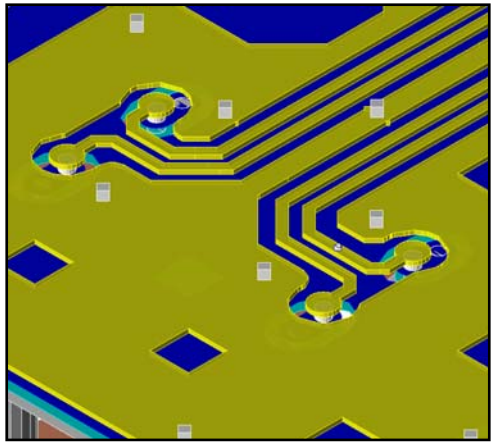
EM Insights Series



Episode #5:
BGA Package Simulation

Agilent EEsof EDA
October 2008

Application Overview

Typical situation

A BGA package is very popular package style for high speed digital applications due to high density, low thermal resistance, and low inductance leads. In a BGA package, the electrical connections are made of solder balls stuck to the bottom of the package. However as the operating frequency and data rate go up, it is critically important for IC designers to understand the package's electrical performance because of the parasitics that can come from the package.

Potential users and targeted market

- IC design engineers, package engineers
- Controller, memory, or other SERDES IC design house both in computer and telecom industry

EM product used

- Momentum: http://www.agilent.com/find/eesof-momentum

Design Challenges

Design challenges

BGA is a very popular package style for high speed serial applications. However, a package is the second most expensive part next to the silicon and can add 6 to 8 weeks to the cycle time. Given the very tight opportunity window for the majority of digital products, a failure to produce a successful package design can significantly reduce the profit margin or even kill the entire project. Designers are challenged to get the desired package performance right the first time. It requires fast and accurate analysis of BGA packages with EM simulators.

- Simulation setup and process are very complex with non-integrated design tools
- The accuracy of some commercial EM simulators is not good enough

Problem solved

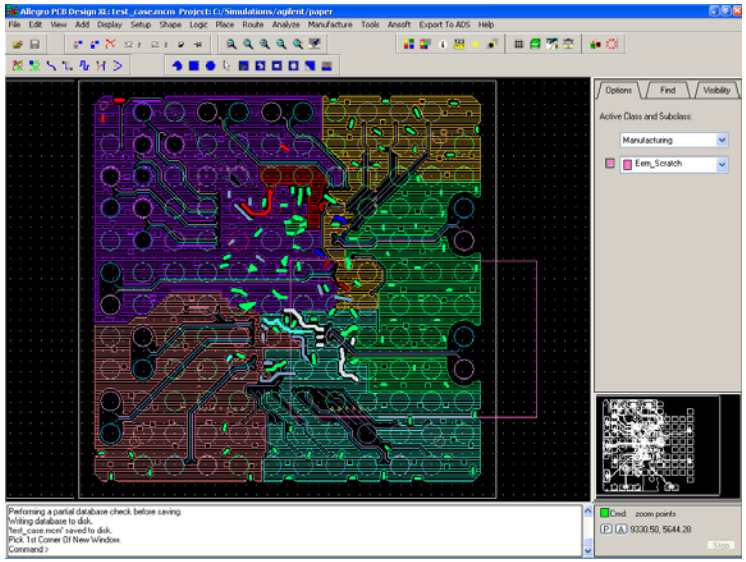
A 45 mm package is simulated for high speed traces and simulated performance is compared against measured data

Value delivered

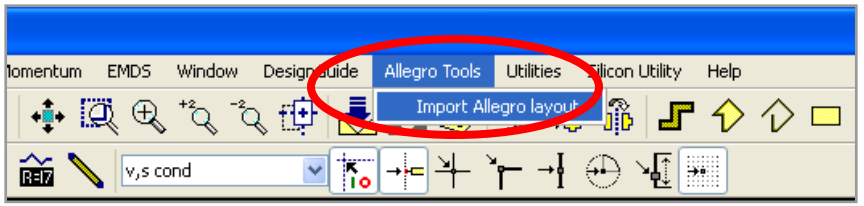
Simulation accuracy is the important factor for high speed applications. A robust, fast, easy to use, and accurate package simulation flow with Momentum provides first pass design success!

