Beamformer Feeding Board Design and IC Package EM Simulation

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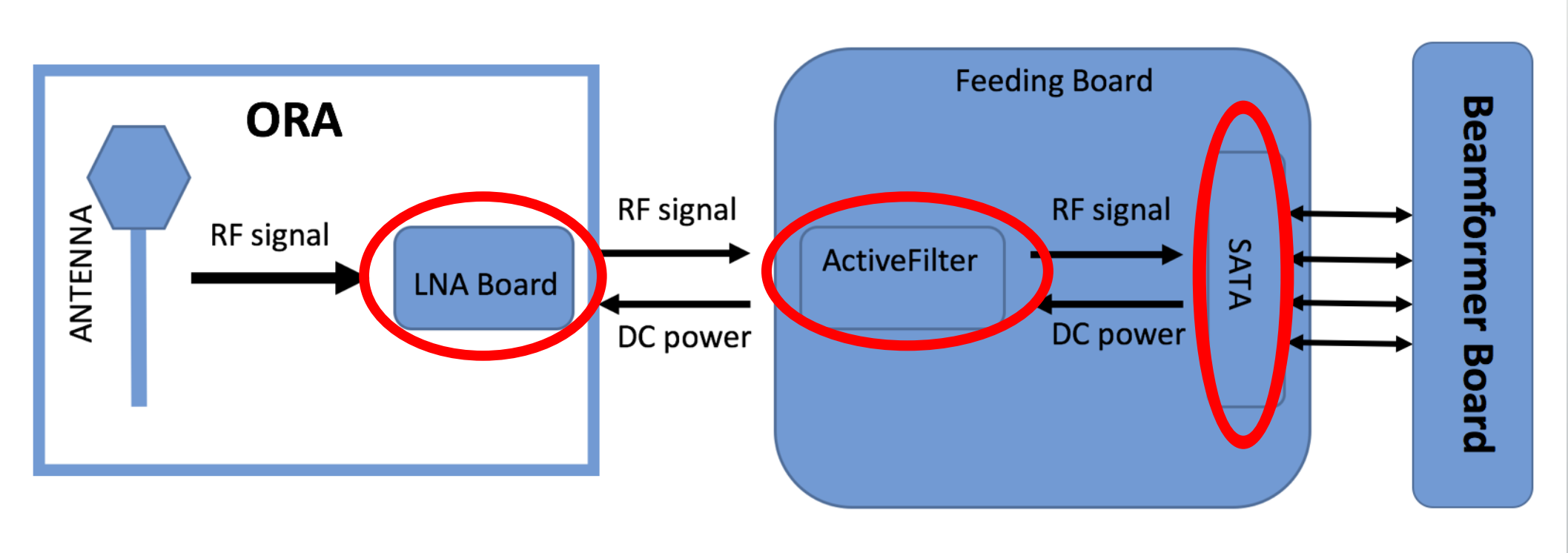
Outline

- Introduction of the Square Kilometer Array (**SKA**) and Octagonal Ring Array (**ORA**);
- Printed Circuit Board (**PCB**) design in Altium;
- Board Electromagnetic (**EM**) Simulation in HyperLynx;
- Integrated Circuit (**IC**) Package **EM** Simulation in ADS and HyperLynx;
- Future Work and Acknowledgement.

