Welcome

Innovations in EDA Webcast Series

August 2, 2012

Jack Sifri
MMIC Design Flow Specialist

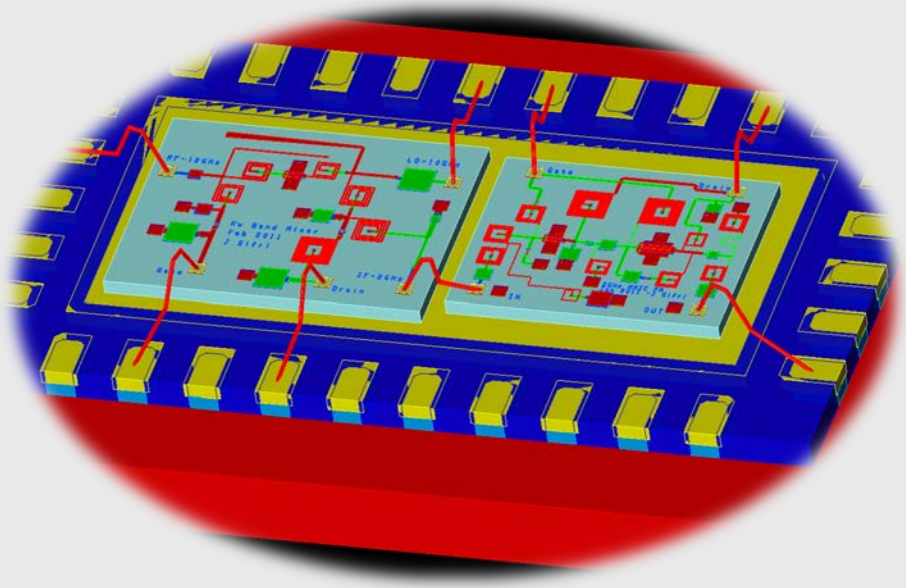
KEYSIGHT TECHNOLOGIES

IC, Laminate, Package Multi-Technology PA Module Design Methodology

Realizing the Multi-Technology Vision within a fully integrated design flow in ADS

Jack Sifri
MMIC Design Flow Specialist

August 2nd, 2012



KEYSIGHT TECHNOLOGIES

Copyright © Keysight Technologies 2014

IC, Laminate, Package Multi Technology PA Module Design

Agenda

1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Typical Example:

Complex ICs in multi-chip RF modules:

The New iPad

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Typical Example:

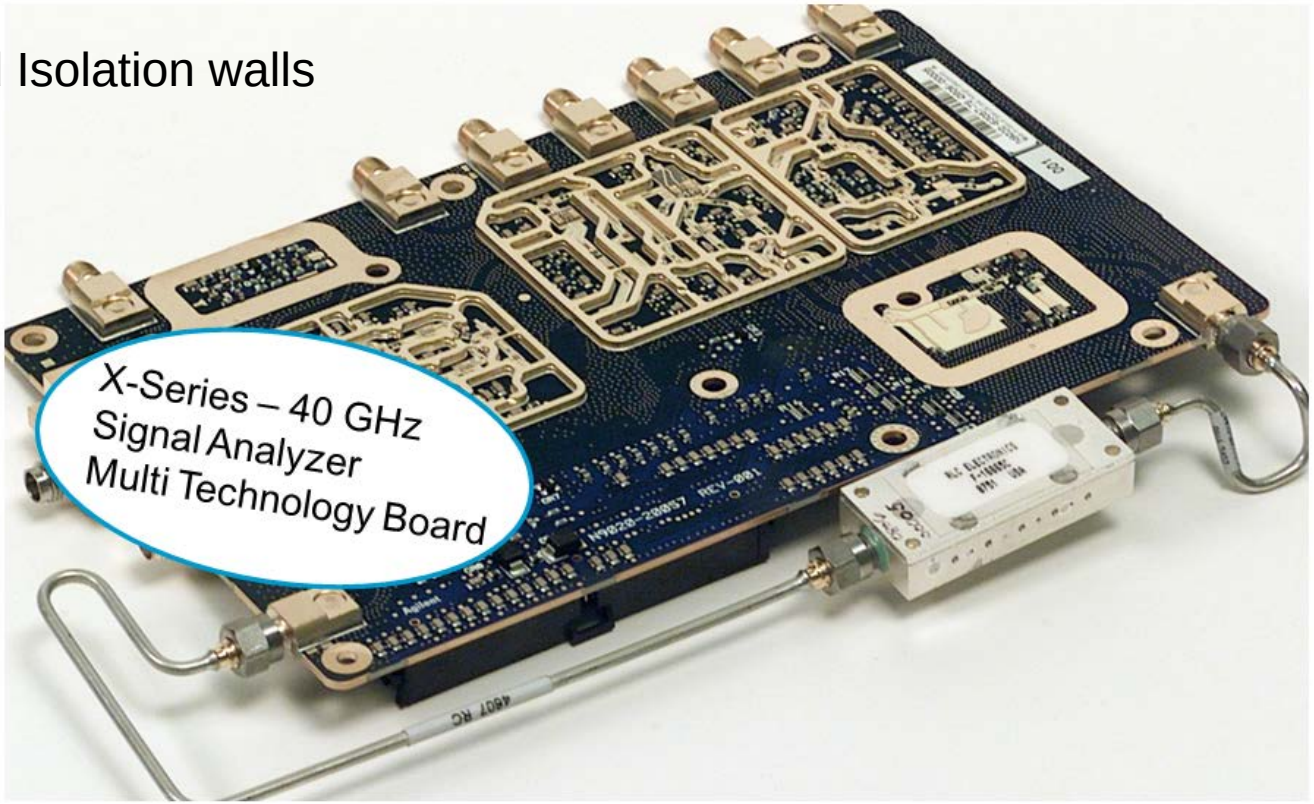
Agilent’s X-Series 40 GHz Signal Analyzer Multi Technology Board

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Multi Technology Example (Agilent EMG)

- Stripline Filter on PC Board
- Designs with SMT packages and bare die components (wire bonded)
- Integrated Circuits Designs and Thin Film Circuit Designs
- Shielding and Isolation walls

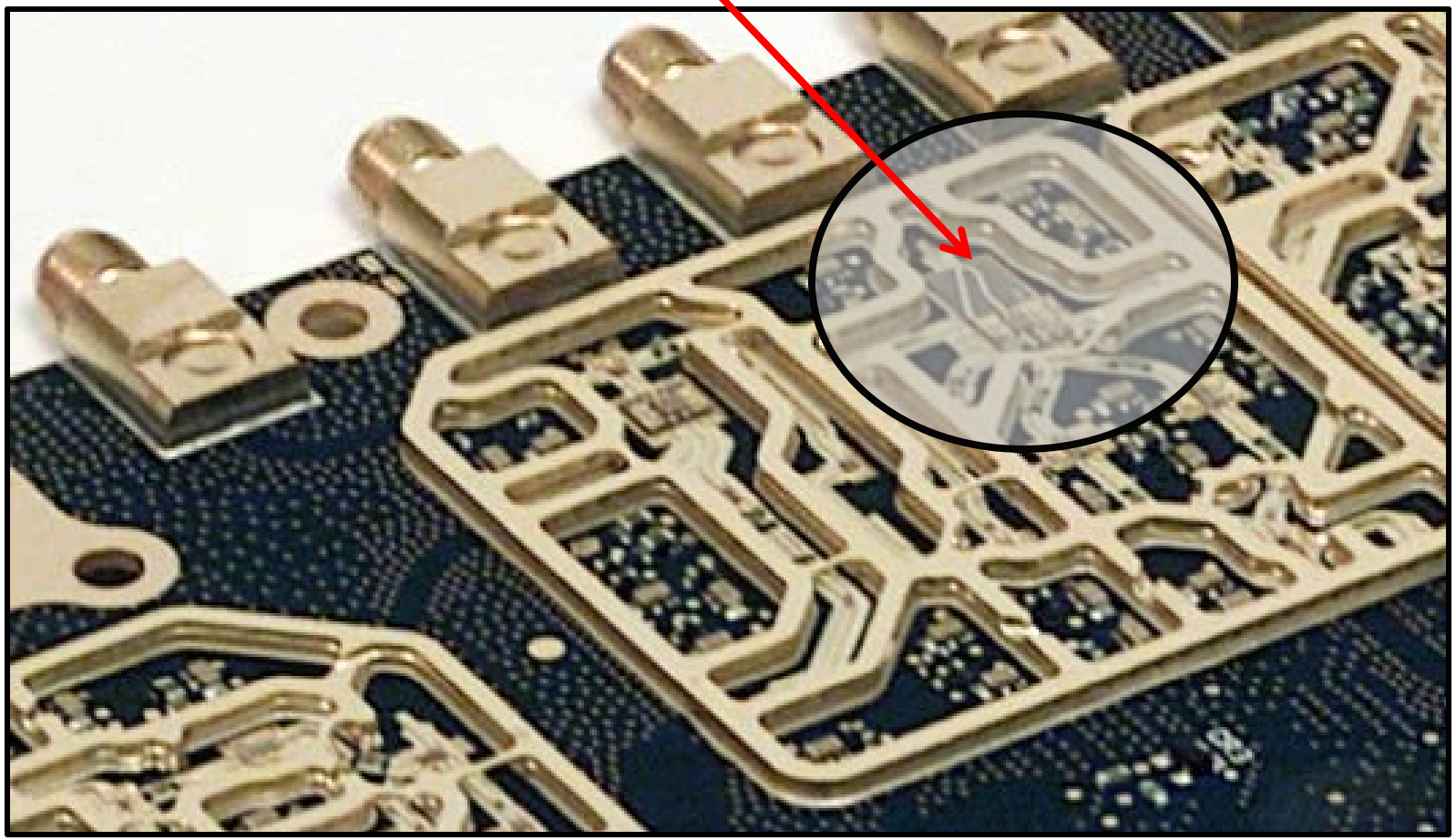


KEYSIGHT TECHNOLOGIES

Copyright © 2014
Keysight
Technologies

Zooming on the Thin Film IC Interface

Wide Band LO Distributing Amp



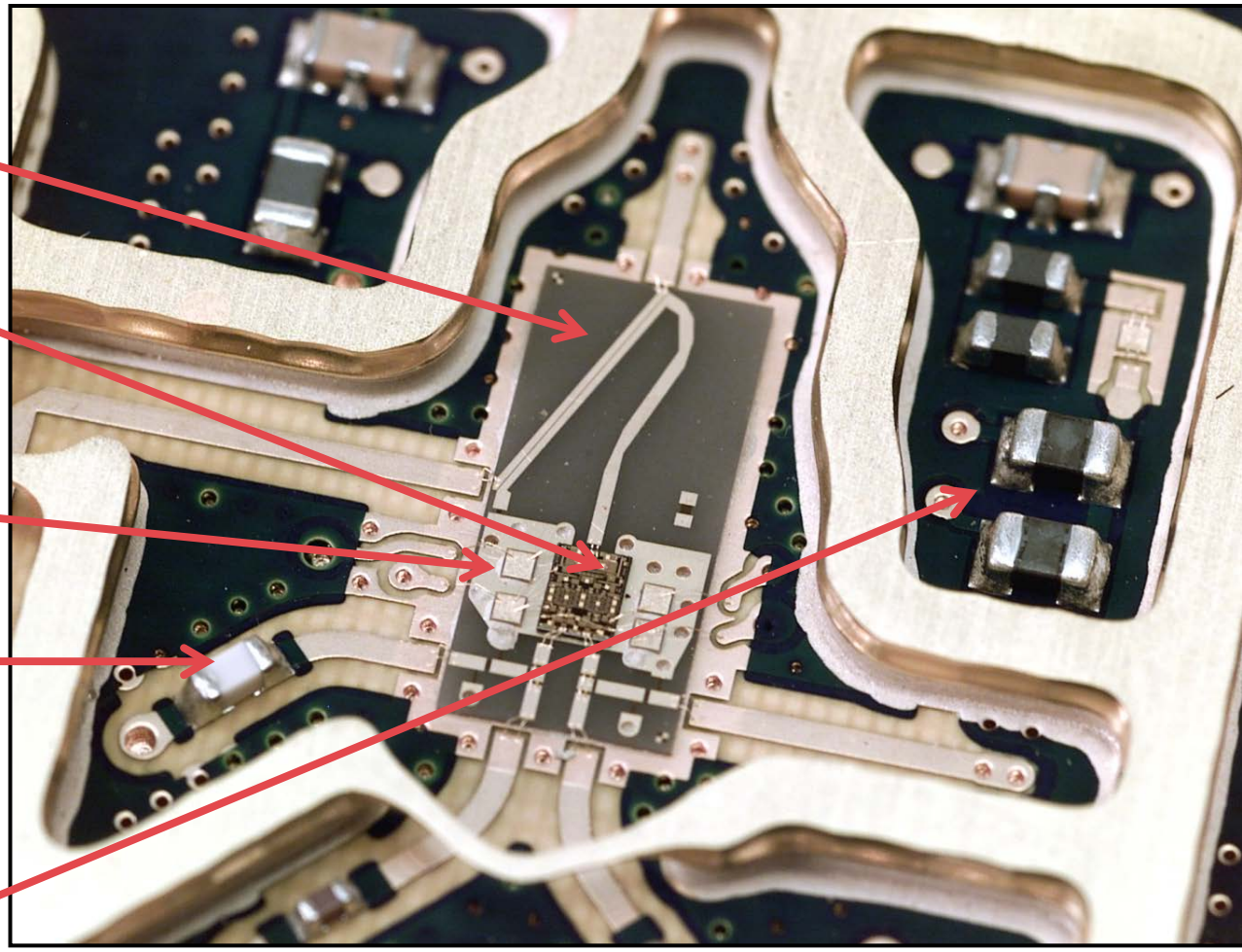
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Thin Film Coupler / LO Distributing Amp Interface

- 6 Layers Rogers Board
- Octave wideband coupler
- GaAs LO distributing amp
- Bond wired and epoxy SMT Caps (DC)
- Blocking Capacitor - to Edge connector
  - available LO for testing mixers

Filtering DC Lines



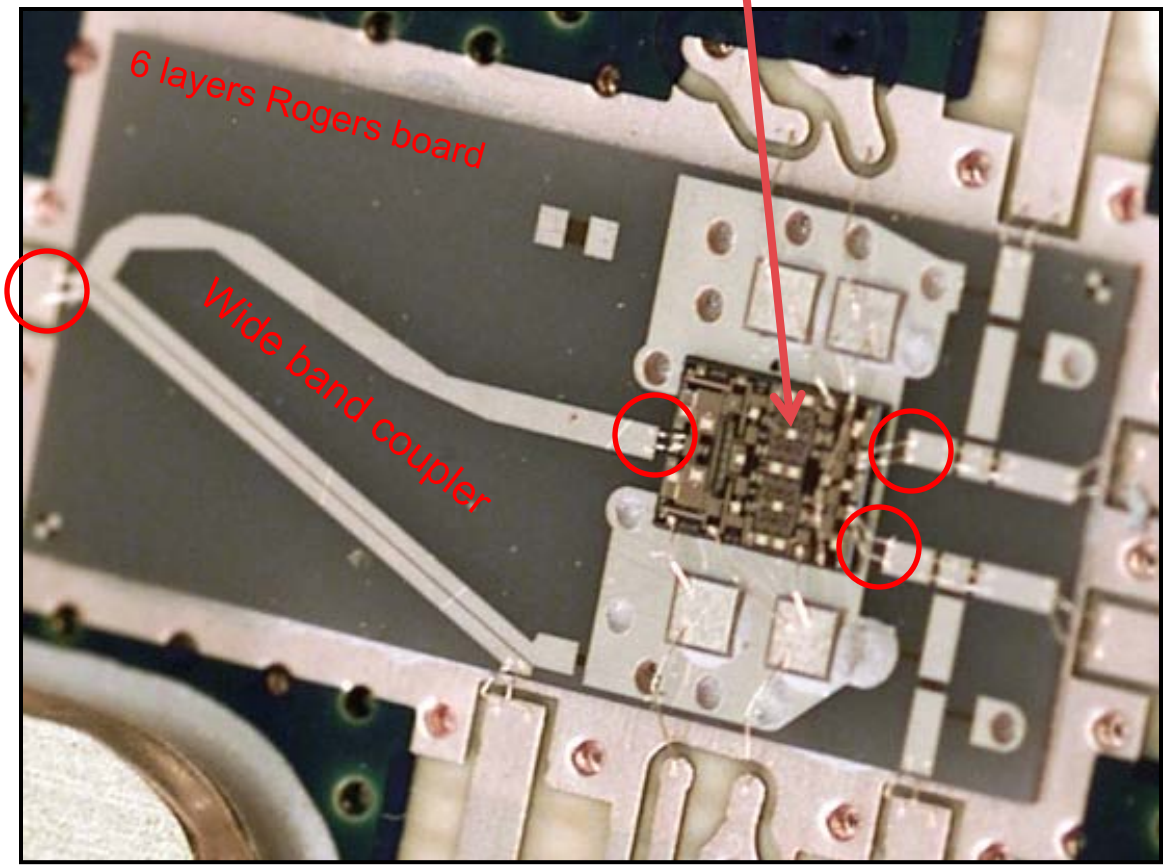
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Board / Laminate / IC/ SMT / Bondwires

A multi-technology module example requires Full 3D FEM Simulation

Wide band LO distributing amp swept for use at different bands



Bond wires / coupler / IC interface caused unleveled ripple in the wide band output signal

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Agenda

1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

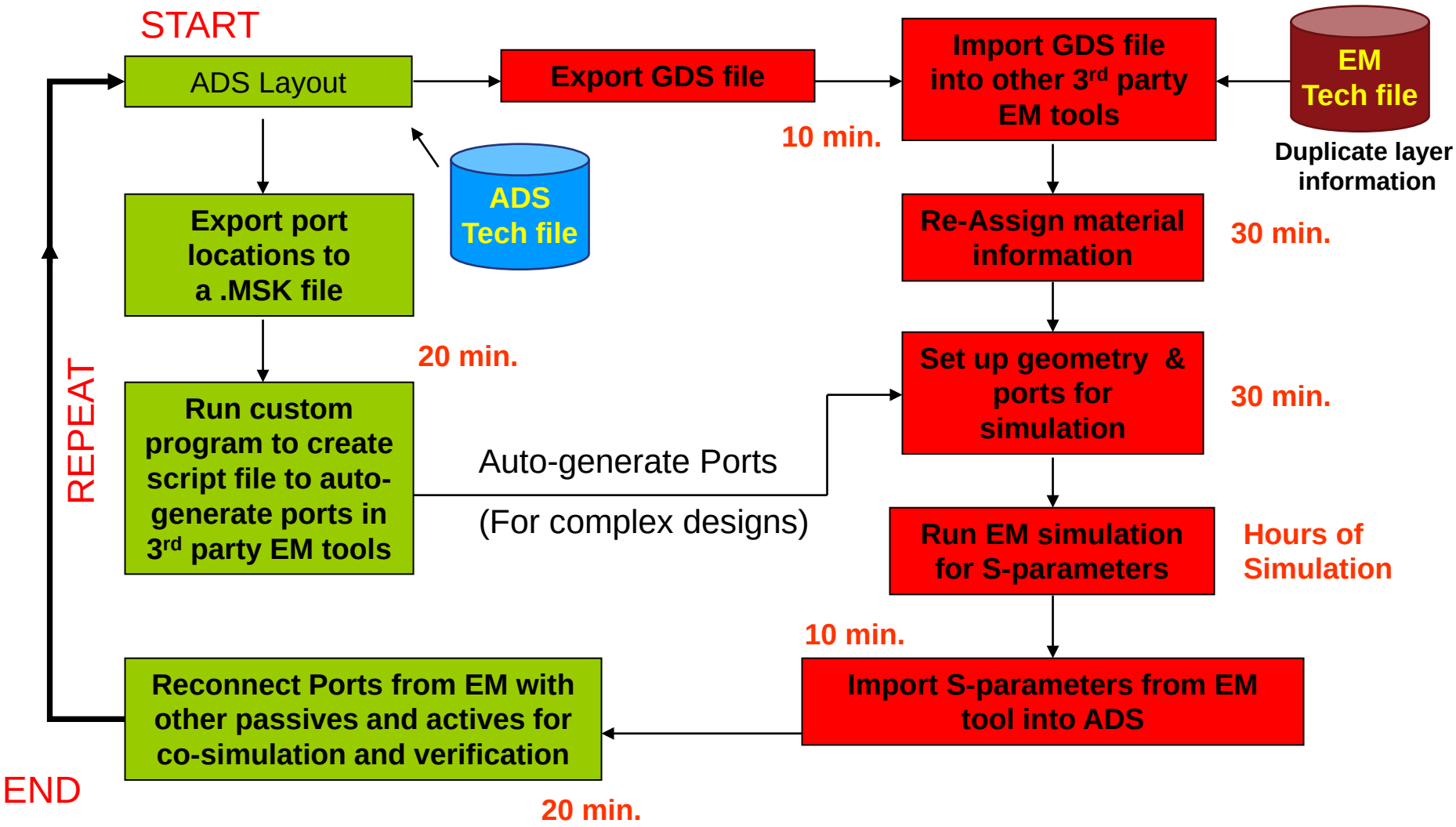
IC, Laminate, Package Multi Technology Module Design Challenges

Design flows are not able to address multiple technology designs

- IC, laminate, package, and PCB need to be designed together
- EM interactions between substrates need to be modeled and accounted for
- The need to move from disjointed tools design flows to simplified integrated flows

Copyright © 2014 Keysight Technologies

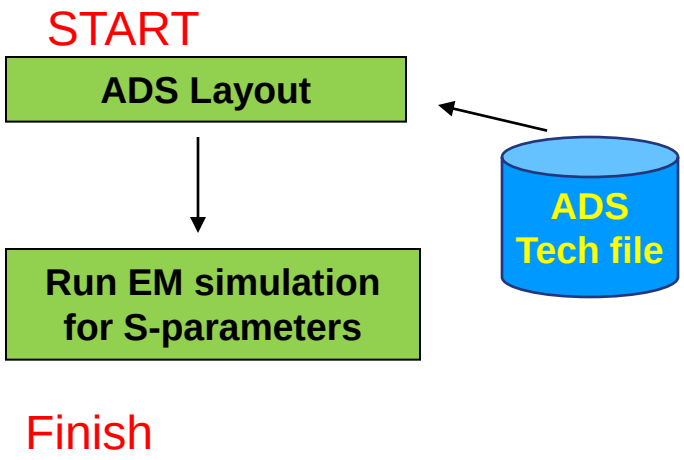
EM Modeling Process in a Disjointed Design Flow



KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

EM Modeling Process in an Integrated Design Flow



Copyright © 2014
Keysight
Technologies

IC, Laminate, Package Multi Technology PA Module Design

Agenda

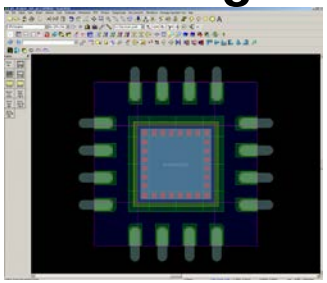
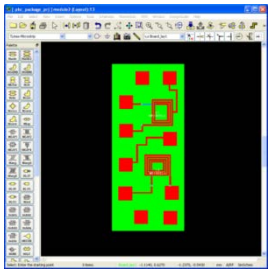
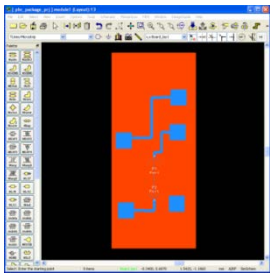
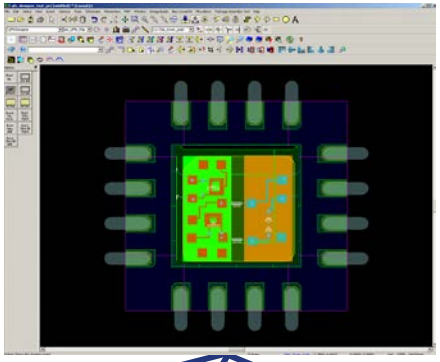
1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