Package Layout Import Process (APD → ADS)

APD/Allegro Momentum Export Setup → Select Critical Nets or Entire Layout → Select Stackup Layers → Cookie-cut Power and Ground Planes Portion → Verify Layout using 3-D Preview and Simulate → Ground Ref Port Adjustments if required → Import in ADS Layout → Export to ADS Layout → Create Ports



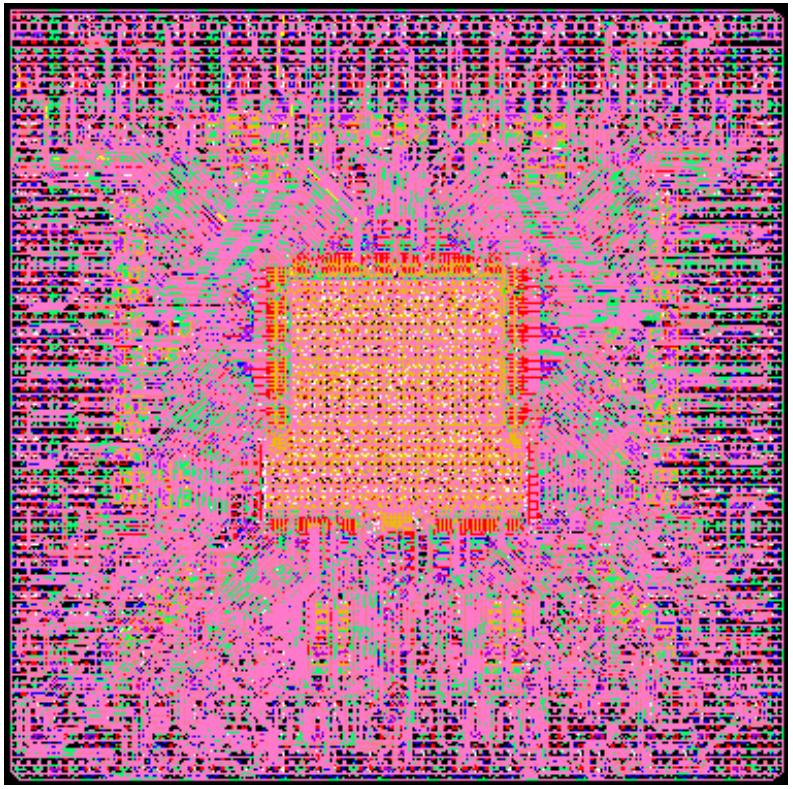