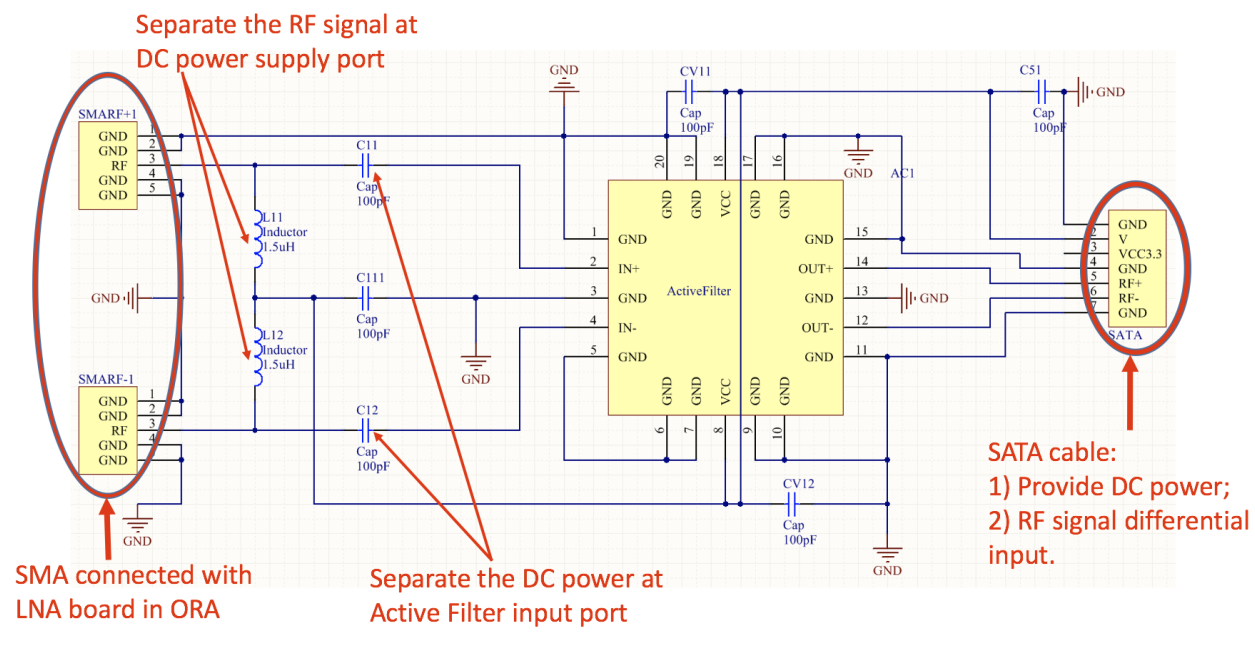
SKA and ORA

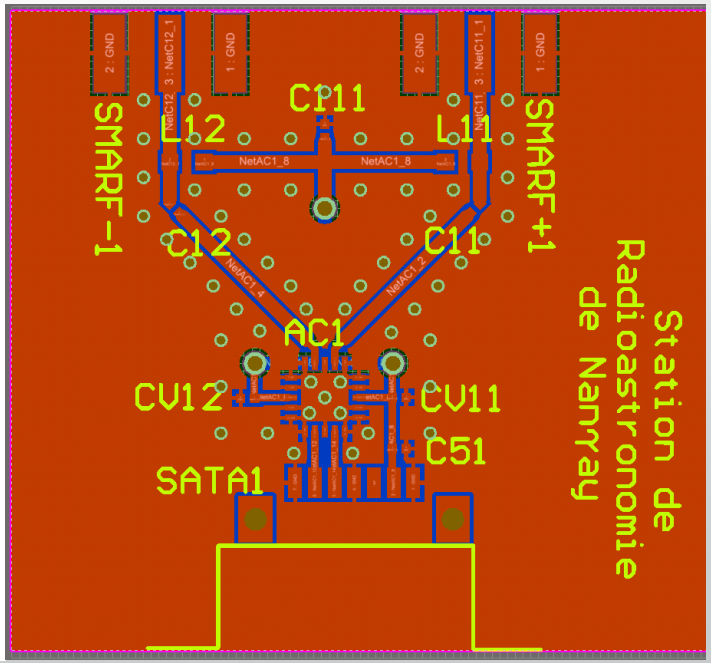
Collecting area: 1 million m²
Spread over thousand kilometers