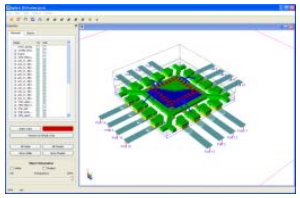
Multi-Technology Design Methodology

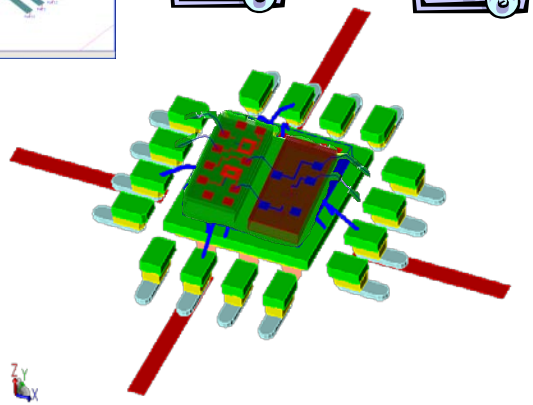
Package + **IC** + **IC** = **Multi-technology EM Simulation**

- Discover coupling efforts prior to fabrication
- More effectively optimize design elements for final packaging
- More easily make design trade-offs
- Help diagnose and solve performance problems

3D view Momentum FEM



KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Fully Integrated Design Flow in ADS 2011 and 2012

System; Circuit; Physical; Thermal; Planar/3D EM; Wireless Verification

ADS Multi Technology Integrated Design Environment

System Specs

X-parameters

- Schematic
- Statistical
- Wireless Verification

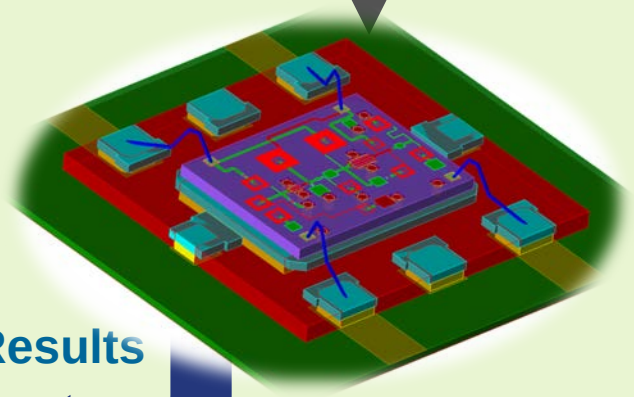
Layout Integrated 3D-Planar & FEM Tools

LVS / DRC

Final Verification

- Package/ Bond Wires/ Module
- Integrated 3D Planar & FEM
- Wireless Standards
- Electro Thermal

Models and PDKs
Electro Thermal Simulation



- Discover coupling effects prior to fabrication
- First Pass Success
- Consistent results / high yield
- Lower development & production costs
- Time to Market
- Lower Risk

Results

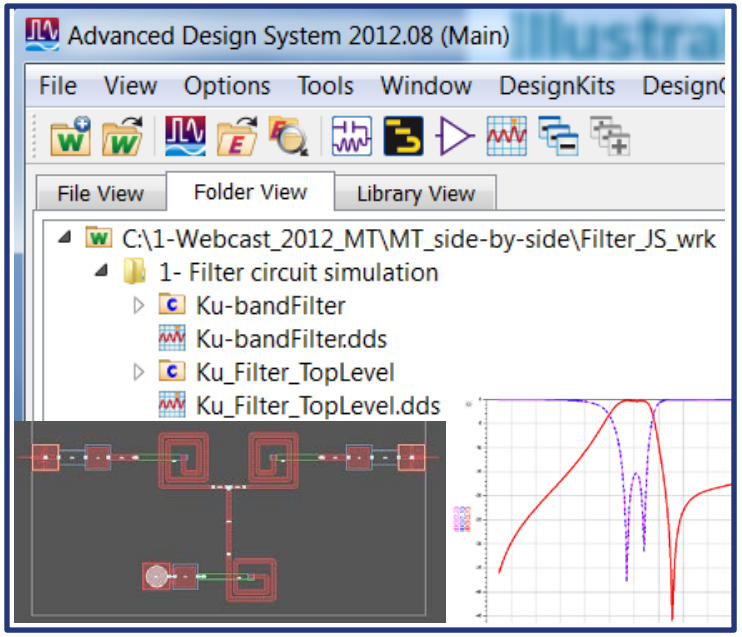
No Walls and no loops in this design process; Fully Integrated Flow;

One designer completes and verifies the full design all in one design environment

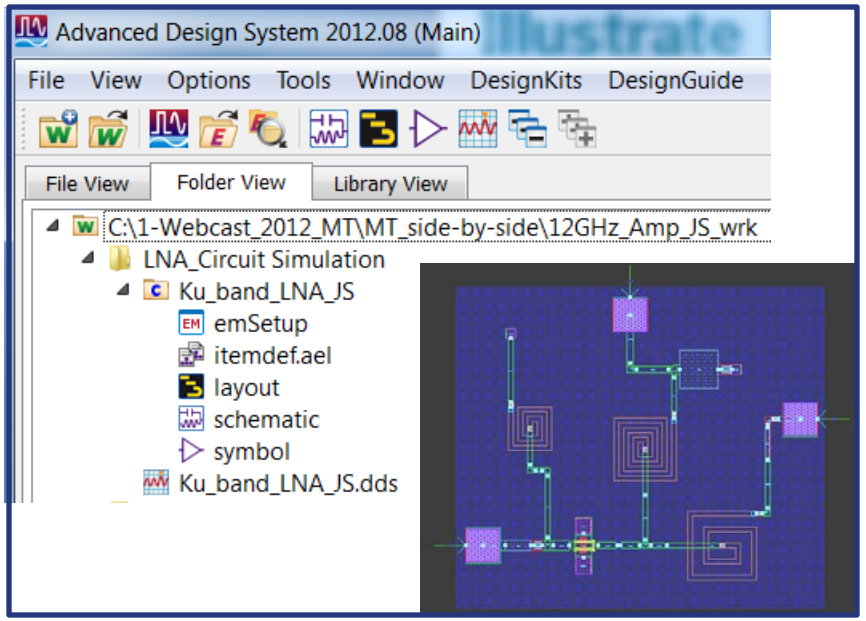
Copyright © 2014 Keysight Technologies

Multi-Technology Design Methodology

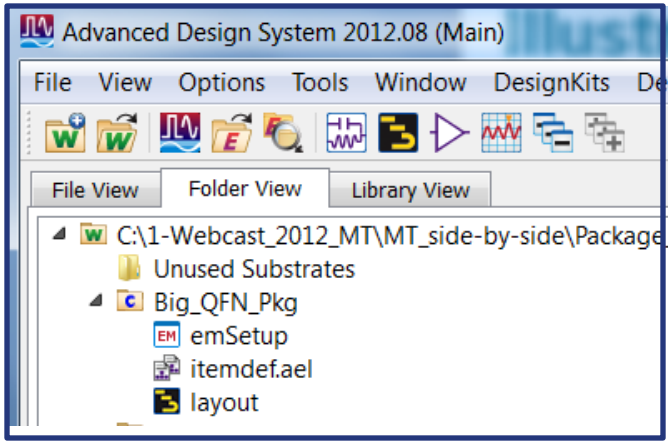
Design IC #1 (IPD – Filter)

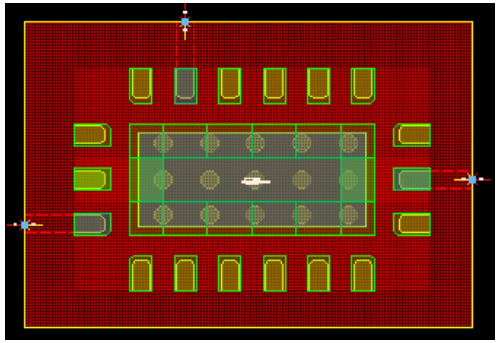


Design IC #2 (LNA)



Design Package/Laminate



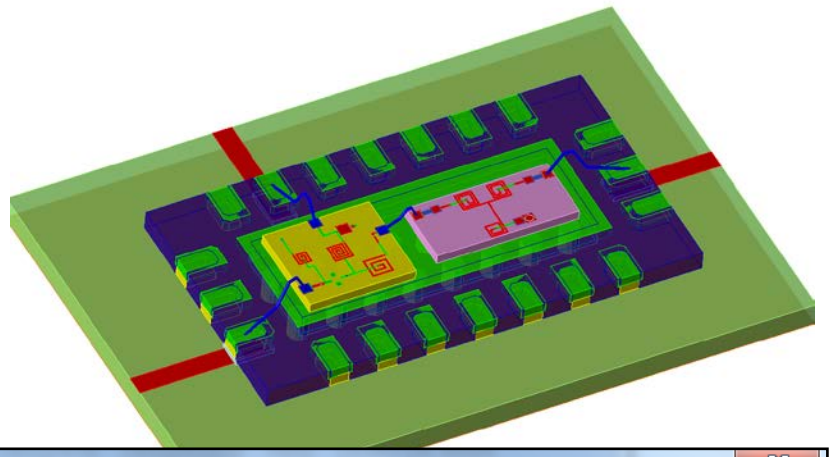


KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Multi-Technology Design Methodology

Bring in all the libraries together
and build the whole assembly



Advanced Design System 2012.08 (Main)

File View Options Tools Window DesignKits DesignGuide H

File View | Folder View | Library View

C:\1-Webcast_2012_MT\MT_side-by-side\MT_Assembly_JS_wrk
- 1- Assembly
  - Module Assembly
    - Module_Assembly
      - emModel
      - emSetup
      - itemdef.ael
      - layout
      - schematic
      - symbol
    - Module_Assembly.dds
    - Module_Assembly_FEM.dds
    - Module_Assembly_FEM_c.dds
  - 2- Package
  - 3- Amp
  - 4- Filter

Manage Libraries

Libraries and library definition files used by this workspace.

Name	Path
lib.defs	C:\1-Webcast_2012_MT\MT_side-by-side\MT_Assembly_JS_wrk\lib.defs
analog_rf.defs	$HPEESOF_DIR\oalibs\analog_rf.defs
dsp.defs	$HPEESOF_DIR\oalibs\dsp.defs
lib.defs	$HPEESOF_DIR\examples\DesignKit\DemoKit_Non_Linear\DemoKit_Non_Linear_v2.0\lib.defs
LNA_Filter_MT_lib	LNA_Filter_MT_lib
lib.defs	$HPEESOF_DIR\examples\DesignKit\DemoKit_V3\lib.defs
lib.defs	..\Package_JS\lib.defs
lib.defs	..\Filter_JS_wrk\lib.defs
lib.defs	..\12GHz_Amp_JS_wrk\lib.defs

Add Library Definition File... | Add Design Kit from Favorites... | Add Library... | Configure Library... | Remove

Close | Help

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Agenda

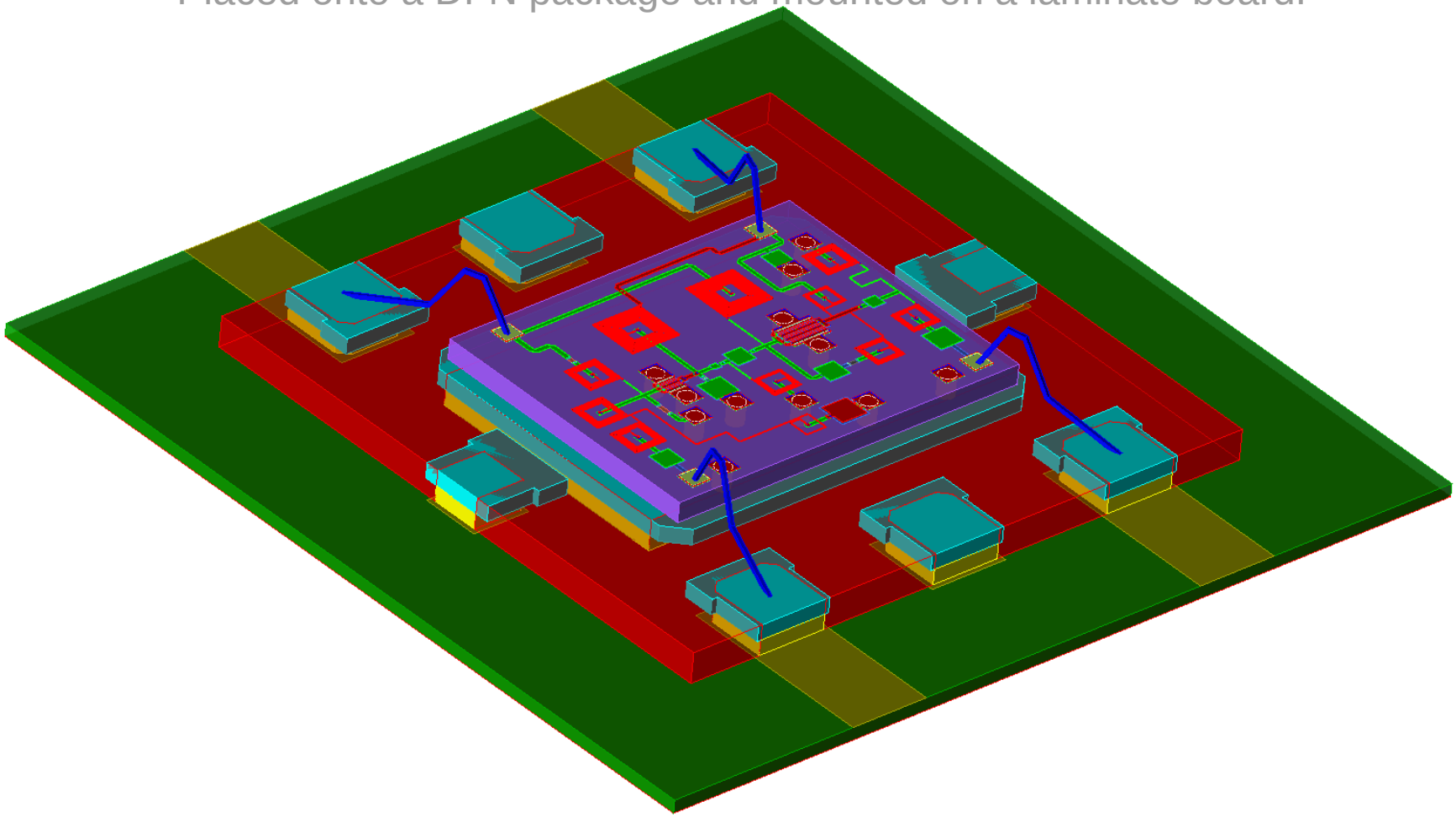
1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Example: Packaged LTE PA on Laminate

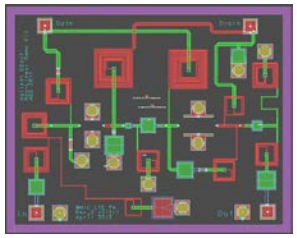
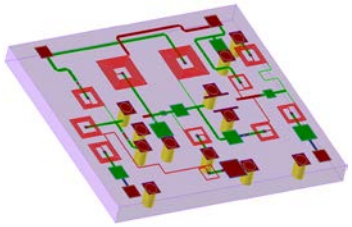
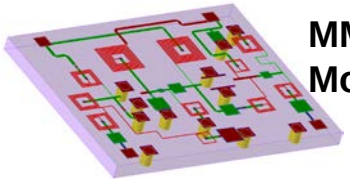
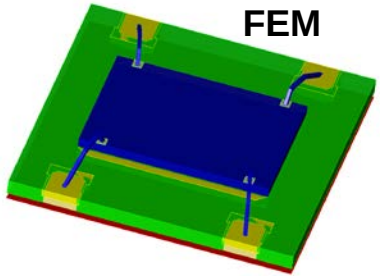
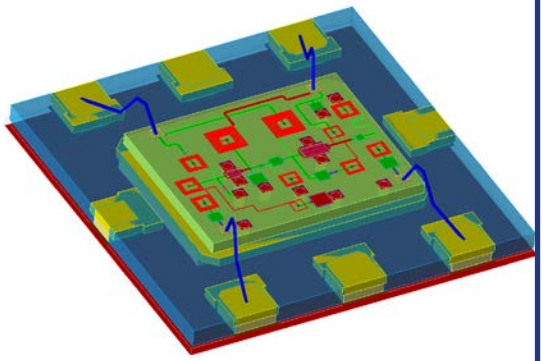
- Two Stage LTE PA built on a GaAs substrate
  - Placed onto a DFN package and mounted on a laminate board.



KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Packaged MMIC PA Design Example

Case 1	Case 2	Case 3	Case 4
 Circuit	 Momentum	 MMIC Momentum +  Package FEM	Whole assembly FEM 

Case 1: MMIC PA - Circuit models Simulation

Case 2: MMIC PA – Momentum Simulation

Case 3: Combine MMIC Momentum & FEM of Package

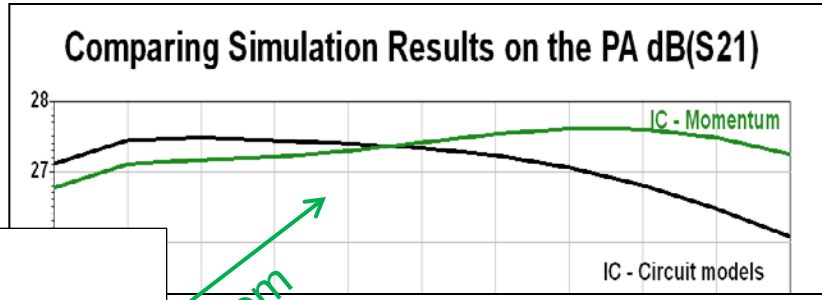
Case 4: FEM on the Whole Module

KEYSIGHT TECHNOLOGIES

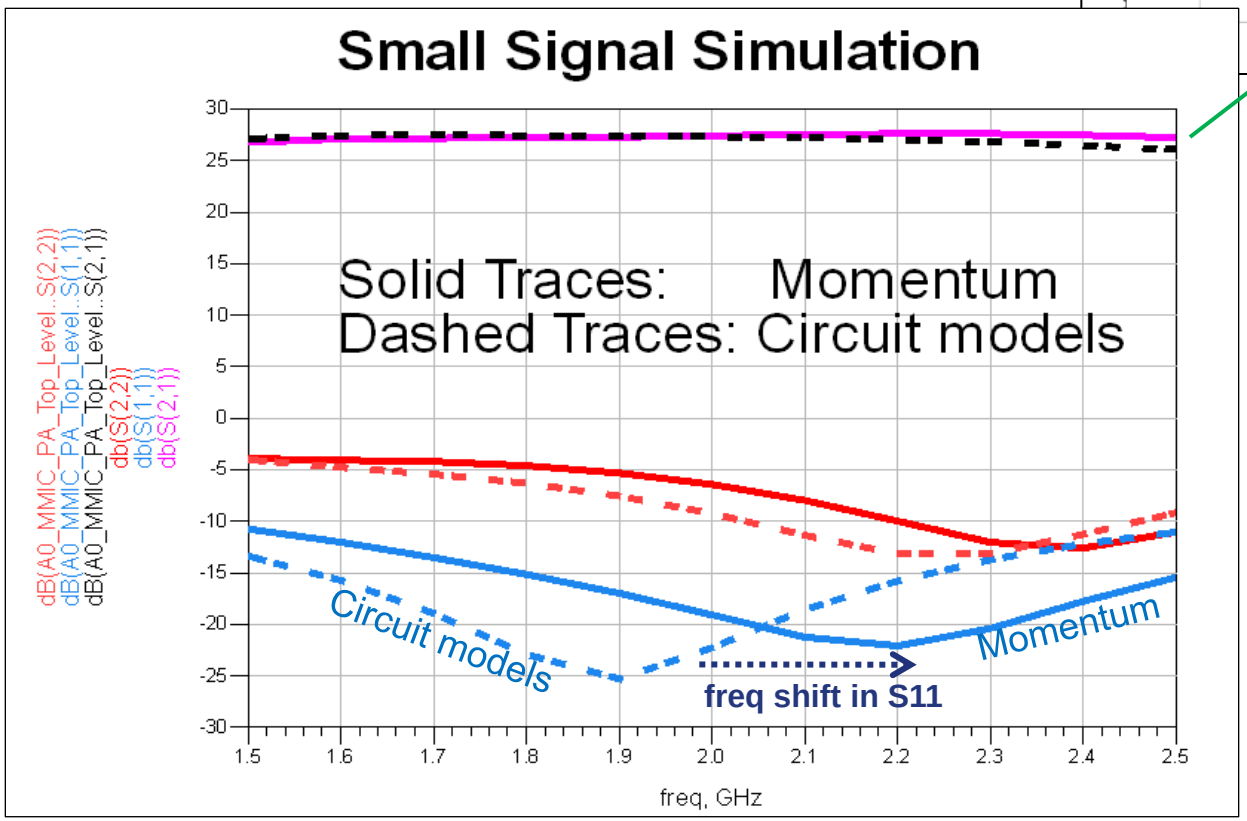
Copyright © 2014 Keysight Technologies

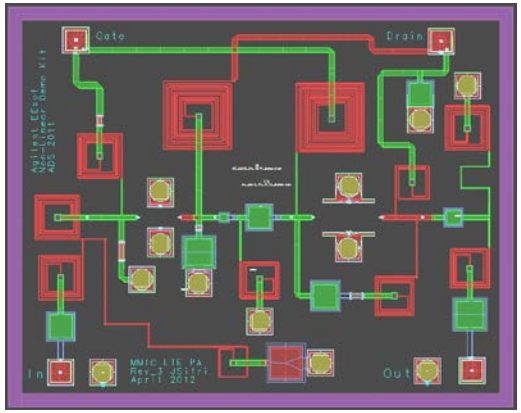
Packaged MMIC PA Design Example

Cases 1 & 2 on MMIC chip



Zoom





Input Matching Network is shown to exhibit coupling effects (freq shift)

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Packaged MMIC PA - Results

Four different simulation results (case 1-4)

