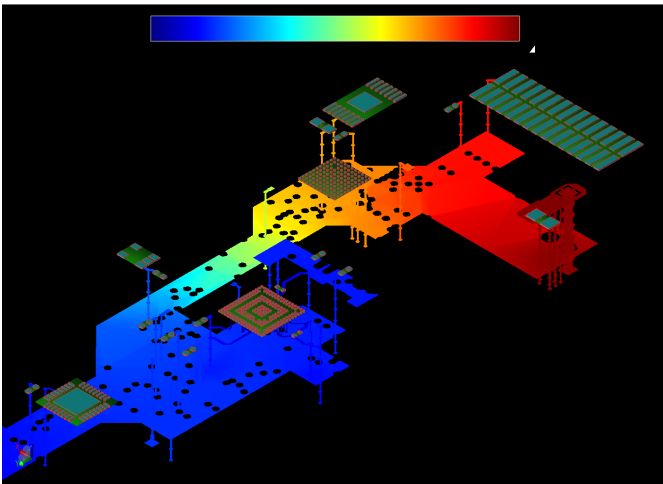
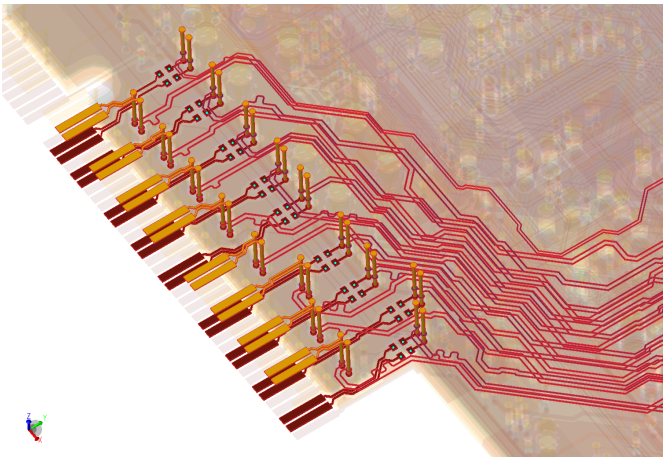


Keysight Technologies

Advanced Design System (ADS)

W2360EP/ET SIPro Signal Integrity EM Analysis

W2359EP/ET PIPro Power Integrity EM Analysis



Data Sheet

Composite EM technology
delivers high-accuracy and
faster results, all within
Advanced Design System

New Cohesive Workflow Redefines SI/PI Solutions

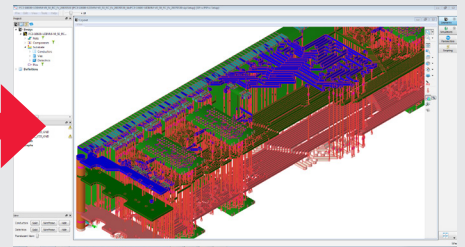
Signal Integrity (SI) and Power Integrity (PI) are often treated as separate design tasks that are closely interrelated, with the same end-goal for a design: Ensure high-speed link performance and system-level reliability.

Consider now a single user interface for both PI and SI analyses, where one setup can be easily copied from one analysis-type to another, with simulations run in the same environment. In ADS, SIPro and PIPro deliver this ideal, sharing a common GUI, workflow, model database, and results visualization; eliminating the need to switch between different point tools, and allowing better collaboration between engineers. Furthermore, with the high-capacity EM solvers in SIPro and PIPro, it is no longer necessary to spend hours manually simplifying designs, reducing size by cookie-cutting and removing layers and nets, that is typically required with general purpose EM tools.

Design import

PCB layout designs imported to ADS using:

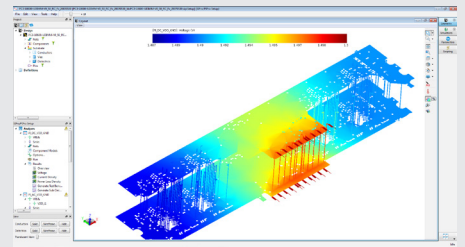
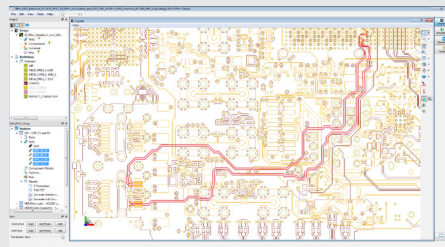
- ODB++
- Direct .brd (Cadence Allegro)
- ADFI (Cadence Allegro)



SI/PI analysis

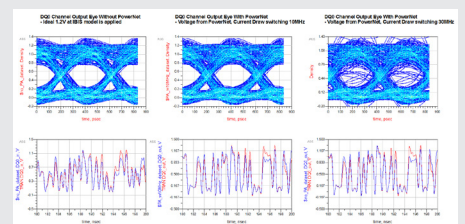
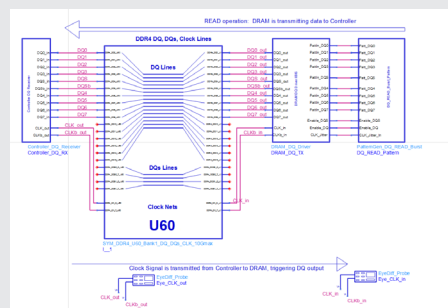
5 Simulation Engines

- DC IR drop analysis
- AC PDN impedance analysis
- Power plane resonance analysis
- Power-aware signal integrity analysis
- DC IR Drop Electro-Thermal
- Thermal-Only Mode



ADS schematic-level analysis

- Transient convolution simulation
- Channel simulation
- DDR bus simulation
- Compliance test benches
- Connect SPICE models and Chip Power Models
- PDN EM model + behavioral VRM



SIPro A Fraction of the Full Wave 3DEM Simulation Time

SIPro provides signal integrity analysis of your high-speed PCBs. It empowers you to characterize loss and coupling of signal nets, signal and power nets, and complete ground nets at once. The resulting EM model can be transferred to the ADS Transient and Channel Simulators in one seamless flow.