Introduction of the Board

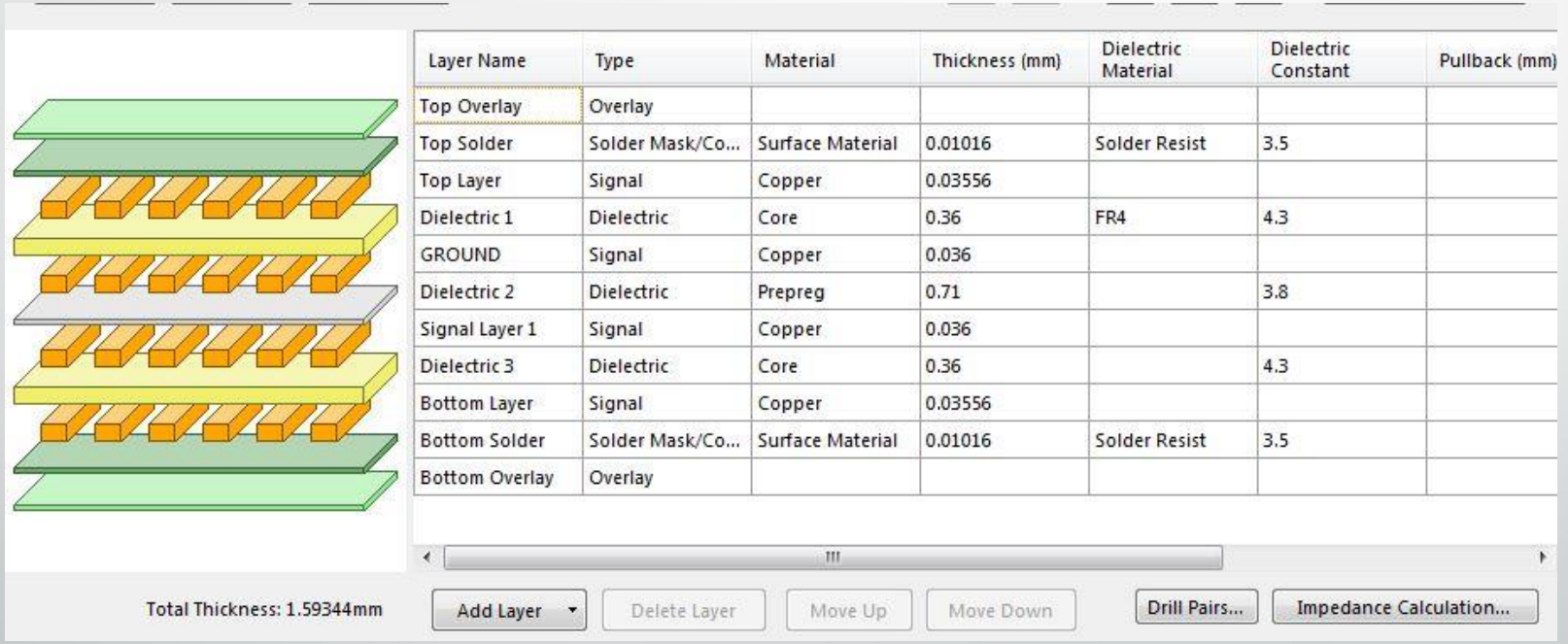


Step 1: Board Design in Altium





Step 2:Layer Stack of the Board

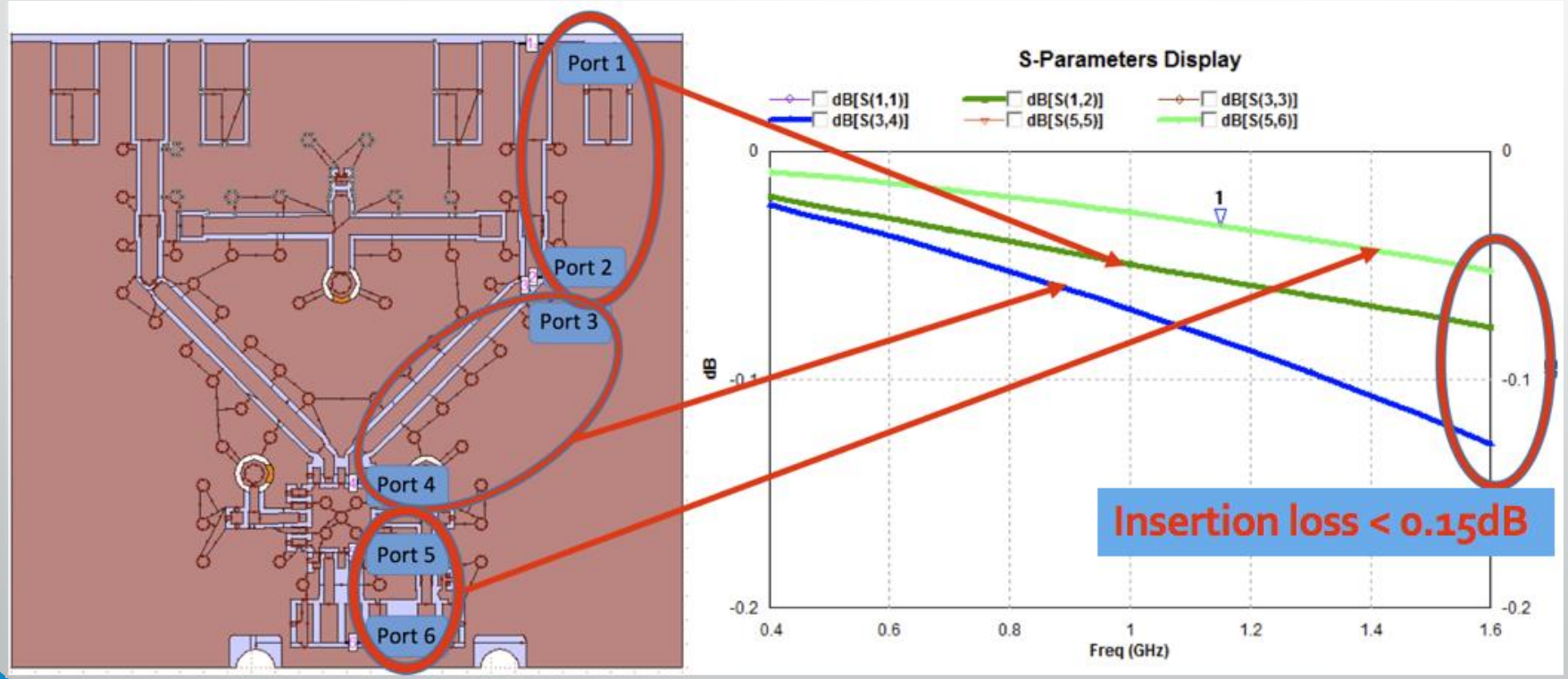


Layer Name	Type	Material	Thickness (mm)	Dielectric Material	Dielectric Constant	Pullback (mm)
Top Overlay	Overlay					
Top Solder	Solder Mask/Co...	Surface Material	0.01016	Solder Resist	3.5	
Top Layer	Signal	Copper	0.03556			
Dielectric 1	Dielectric	Core	0.36	FR4	4.3	
GROUND	Signal	Copper	0.036			
Dielectric 2	Dielectric	Prepreg	0.71		3.8	
Signal Layer 1	Signal	Copper	0.036			
Dielectric 3	Dielectric	Core	0.36		4.3	
Bottom Layer	Signal	Copper	0.03556			
Bottom Solder	Solder Mask/Co...	Surface Material	0.01016	Solder Resist	3.5	
Bottom Overlay	Overlay					

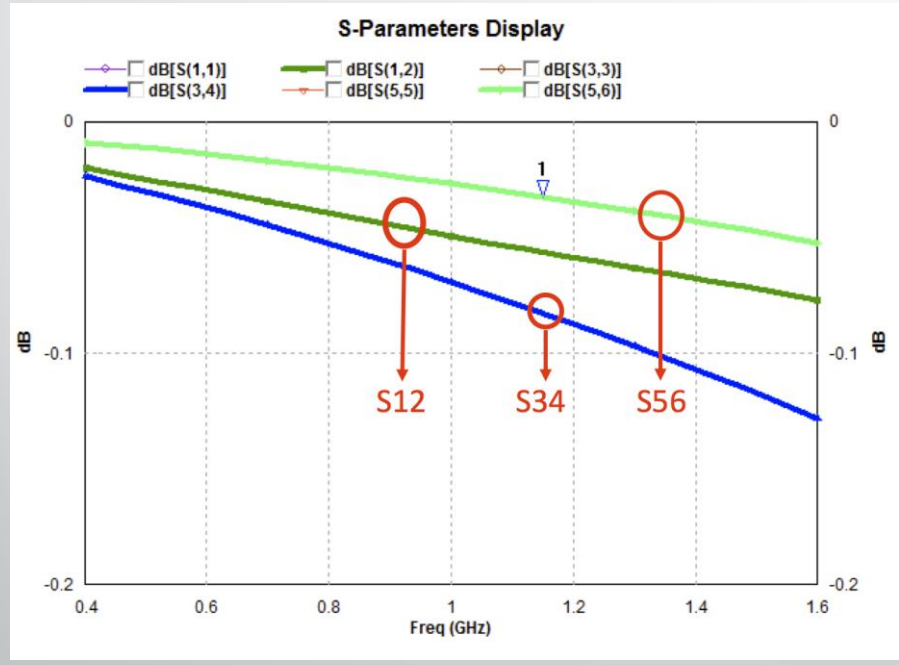
Total Thickness: 1.59344mm | Add Layer | Delete Layer | Move Up | Move Down | Drill Pairs... | Impedance Calculation...