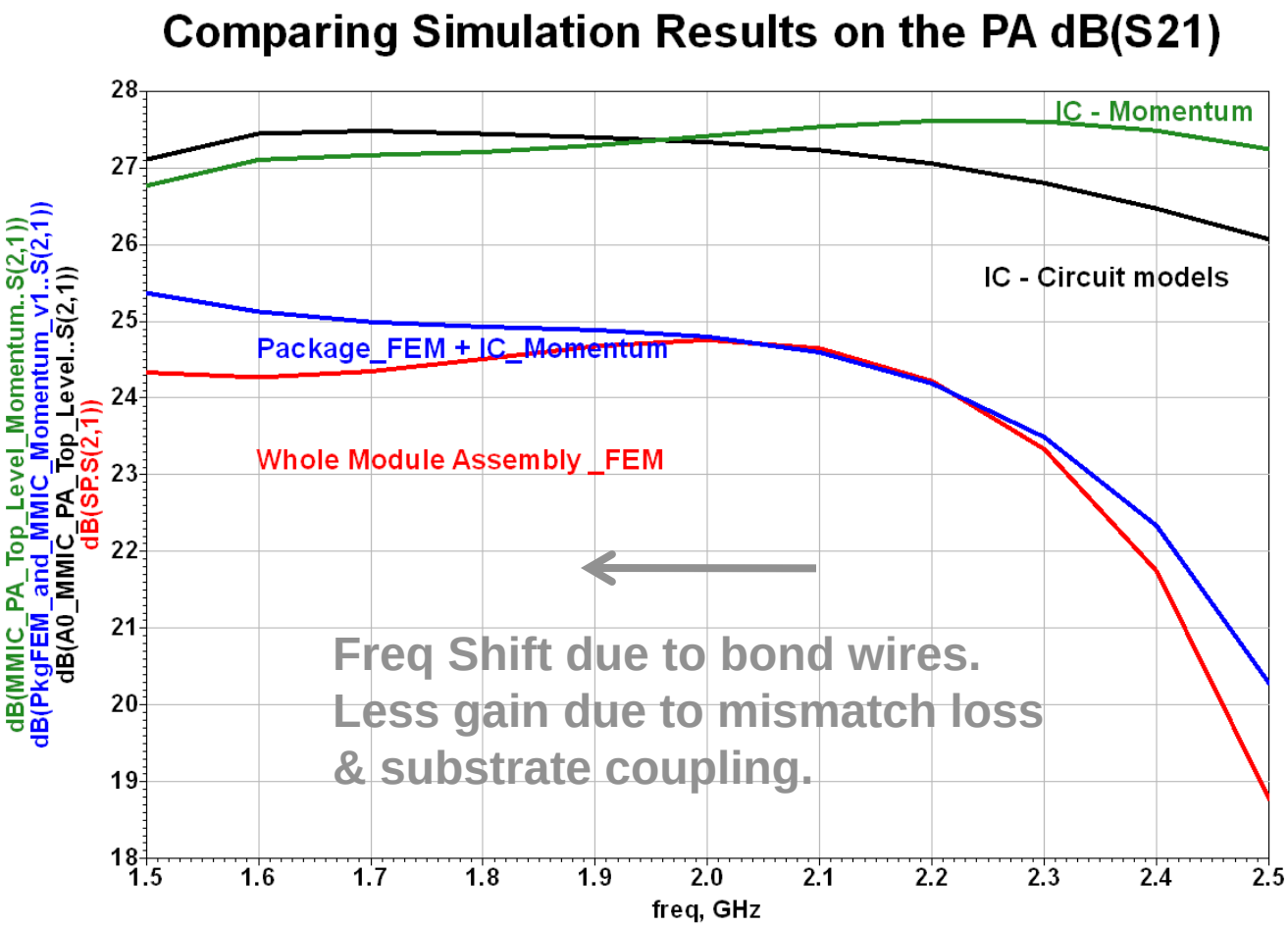
MMIC

Black: Circuit Model
Green: Momentum

MMIC + Package

Blue
IC_Mom + Pkg_FEM

Red
Whole Module_FEM

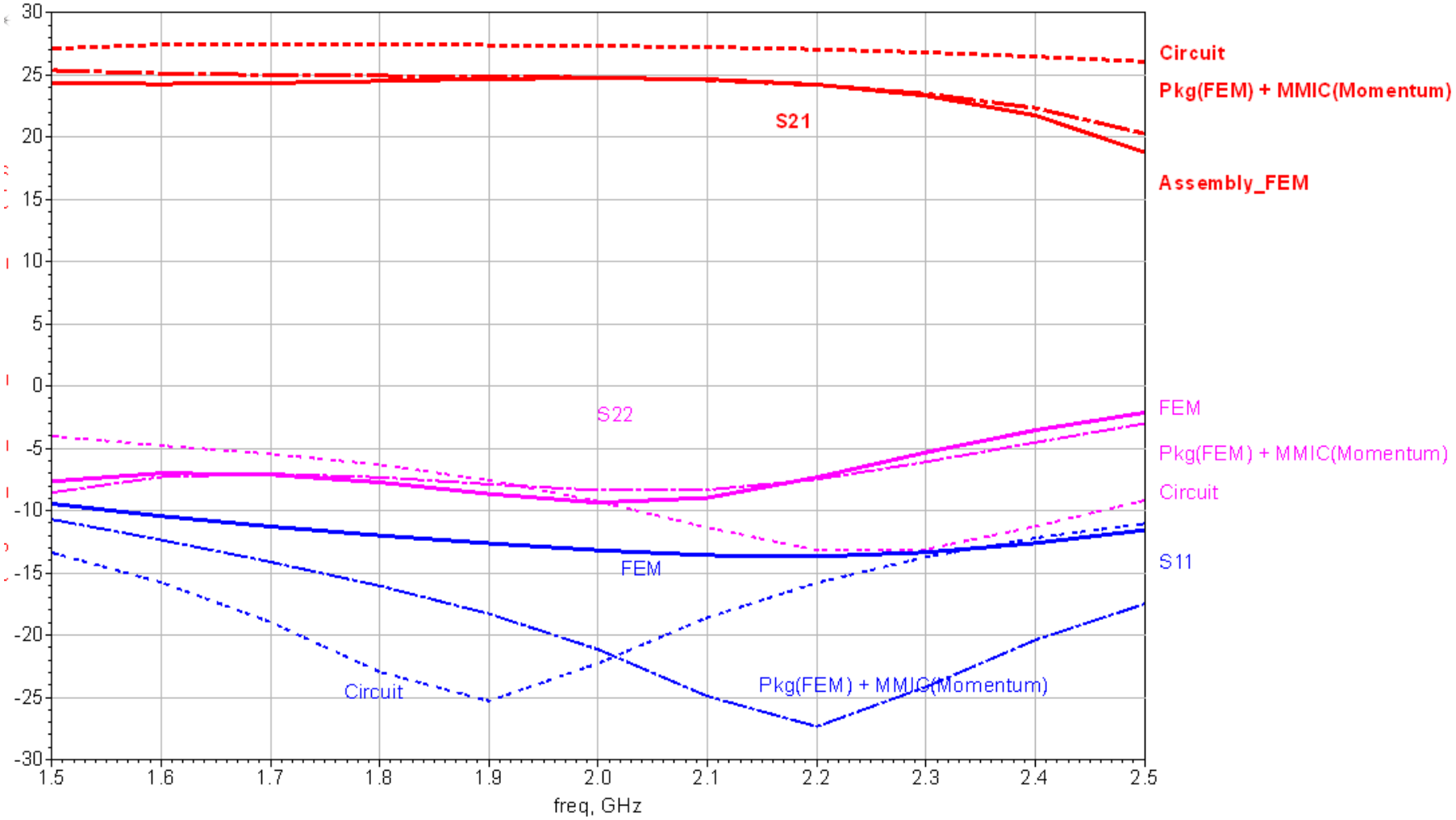


Cases: 1-4

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

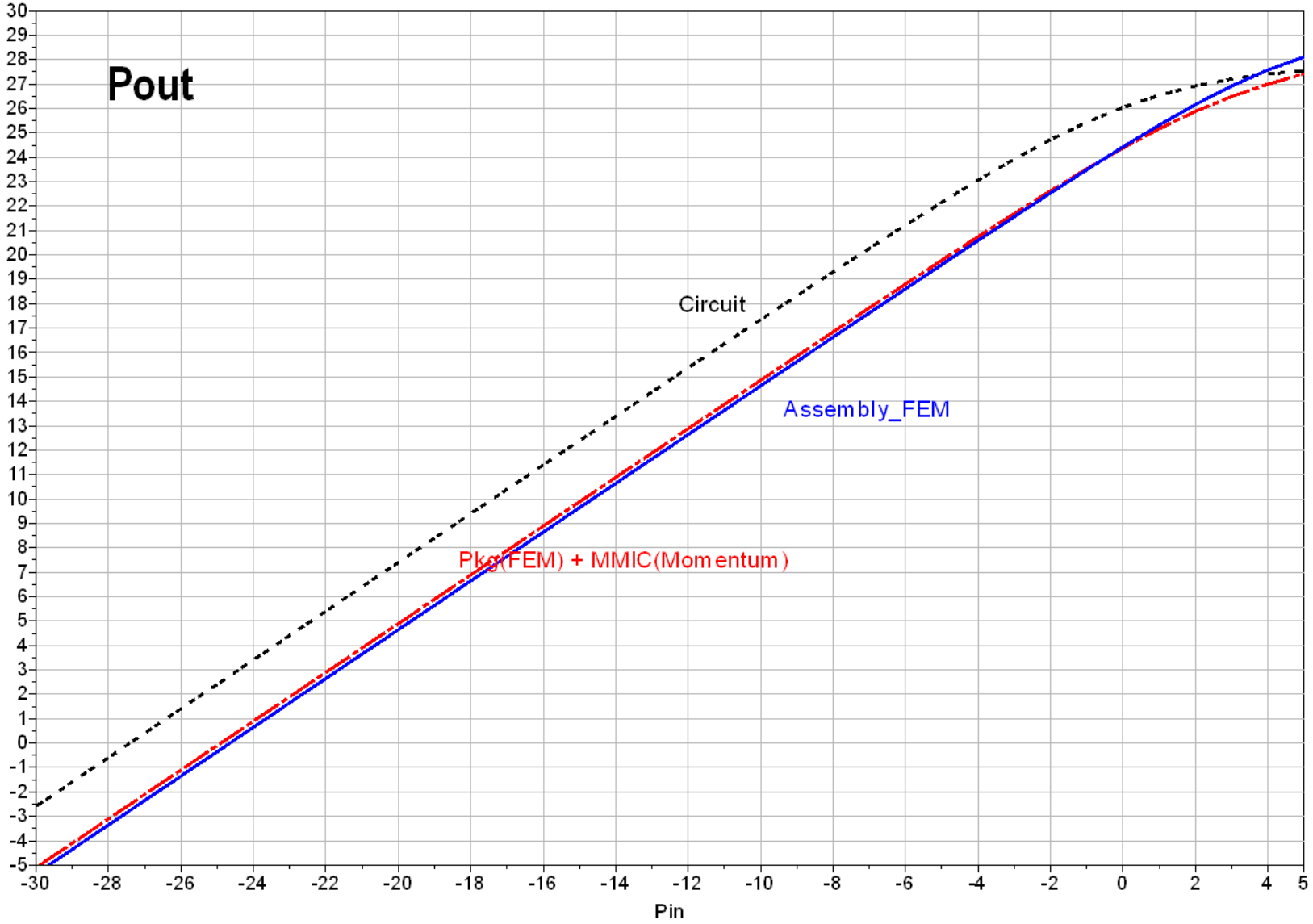
Compare Module FEM Results with (Pkg_FEM + MMIC_Momentum) and with Circuit simulation results



KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Packaged MMIC PA Design Example Results

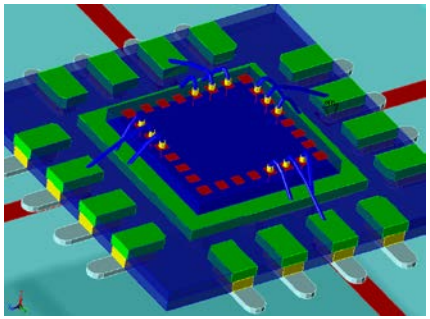


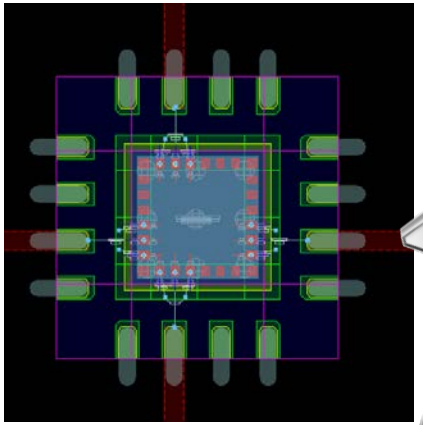
KEYSIGHT TECHNOLOGIES

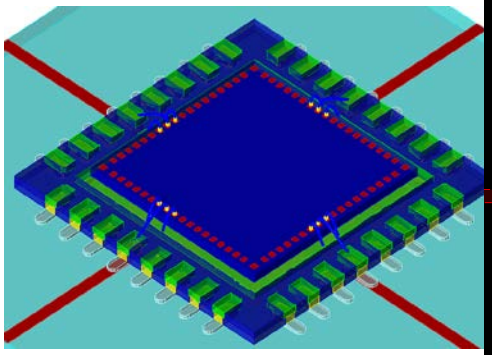
Copyright © 2014 Keysight Technologies

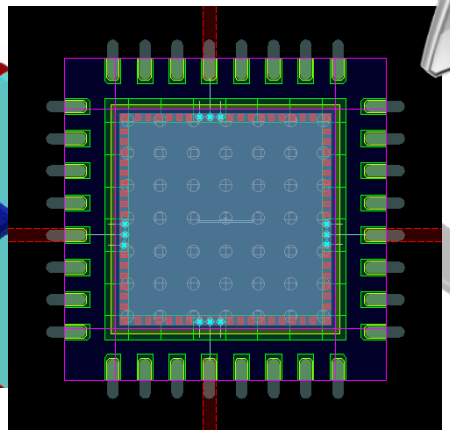
QFN Designer in ADS

Predict Packaged Performance in Minutes

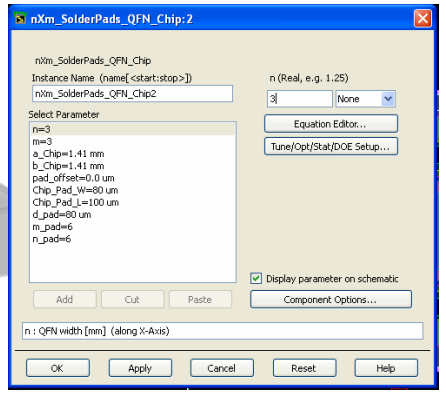




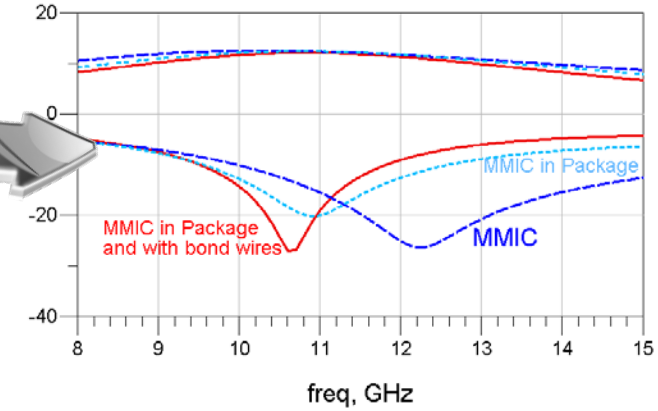




Configure QFN package



Accurately predict real performance



Performance w/ & w/o package

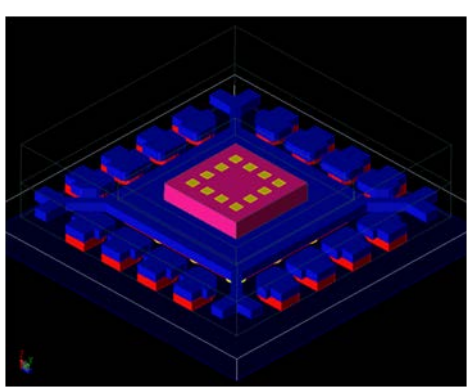
Quickly synthesize complex package, combine with IC & PCB data

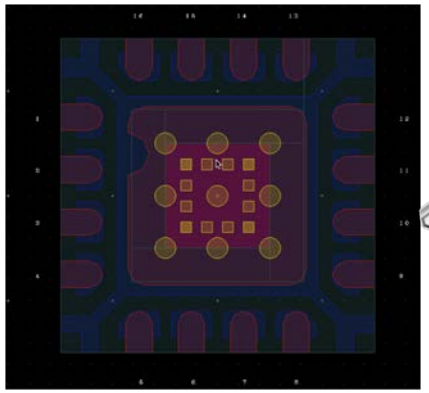
KEYSIGHT TECHNOLOGIES

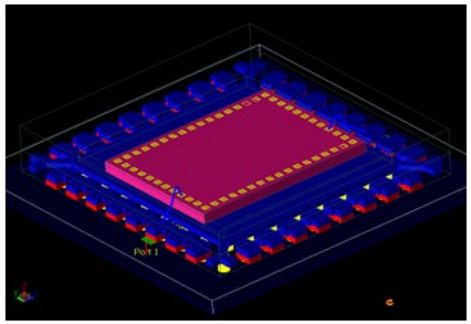
Copyright © 2014 Keysight Technologies

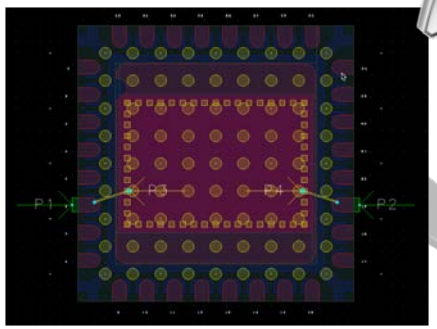
Amkor Package Design Kit for ADS

Predict Packaged Performance in Minutes

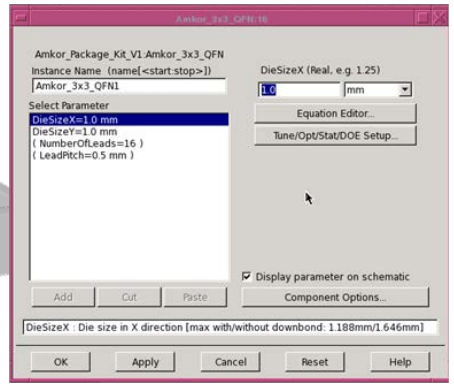




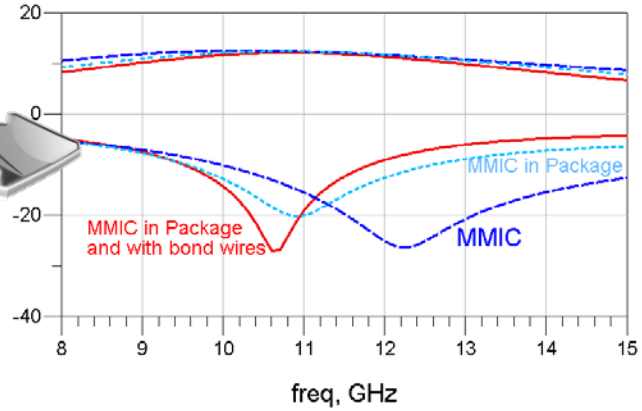




Configure QFN package



Accurately predict real performance



Performance w/ & w/o package

Quickly synthesize complex package, combine with IC & PCB data

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Agenda

1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

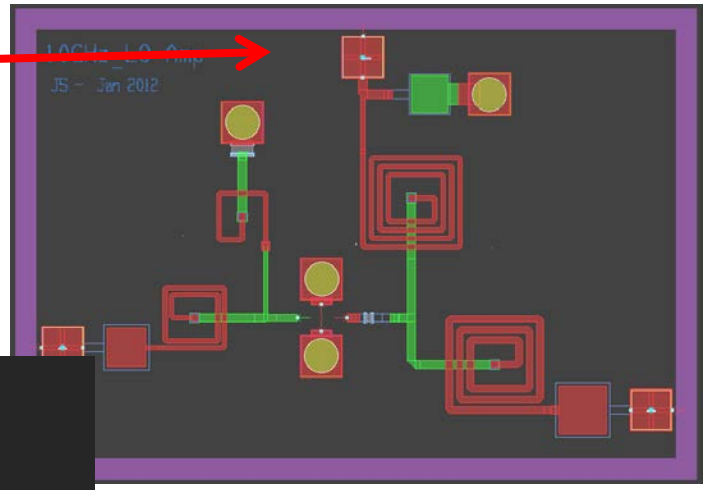
Bounding the IC within the Package/ Laminate Assembly

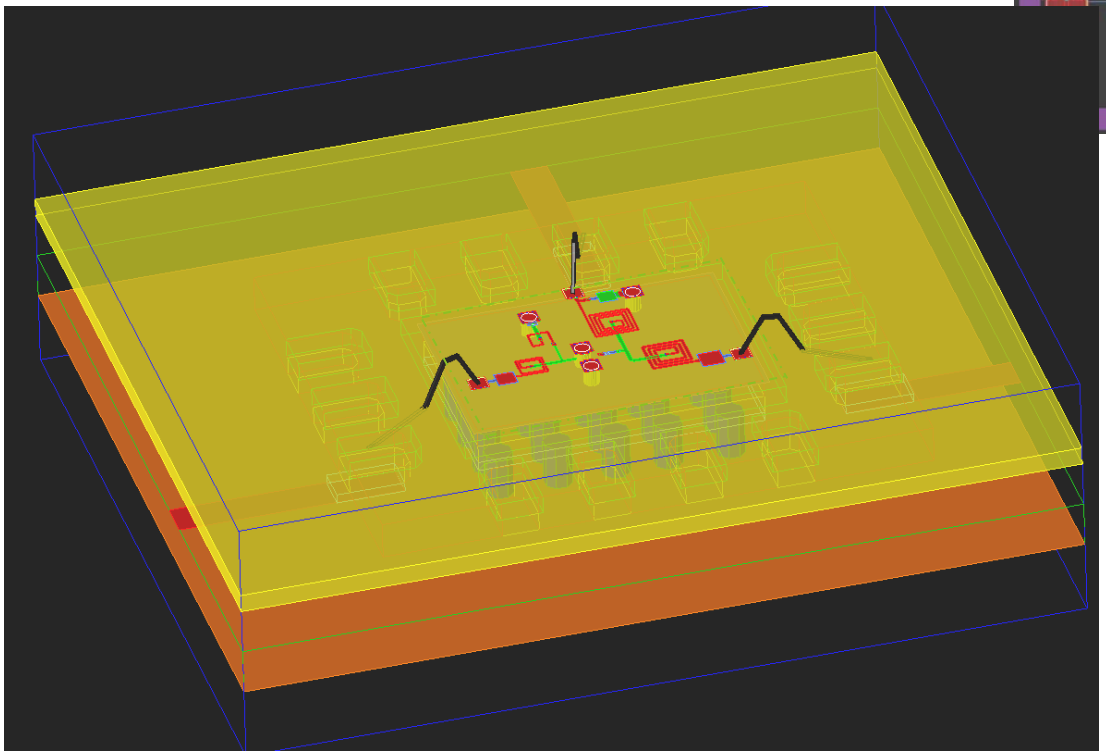
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

A Word on Bounding the IC using “Boundary Area Layer”

– Layout has no Bounding Area
– 3D view shows the MMIC substrate extending out through the bond wires
(Results in inaccurate FEM simulation results)

