Presentation on Spiral Inductors Simulation with EMDS for ADS: Part 3
Simulating a Variety of Spiral Inductors with “EMDS for ADS”

(Electro Magnetic Design System Integrated in ADS)

July 26, 2007
Today’s Agenda

Brief Overview of “EMDS for ADS”
- Brief overview of “EMDS for ADS” basics (and EM promotion!)
- Brief mention of some of the Spiral Inductors that can be simulated

Demonstration of “EMDS for ADS”
- Live demonstration of simulating some Spiral Inductors with “EMDS for ADS”

Summary of Examples (for archive version of presentation)
- Screenshots of layouts, 3D views, comparison schematics, and results
- Summary of simulation statistics
“EMDS for ADS” is Here!
Two Affordable, Full-featured Products (June 2007)

“EMDS for ADS”
$18K
- A full 3D EM tool that is completely integrated in the ADS environment:
  - Use directly from ADS Layout
  - Include simulation of bondwires & dielectric bricks (finite dielectrics)
  - New, user-friendly 3D Viewer
  - Create parameterized components for circuit co-simulation
  - Momentum-like usage & flow
  - View currents, fields, and radiation patterns
  - View results with data display

EMDS Standalone
$15K
- A full 3D EM stand-alone tool:
  - Draw or import arbitrary shapes in 3D
  - Good for high performance connectors, adaptors, filters, transitions, packages, etc.
  - View currents, fields, and radiation patterns
  - Includes 64-bit simulation capability for larger problems (no additional charge)
  - Upgrades included with Support
  - Available on Windows XP

Same codewords enable standalone version – no extra investment needed!
With the “EMDS for ADS” License…Part 1/2

The Power of EMDS (FEM) Directly Within ADS (Momentum-like Flow)
With the “EMDS for ADS” License…Part 2/2

Even More 3D Flexibility with the Stand-alone Version of EMDS

Note that the “*.geo” files created by the stand-alone version can also be viewed in the new 3D Preview Tool.
Finding More Information for EMDS

Online Resources for EMDS (Electro Magnetic Design System)

June 2007 Archive (presentation, recording, and ADS 2006 Update2 project for an “EMDS for ADS” introductory session):
http://eesof.tm.agilent.com/news/events_archive.html#emds_ads_june

EMDS Product Webpage:
http://eesof.tm.agilent.com/products/emds_main.html
EMDS Web-based Demo:
EMDS eLearning (free):
http://eesof.tm.agilent.com/forms/emds_e_learning_registration.html
EMDS Evaluation Request Form:
http://eval.soco.agilent.com/emdscrf.html
EMDS 2006C Online Manual:
EMDS Articles and Webcast Archive:
http://eesof.tm.agilent.com/products/emds_main.html#publications
SuperEM Promo Overview *(ends Oct. 31, 2007)*

**The Full Monty**

- This package includes one bundled ADS “core” (Data Display, Design Environment, Linear, Layout and translators) plus full EM capability (Momentum, Momentum Visualization, Momentum Optimization, AMC, “EMDS for ADS”, and stand-alone EMDS).
- Promo price is $\leq $50K for the package!

**Just EM, Please**

- This package supplants the ADS “core” with full EM capability (Momentum, Momentum Visualization, Momentum Optimization, AMC, “EMDS for ADS”, and stand-alone EMDS).
- Promo price is $\leq $35K for the package!

**Beyond Momentum**

- For current ADS users who have the ADS “core” and Momentum, but desire an enhanced Momentum and 3D capability.
- This package supplants the core and Momentum with Momentum Visualization, Momentum Optimization, AMC, “EMDS for ADS”, and stand-alone EMDS.
- Promo price is $\leq $22K for the package!

*Note: AMC = Advanced Model Composer*
A Variety of Spiral Inductors That can be Simulated

MMIC Spiral Inductors
LTCC Spiral Inductors
RFIC Spiral Inductors
Suspended Spiral Inductors
Deep Trench Spiral Inductors
Single-layer and Multi-layer Spiral Inductors
Variety of shapes/numbers of sides (square, octagonal, round, etc.)
Single-ended & Differential Spiral Inductors
Spiral Inductors with/without Patterned Ground Shields
Symmetrical/Non-symmetrical Windings
With/without Conformal Coating on Spiral Inductor Windings

Note: This is just a sample of the kinds of Spiral Inductors that can be simulated using “EMDS for ADS” (and stand-alone EMDS).
Spiral Inductors That We Will Look at Today

**LTCC Spiral Inductor**
- Taken from ADS Momentum example directory.
- Compare MomentumRF and “EMDS for ADS” results (L, Q, R, and Smith Chart).