Total Thickness: 1.59mm

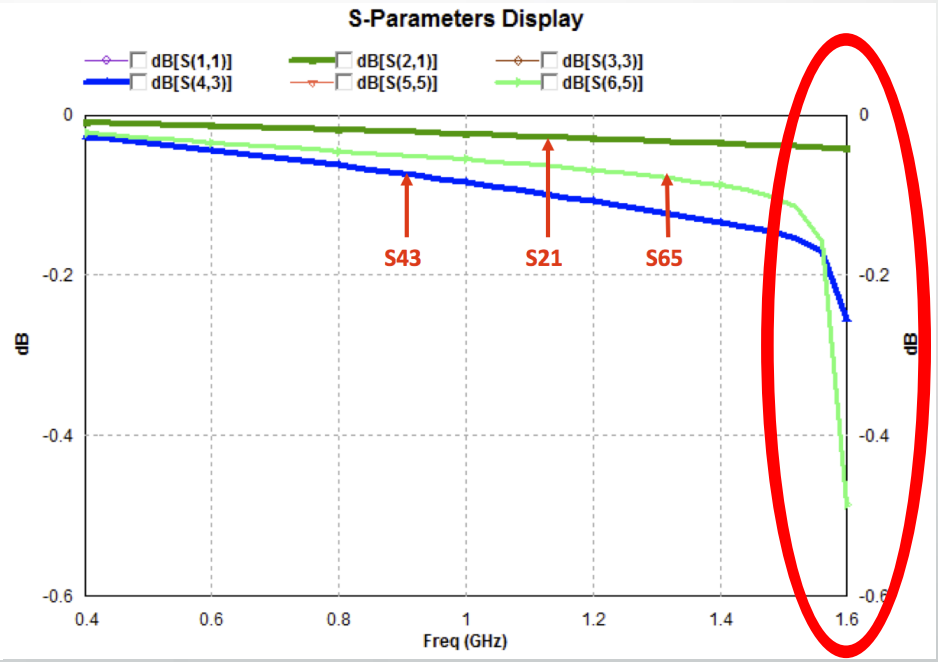
Step 3: EM Simulation with Hyperlynx



The Influence of Metal Via

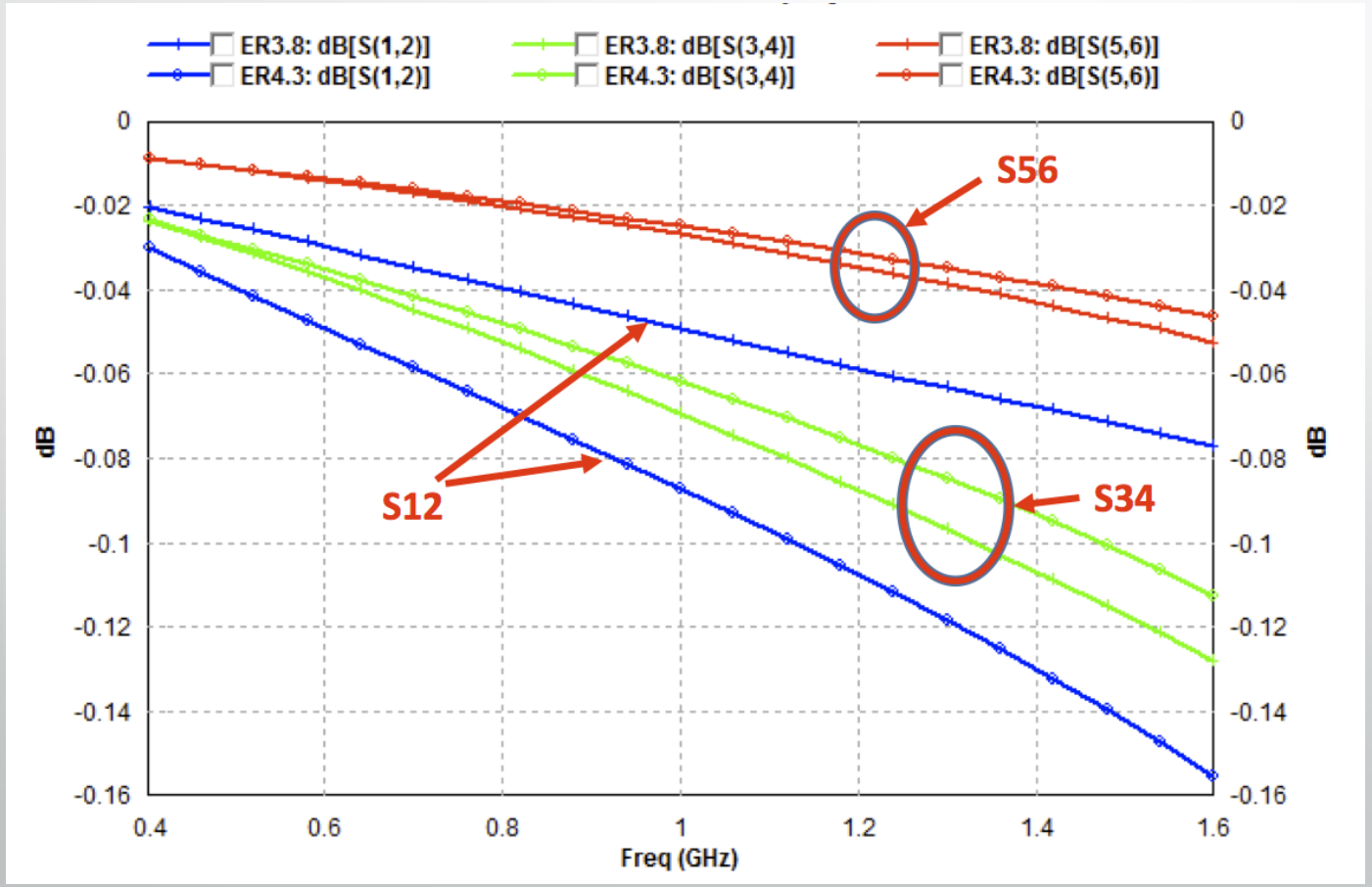