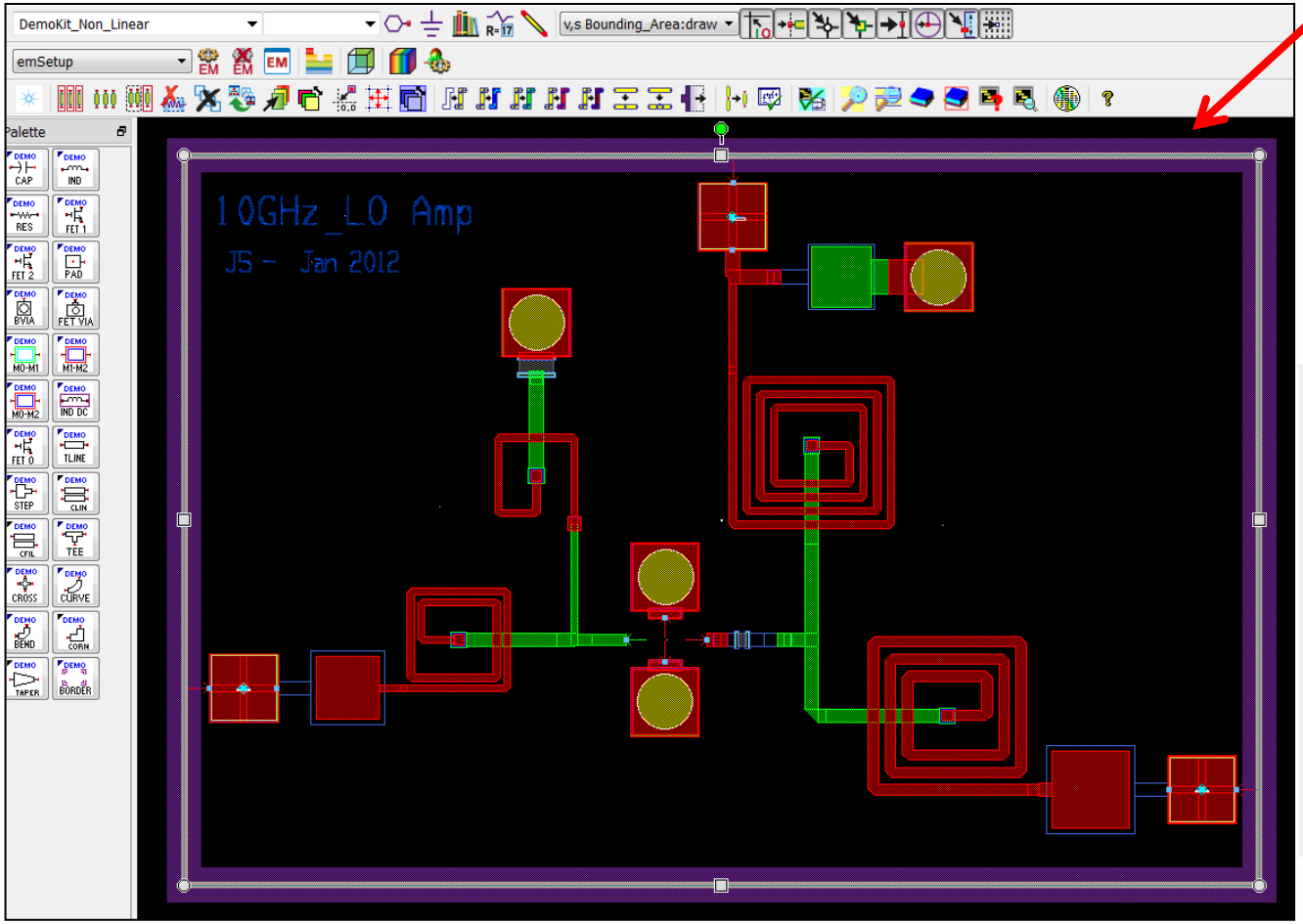


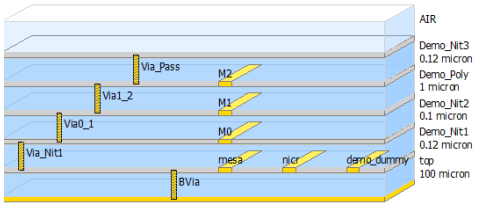


Copyright © 2014 Keysight Technologies

Multi Technology Module Setup with Bounding the IC

- Bounding Area layer box has been added in the Layout as shown.
- 3D view (next page) shows the bounding of the MMIC for FEM simulation





Entire Substrate

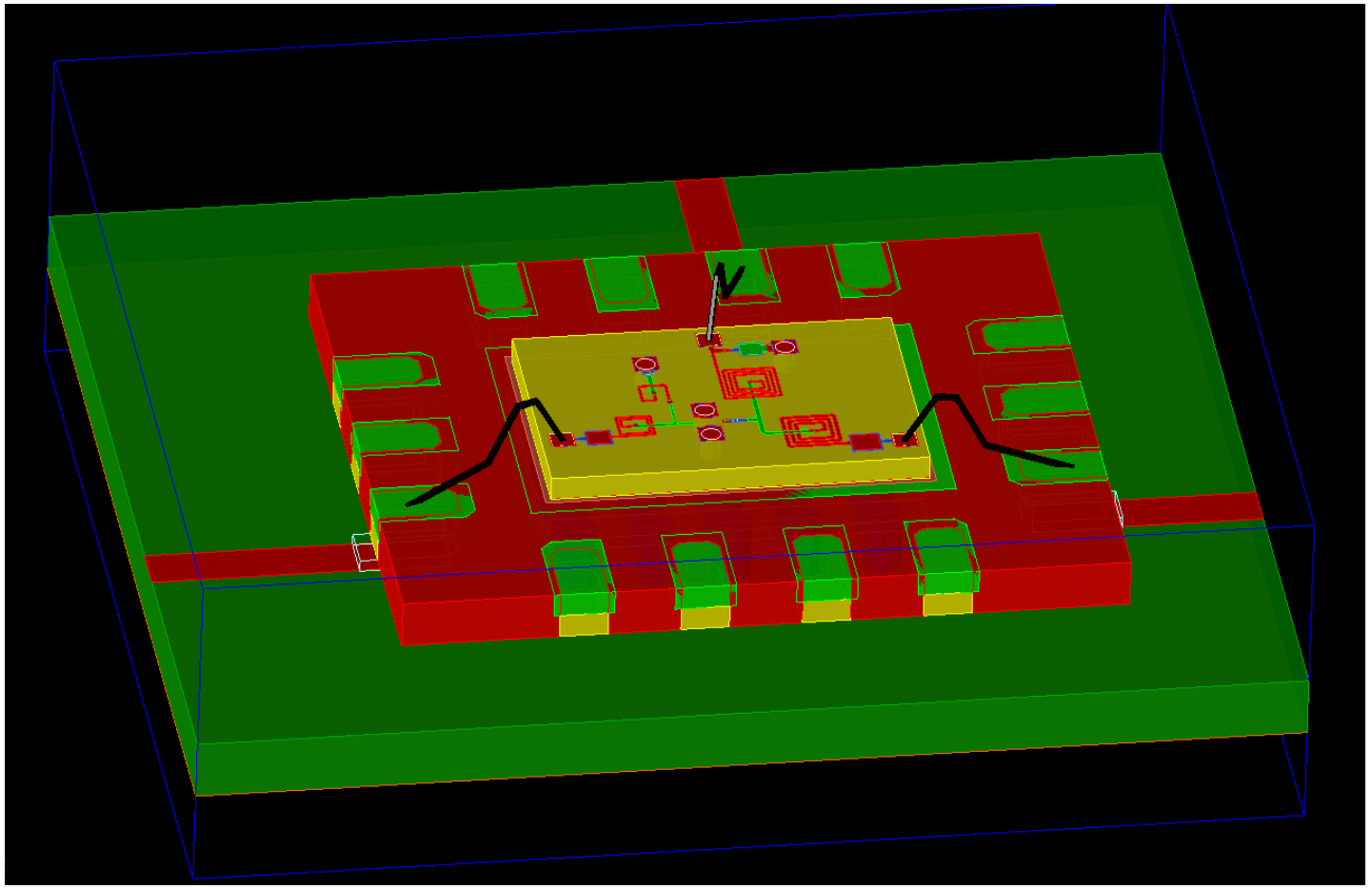
Bounding area layer: Bounding_Area (39)

Select a substrate item to see more information about that item.

Copyright © 2014 Keysight Technologies

Multi Technology Module Setup with Bounded IC

- 3D view shows how the use of “Bounding Area Layer” (last page) has resulted in bounding IC substrate (cookie cut) for FEM simulation



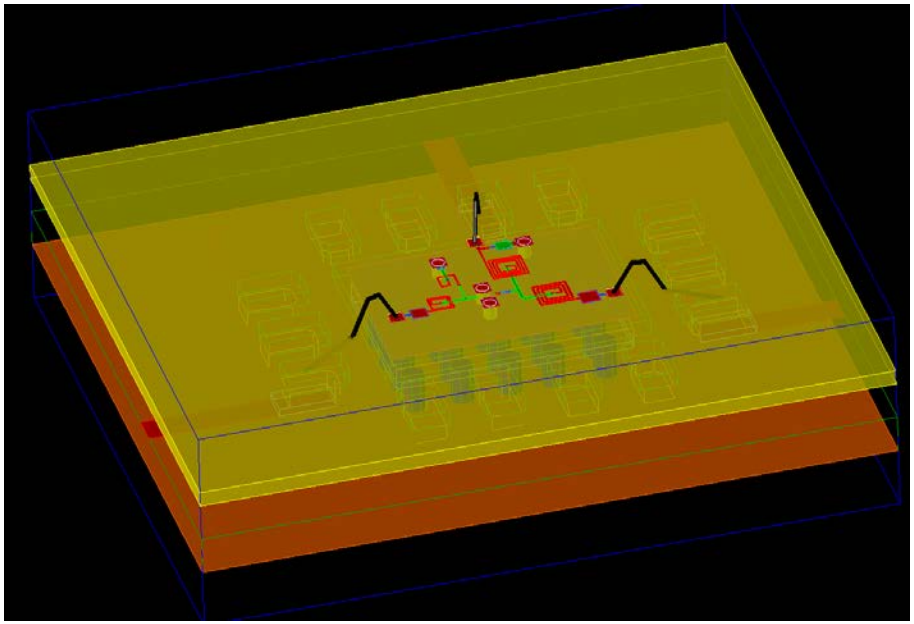
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

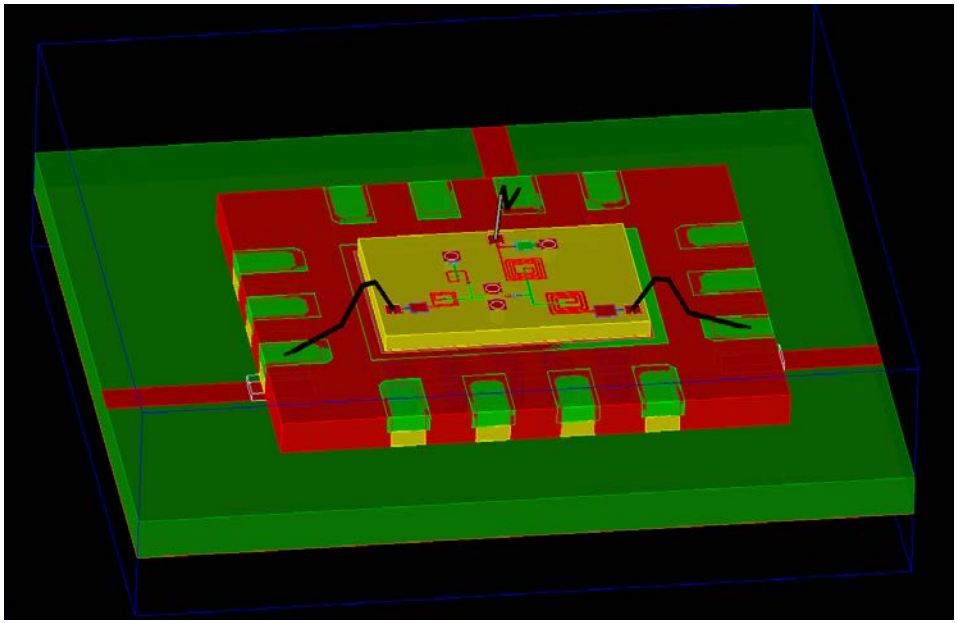
Multi Technology Module Setup

With and without Bounding area layer

Before adding Bounding Layer to the IC



After adding Bounding Layer to the IC



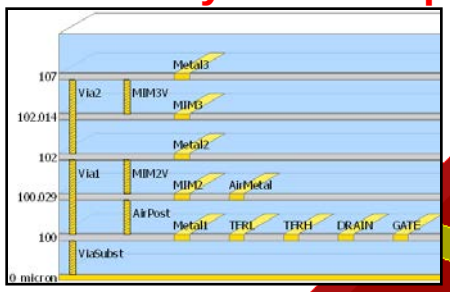
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

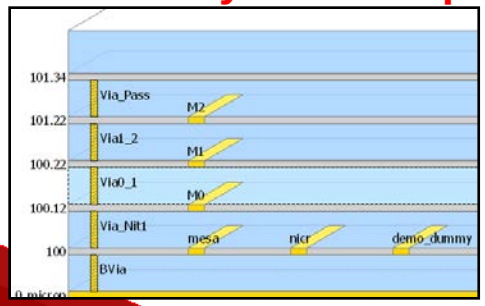
Multi Technology FEM Simulation Set up

Ku band LNA (PDK1) followed by Ku band Filter (PDK2)

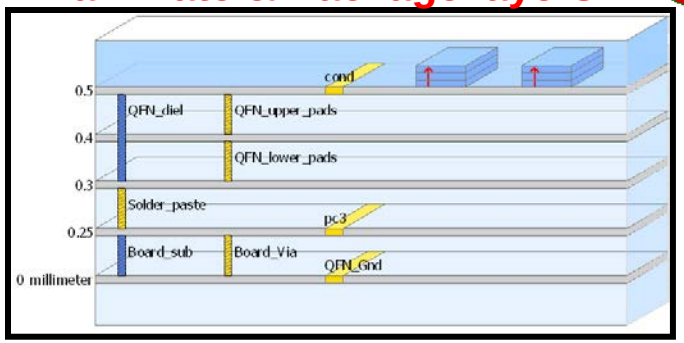
PDK1 layer stack up



PDK2 layer stack up



Laminate & Package layers



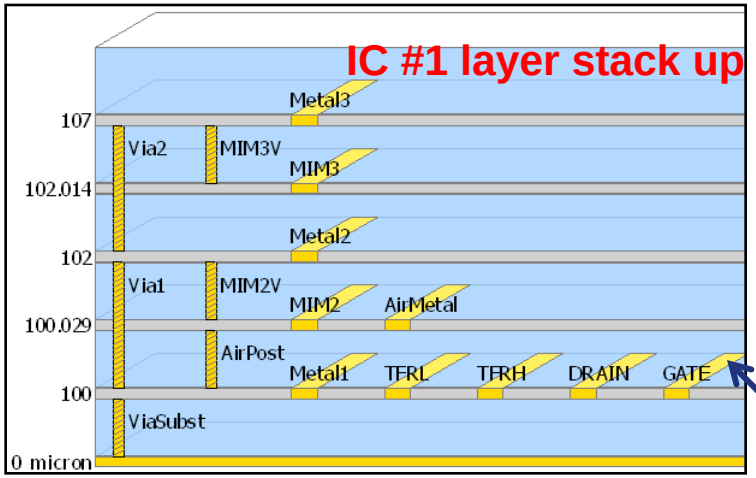
Two Bounded IC's

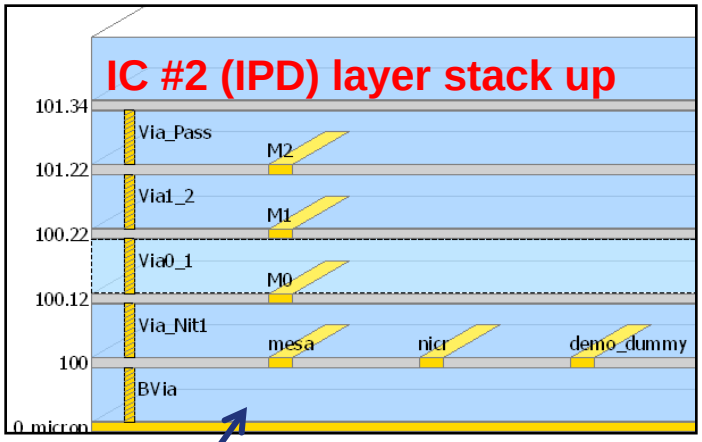
KEYSIGHT TECHNOLOGIES

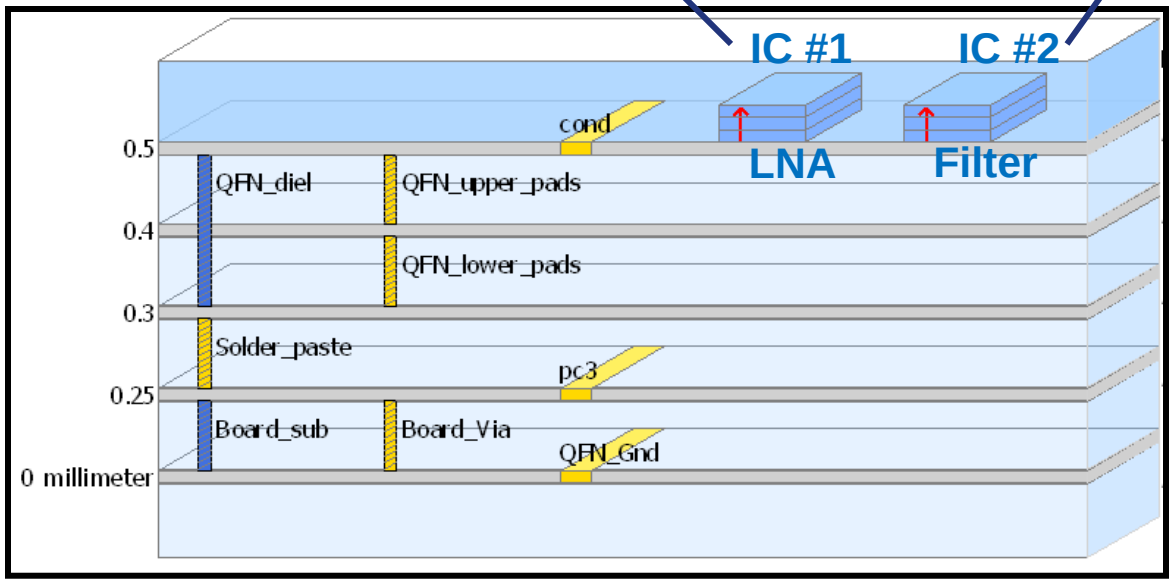
Copyright © 2014 Keysight Technologies

Multi Technology Module Layers Stack up

Nested Technology substrates







Mounted ICs

QFN Package layers

Laminate layers

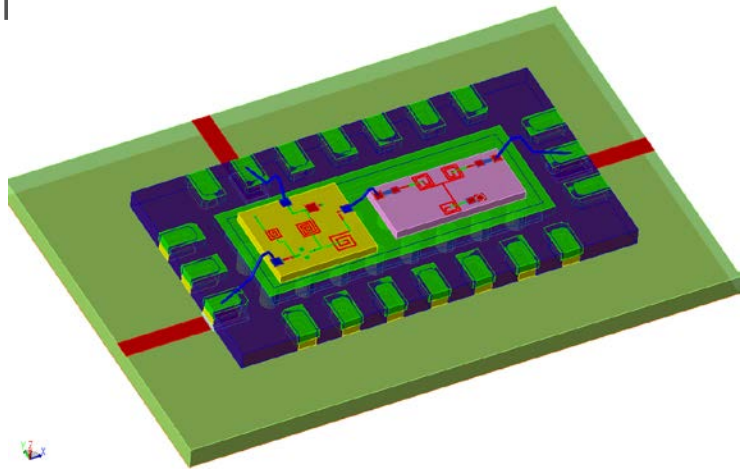
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

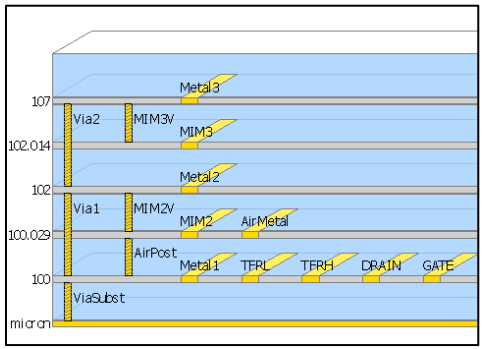
Multi Technology 3D FEM Simulation in ADS 2012

Substrate stackup

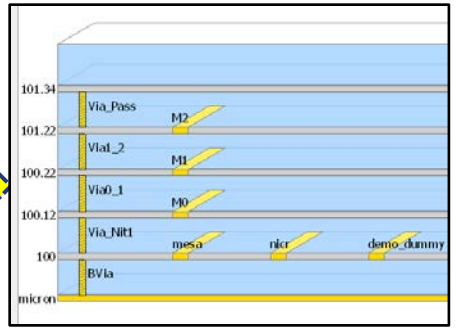
Demo

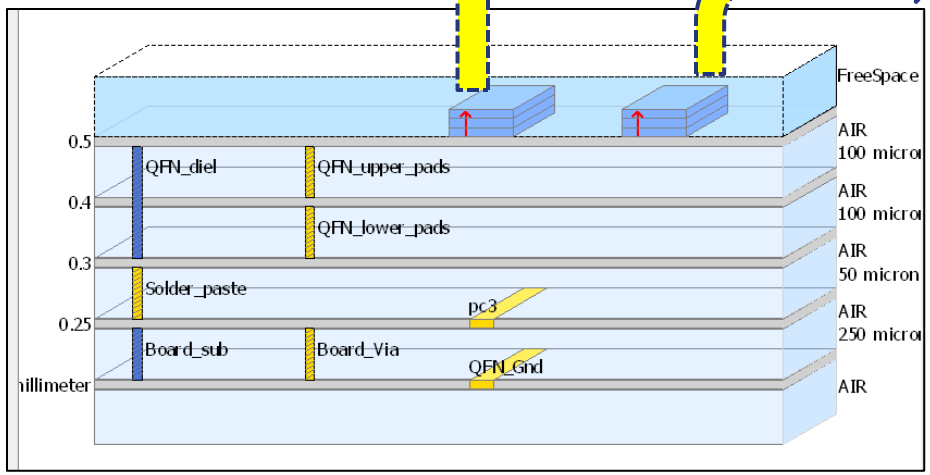


IC#1



IC#2





Package

Laminate

Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Agenda

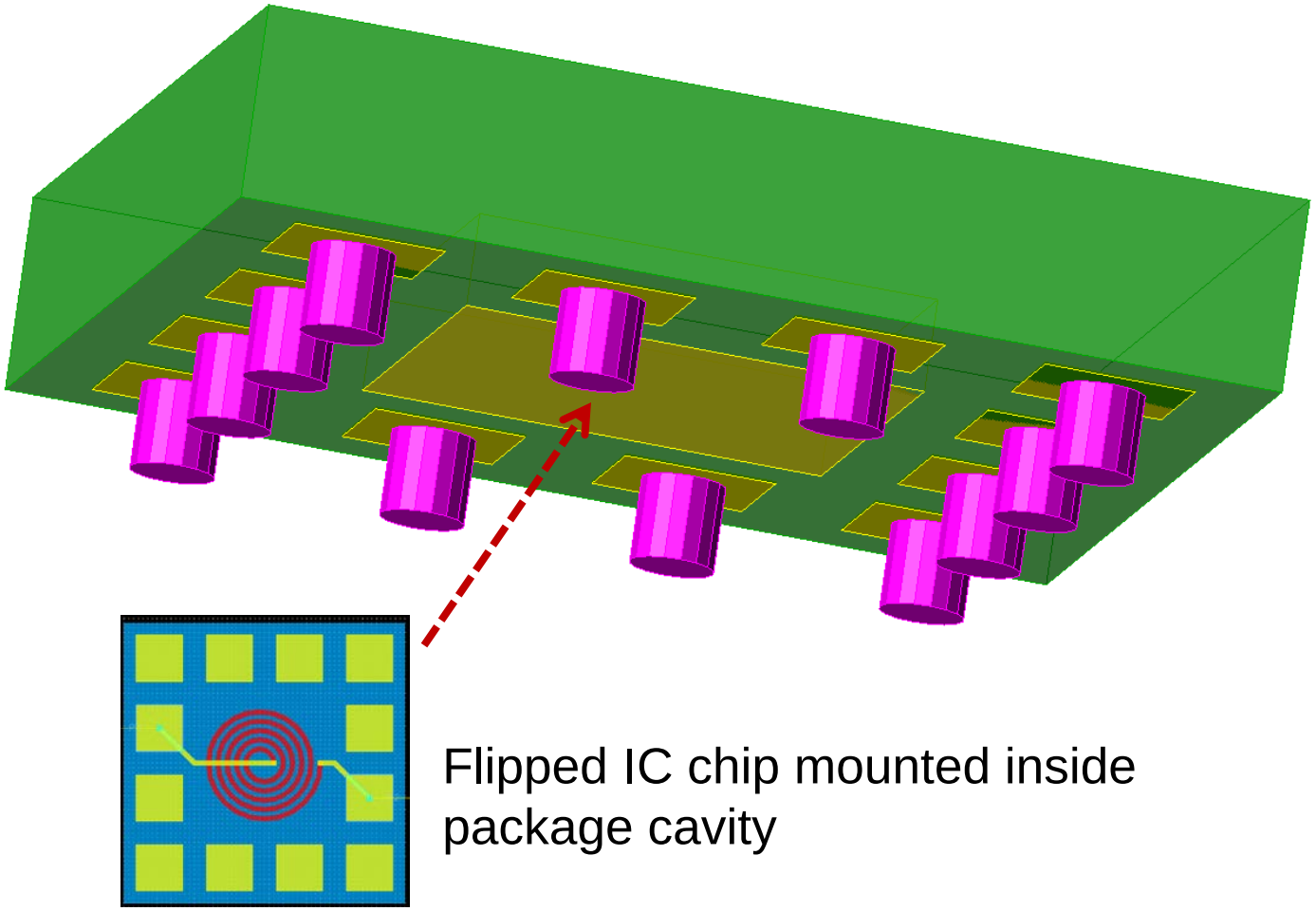
1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Flip Chip / Flip Package onto Board