Speed and accuracy

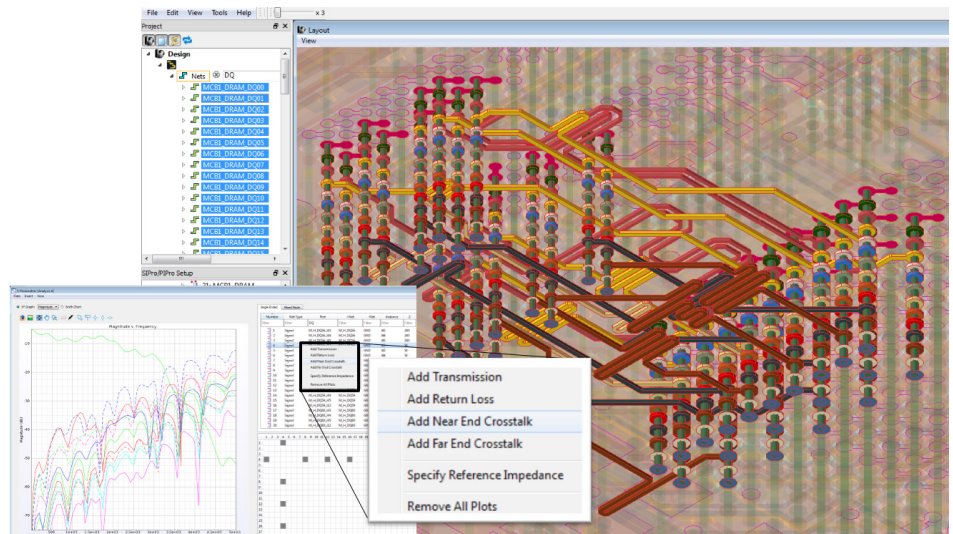
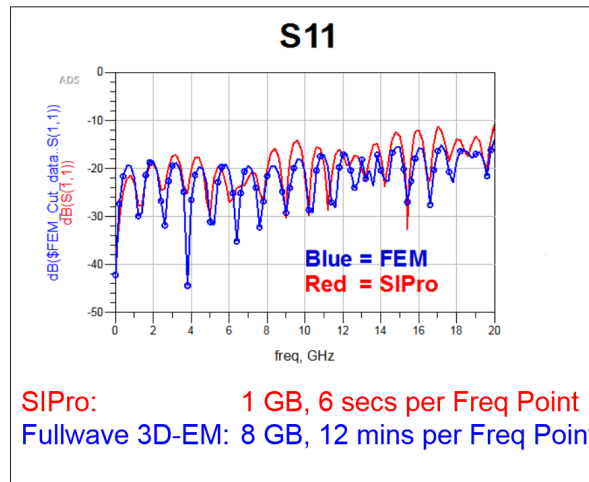
- Innovative composite EM technology for fast and accurate simulations of large, complex PCB designs
- Based on pure EM technology that delivers accuracy approaching industry-standard 3D EM solvers, in a fraction of the time
- Focused net-driven use-model specifically for SI/PI, to be much faster and more efficient than general purpose EM tools
- EM effects captured:
 - All relevant signal coupling
 - Accurately modeled ground return paths, cut-outs and drills in GND/PWR planes
 - Via-via coupling
 - Via transition effects
 - Via-GND/PWR coupling

Layout to results in less than 20 clicks

- No layout simplification required!
- Net-driven setup
- Guided port creation
- Quickly plot all crosstalk elements from the same component

Innovations in EM - Mesh Domain Optimization

- SIPro optimally reduces the problem size to solve of the final mesh. Removing areas of the mesh that will have no bearing on the simulation results.



SIPro

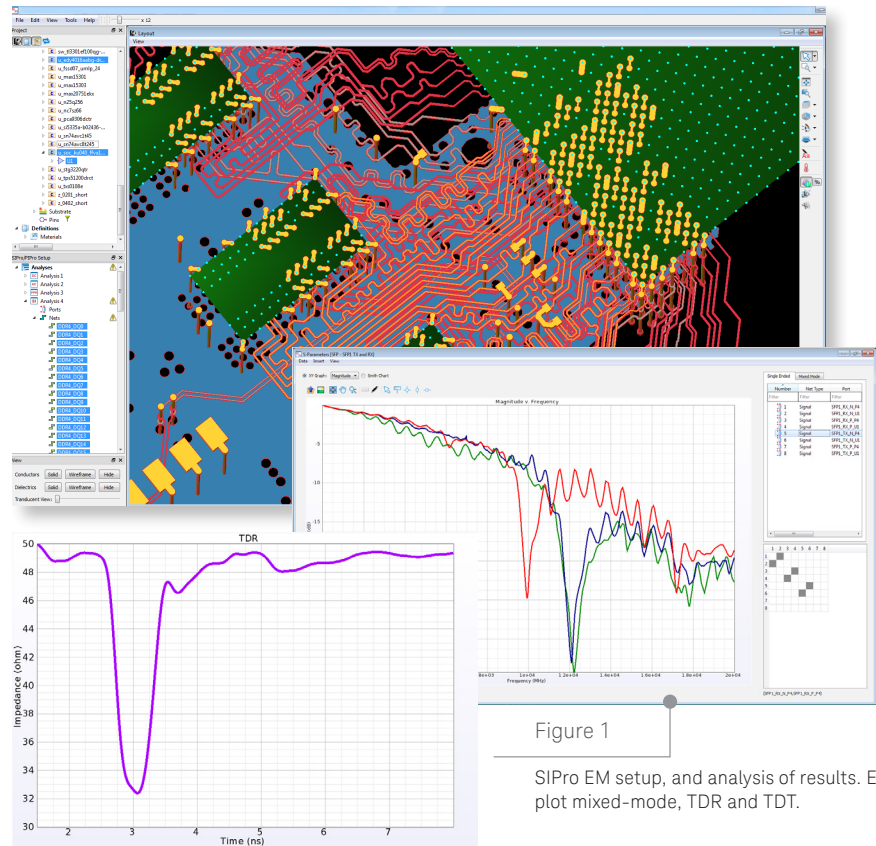
The following analyses can be performed in SIPro:

EM model extraction

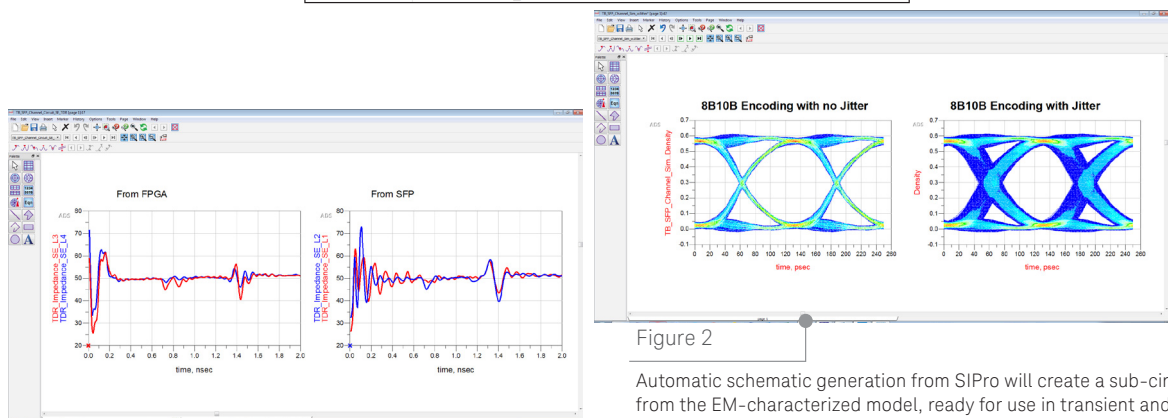
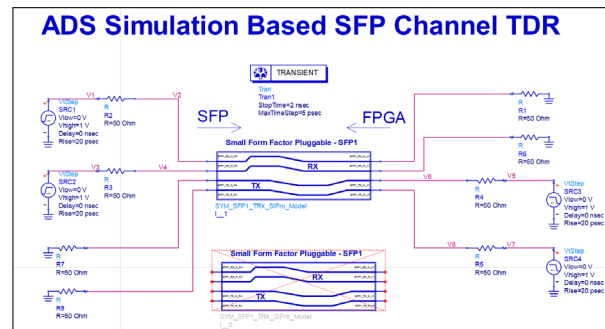
- Generate an EM-accurate model that captures signal-net losses and coupling
- Filter by port, by net, by impedance, for quickly finding and plotting the desired relationships
- Frequency domain S-parameter results
- Time domain TDR and TDT results
- Mixed-mode S-parameters (e.g. Differential to Common mode conversion)
- Fast plotting of crosstalk (NEXT, FEXT)
- Fast change of reference impedances for plotting without resimulation

Complete channel analysis

- With Automatic Schematic Generation, the extracted EM model flows directly into an ADS transient simulation and ADS channel simulation



SIPro EM setup, and analysis of results. Easily plot mixed-mode, TDR and TDT.



Automatic schematic generation from SIPro will create a sub-circuit from the EM-characterized model, ready for use in transient and channel simulations.

