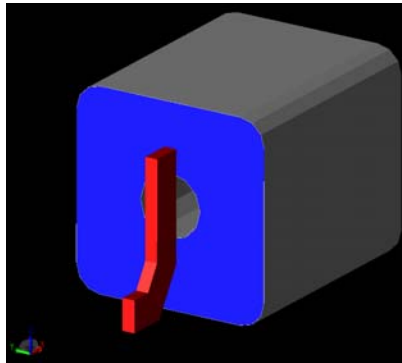


EM Insights Series



Episode #11: An Oscillator Design Flow With Integrated 3DEM

Agilent EEsof EDA
June 2009

Application Overview

Typical situation

A VCO design normally involves some type of resonator, which is a device that naturally oscillates at a certain frequency. Popular resonators used in many communication systems are ceramic resonators and dielectric resonators but are not limited to these. In a typical oscillator design process, designers create a drawing of resonator and characterize it in a 3D EM simulation tool. Then the simulated results (s-parameters) are brought back to a circuit design tool as an s-parameter block for further analysis such as circuit model extraction, Q-factor calculation, power, tuning range, harmonics, and phase noise.

Potential users and targeted market

- Oscillator or VCO design engineers
- RF/MW boards and module

EM product used

EMDSG2 for the 3D EM simulation

EMPro UI for creating 3D components

Design Challenges

Design challenges

Since the resonator typically sits on a printed circuit board, it's important to take board parasitics into account such as vias and board traces nearby that may couple with the resonator. Therefore designers often take extra steps to re-create(or export) the board layout in a 3D EM tool. However these additional steps can be very hard, error prone or tedious processes and if not done, inaccurate performance prediction of the VCO or even product introduction delays can occur.

Problem solved

Designers can now accurately predict the performance of VCOs with resonators by simply dropping the resonator as a 3D component in ADS layout for the complete EM simulation.

Value delivered

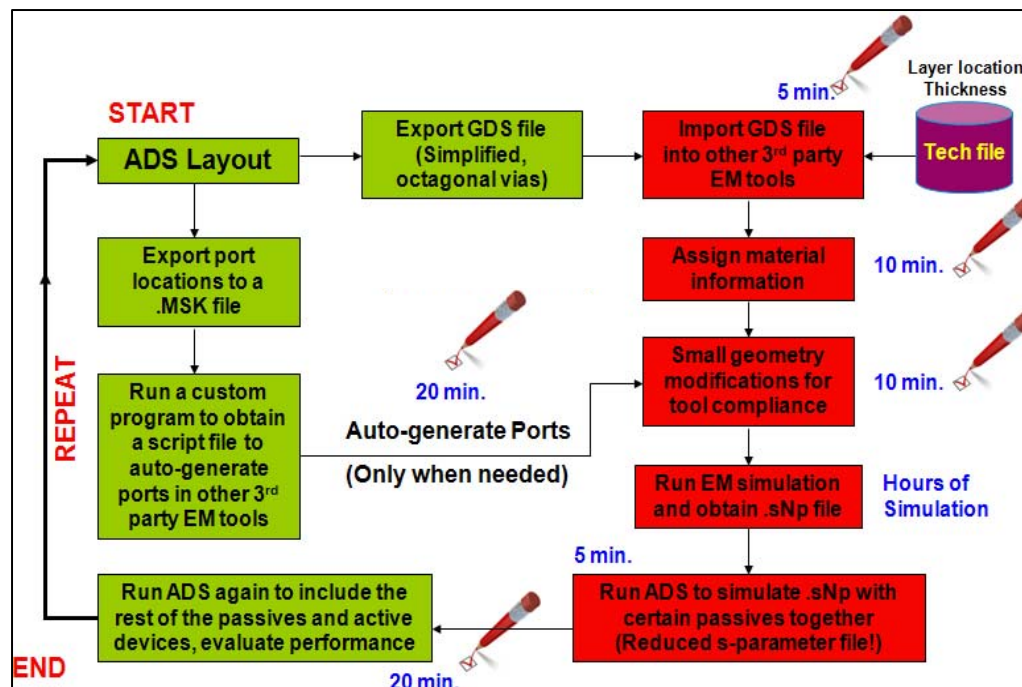
Increased simulation accuracy by bringing 3D resonator into ADS simulations