Flipped Package ready to mount onto a board



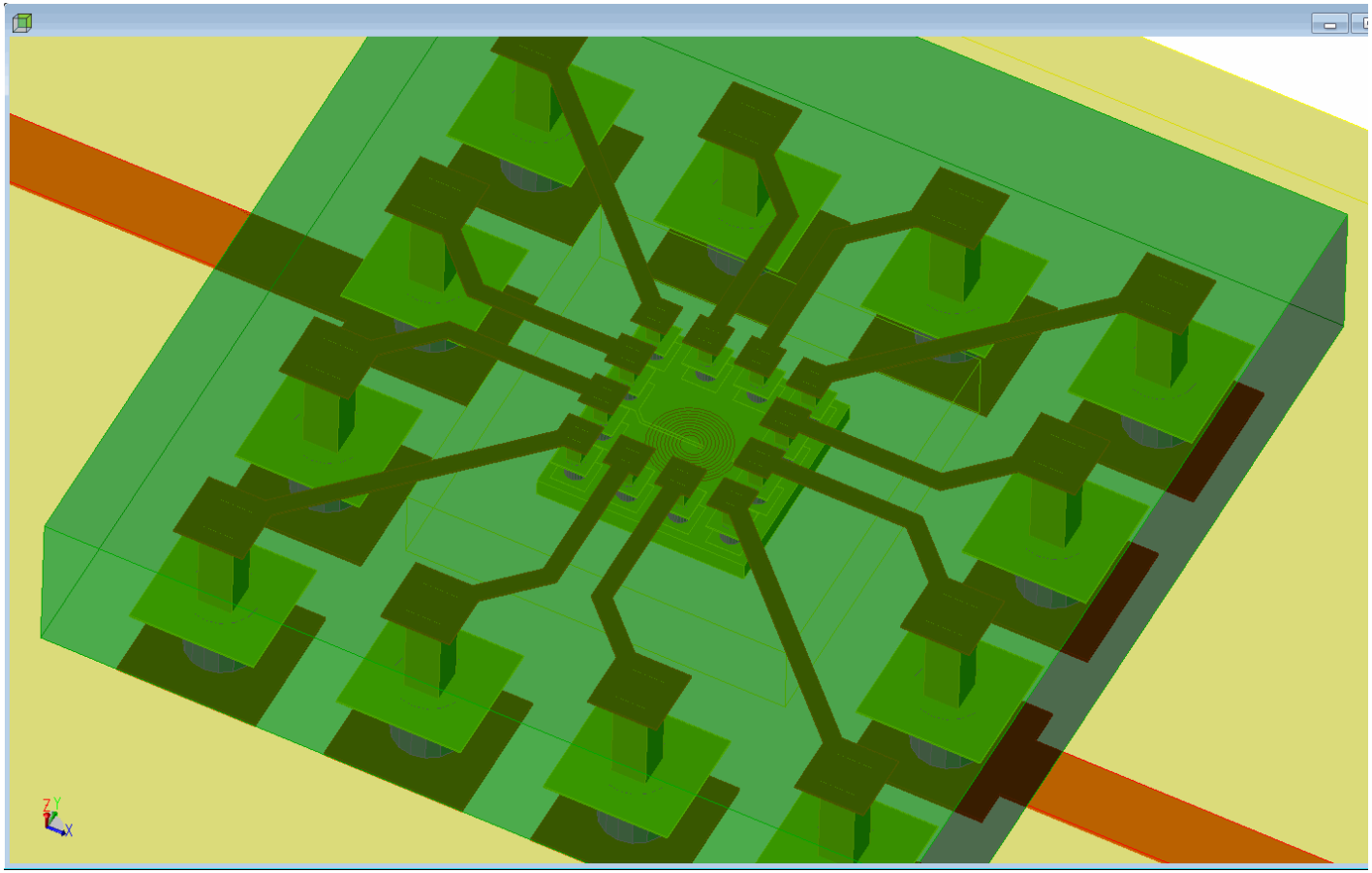
Flipped IC chip mounted inside package cavity

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Flip Chip / Flip Package onto Board

Flipped Package mounted onto a board

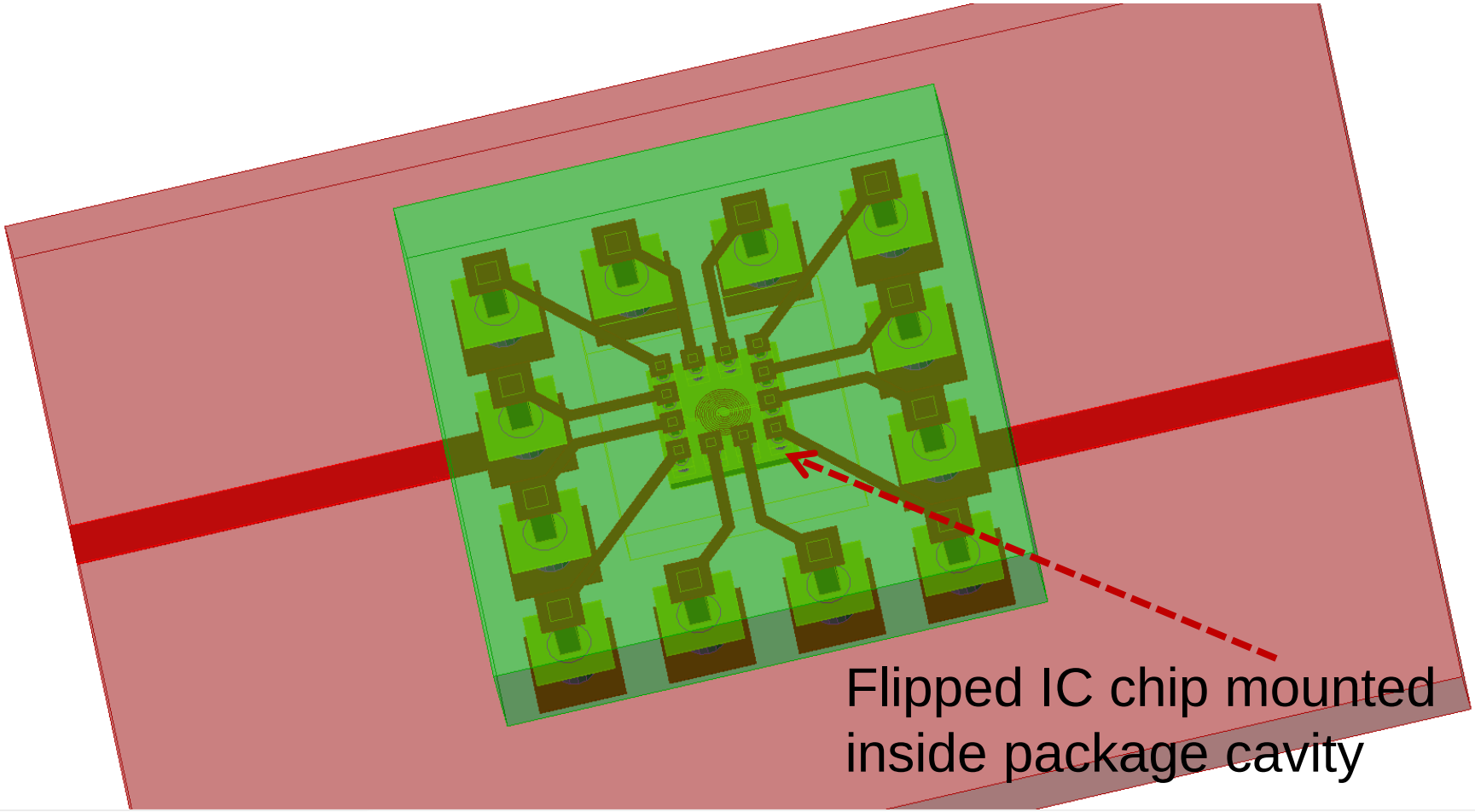


KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Flip Chip / Flip Package onto Board

Flipped Package mounted onto a board

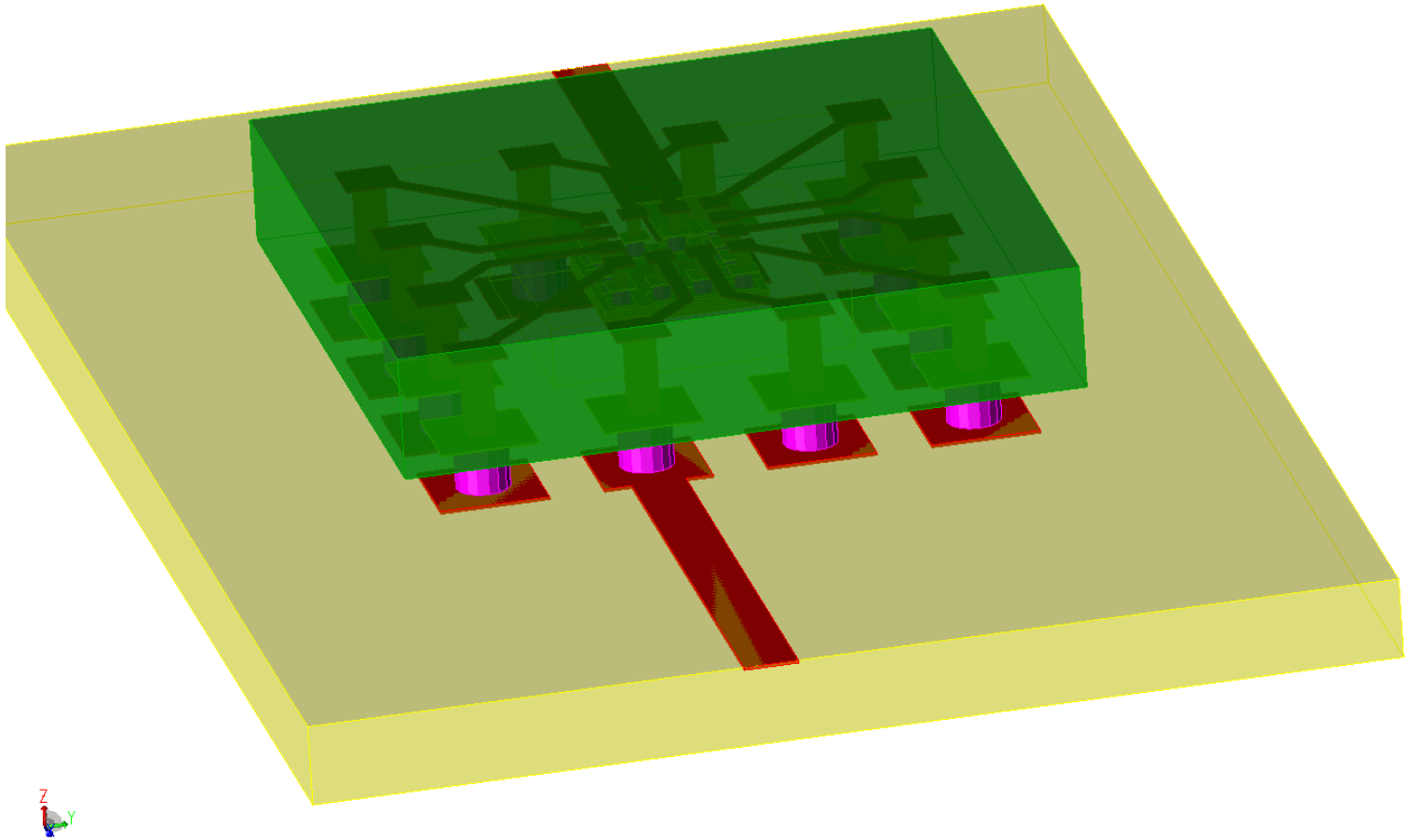


KEYSIGHT TECHNOLOGIES

Copyright © 2014
Keysight
Technologies

Flip Chip / Flip Package onto Board

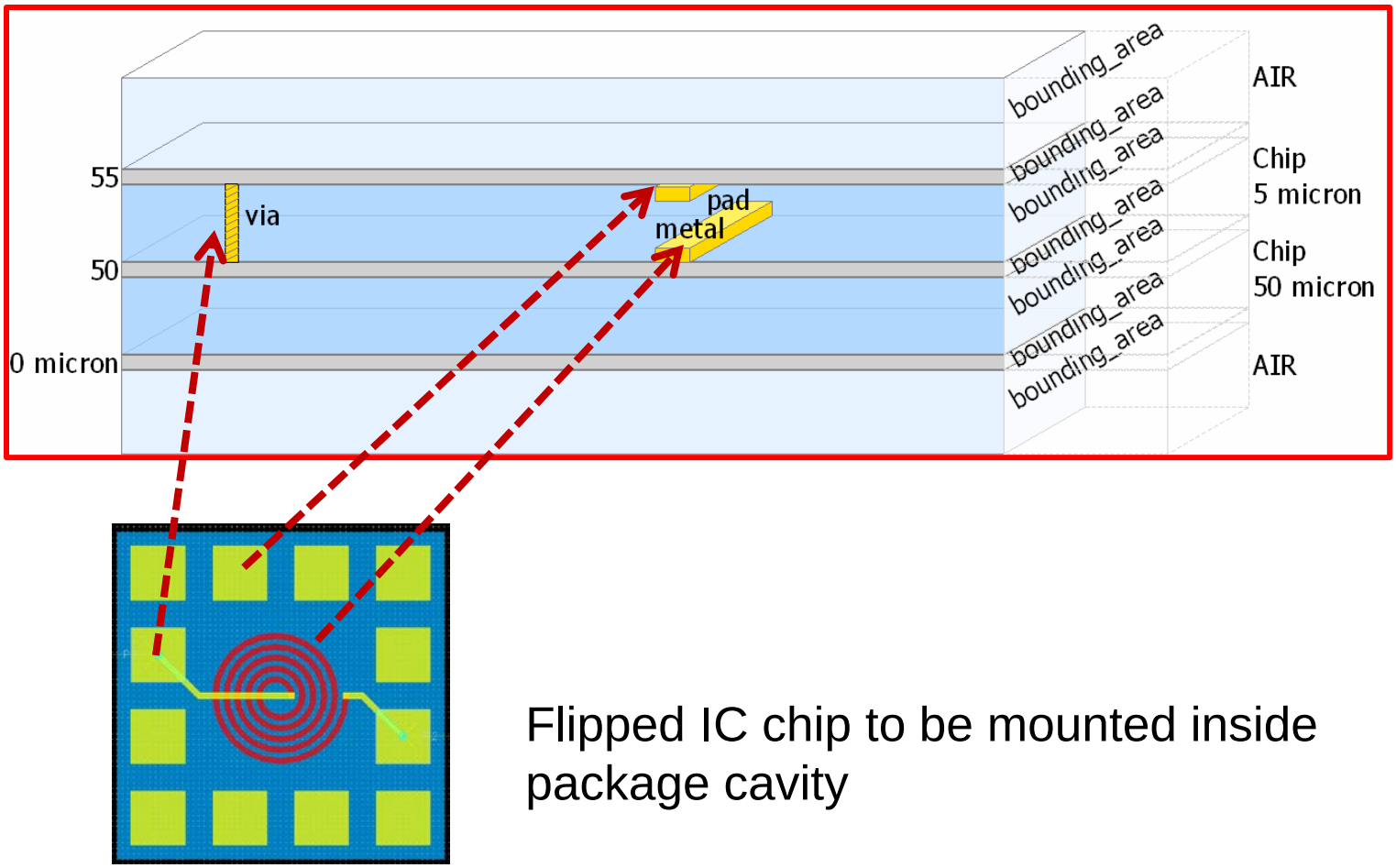
Flipped Package mounted onto a board – side view



KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Flip Chip / Flip Package onto Board



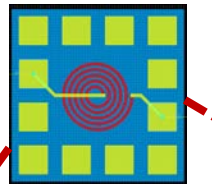
Flipped IC chip to be mounted inside package cavity

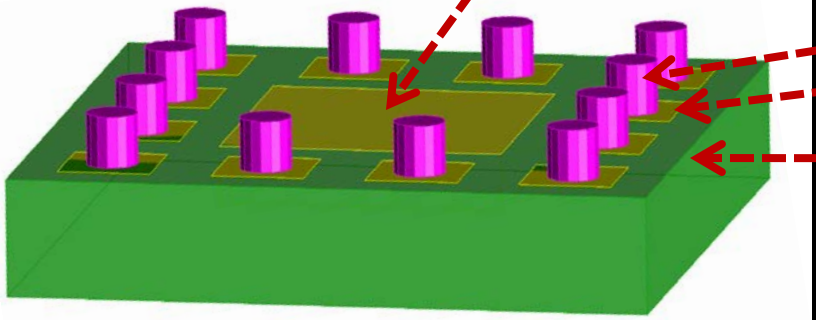
KEYSIGHT TECHNOLOGIES

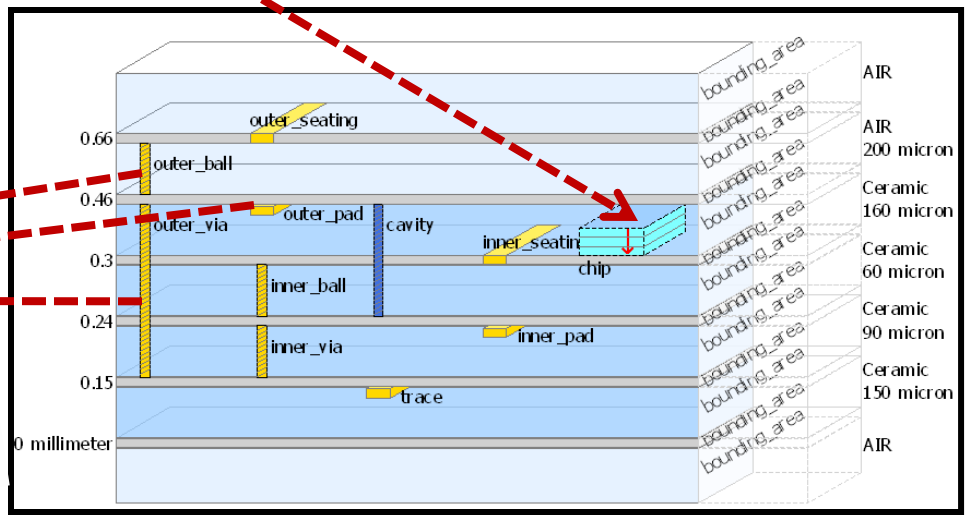
Copyright © 2014 Keysight Technologies

Flip Chip / Flip Package onto Board

Flipped IC chip mounted inside package cavity





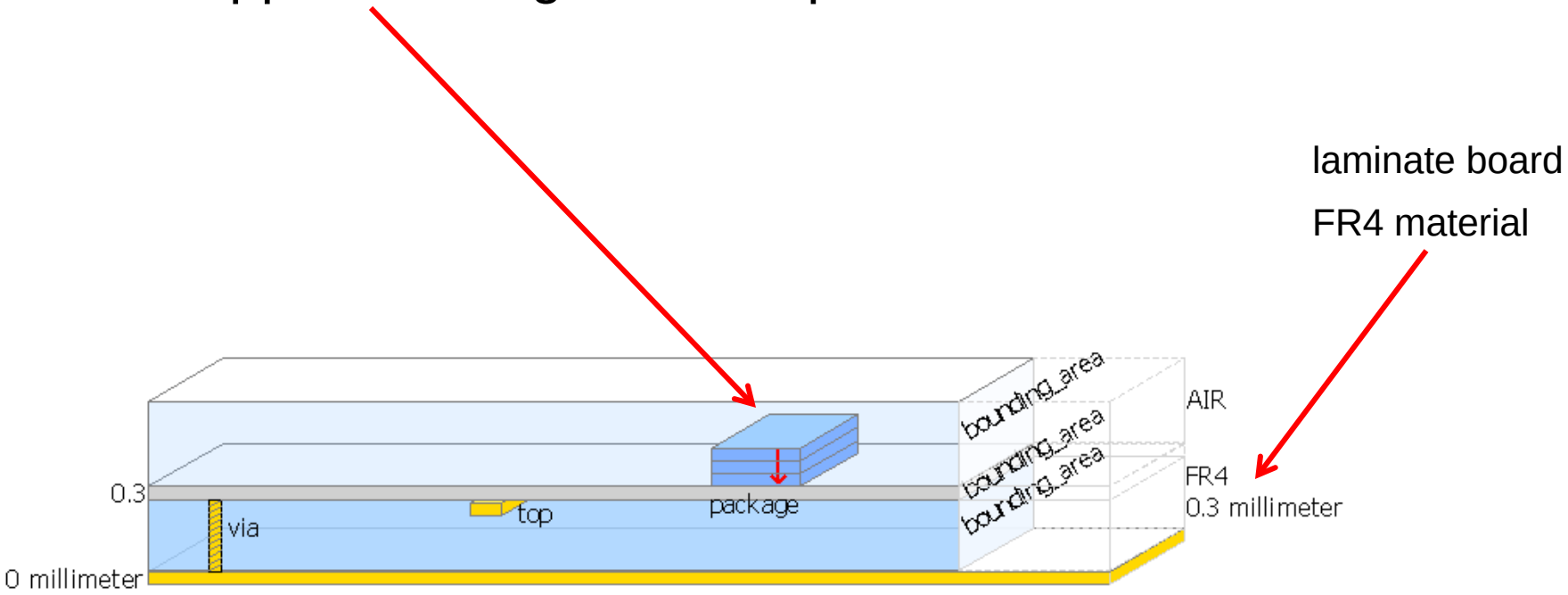


KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Flip Chip / Flip Package onto Board