PIPro Accurate and Efficient Net-Driven PI Analysis

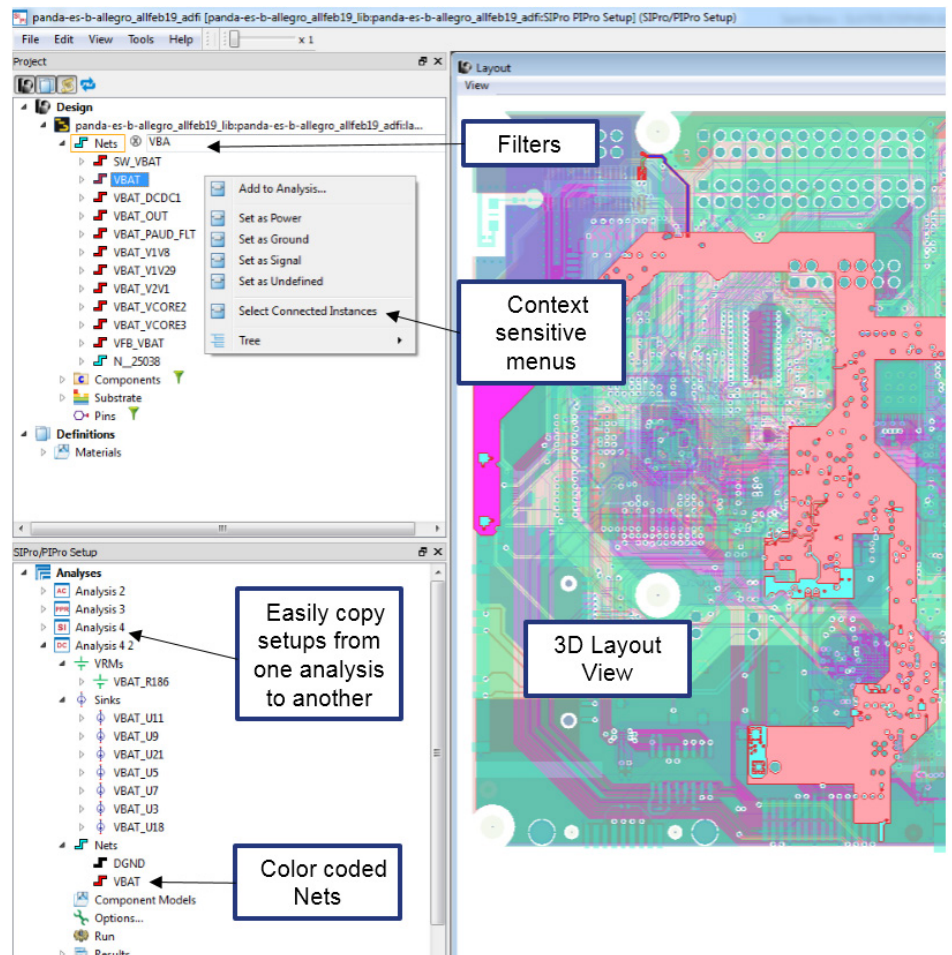
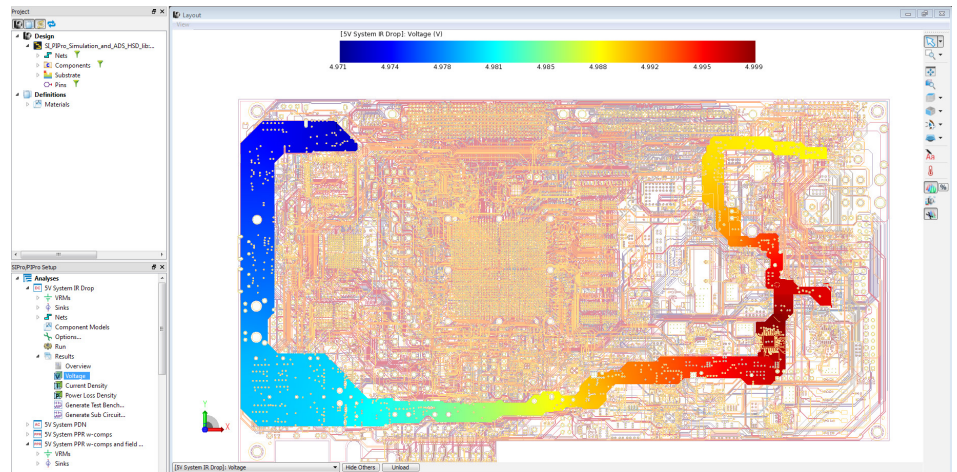
PIPro provides power integrity analysis of your power distribution network (PDN), including DC IR drop analysis, DC IR Drop Electro-Thermal analysis, AC impedance analysis and power plane resonance analysis.

Speed and accuracy

- Pure EM-based solution
- DC IR drop analysis
- AC PDN impedance analysis
- Power plane resonance analysis
- DC IR Drop Electro-Thermal analysis
- Thermal Analysis
- Bill of materials optimization utility for best decap and inductor selections

Designed for usability

- Full-time 3D view of layout, selected nets, ports and components
- Filter by Net
- Filter by Component
- Right-click to add-to-analysis
- Drag & Drop
- Hierarchical search for complex selections
- Context sensitive menus e.g. ‘Select instances connected only to all selected nets’
- Quickly compare two sets of results with the “Compare-To” feature



PIPro

The following analyses can be performed in PIPro:

DC IR drop analysis

- Voltage delivered to each sink, and failures based on user-defined tolerances
- Current flow through each via, with over-current failures reported. Current limits are set proportionally to the area of the via, an equation that is editable by the user
- 3D power dissipation visualization
- 3D voltage distribution visualization
- 3D current density visualization

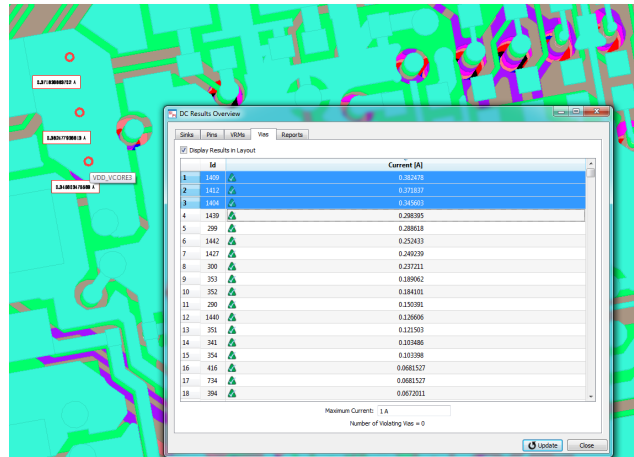


Figure 3

Excessive DC current flowing through individual vias, are reported and highlighted in the 3D-geometry.