Minimized design translations between multiple design tools

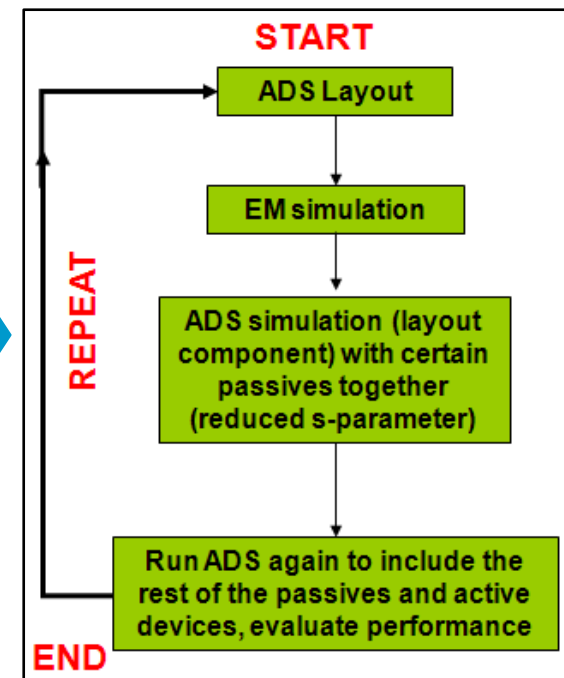
Integrated 3D EM Saves Cycle Time

Integrated 3D EM also saves cycle time on the EM front-end process

Reducing “EM front-end process”, the process from entering the design geometry to being ready for the simulation, could save hours of simulation setup time (1hr +) and also on CAD resources