Flipped Package and Chip onto a laminate board



Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Agenda

1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

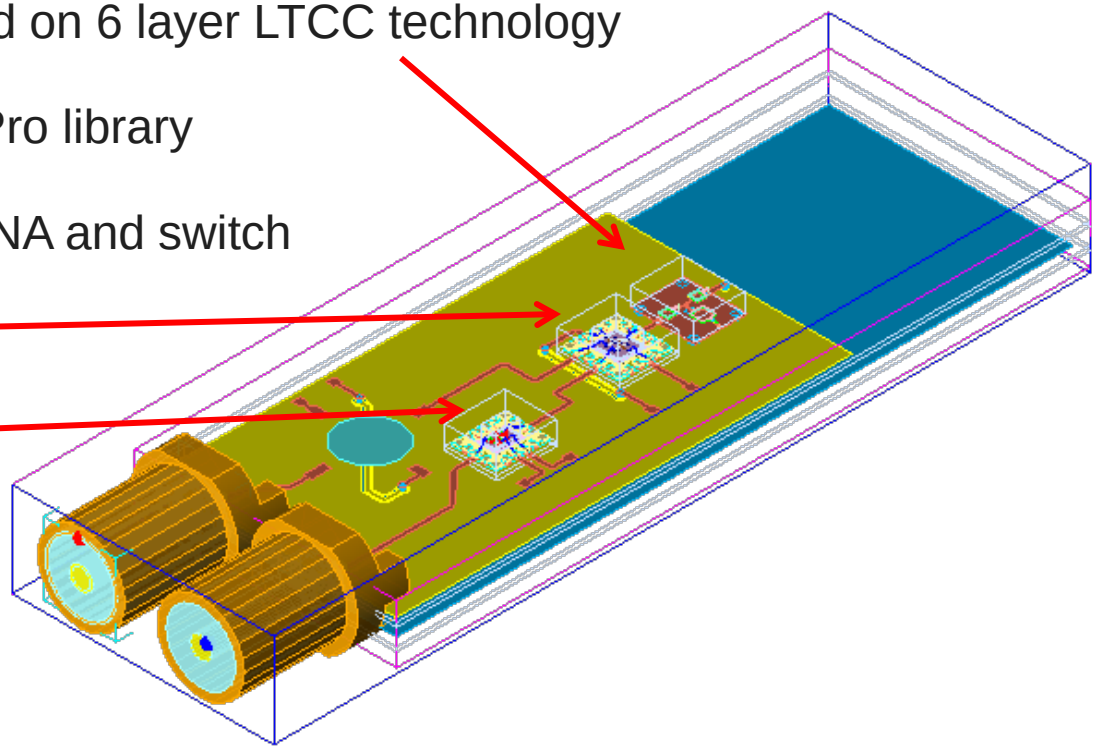
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Example: Transceiver using Multi Technology

– Transceiver consists of mainly seven major technologies:

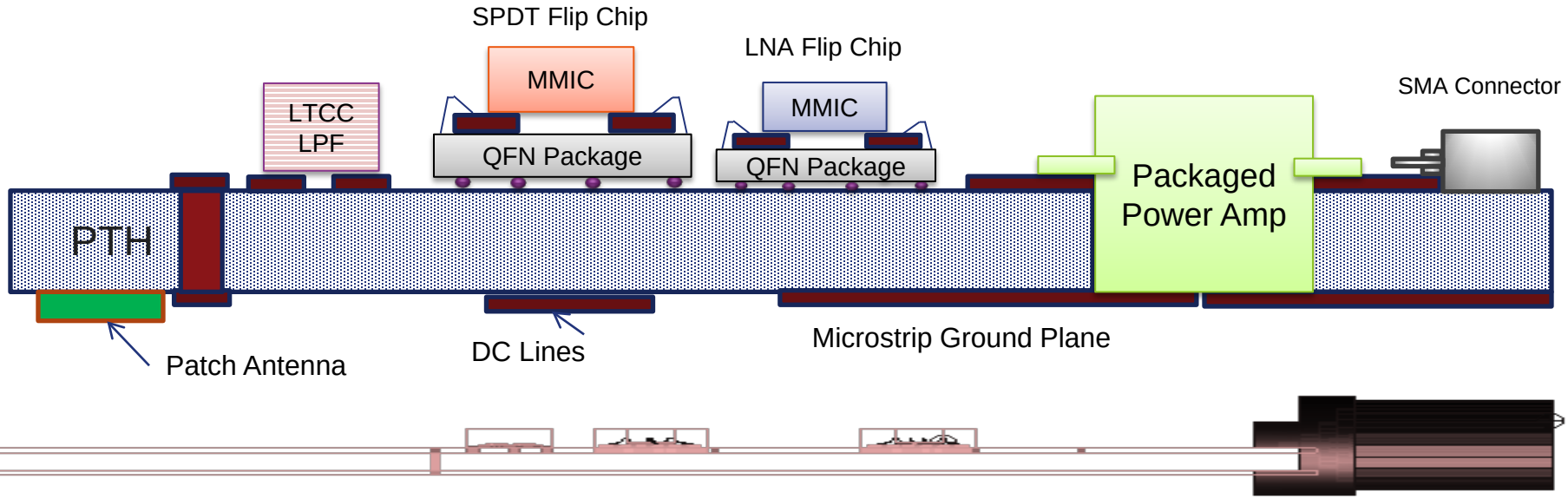
1. Antenna: single layer C-band microstrip patch antenna
2. Power Amplifier - X-parameter file of MMIC power amplifier
3. LTCC BPF : 3 pole filter based on 6 layer LTCC technology
4. 3D SMA Connector from EMPro library
5. Standard QFN Package for LNA and switch
6. MMIC SPDT switch
7. MMIC LNA

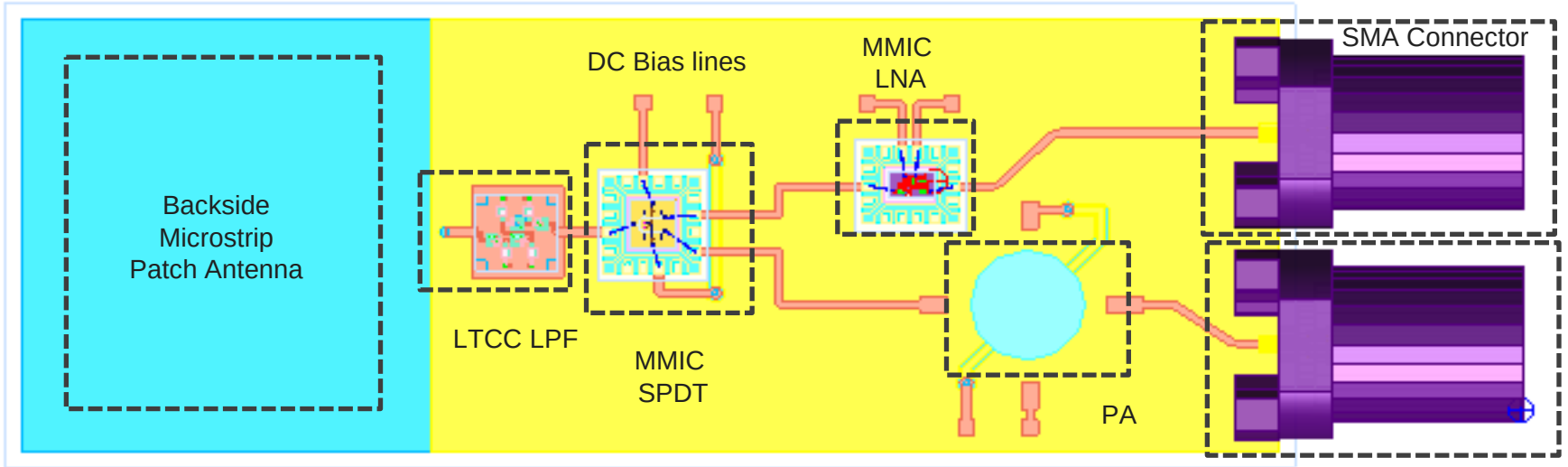


KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Transceiver Cross Section View





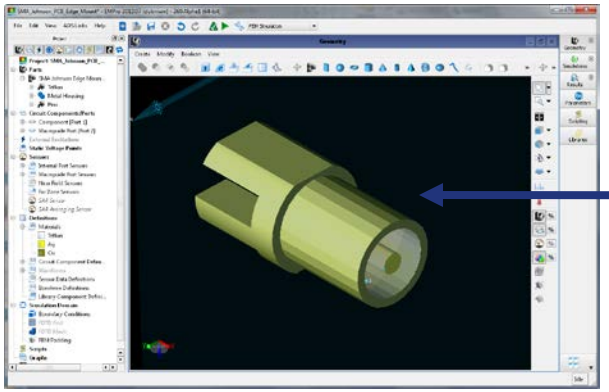
Copyright © 2014
Keysight
Technologies

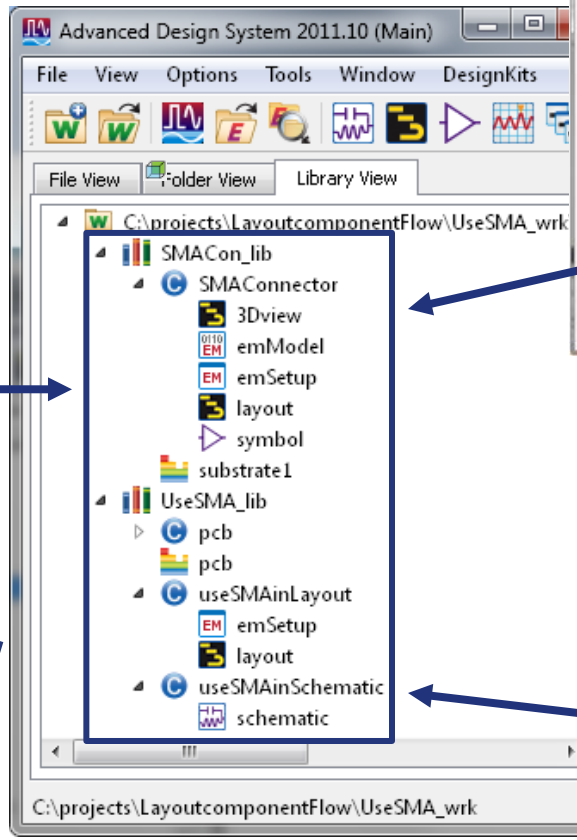
EMPro 2012 3D EM Components Improved ADS Integration

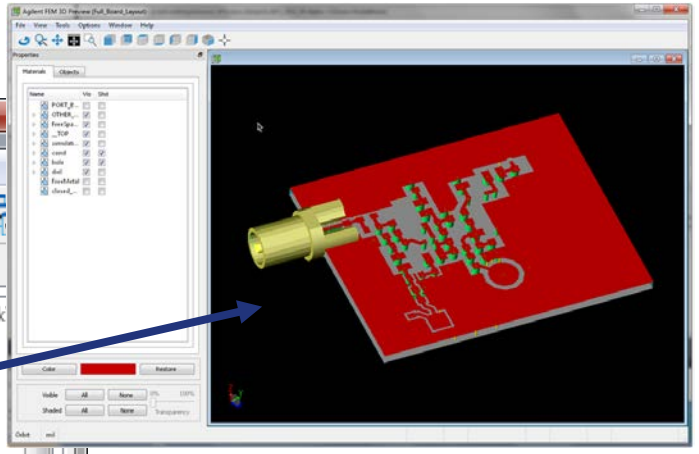
ADS Layout (3D View)

ADS

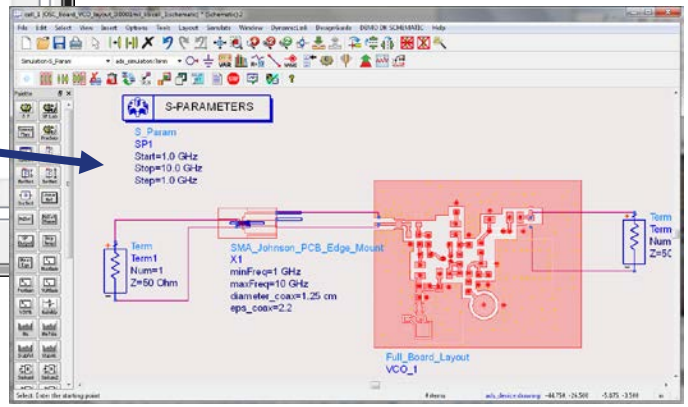
EMPro 3D Design







ADS Schematic



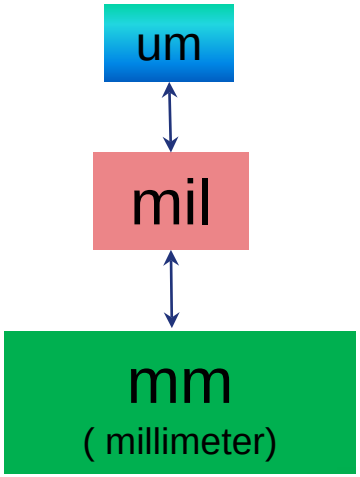
Common Database

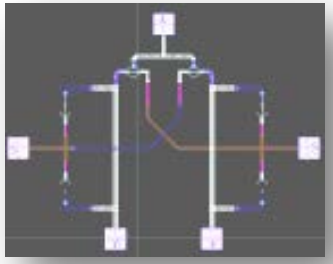
KEYSIGHT TECHNOLOGIES

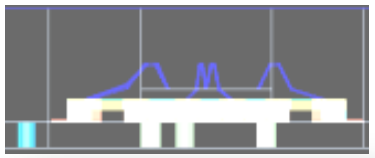
Copyright © 2014 Keysight Technologies

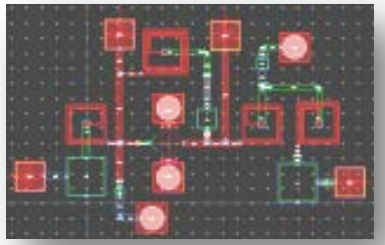
Transceiver Parts and Technologies

- Total 12 equivalent layer board
- 7 different technologies
- 2 stack up + 4 side by side technologies
- EMPro design as lib component
- 3 different layout units

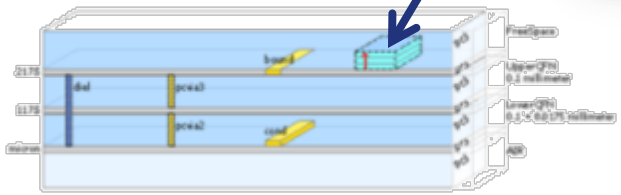








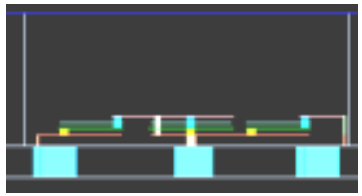
MMIC SPDT Substrate

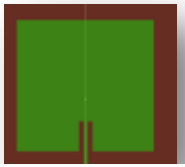


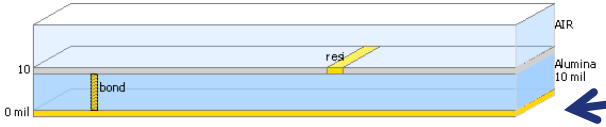
MMIC LNA Substrate

SPDT + Package Substrate

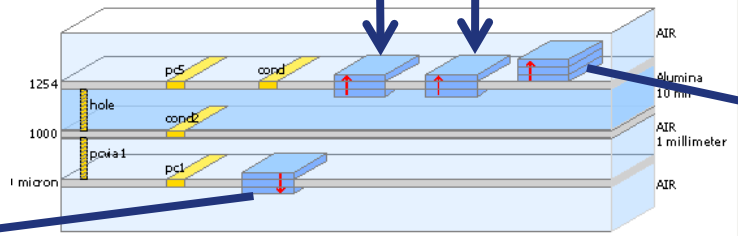
LNA + Package Substrate







Antenna Substrate



LTCC LPF

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Agenda

1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

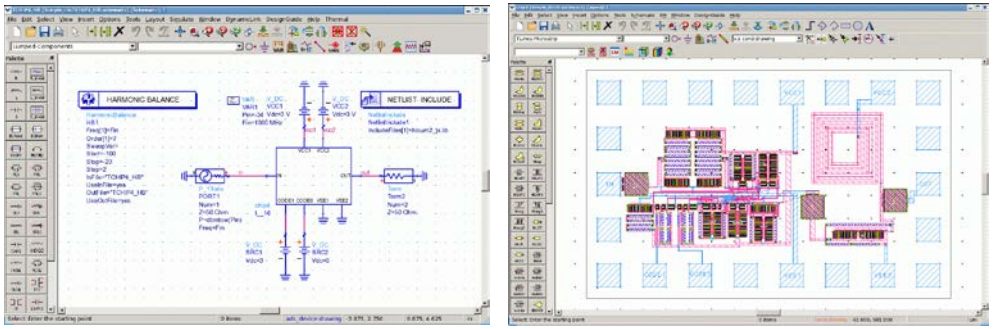
KEYSIGHT TECHNOLOGIES

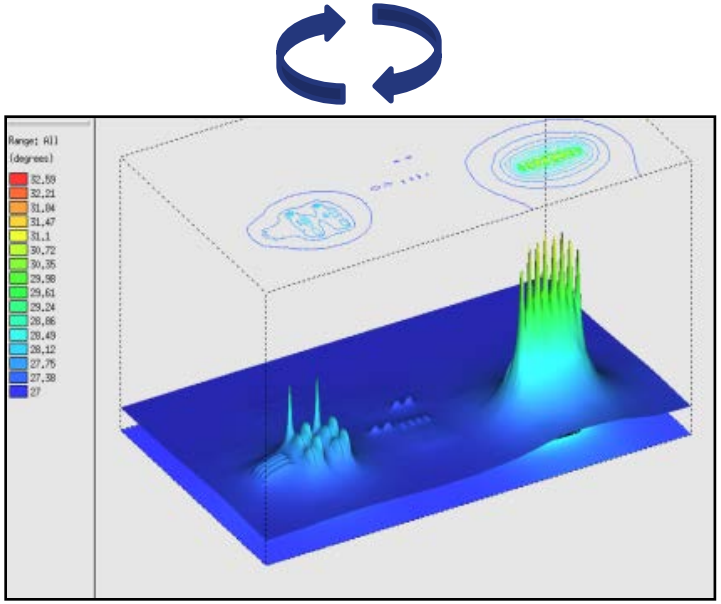
Copyright © 2014 Keysight Technologies

New Electrothermal Solution in ADS2012

- Improves high power MMIC / RFIC designs
- Delivers ‘thermally aware’ circuit simulation results
- Includes effects of package and PCB
- Easy to set up and use from within ADS
- Works with all simulation types: DC, AC, SP, HB, Transient, Envelope

ADS Schematic ***ADS Layout***



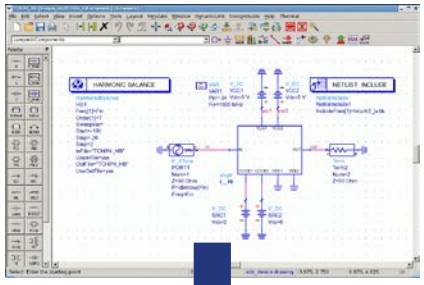


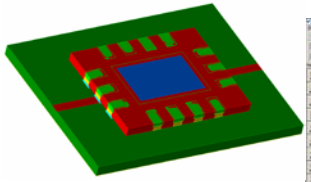
Integrated Thermal Solver

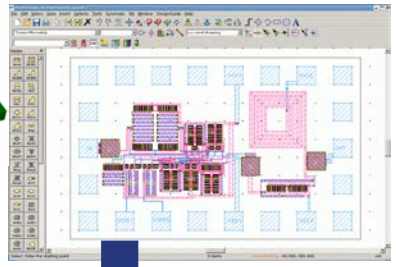
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

New Electrothermal Solution in ADS2012







Thermal technology files

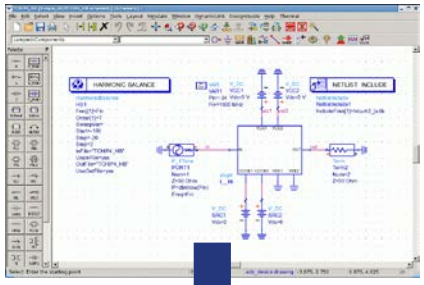
Circuit Simulator

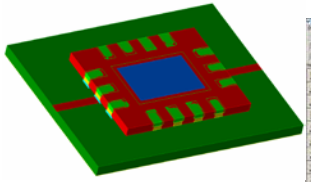
Thermal Simulator

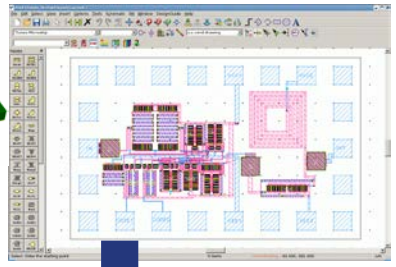
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

New Electrothermal Solution in ADS2012







Thermal technology files

Circuit Simulator

simulate to convergence
write power dissipation

$T_{DEVICES}$

P_{DISS}

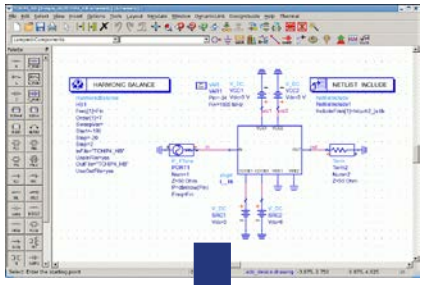
Thermal Simulator

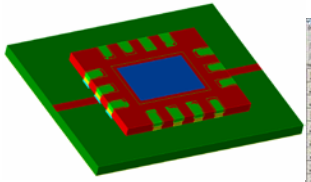
read power dissipation
create heat sources
solve thermal equation
write temperatures

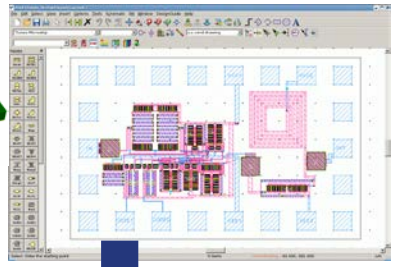
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

New Electrothermal Solution in ADS2012







Thermal technology files

Circuit Simulator
read temperatures
use previous solution
simulate to convergence
write power dissipation

$T_{DEVICES}$

P_{DISS}

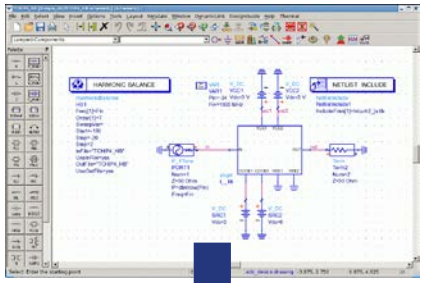
Thermal Simulator
read power dissipation
create heat sources
solve thermal equation
write temperatures

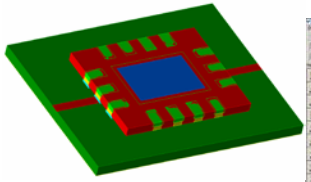
Iteration loop is done automatically until powers and temperatures are self-consistent

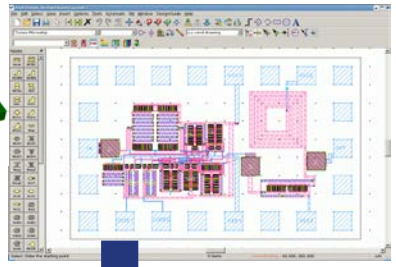
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