With metal via

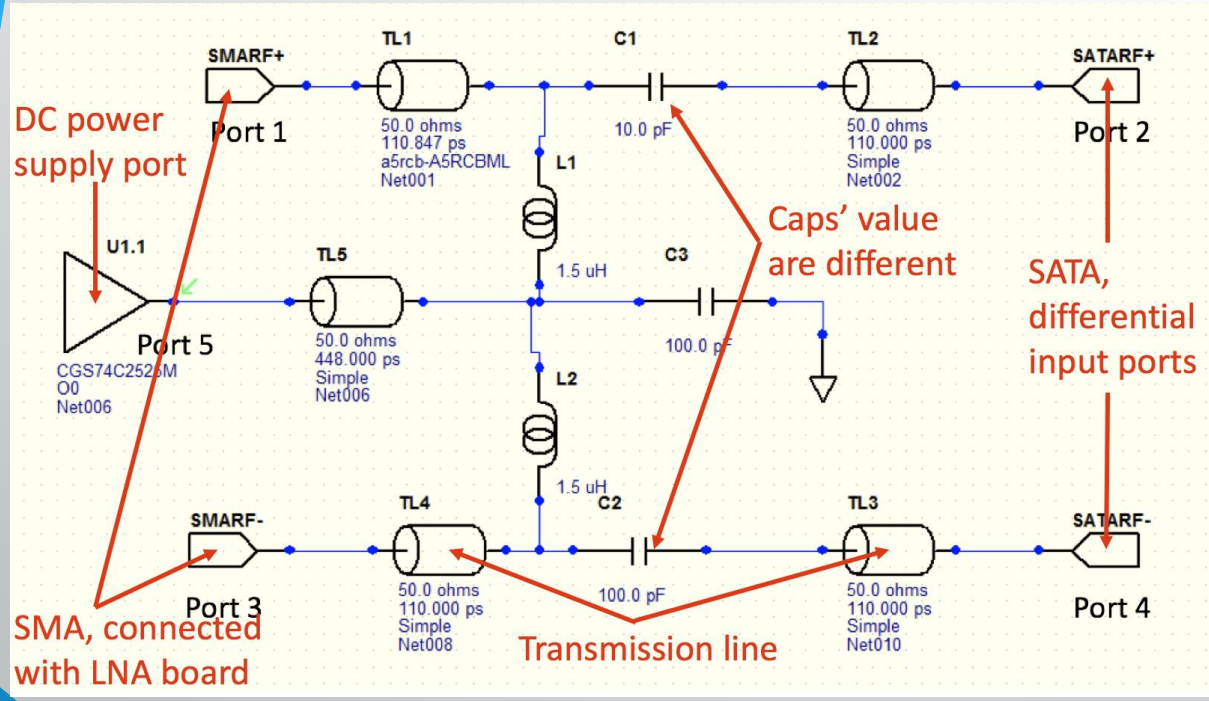


Without metal via

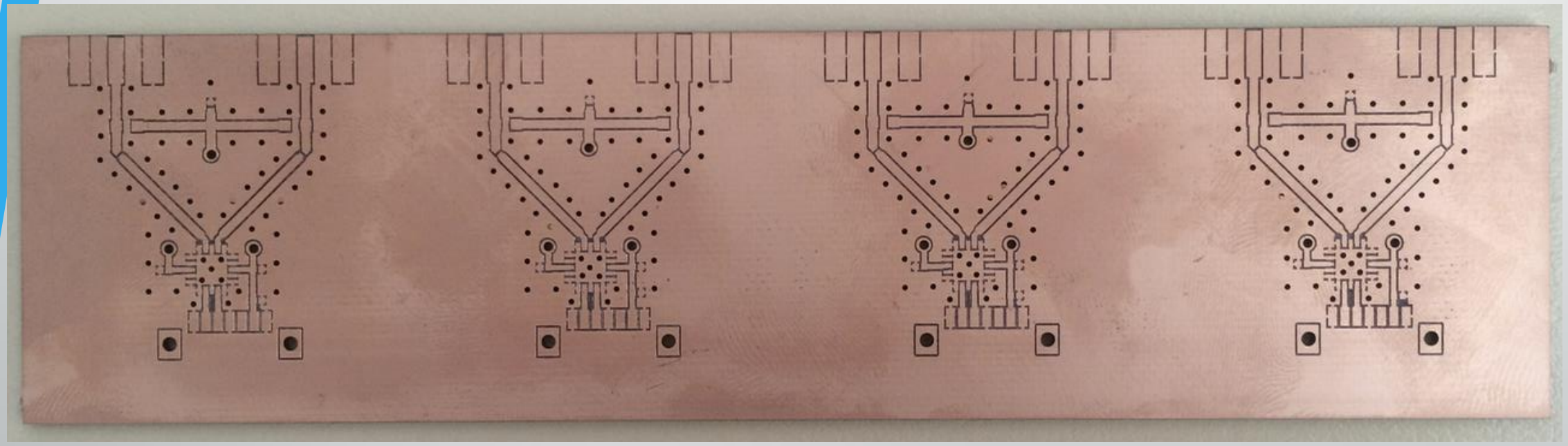
The Influence of Dielectric Constant Variation