Non-integrated EM flow



Integrated EM flow

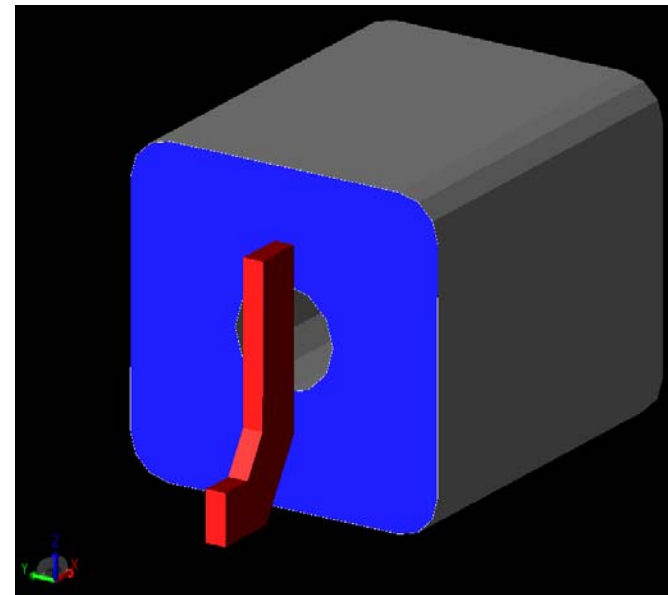
Coaxial Ceramic Resonator

Coaxial ceramic resonator

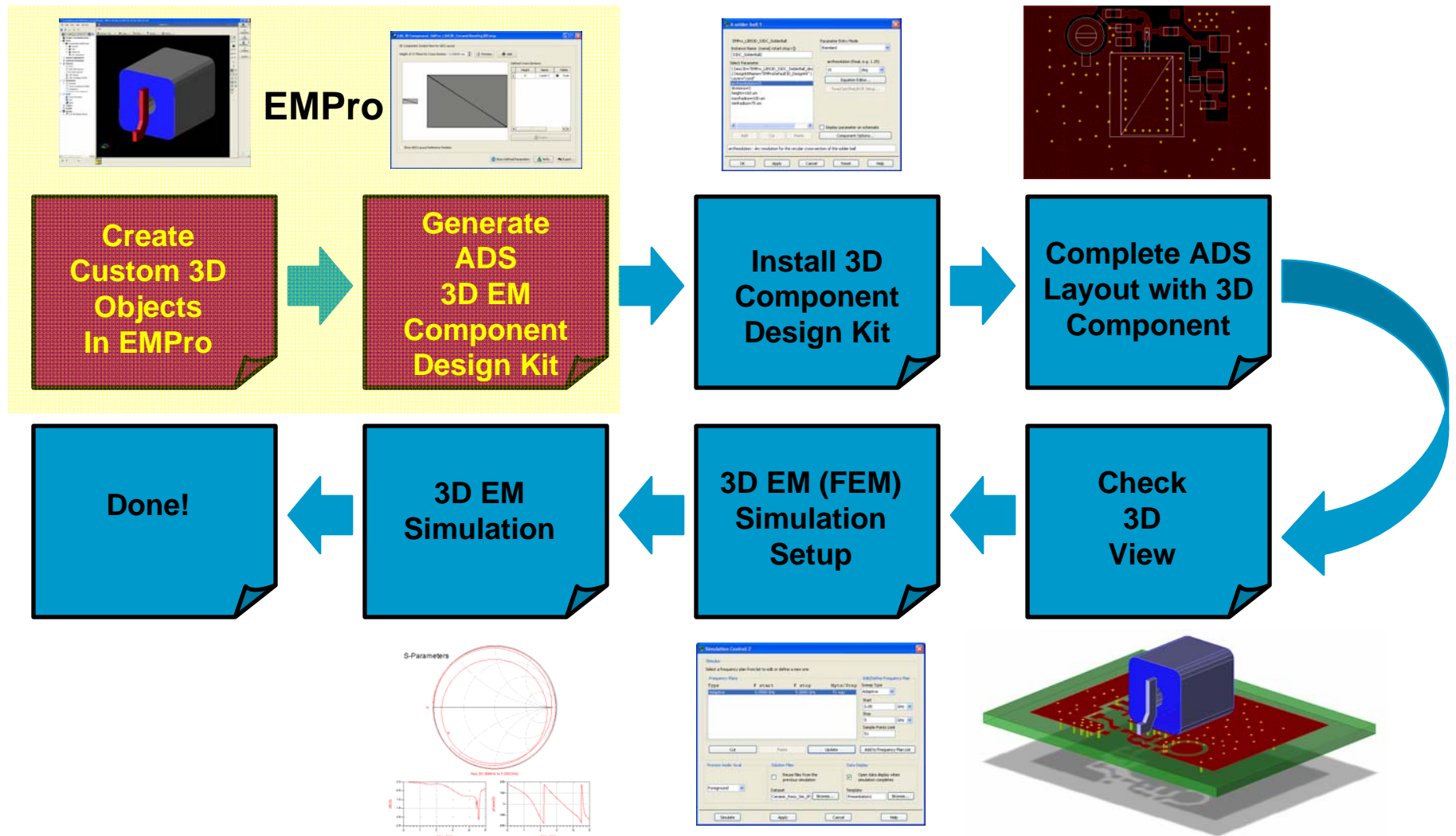
- High Q, reduced size, better shielding, and temperature performance

Features

- Frequency tolerance of 0.5% or 1%
- Various dielectric constants – 10 to 90
- Rugged construction
- Low loss silver = Higher Qu
- Act as parallel resonant circuit