New Electrothermal Solution in ADS2012







Thermal technology files

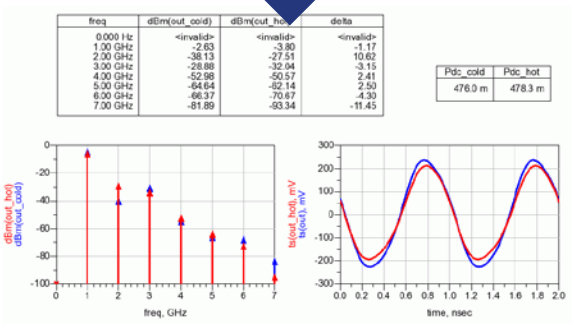
Circuit Simulator
read temperatures
use previous solution
simulate to convergence
write power dissipation

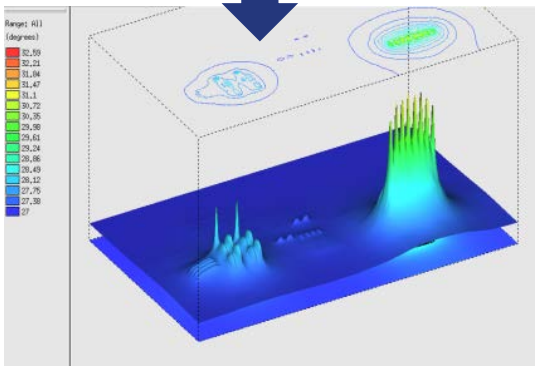
$T_{DEVICES}$

P_{DISS}

Thermal Simulator
read power dissipation
create heat sources
solve thermal equation
write temperatures

Iteration loop is done automatically until powers and temperatures are self-consistent

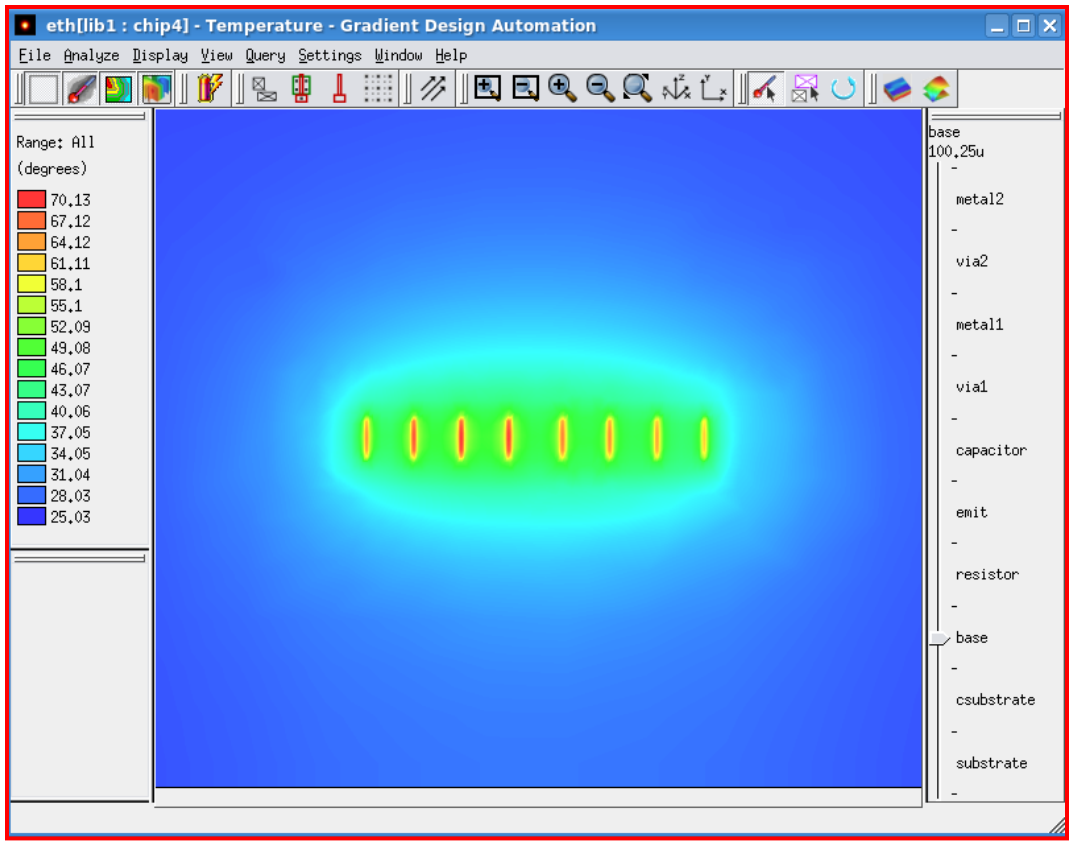


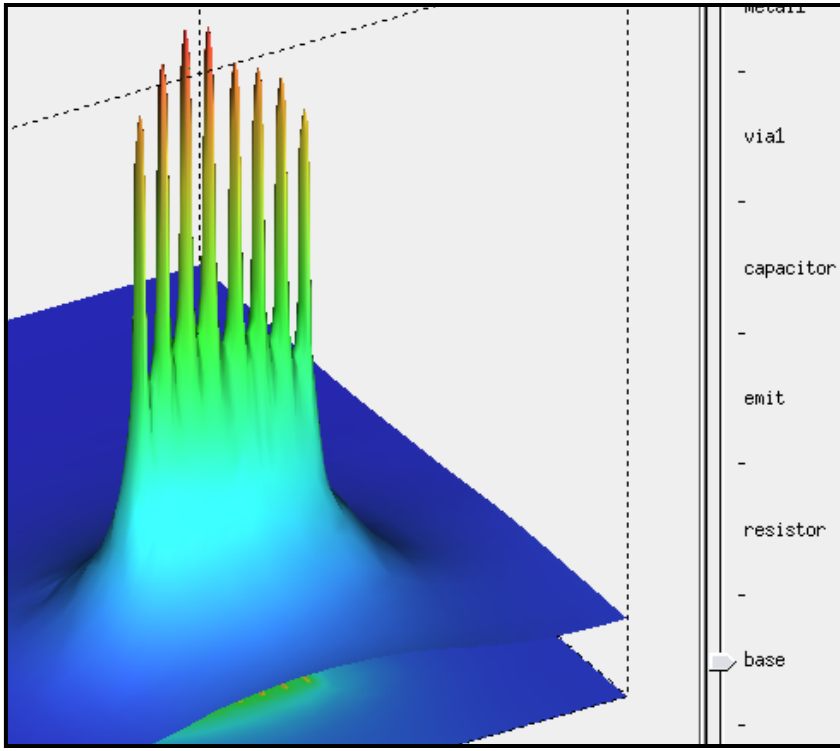


KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Temperature Profile – Active Base Region





KEYSIGHT TECHNOLOGIES

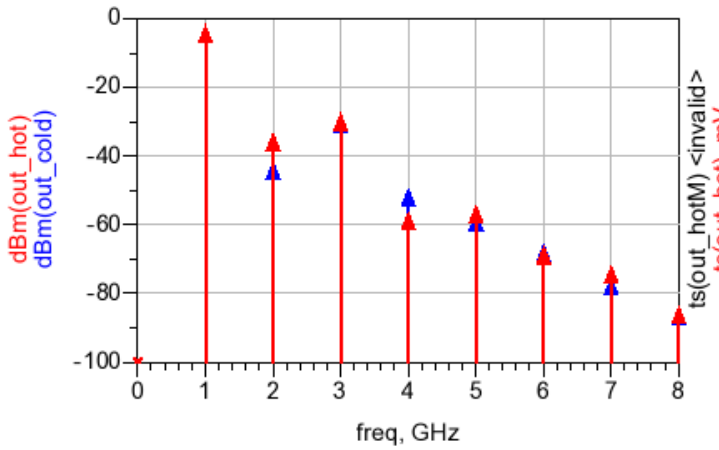
Copyright © 2014 Keysight Technologies

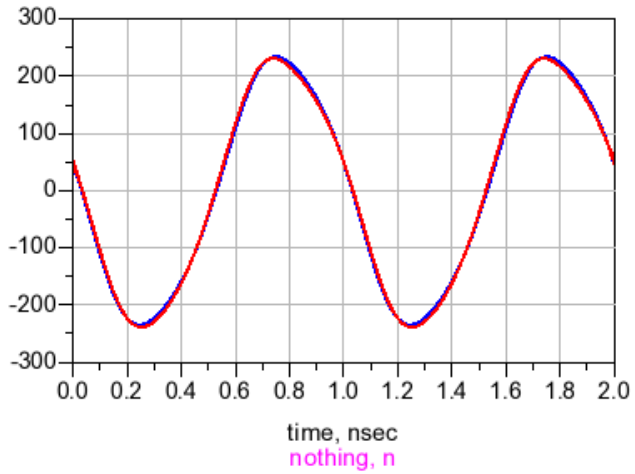
Output Results

TCHIP4_HB

Palette

freq	dBm(out_cold)	dBm(out_hot)	delta
1.00 GHz	-2.57	-2.57	7.15E-5
2.00 GHz	-42.06	-33.97	8.08
3.00 GHz	-28.48	-28.25	0.22
4.00 GHz	-50.03	-56.92	-6.88
5.00 GHz	-57.16	-54.84	2.32
6.00 GHz	-66.20	-66.84	-0.64
7.00 GHz	-75.86	-72.56	3.30
8.00 GHz	-84.32	-84.30	0.01
9.00 GHz	-94.32	-89.87	4.44
10.0 GHz	-100.54	-99.38	1.16
11.0 GHz	-113.14	-106.76	6.38
12.0 GHz	-117.11	-115.14	1.96
13.0 GHz	-128.54	-122.43	6.11