Simple and Easy Translation to Momentum



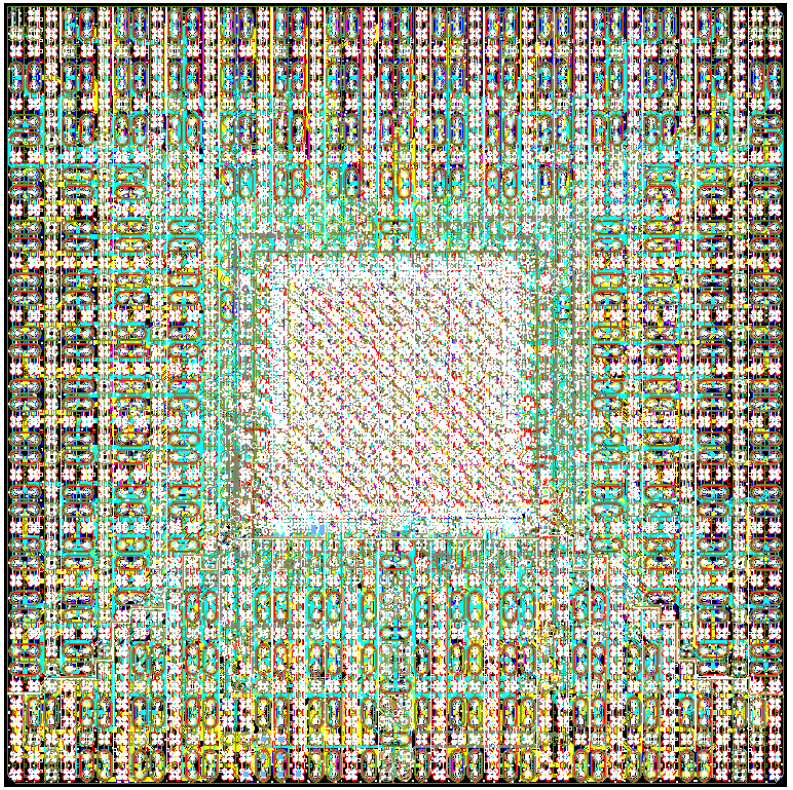
Agilent Technologies

Entire Package Layout in Allegro and ADS

Allegro View

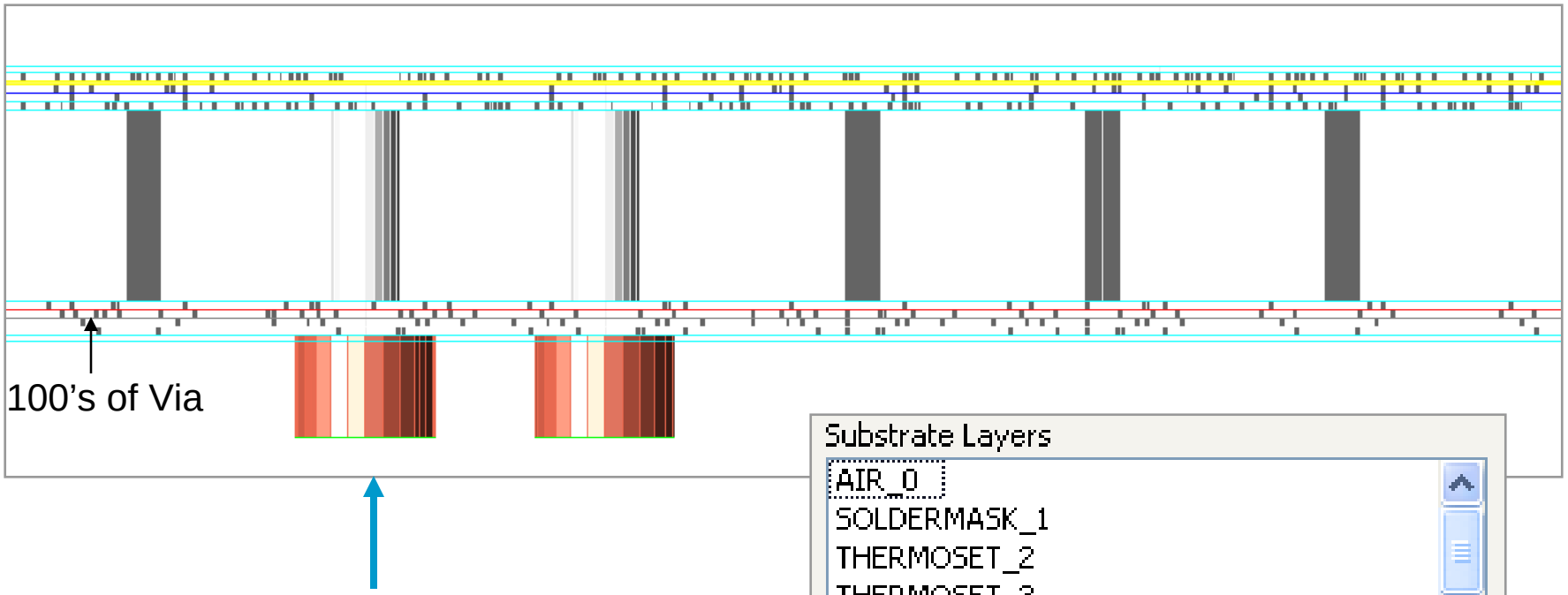


ADS View

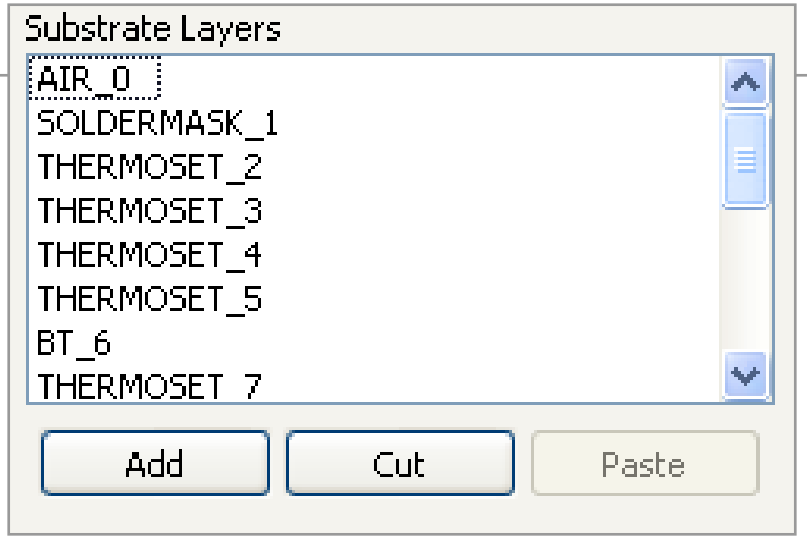


The critical high speed nets need to be accurately simulated to ensure the required signal integrity performance.

BGA Package and Stack-up (Side View)