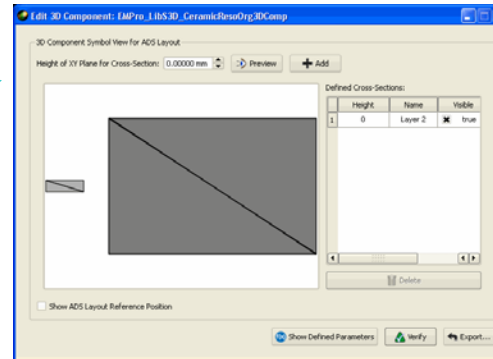
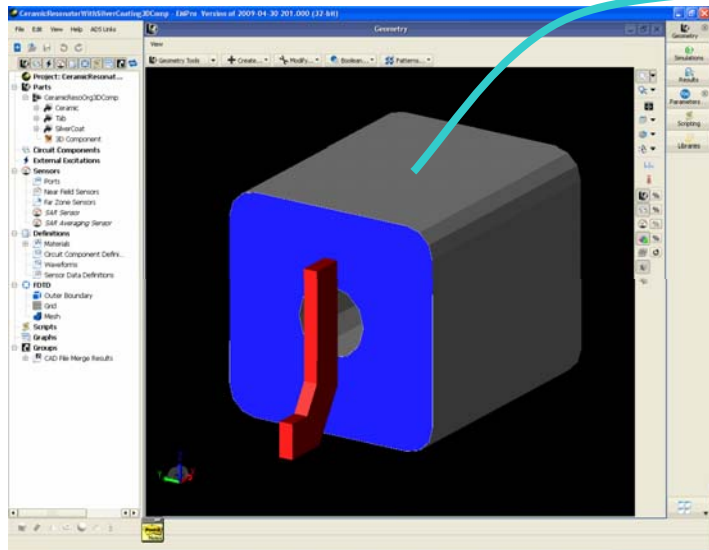
3D EM Design Flow with Custom 3D Components in ADS



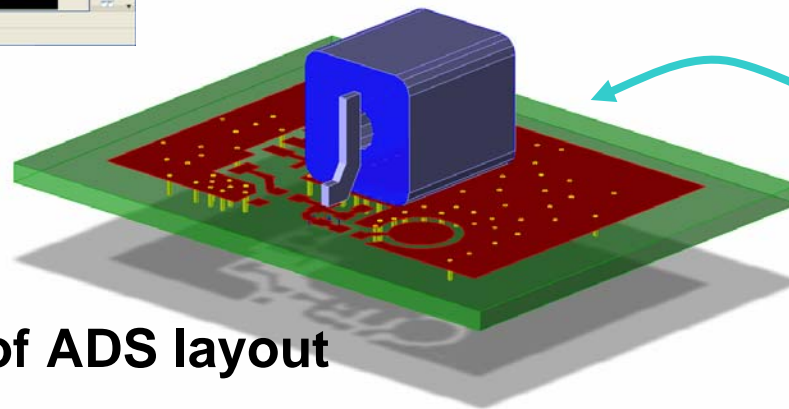
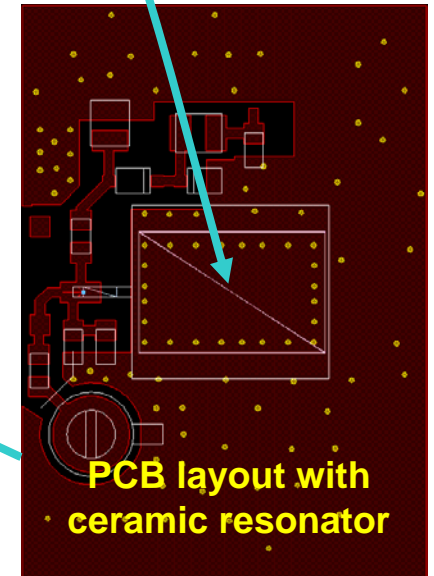
Creating Ceramic Resonator 3D Component in EMPro