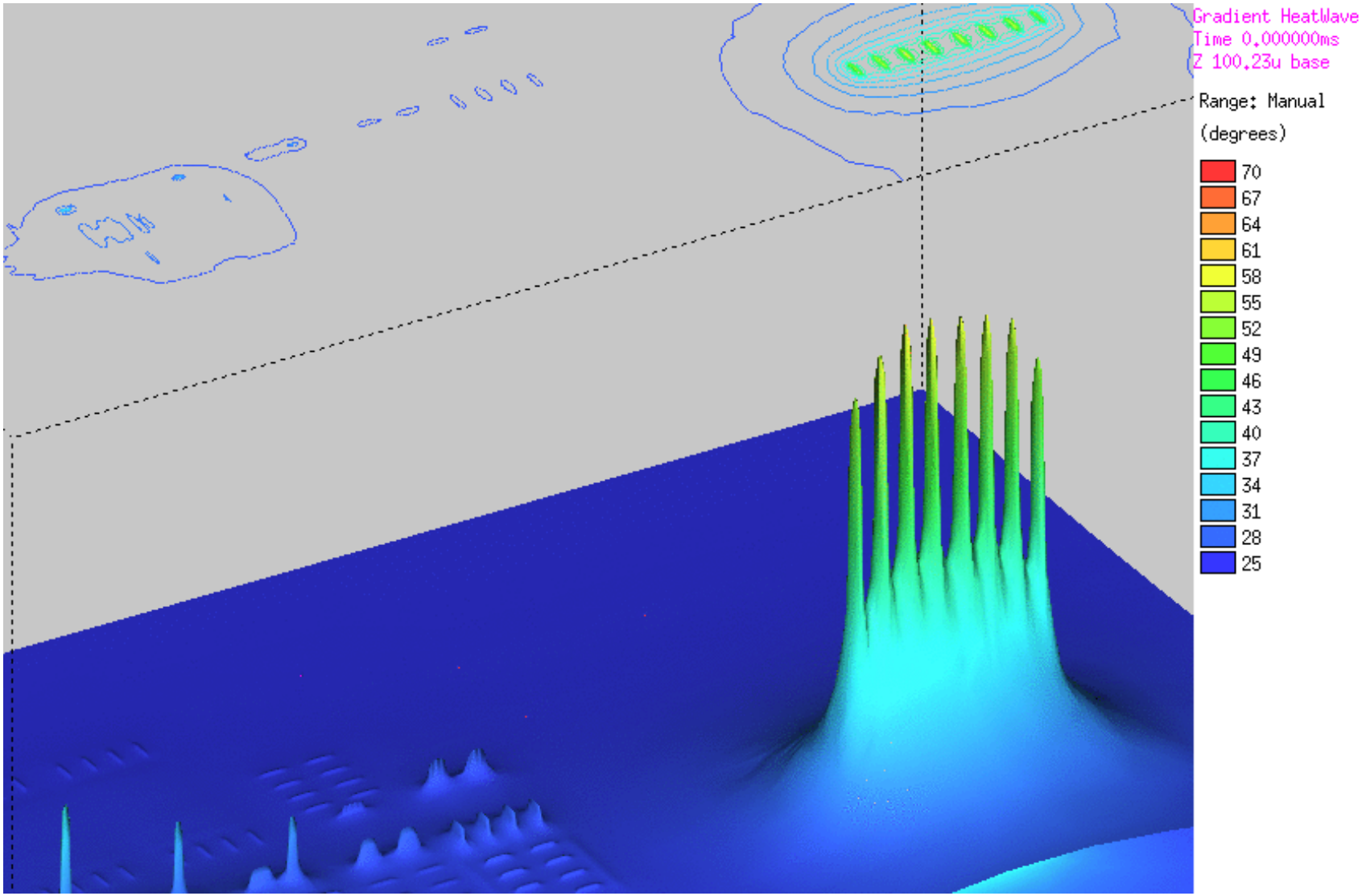




KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Time-Domain Results

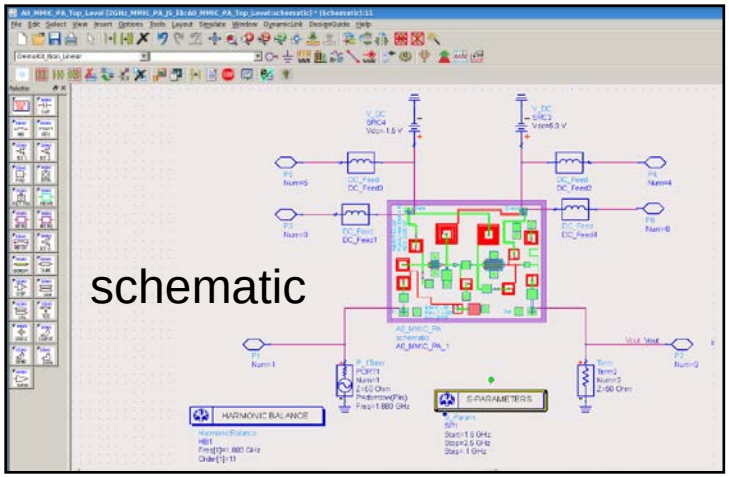


KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

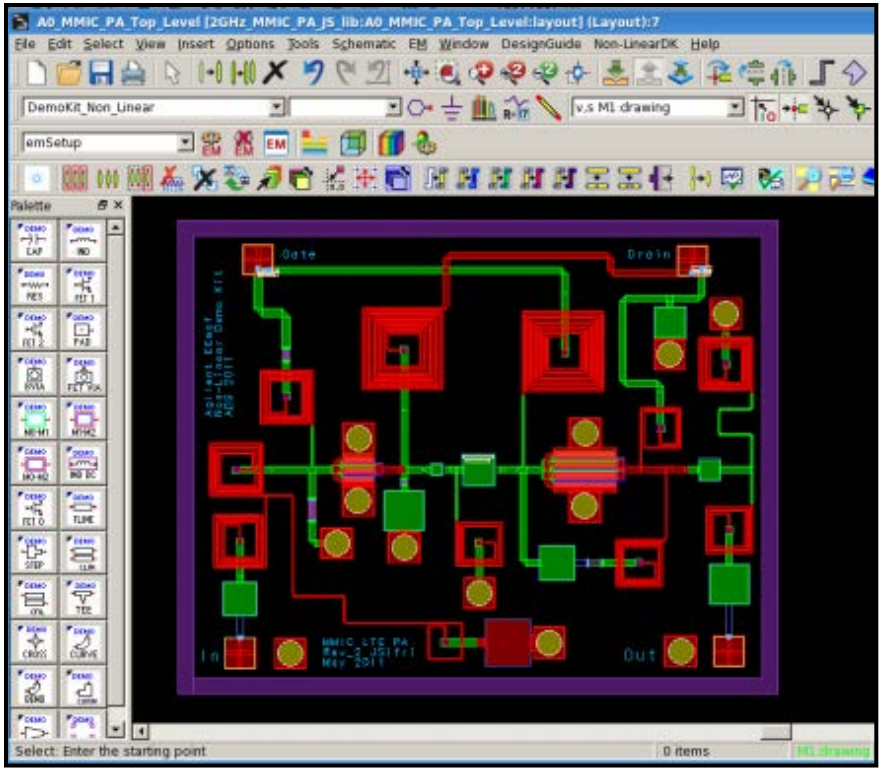
Electro Thermal Simulation

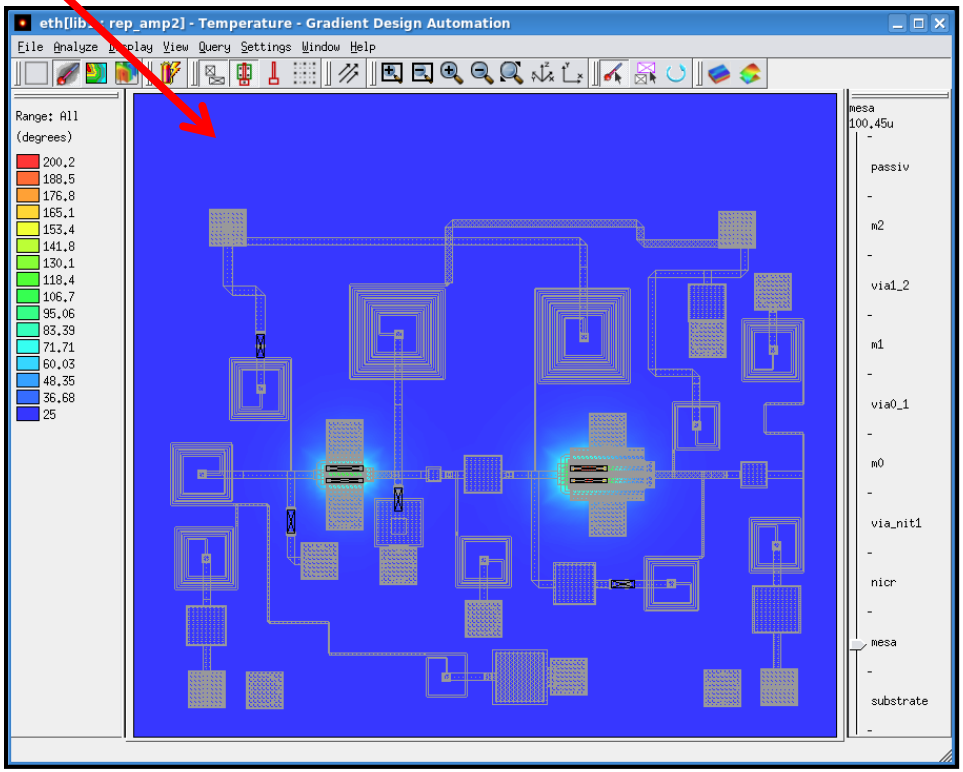
2-Stage GaAs LTE PA



Layout with heat sources

Layout



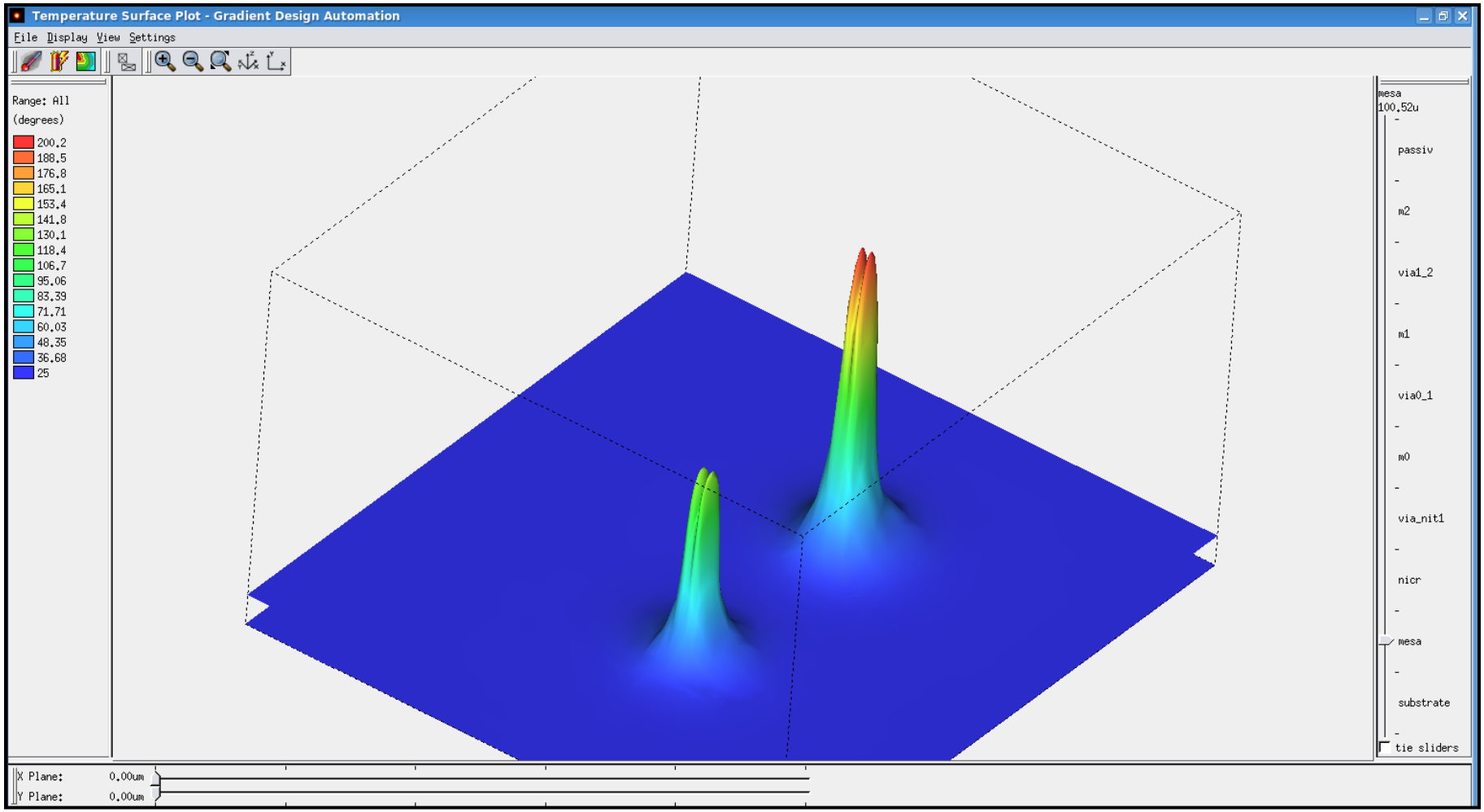


KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Electro Thermal Simulation

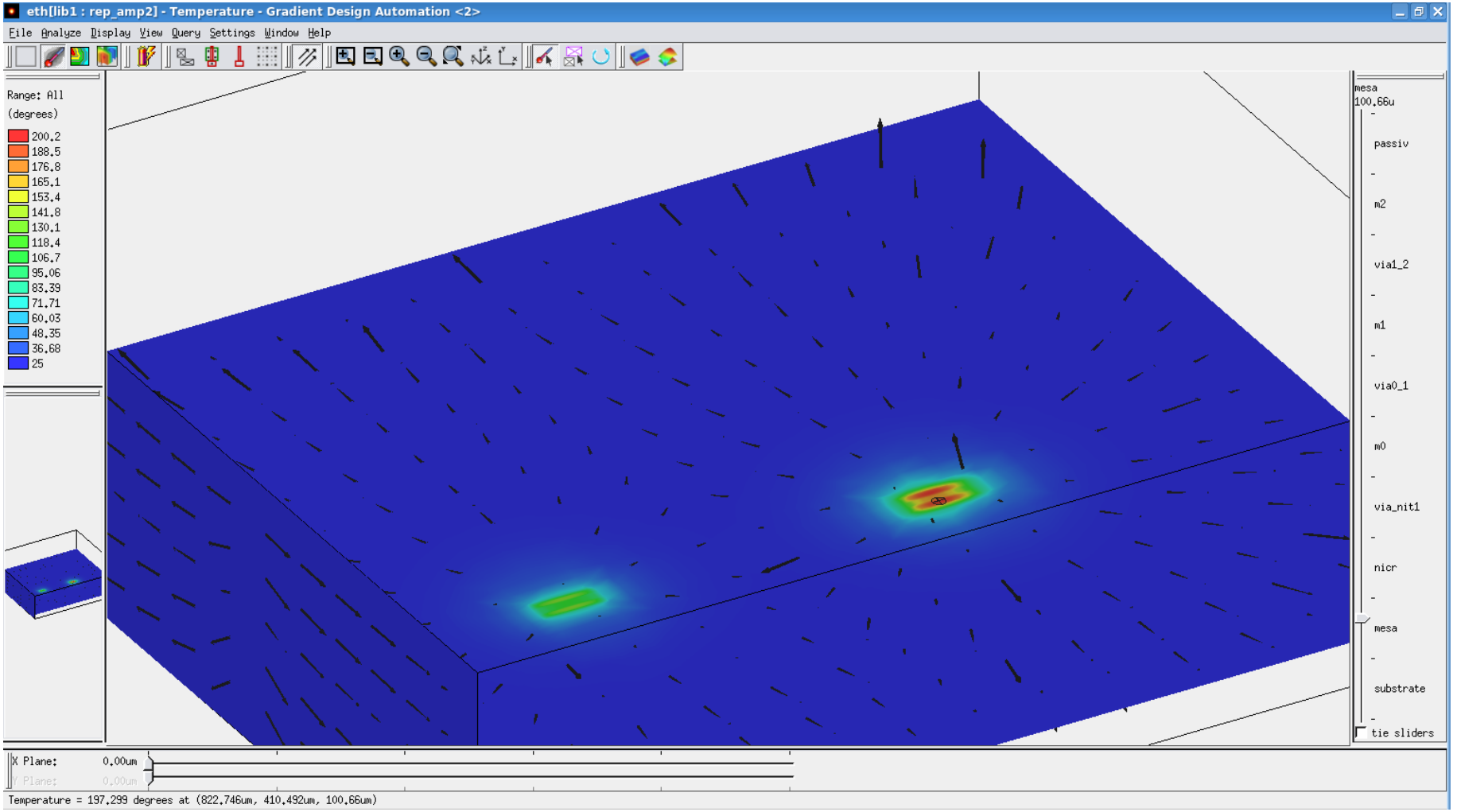
2-Stage GaAs LTE PA



Copyright © 2014 Keysight Technologies

Electro Thermal Simulation – Heat Flux

2-Stage GaAs LTE PA

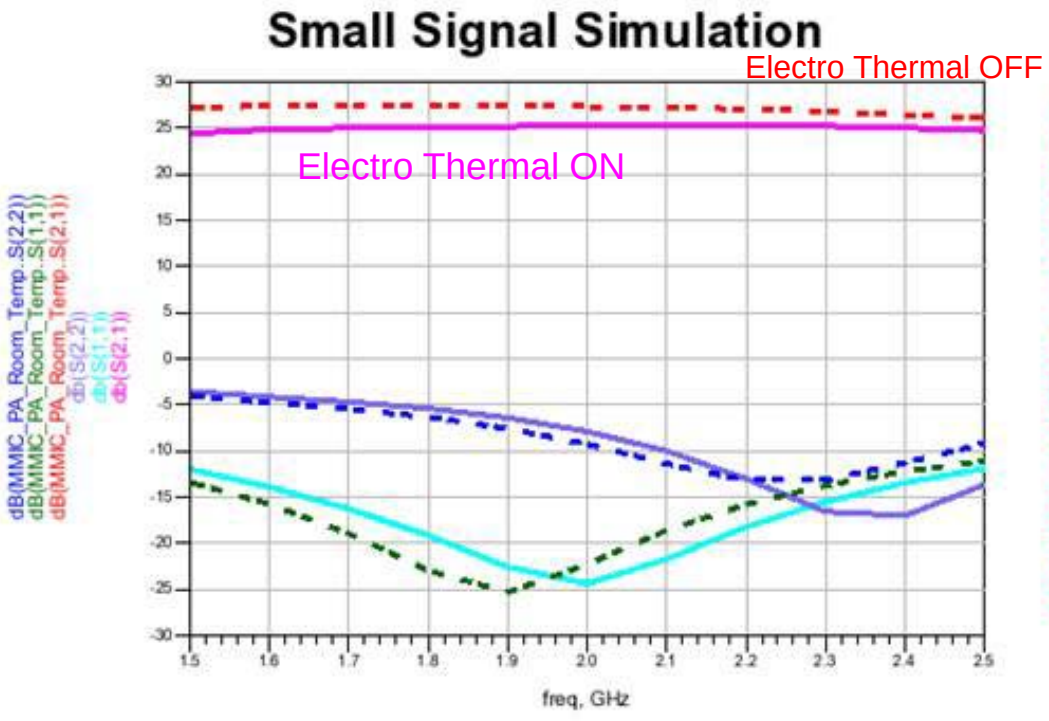


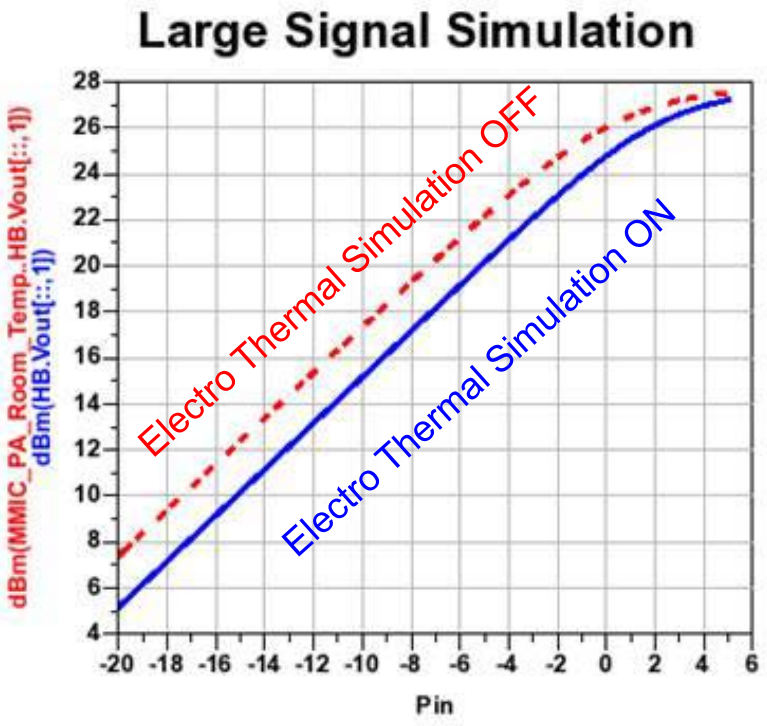
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Electro Thermal Simulation Results

2-Stage GaAs LTE PA





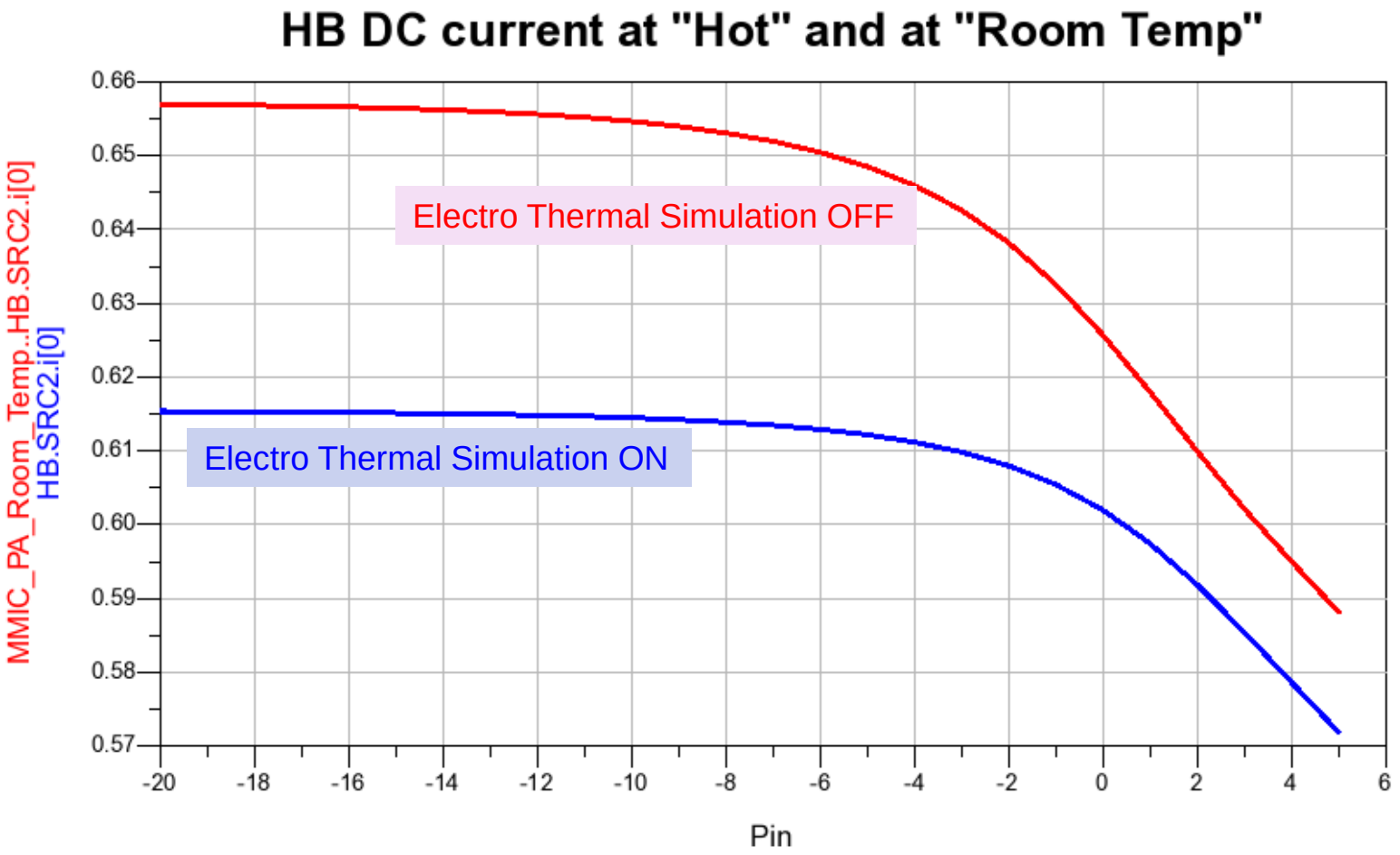
Solid Lines: Electro Thermal Simulation ON
Dashed Lines: Electro Thermal Simulation OFF

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Electro Thermal Simulation Results

HB DC current at Hot Vs Room Temp

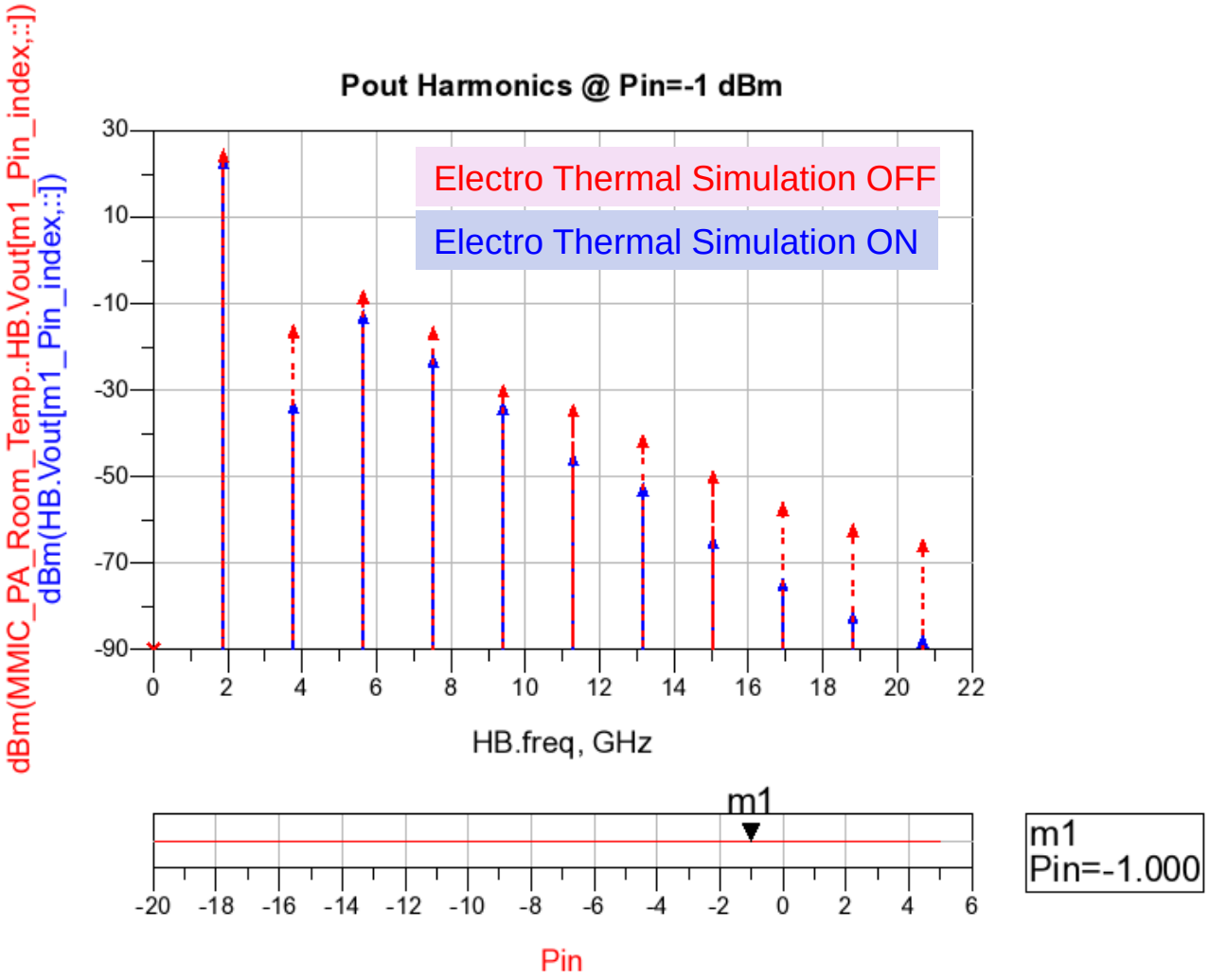


KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Electro Thermal Simulation Results

Harmonics at Hot Vs Room Temp



KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

IC, Laminate, Package Multi Technology PA Module Design

Agenda

1. Multi technology Examples
2. Design Challenges
3. Improved Design Methodology
4. Illustrate with few applications
   - Single chip module
   - Multi chip module
   - Flip chip /solder bumps module
   - Transceiver module
   - Electro thermal simulation
5. Conclusion

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Integration Challenges with Multi-Technologies

The Ultimate "Device" Characterization Challenge

Behavioral model for PA IC (X-parameters)

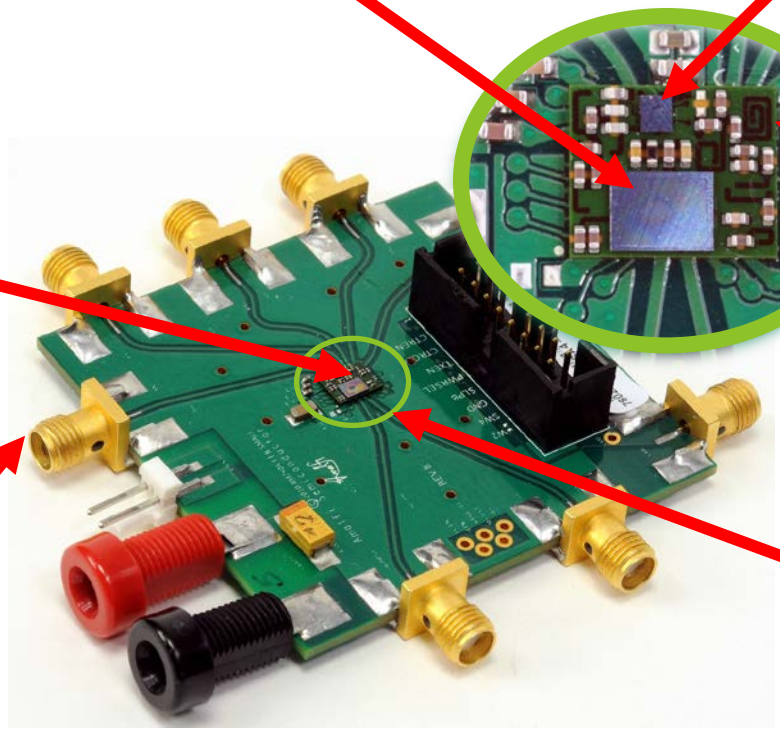
Multiple IC's of different fabrication technologies

Passive EM Simulation of Entire Laminate

Model Package, solder bumps, bond wires

Model connector

Chip, module, board interactions



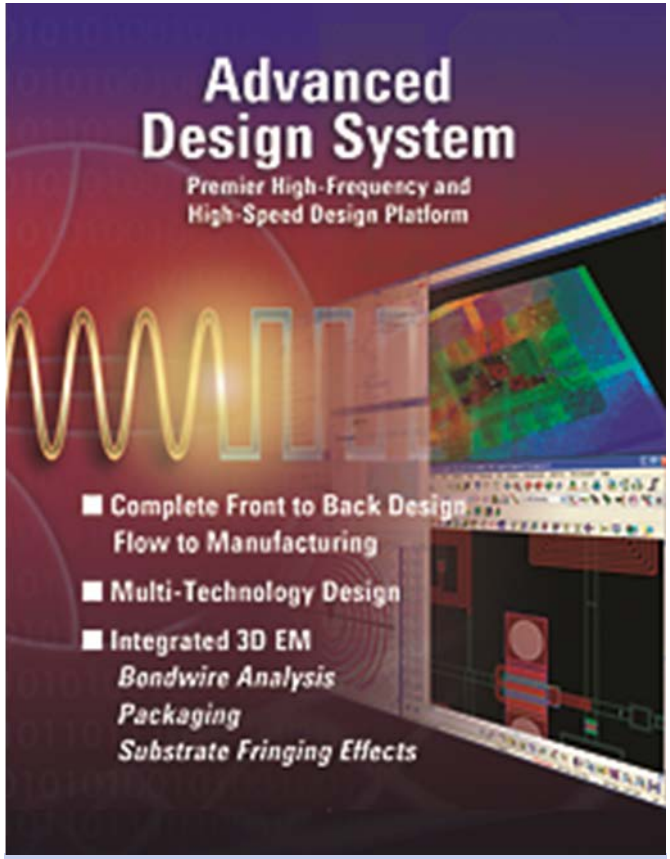
Amalfi AM7802
PA Front End Module

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Summary

- RF design has moved to complex ICs in multi-chip RF modules
- Today's design flows are not able to address multiple technology design
- The IC, laminate, package, and PCB need to be designed together
- Electro-magnetic interactions between substrates need to be modeled
- ADS 2012 EDA software is able to address these multi-technology design challenges



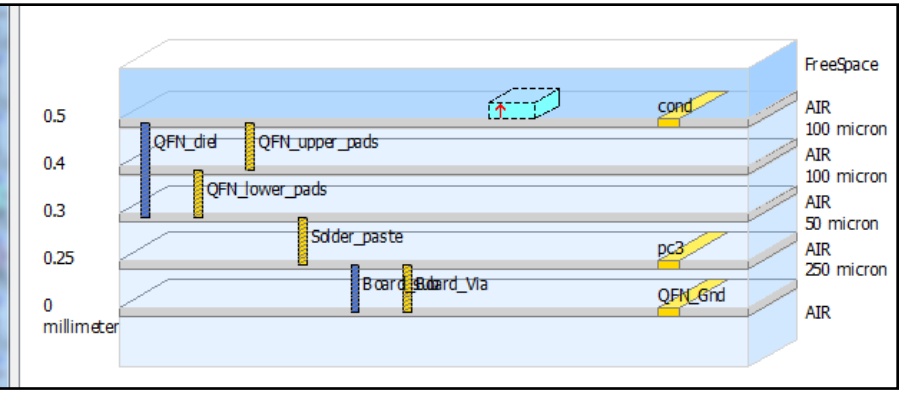
Keysight EEsof EDA
"Innovative Solutions, Breakthrough Results"

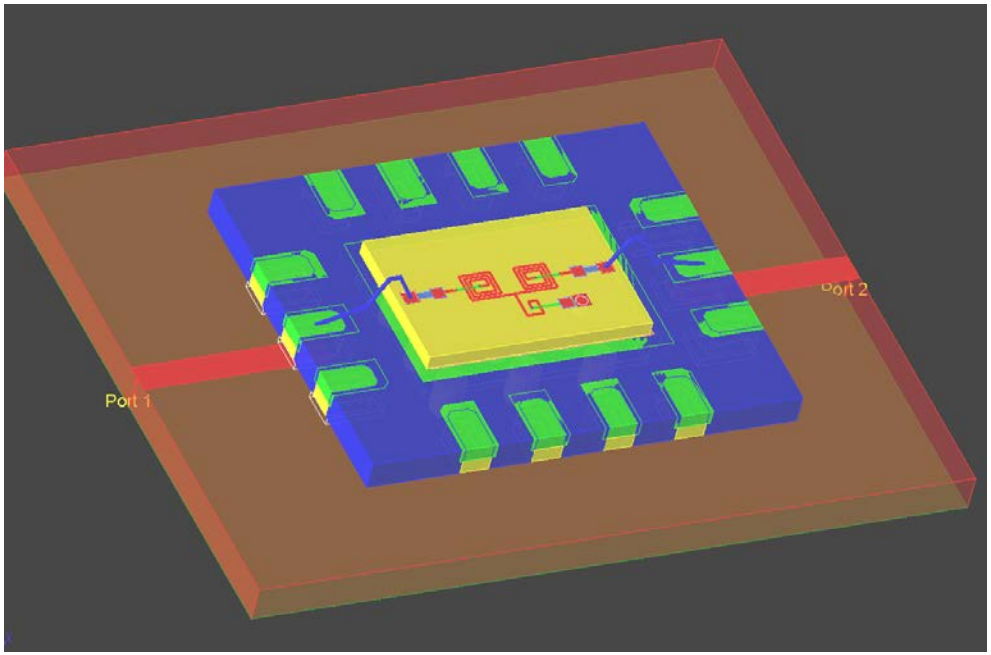
KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Hands-on Workshop Available

- A Hands-on Workshop is available for training





KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies

Workshop Outline

Copyright © 2014 Keysight Technologies

You Are Invited

Dr. Larry Dunleavy, President & CEO Modelithics Inc.

www.keysight.com/find/eesof-innovations-in-eda
www.keysight.com/find/eesof-webcasts-recorded

KEYSIGHT TECHNOLOGIES

Copyright © 2014 Keysight Technologies