Step 4: Line Simulation with Hyperlynx



Step 5: Prototype of the Board



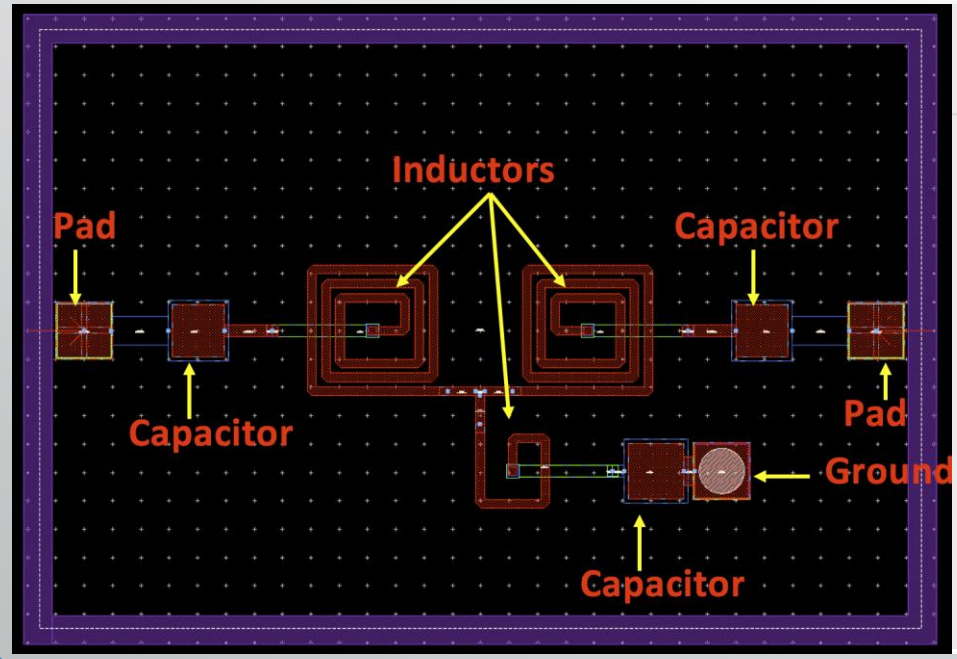
Size: 162mm*41.3mm

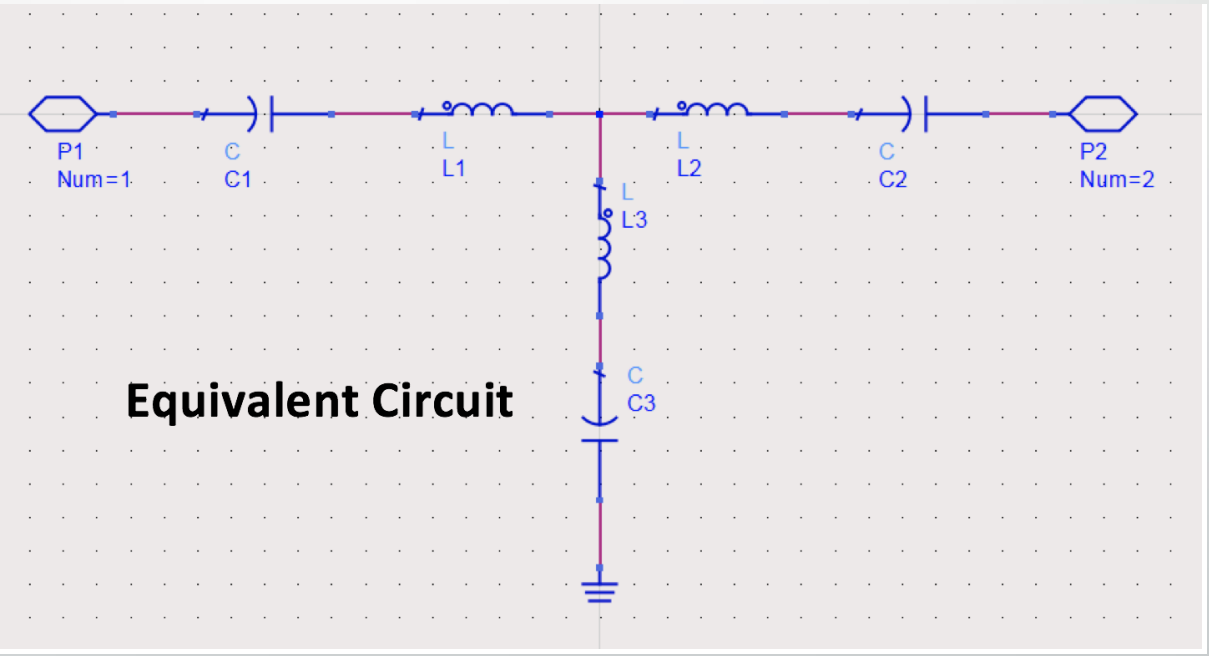
Package EM simulation in ADS

Why do we need to do the simulation?

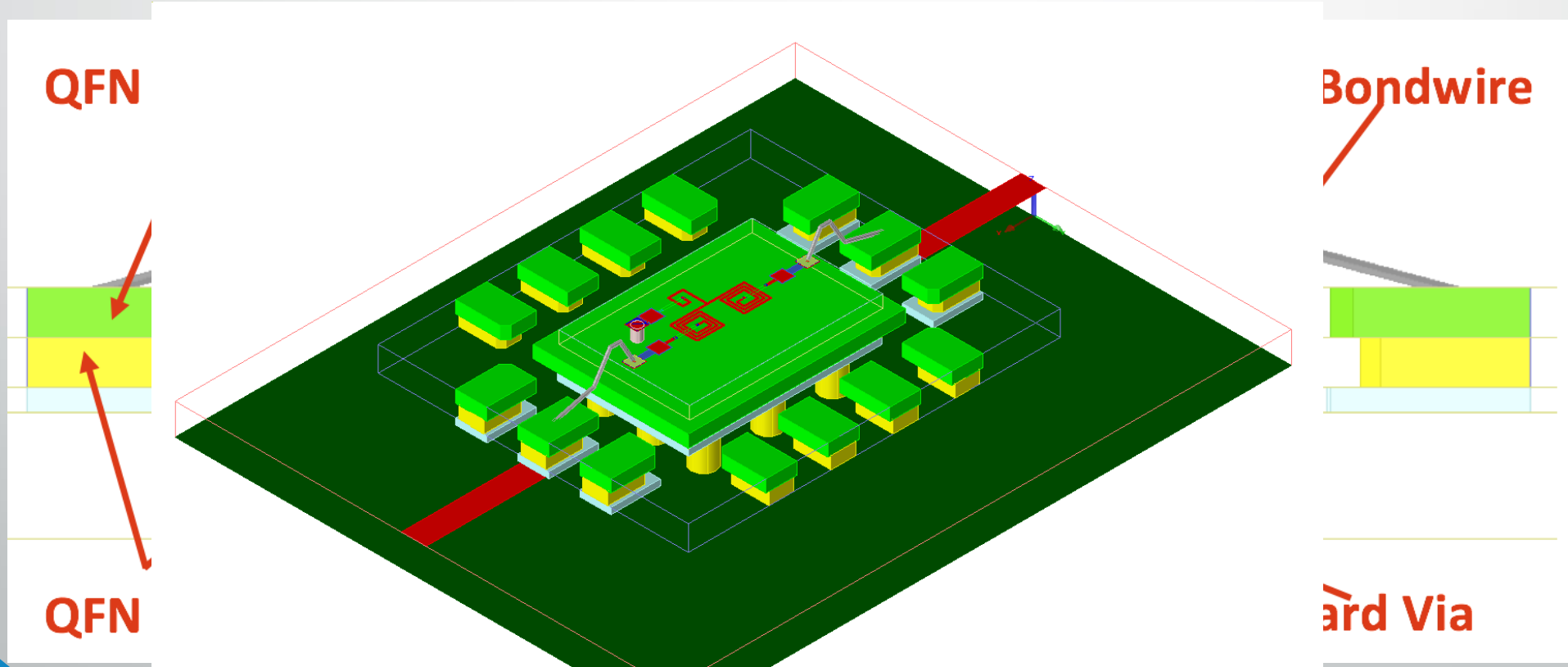
- IC characterization is no longer limited to the IC itself, as we know, ICs need to be packaged, so the packaging and bondwire will affect the performance.
- Accurate prediction of the affects of package and bondwire at high frequency is increasingly important as ICs continue to shrink and to operate at higher frequencies.