ADS design kit component

EMPro



Ceramic resonator in ADS layout

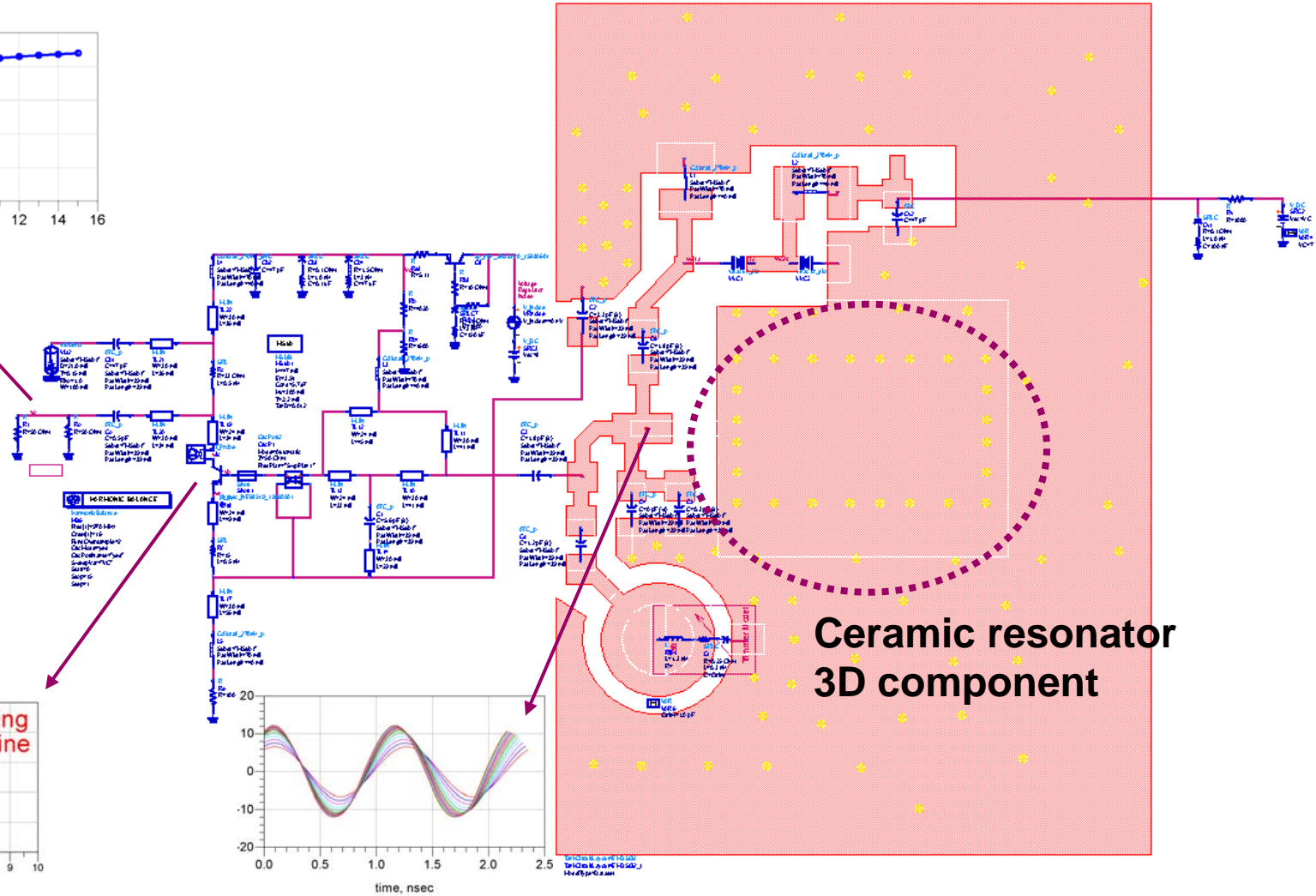
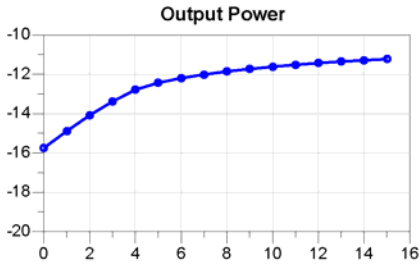


3D view of ADS layout

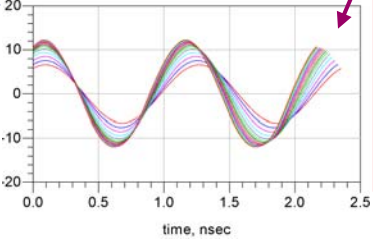
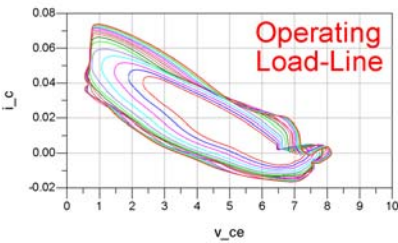