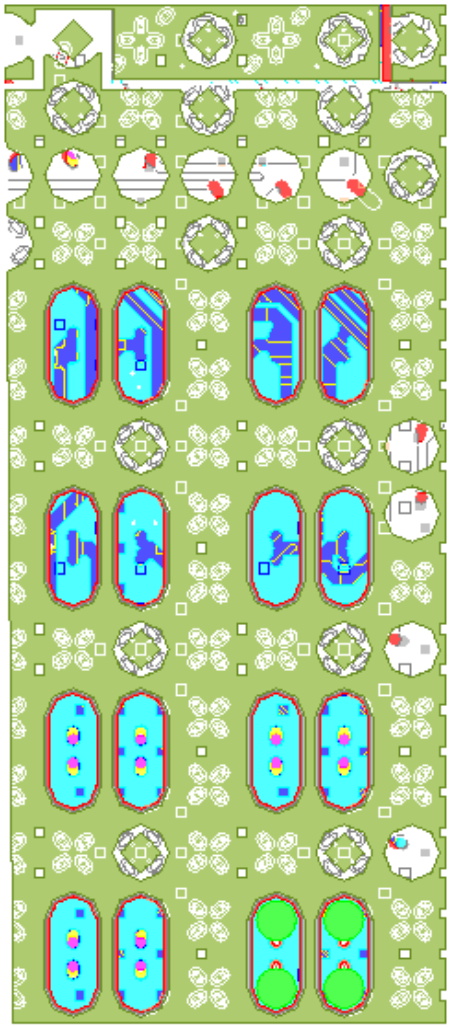
BGA balls models in Momentum

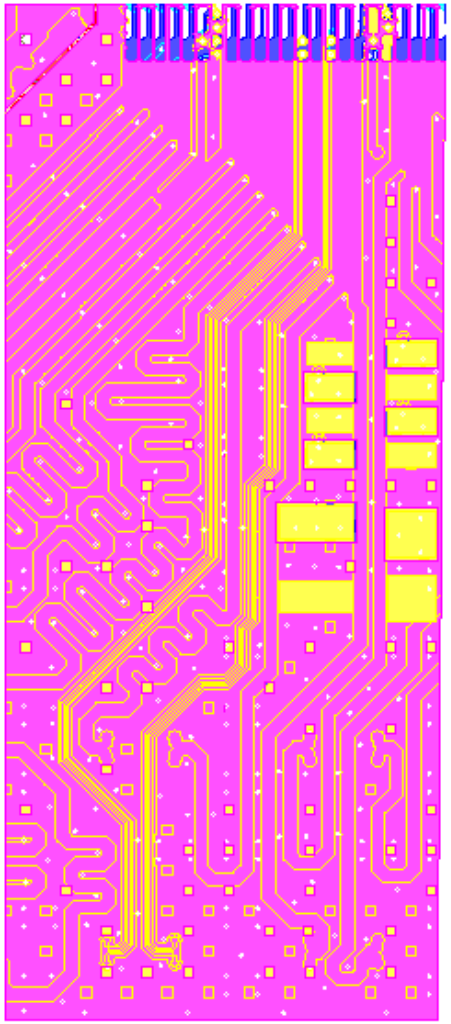


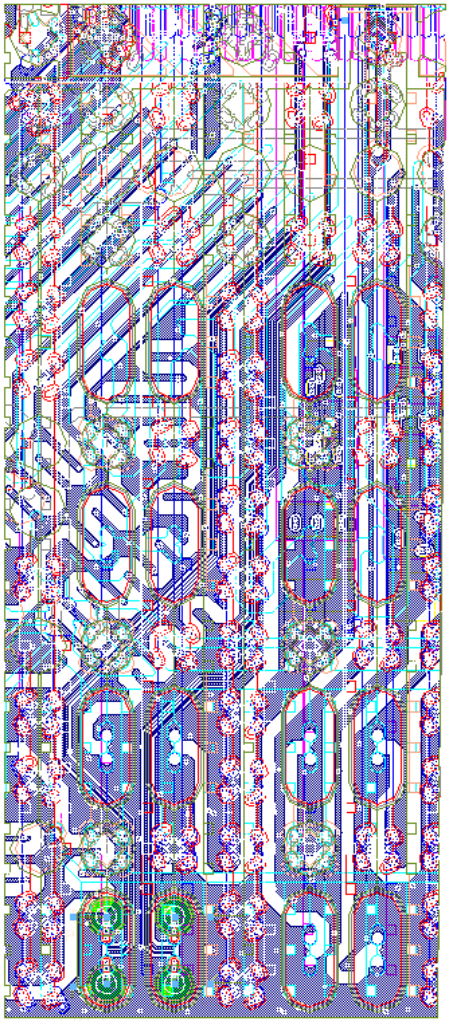
The package structure contains:

- 100’s of micro via
- 10’s of core via
- BGA balls

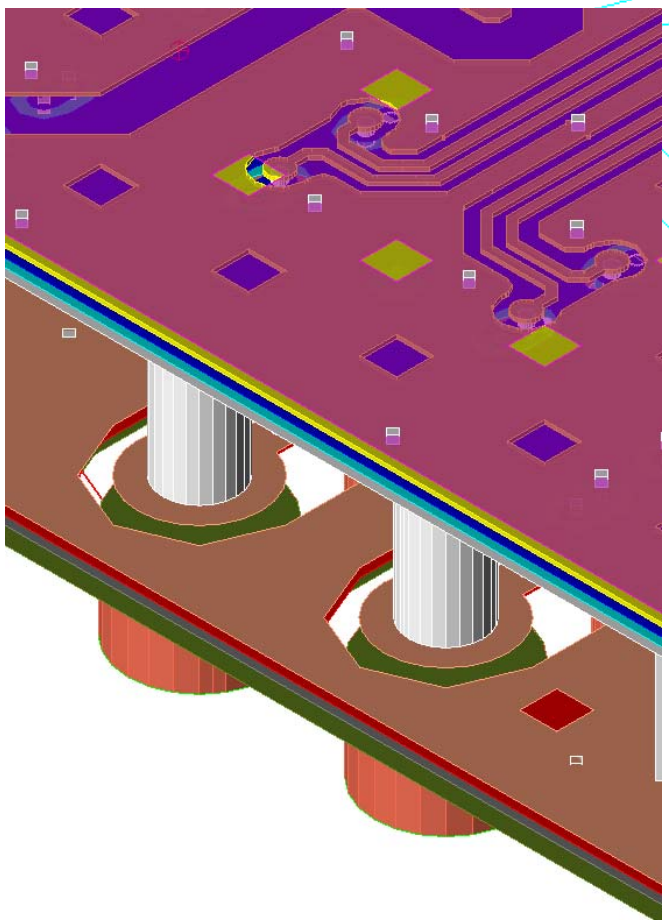
Critical Portion of BGA Package for EM Simulation