An Example of Filter designed for 7GHz-9GHz

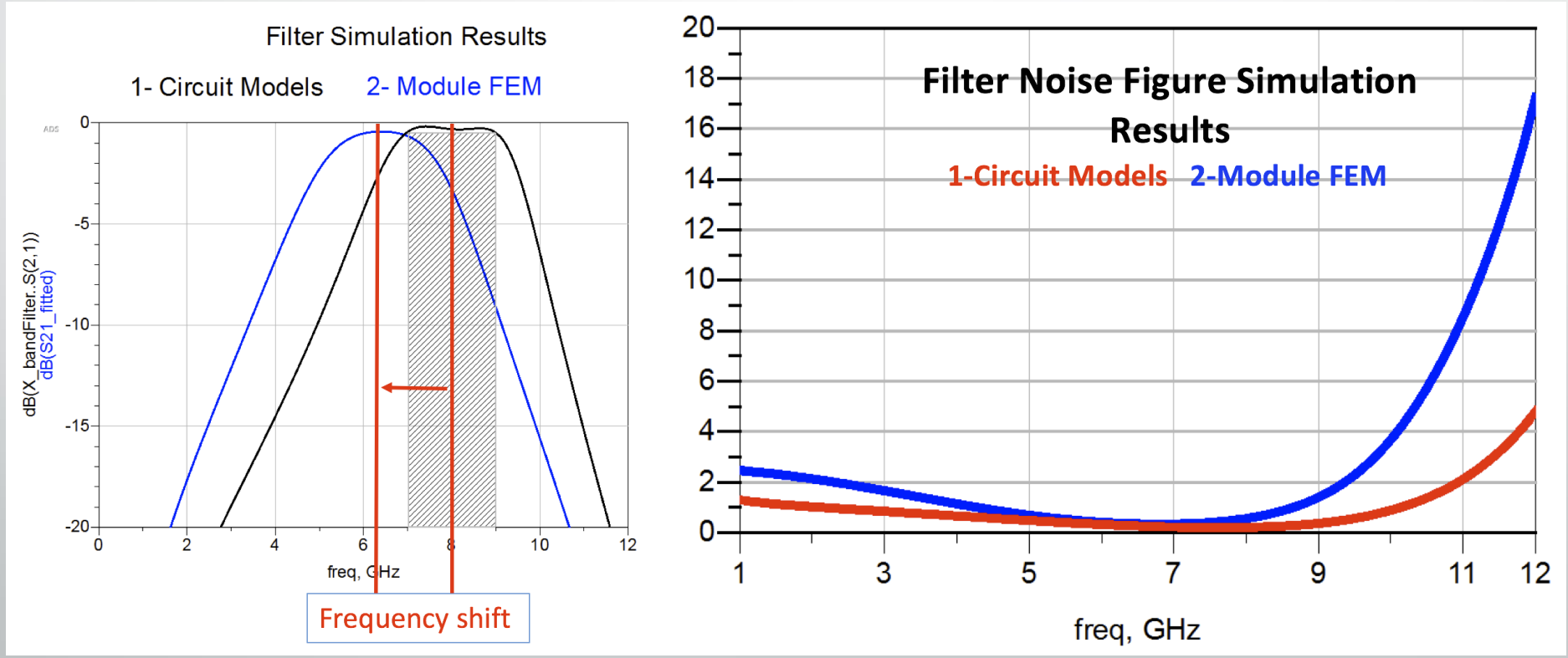




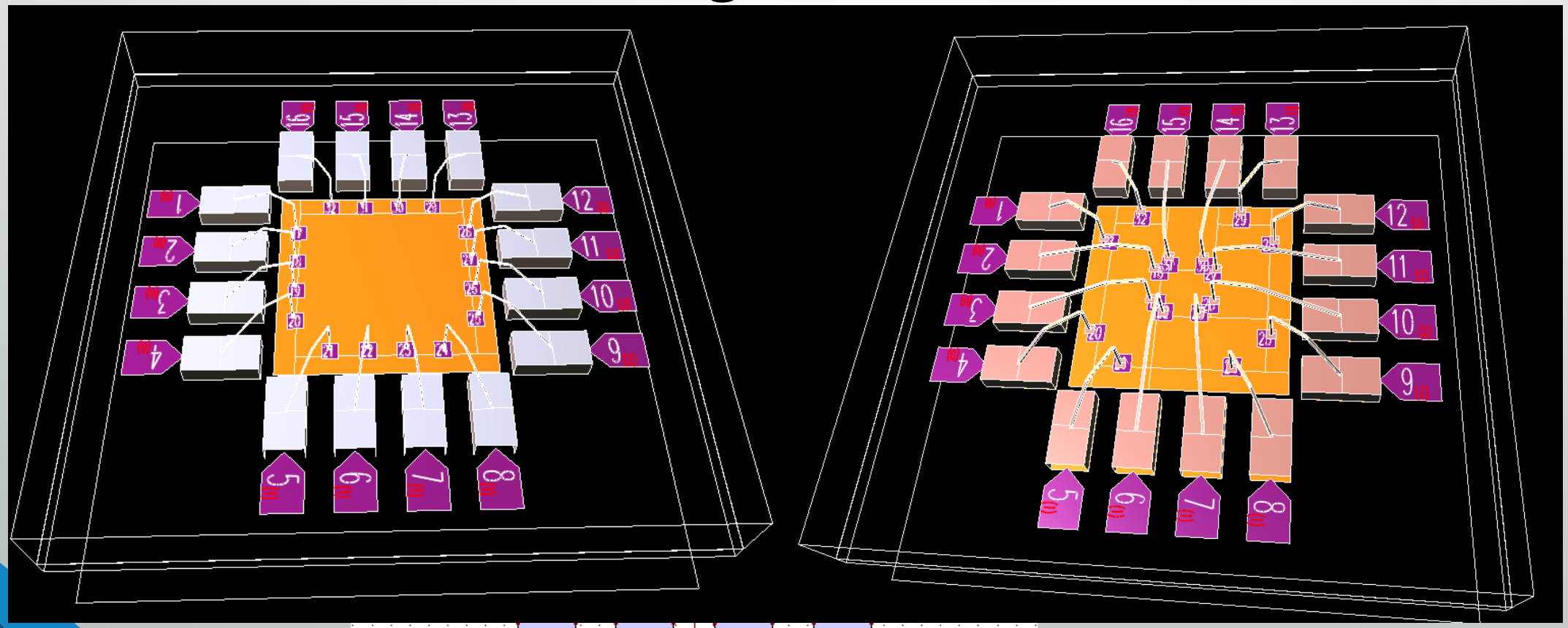
View of the Filter with Package in ADS

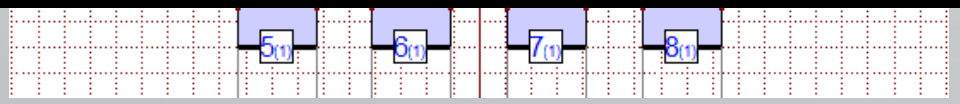


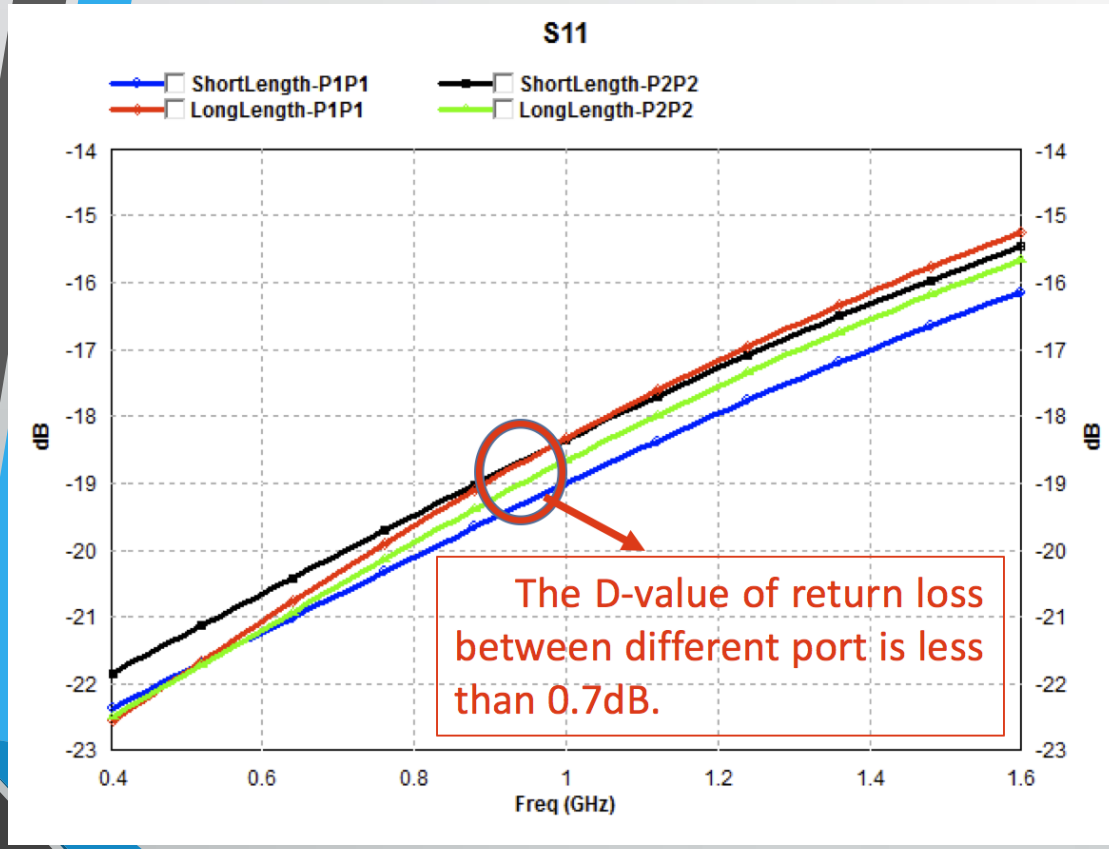
Simulation Results

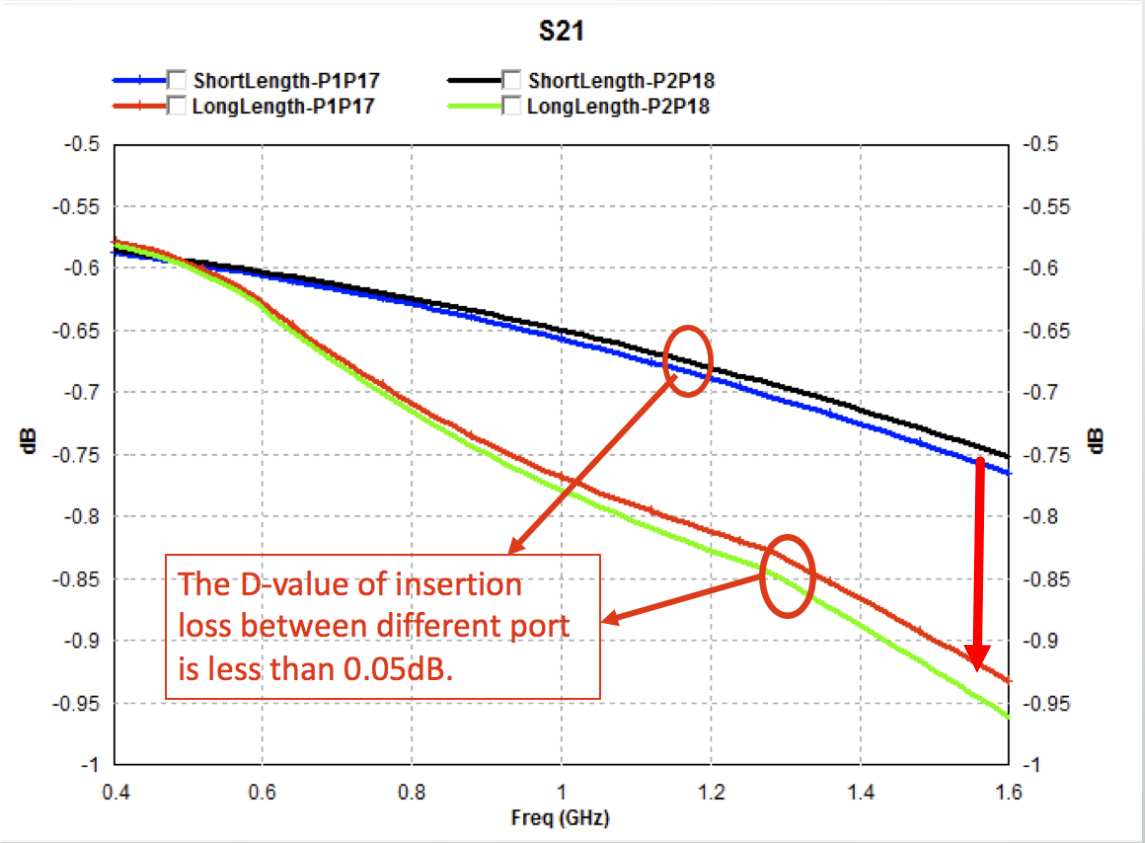


Bondwire Length Influence






S11
ShortLength-P1P1
LongLength-P1P1
ShortLength-P2P2
LongLength-P2P2
dB
Freq (GHz)
The D-value of return loss between different port is less than 0.7dB.


S21
ShortLength-P1P17
LongLength-P1P17
ShortLength-P2P18
LongLength-P2P18
dB
Freq (GHz)
The D-value of insertion loss between different port is less than 0.05dB.

Future Work

- Manufacture the board;
- Connect with the beamformer board and Antenna and measurement;
- Further EM simulation about QFN package in HyperLynx, like adding IC and other package types;
- Writing HyperLynx Package EM simulation manual;
- Learn LNA and filter design.

Acknowledgement

- This work is supported by EU FP7-PEOPLE-2012-ITN project nr317446, INFIERI, "Intelligent Fast Interconnected and Efficient Devices for Frontier Exploitation in Research and Industry".

cnrs
dépasser les frontières

Station de
Radio astronomie
de Nançay

SKA
SQUARE KILOMETRE ARRAY
MID-FREQUENCY APERTURE ARRAY

2012-FP7-ITN-317446
INFIERI

Thank YOU