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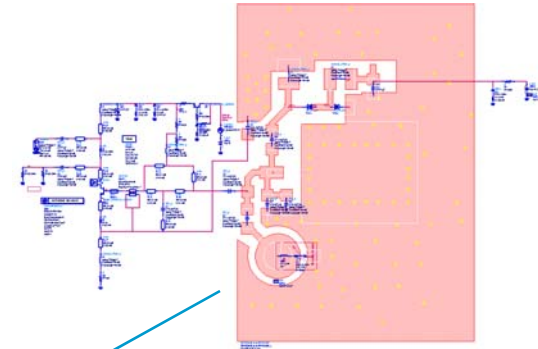
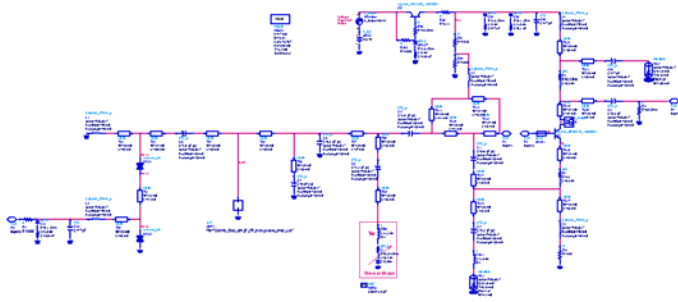
Simulated Results of VCO Schematic with Ceramic Resonator + Layout



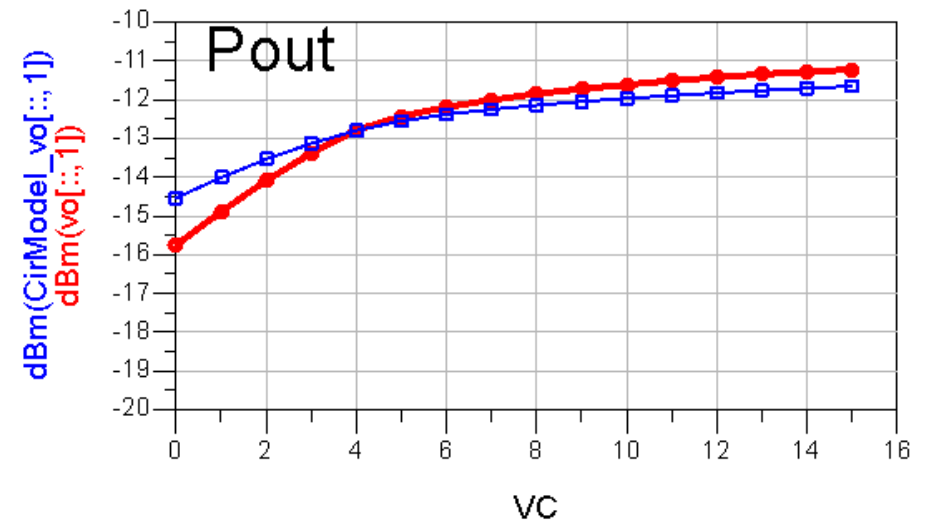
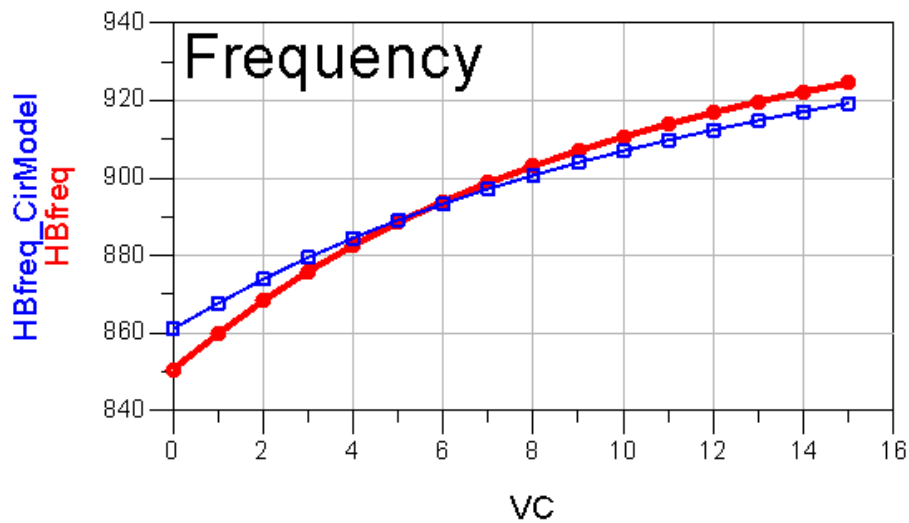
**Ceramic resonator
3D component**