Power plane resonance analysis

- Analyze self-resonances of the PCB and inspect trouble areas that have the highest field strength
- Report self-resonant frequencies and quality factors for the PDN
- 3D field plots

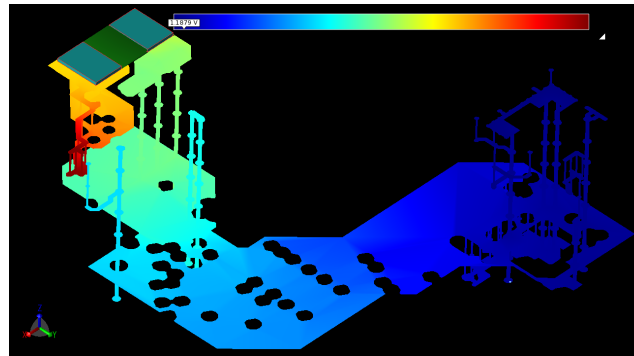


Figure 4

Visualization of DC voltage distribution within the PDN.

Results reporting

- Power Tree Representation
- Comprehensive output reports (html and docx formats)

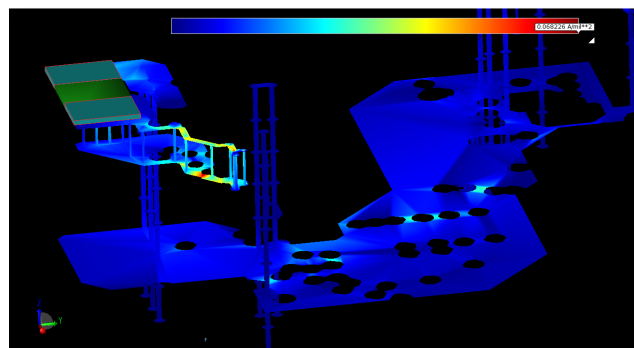


Figure 5

Current density plot highlights areas where resistance is high, and quantifies the Amps per mm^2 .

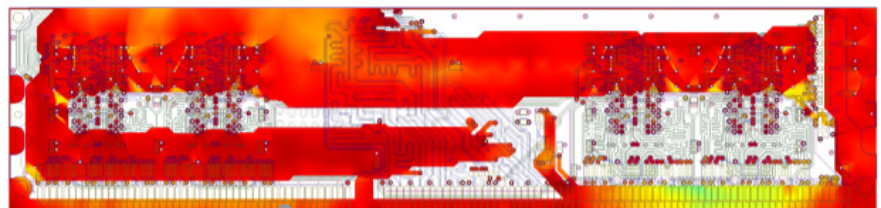
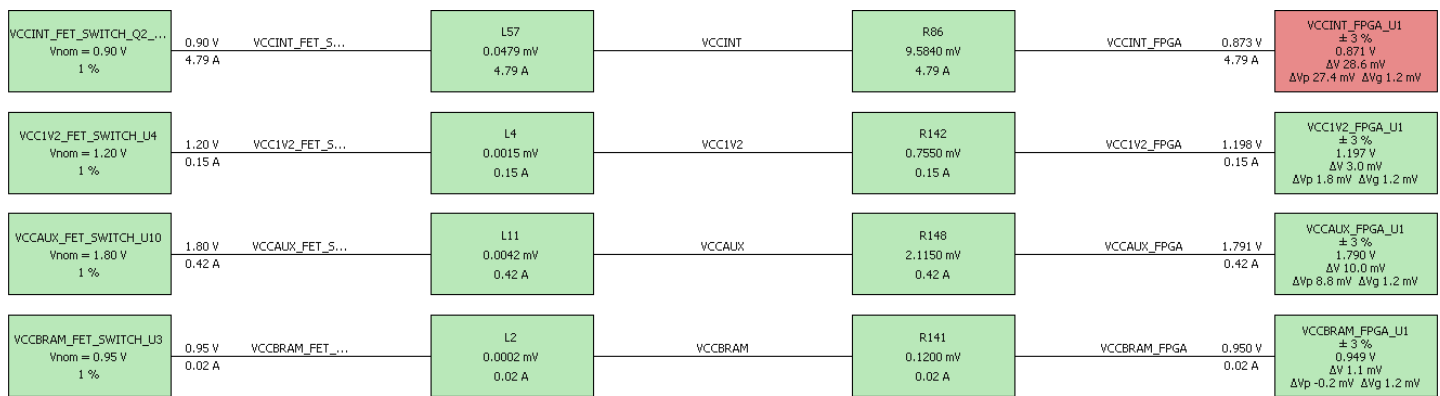
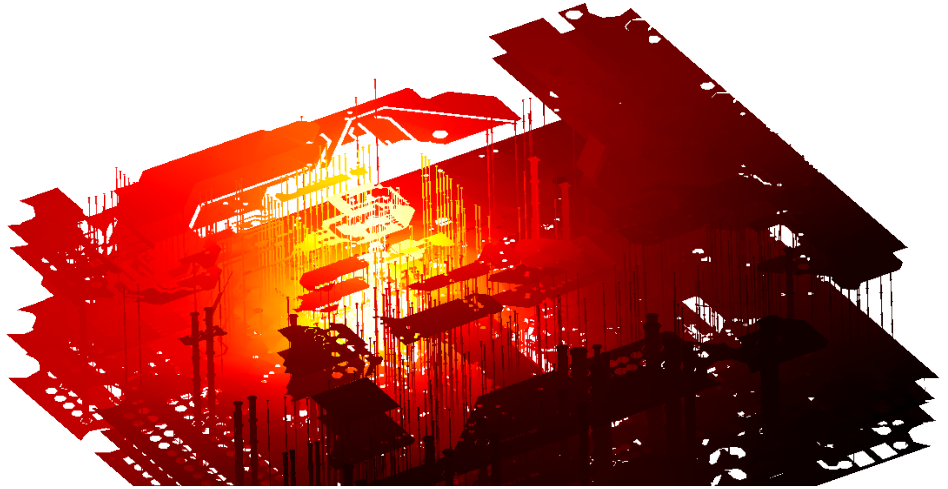


Figure 6

Power plane resonance analysis finds resonant frequencies of the board, and shows the E-field to locate the problematic region of the board.