**RFIC Spiral Inductor**
- A Momentum accuracy benchmark example.
- Compare MomentumRF and “EMDS for ADS” results to measured data (L, Q, R & S-parameters).

**MMIC Spiral Inductor**
- An inductor from WIN Semiconductor’s PDK (WIN PD5001 0.5um pHEMT PDK)
- Compare MomentumRF and “EMDS for ADS” results to PDK’s “target” inductance.
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Demonstration of “EMDS for ADS”

➢ Live demonstration of simulating some Spiral Inductors with “EMDS for ADS”

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• Screenshots of layouts, 3D views, comparison schematics, and results
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➤ Summary of simulation statistics
Summary of Examples Demonstrated

**LTCC Spiral Inductor – ADS Layout and 3D Preview**
Summary of Examples Demonstrated

LTCC Spiral Inductor – ADS Schematic to Compare Results
Summary of Examples Demonstrated

**LTCC Spiral Inductor – Data Display to Compare Results**

**LTCC Spiral Inductor Comments**
- Taken from ADS Momentum example directory.
- Compare MomentumRF and “EMDS for ADS” results (L, Q, R, and Smith Chart).
- No measured data to which we can compare to know which results are better. Also, minimal setup was performed…perhaps more work on the simulation setups would yield more comparable results for Q, too.

**“EMDS for ADS” Simulation Statistics**
- Memory consumed = 570 MB
- Total simulation time = 4 mins
  - Simulation time for adaptive meshing = 3 mins 5 secs
  - Simulation time for adaptive frequency sweep = 55 secs
  - Number of adaptive frequencies = 2

**MomentumRF Simulation Statistics**
- Memory consumed = 34 MB
- Total simulation time = 2 mins 11 secs
  - Simulation time for substrate calculation** = 1 min 43 secs
  - Simulation time for meshing/mesh reduction = 1 sec
  - Simulation time for adaptive frequency sweep = 27 secs
  - Number of adaptive frequencies = 8
Summary of Examples Demonstrated

MMIC Spiral Inductor – ADS Layout and 3D Preview

Special thanks to WIN Semiconductor for providing the original artwork and substrate stack-up. The spiral used is from the WIN PD5001 0.5um pHEMT PDK.
Summary of Examples Demonstrated

**MMIC Spiral Inductor – ADS Schematic to Compare Results**
Summary of Examples Demonstrated

**MMIC Spiral Inductor – Data Display to Compare Results**

**MMIC Spiral Inductor Comments**

- An inductor from WIN Semiconductor’s PDK (WIN PD5001 0.5um pHEMT PDK)
- Compare MomentumRF and “EMDS for ADS” results to PDK’s “target” inductance.

![Inductance Comparison Graph](image)

**“EMDS for ADS” Simulation Statistics**

- Memory consumed = 1.8 GB
- Total simulation time = 13 mins 48 secs
  - Simulation time for adaptive meshing = 8 mins 11 secs
  - Simulation time for adaptive frequency sweep = 5 mins 37 secs
  - Number of adaptive frequencies = 2

**MomentumRF Simulation Statistics**

- Memory consumed = 169 MB
- Total simulation time = 13 mins 49 secs
  - Simulation time for substrate calculation** = 2 mins 6 secs
  - Simulation time for meshing/mesh reduction = 5 secs
  - Simulation time for adaptive frequency sweep = 11 mins 38 secs
  - Number of adaptive frequencies = 4
Summary of Examples Demonstrated

RFIC Spiral Inductor – ADS Layout and 3D Preview
Summary of Examples Demonstrated

RFIC Spiral Inductor – ADS Schematic to Compare Results
Summary of Examples Demonstrated

RFIC Spiral Inductor – Data Display to Compare Results

RFIC Spiral Inductor Comments

• An old Momentum accuracy benchmark example.
• Compare MomentumRF and “EMDS for ADS” results to measured data (L, Q, R & S-parameters).

“EMDS for ADS” Simulation Statistics
• Memory consumed = 2.02 GB
• Total simulation time = 33 mins 41 secs
  • Simulation time for adaptive meshing = 24 mins 21 secs
  • Simulation time for adaptive frequency sweep = 9 mins 20 secs
  • Number of adaptive frequencies = 2

MomentumRF Simulation Statistics
• Memory consumed = 250 MB
• Total simulation time = 9 mins 10 secs
  • Simulation time for substrate calculation = 24 secs
  • Simulation time for meshing/mesh reduction = 1 sec
  • Simulation time for adaptive frequency sweep = 8 mins 45 secs
  • Number of adaptive frequencies = 11
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