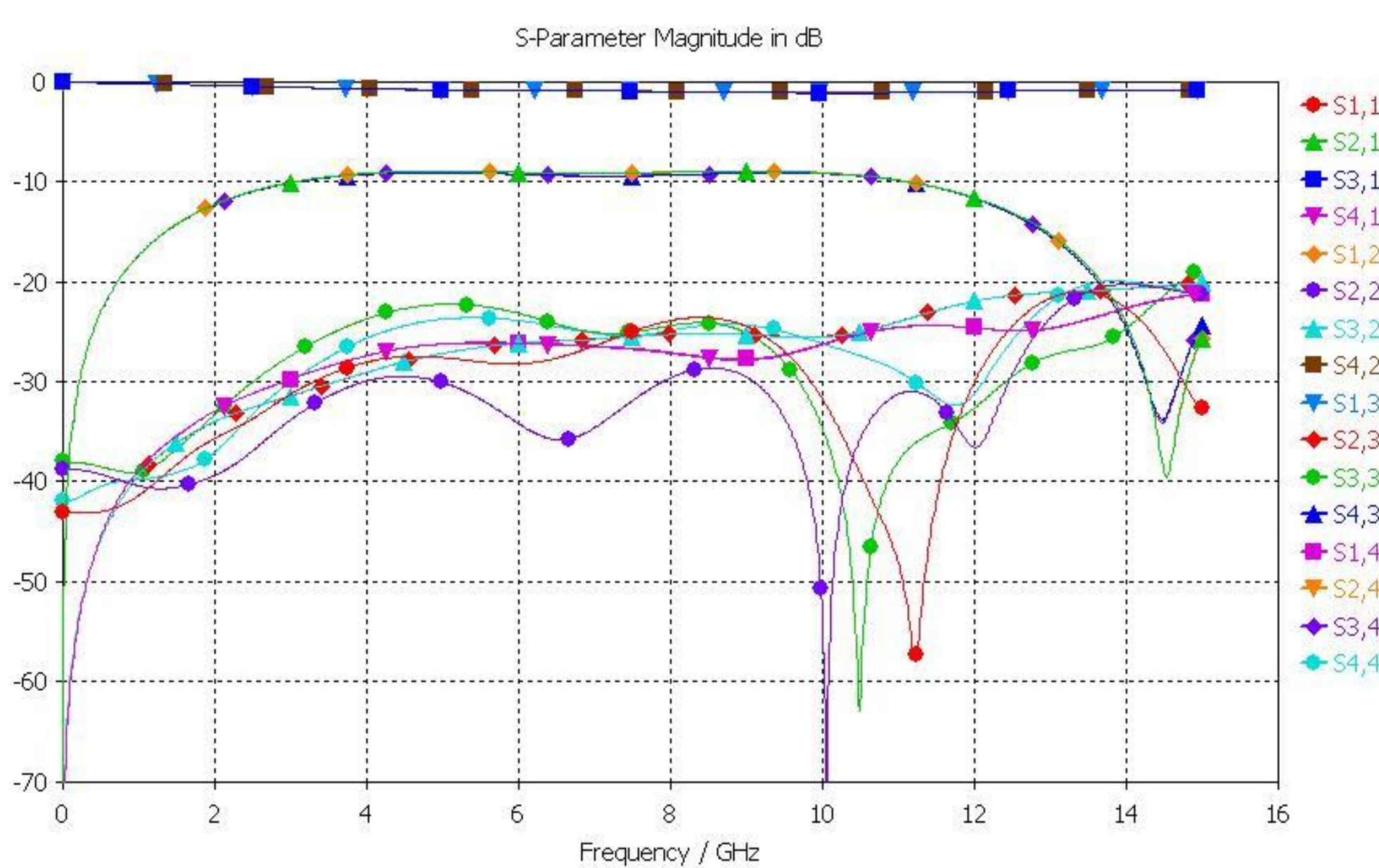
Final Layout

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

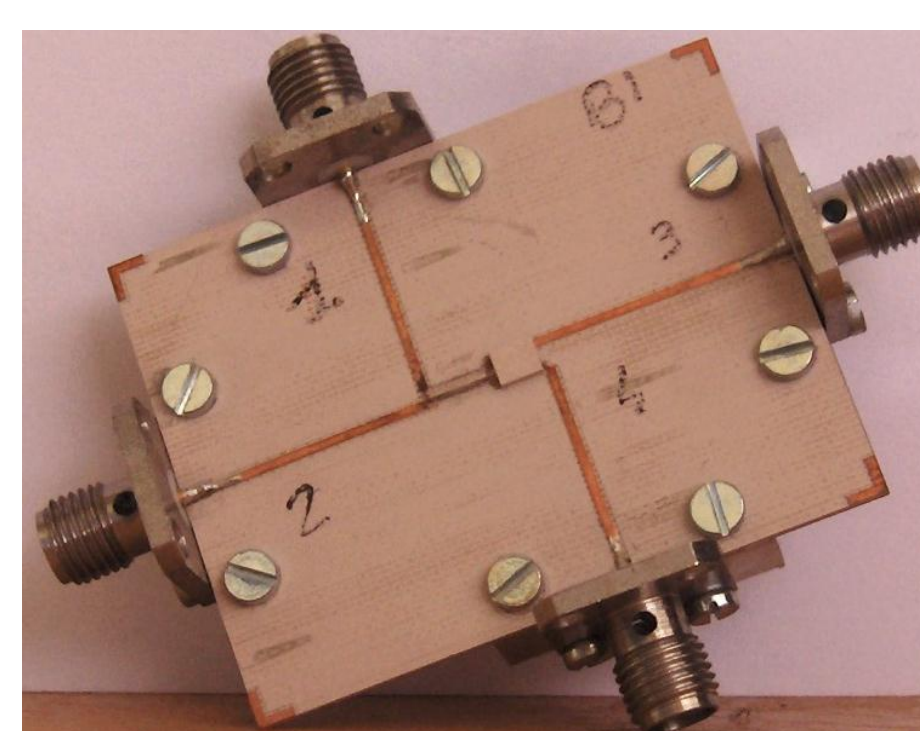
First Approach

broadband Chebyshev equal-ripple coupling response

- S-parameters: simulated \neq 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