DC IR Drop Electro-Thermal

As power delivery networks are forced into tighter PCB real-estate, the power plane becomes far from idealized. The power and ground planes become heavily perforated with clearance holes from signal vias and stitching vias. It can be a struggle for the layout engineer to get the required current up into the package of the device that requires it, without passing through narrow traces of metal. Calculating an accurate IR-Drop is important for the PI designer, but also knowing the absolute temperature that the PDN traces, vias and chip die will reach, is invaluable information. High temperatures can cause reliability issues; as the temperature cycles from on/off states can cause the via barrels to weaken and crack over time.



It is not intuitive to the designer whether a via is undersized for the current that is passing through it. The temperature rise is very dependent on the width of the traces attached to it. Secondly, resistance of a trace increases with temperature, requiring simulation analyses to determine the final steady state condition. For every 10 degC change in temperature we see a 4% change in resistance of a trace.

These observations point to a need to simulate the PDN design with a DC IR Drop Electro-Thermal solution.

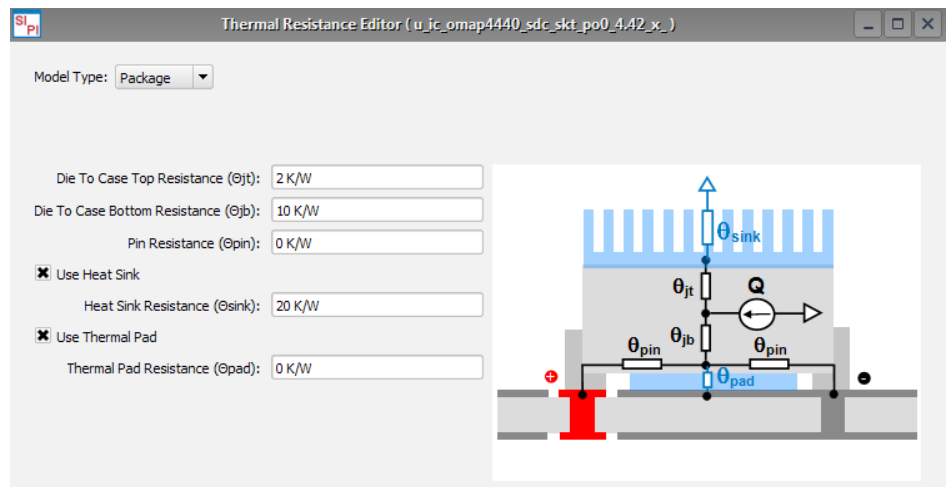
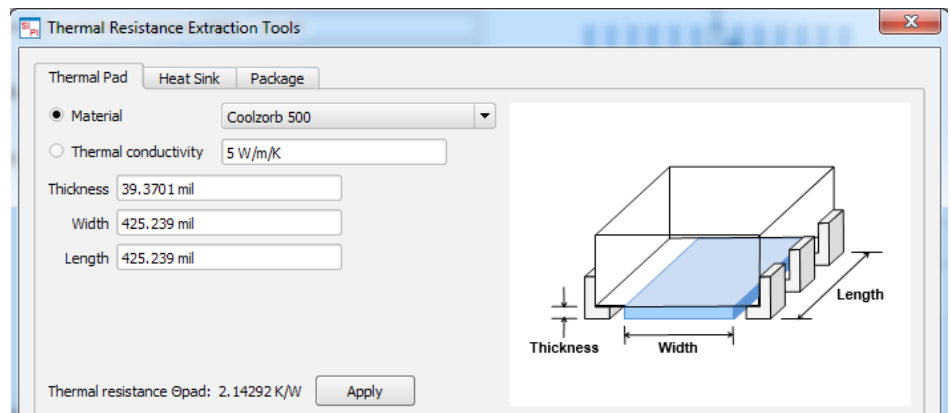
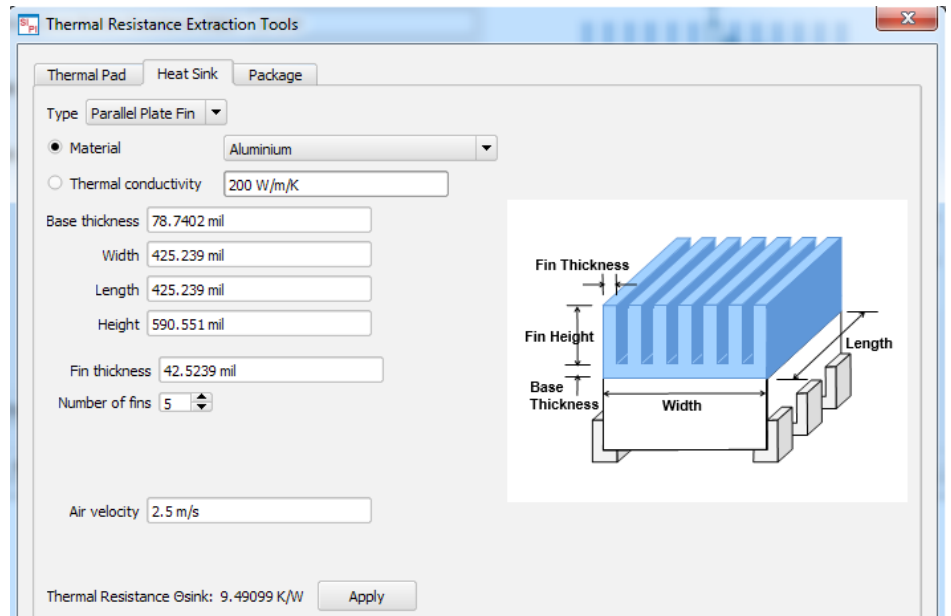
Feature benefits:

- Fully-automated integrated Electro-Thermal iterative simulation
- Easily copy existing DC IR Drop simulation setup to new Electro-Thermal simulation
- Visualize and list the temperatures of planes, pins, vias and devices
- Most accurate representation of DC IR Drop results by taking into account local resistivity changes due to heating
- Test potential cooling solutions such as increasing the heatsink size, or increasing airflow
- Additional Thermal-only simulation, gives the user the ability to perform thermal floor planning

DC IR Drop Electro-Thermal (Continued)

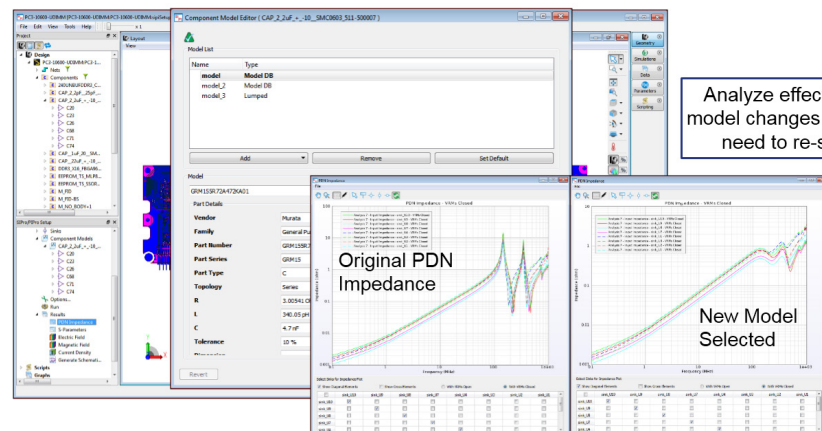
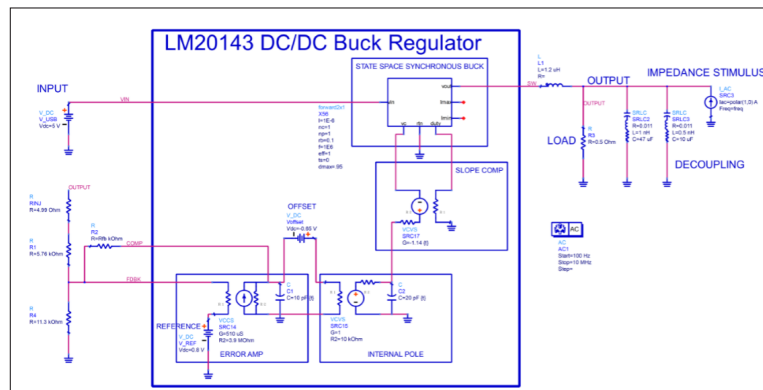
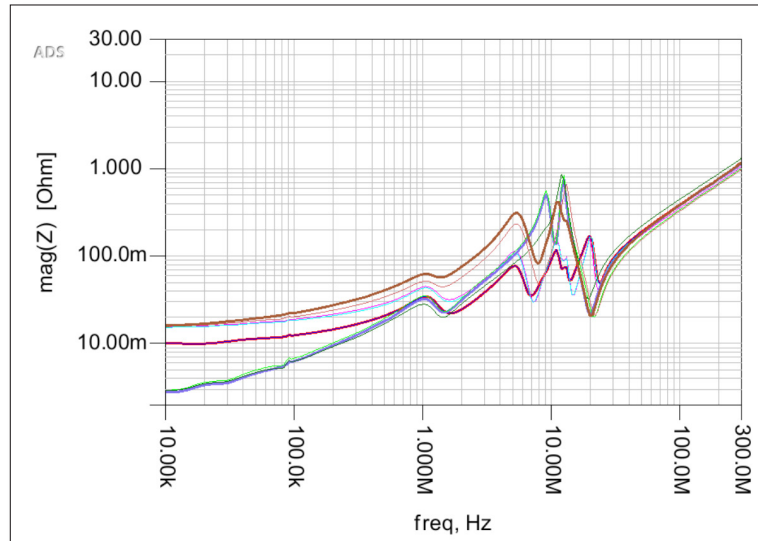
Unique features:

- Single consistent mesh for conductors used in both DC and Thermal sims, resulting in greater accuracy
- Electro-Thermal solution can account for multiple mixed heating sources, such as joule-heating, heat power from devices, and fixed temperature sources
- 'Compare-to' reporting allows direct comparison of two simulation results
- Wizard tools to synthesize thermal parameters for heatsinks, heat pads and packages



PDN Impedance Analysis

- Easy setup: Select nets, filter, drag and drop component. Guided port creation
- PDN impedances vs. frequency
- S-parameter model extraction of PDN for further simulation in schematic
- 3D field plots and current density plots
- Decap tuning – quickly see effects of changing decap values without re-simulating
- Completely flexible PDN optimization strategy from schematic
- Component model assignment:
 - Lumped
 - SnP
 - Murata
 - Samsung
 - TDK
 - Create custom parts from schematic models
- Full scripting support for setup, advanced automated simulation and post-processing
- VRM behavioral modeling from schematic together with EM-extracted model of the PDN. An engineering-approach to a flat impedance response!