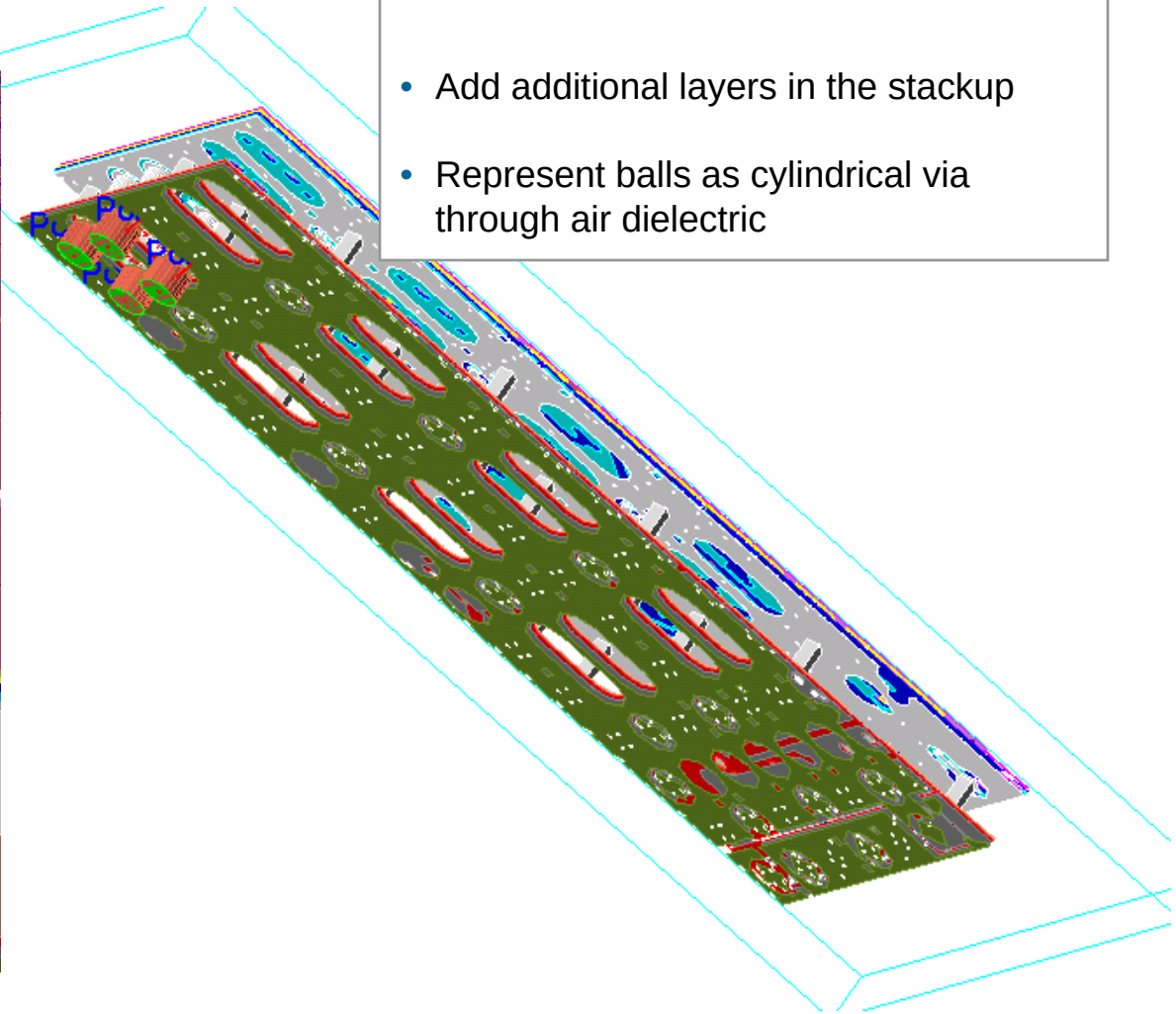






Modeling BGA Balls in Momentum





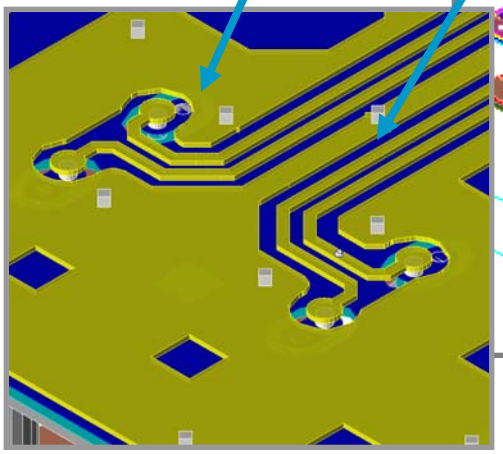
To model BGA balls:

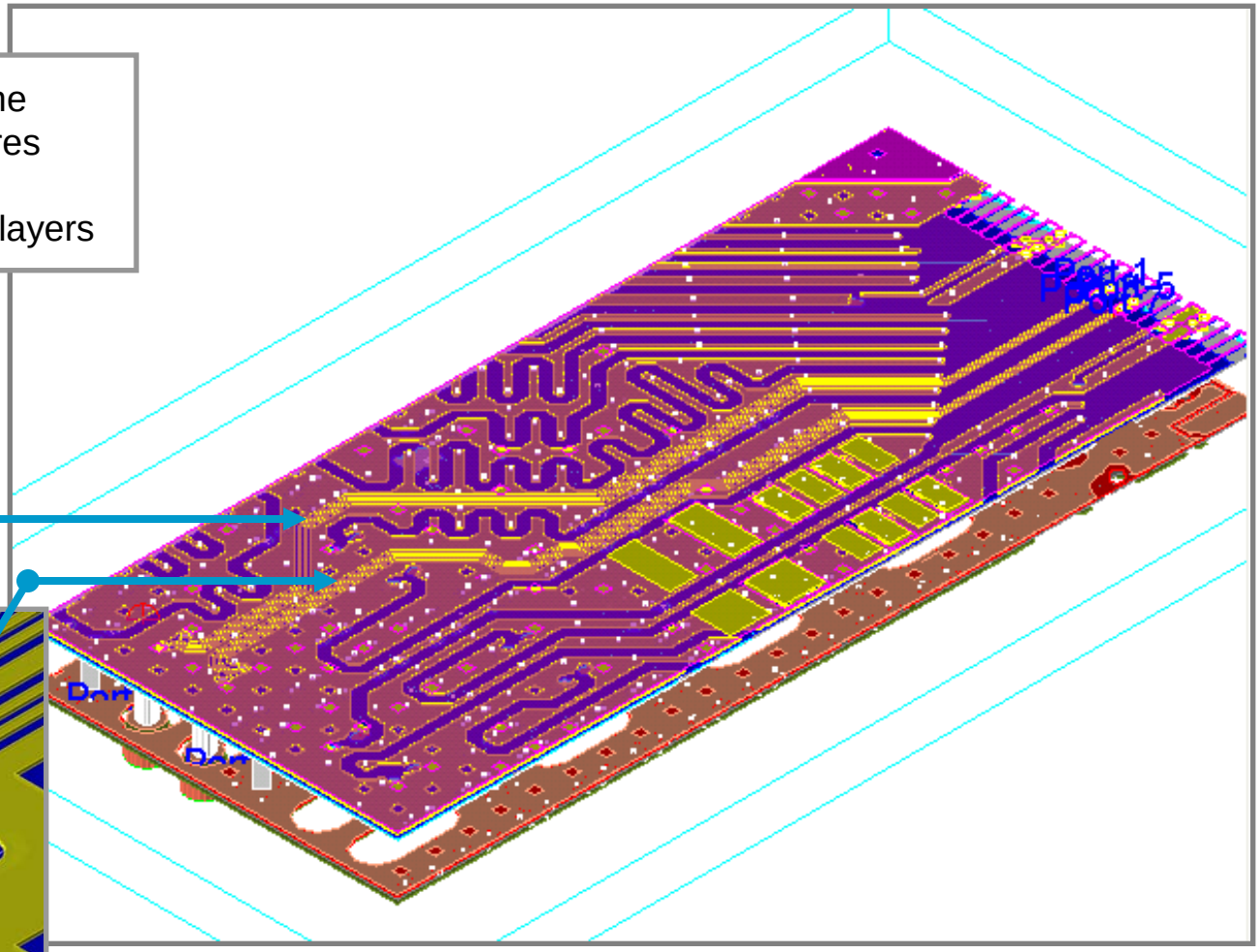
- Add additional layers in the stackup
- Represent balls as cylindrical via through air dielectric