VCO Simulation Comparison With and Without PC Board Parasitic Effects

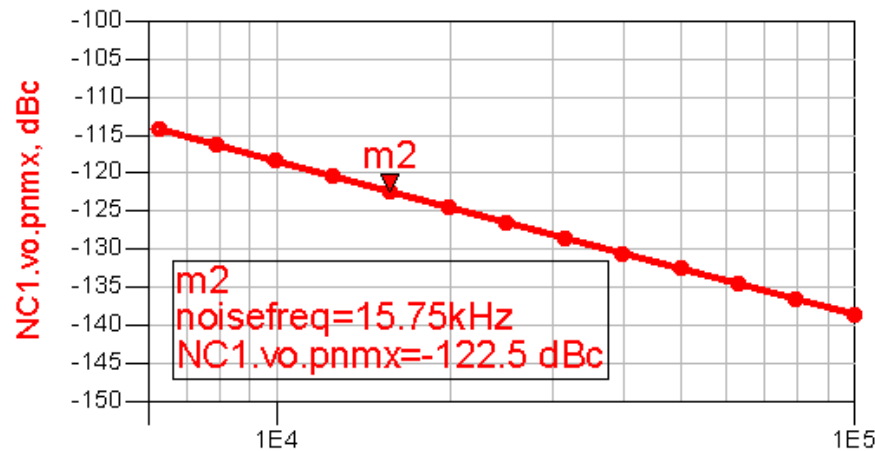


Red: VCO with Ceramic Resonator + ADS Layout
Blue: VCO with Ceramic Resonator EM data only