Bill-of-Materials (BOM) Optimization for Decaps and Inductors

Reference designs for many ICs provide a comprehensive list of decaps that should be placed on the PDN for best performance and reliability. The difficulty is that it doesn't take into account the specific constraints that the designer may have on their PCB (size and layer count). Often there is not enough space around the IC and below the IC, to place all of the decaps, leaving the layout engineer to place the remaining components wherever they fit on the PDN. This practice offers little help to the PDN and can create a resonance that is detrimental to the performance.

BOM Optimization in PIPro can take all the decaps as laid out on the board, and search for the optimal solution that meets the desired target impedance profile.

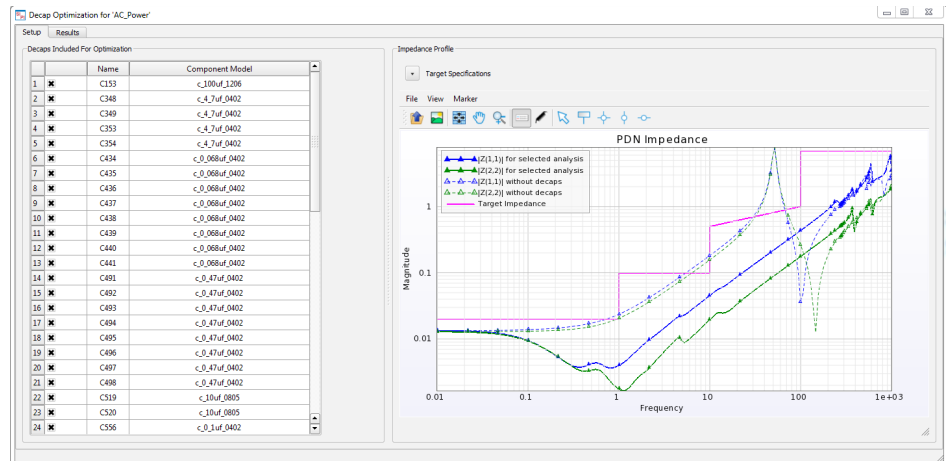
The user can define an optimal solution, by specifying weighted criteria such as:

- Number of decaps
- Number of unique models
- Number of vendors
- Cost

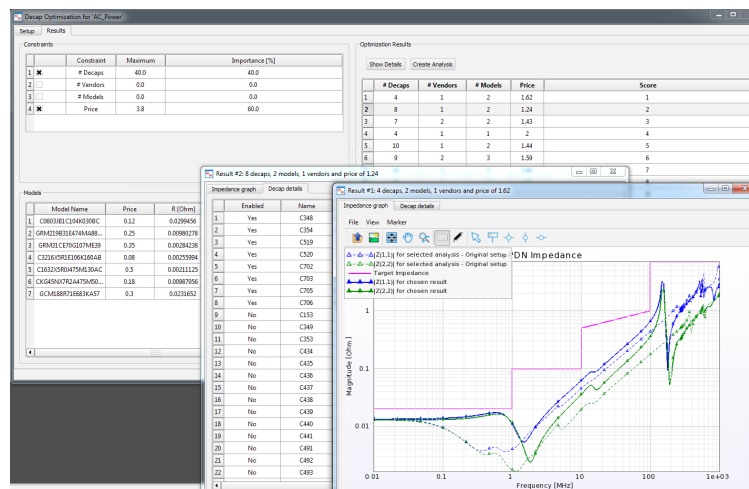
The optimization is fast due to the nature of the intelligent algorithms and the fact that changing decap models does not require a re-computation of the EM solution.

The optimization results are presented as a list of candidate solutions that meet the target impedance, and are ranked according to the weighted criteria.

For each candidate solution, the user can view the PDN Z-impedance and target impedance, to quickly decide upon the best mix of performance and cost-reduction.



The optimizer uses an intelligent algorithm, evaluating the best possible candidate solutions, based on loop inductance. It will enable/disable component electrical models, and swap for alternative models, to find the best solutions.



PIPro Capabilities Summary Table

Summary of capabilities
DC IR Drop including losses in ground planes
Results overview with voltage, current; per pin, via, and layer
Results 'Compare-to', allowing easy comparison between results from different simulations
Voltage, current density and power loss visualization
Easy 'copy-to' command to move current setup to new setup type (e.g. IR Drop to IR Drop Electro-Thermal)
Power Tree results view
Comprehensive output report format
Electro-Thermal
Thermal Only
Wizard tools for synthesis of thermal parameters
PDN Z-impedance simulation
E & H-field visualization
Real-time PDN impedance update (changing decap models doesn't need a new EM sim)
Mesh Domain optimization (optimally reduces mesh size to solve)
Bill of Materials optimization (reduce number of decaps, number of vendors, cost etc.)
Power Plane Resonance simulation
Python scripting interface

SIPro and PIPro Product Configurations

SIPro and/or PIPro can be purchased as individual elements, or pre-configured bundles.

	W2223 ADS bundle	W2224 ADS bundle	W2359 PIPro element ¹	W2360 SIPro element ¹
ADS core environment	✓	✓		
ADS layout	✓	✓		
Transient convolution simulation	✓	✓		
Channel simulation	✓	✓		
Interconnect toolbox	✓	✓		
Momentum EM analysis		✓		
PIPro EM analysis	✓	✓	✓	
SIPro EM analysis	✓	✓		✓

1. Use of SIPro and PIPro Elements require ADS Core Environment and ADS Layout.

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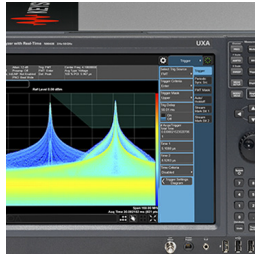
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