BGA Package (45 mm)

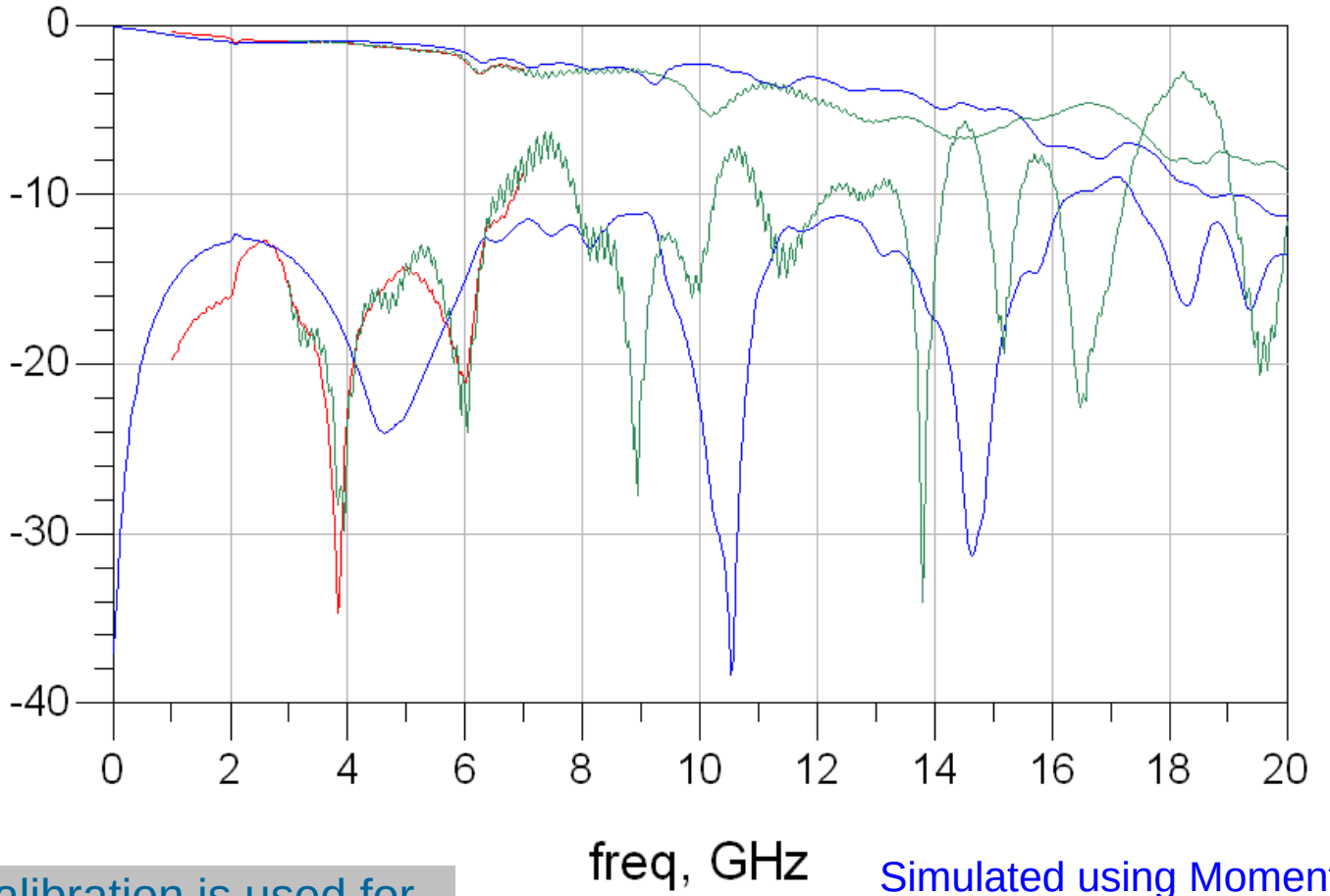
- Use finite thickness for the transmission line structures
- Use strip metal for other layers