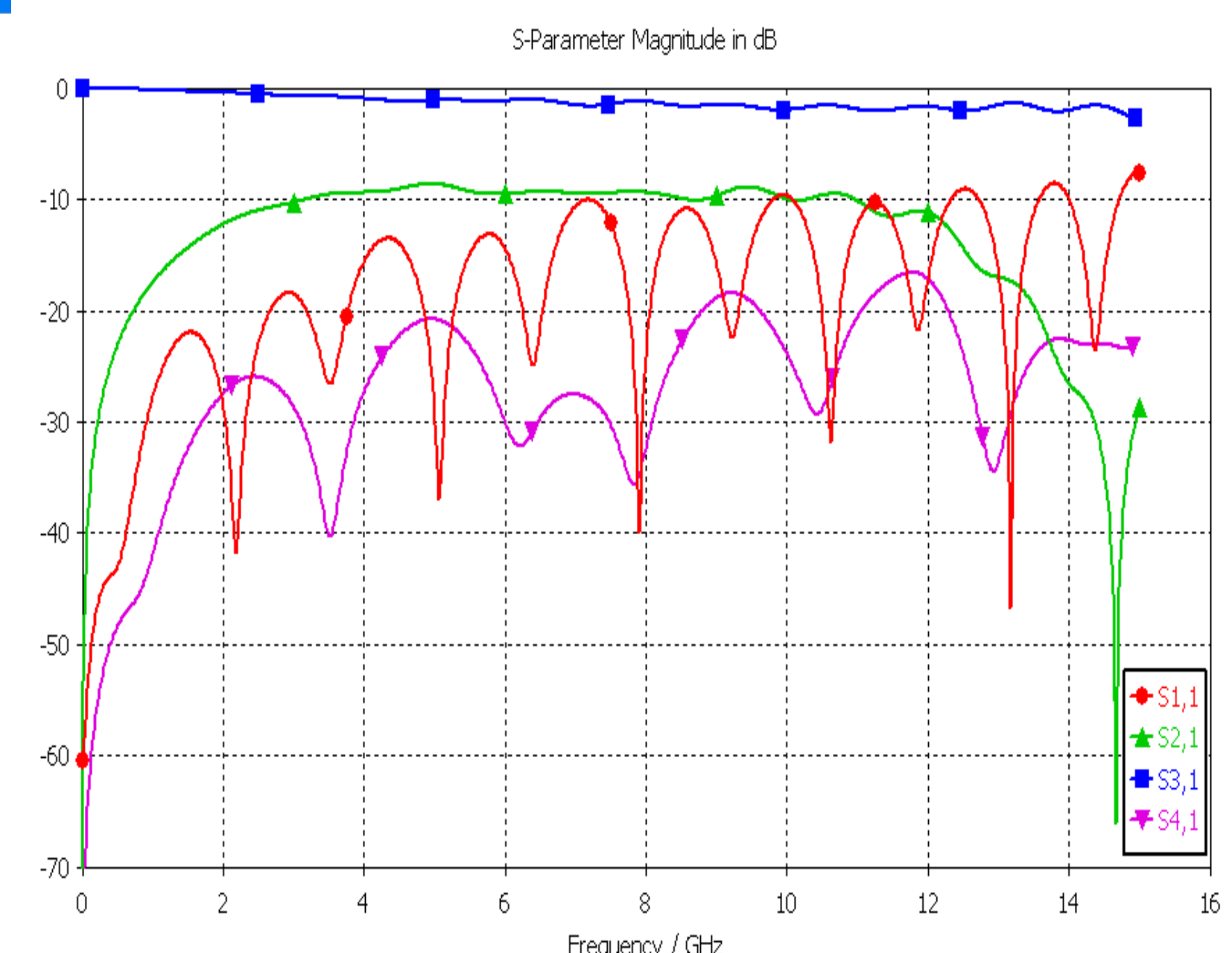


Final Layout Simulated S-parameters



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.

References

- [1] Dipaolo F., Networks and Devices Using Planar Transmission Lines, Boca Raton, CRC Press LLC, 2000
- [2] Konishi Y., Awai I., Fukuoka Y., Nakajima M., "A Directional Coupler of a Vertically Installed Planar Circuit Structure", IEEE Transactions on Microwave Theory and Techniques, vol. 36, No. 6, June 1988
- [3] Le Kerne^{J.}, Klepal M., "UWB radar for People Location and Tracking", Master's Thesis, Adaptive Wireless Systems Group, Cork Institute of Technology, 2006
- [4] Levy R., "General Synthesis of Asymmetric Multi-Element Coupled-Transmission-Line Directional Couplers", IEEE Transactions on Microwave Theory and Techniques, July 1963
- [5] Levy R., "Tables for Asymmetric Multi-Element Coupled-Transmission-Line Directional Couplers", IEEE Transactions on Microwave Theory and Techniques, May 1964
- [6] Sokol V., Waliwander T., Rulikowski P., Le Kerne^{J.}, "The Experimental UWB Link", 15th International Traveling Summer School on Microwaves and Lightwaves, L'Aquila, Italie, 9-15 July 2005