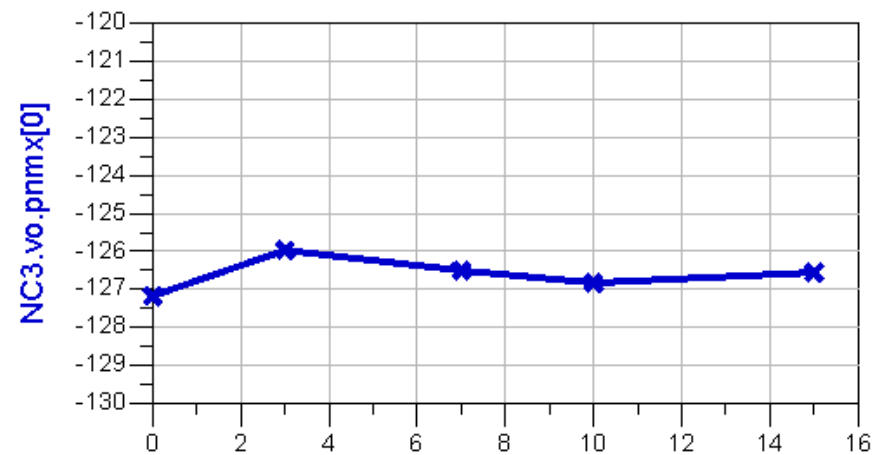


Phase Noise Simulation Results

VC=7V, Phase Noise versus offset



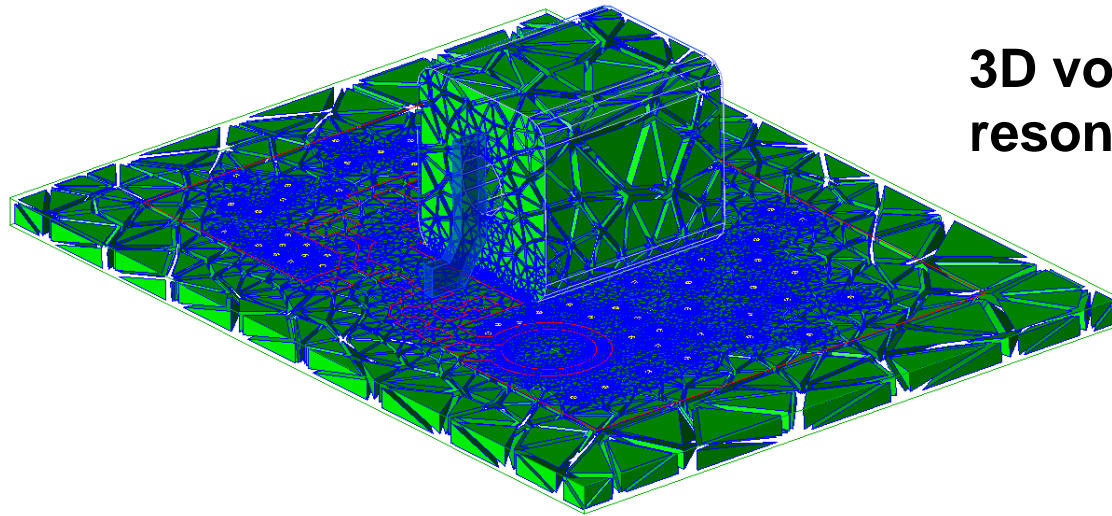
Offset=25kHz, Phase Noise versus VC



Offset=25kHz, VC=7, Phase Noise Contributors

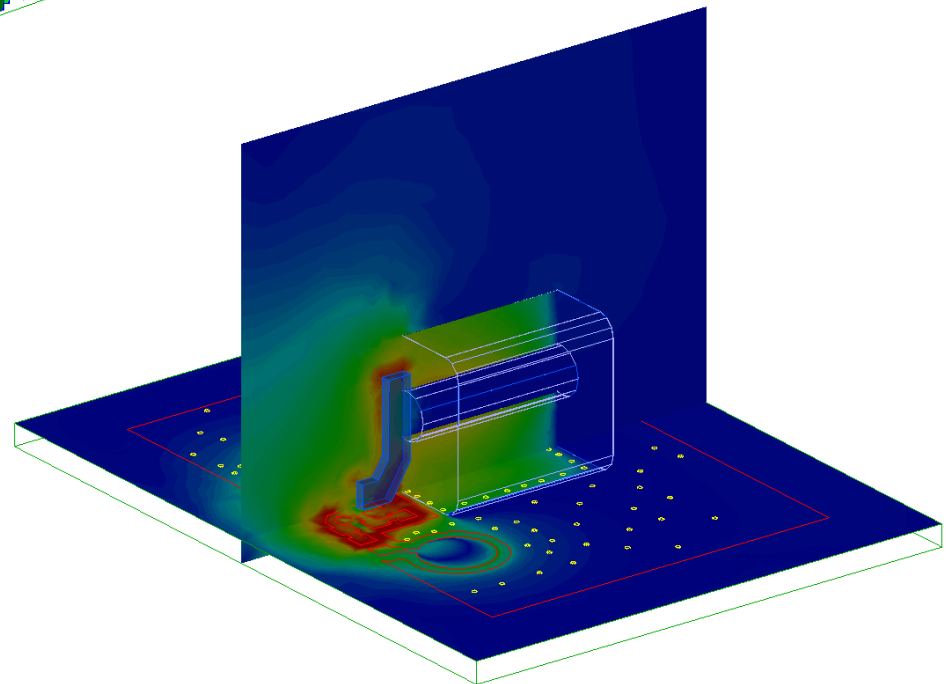
NC2..noisefreq	NC2.vo.pnmx
25.000 kHz	-126.5056
NC2..name	NC2..vnc
_total	-126.5 dBc
Q1	-127.4 dBc
Rb4	-139.0 dBc
Rf	-141.5 dBc
VRnoise	-142.1 dBc
Rb	-143.0 dBc
TankCircuitLayout4...	-144.8 dBc

3D Meshes and Field Plot



3D volume mesh for the resonator on PC board

E-field plot on both horizontal and vertical planes



EM Insights Series

Episode #11 summary

3D EM integration improves predictive design of VOCs. You can increase the simulation accuracy by taking into account the interaction between resonator and board design.

Interested in learning more about this application?

- Request an evaluation copy of EMPro

<http://www.agilent.com/find/eesof-empro-evaluation>

- Request a demo of EMPro

<http://www.agilent.com/find/eesof-contact>

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