Differential Pair





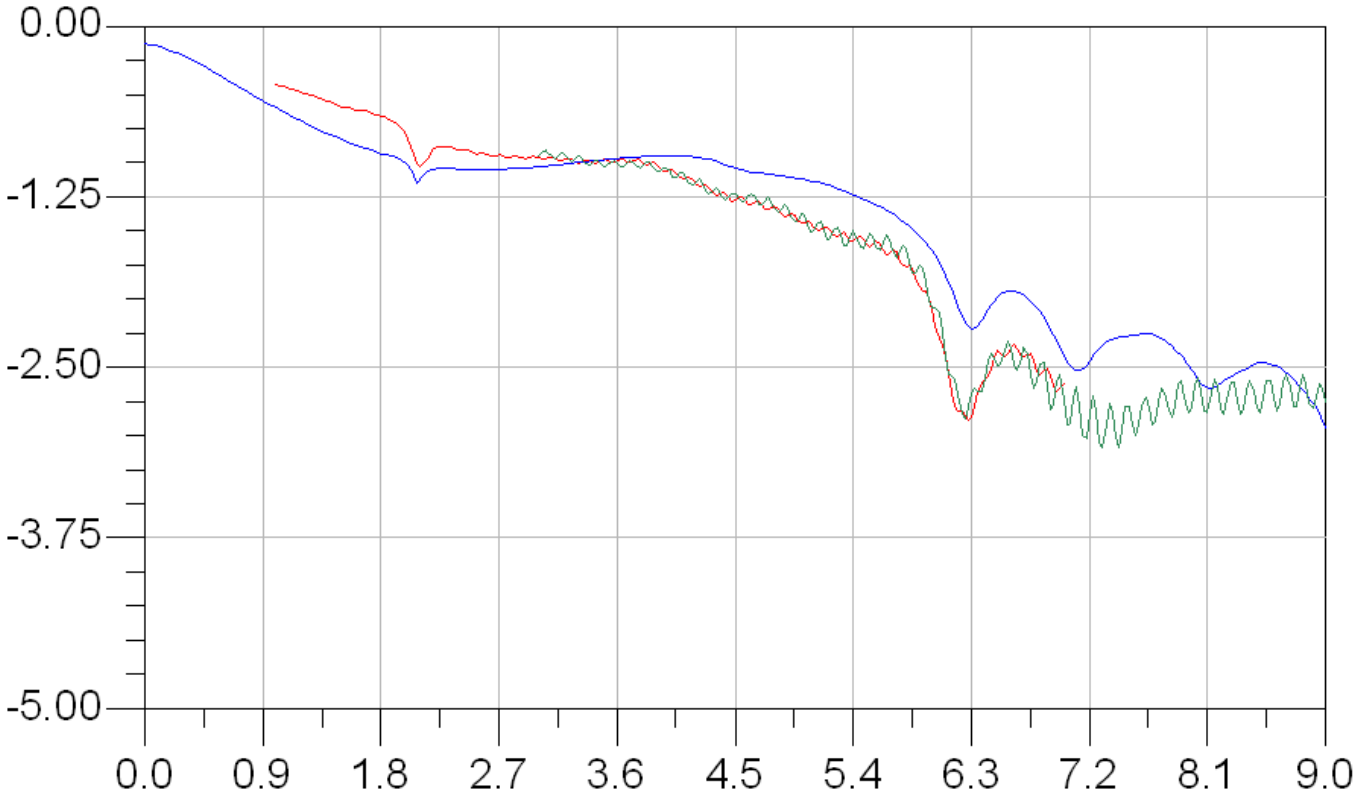
Measured vs. Simulated (S11 & S21)



TRL calibration is used for this package measurement

Simulated using Momentum
Measured using VNA (1-3 GHz)
Measured using VNA (3-20 GHz)

Measured vs. Simulated (Finer Scale for S21)



Excellent match with measured data.

EM Insights Series

Episode #5: BGA Package Summary

Fast and accurate analysis of BGA packages with Momentum helps you to get the desired package performance right the first time

Interested in learning more about this application?

- Request an evaluation copy of Momentum

  http://www.agilent.com/find/eesof-ads-evaluation

- Request a demo of Momentum

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

www.agilent.com

For more information about Agilent EEsof EDA, visit:

www.agilent.com/find/eesof

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

www.agilent.com/find/contactus

Contact Agilent at:

Americas

Canada (877)	894-4414
Latin America	305 269 7500
United States	(800) 829-4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Thailand	1 800 226 008

Europe & Middle East

Austria	01 36027 71571
Belgium	32 (0) 2 404 93 40
Denmark	45 70 13 1515
Finland	358 (0) 10 855 2100
France	0825 010 700* *0.125 €/minute
Germany	07031 464 6333
Ireland	1890 924 204
Israel	972-3-9288-504/544
Italy	39 02 92 60 8484
Netherlands	31 (0) 20 547 2111
Spain	34 (91) 631 3300
Sweden	0200-88 22 55
Switzerland	0800 80 53 53
United Kingdom	44 (0) 118 9276201

Other European Countries:
www.agilent.com/find/contactus

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, March 31, 2009
5989-9985EN

Agilent Technologies