

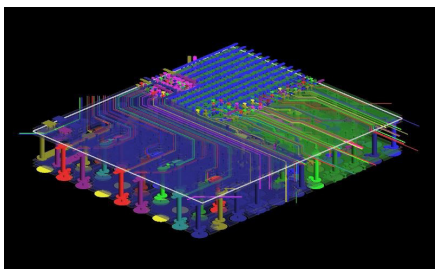
## Electrical Characterization

### Electrical Co-Design and Modeling

Amkor's electrical team members are experienced in the latest simulation tools and packaging technology. This allows our world class electrical team to reduce design cycle times and provide expert advice and services to customers.

Amkor plays a leading role in supporting customers in the development of next generation packages and electronic technology for existing and emerging products. Our unparalleled level of electrical design expertise provides the following "best in class" electrical services:

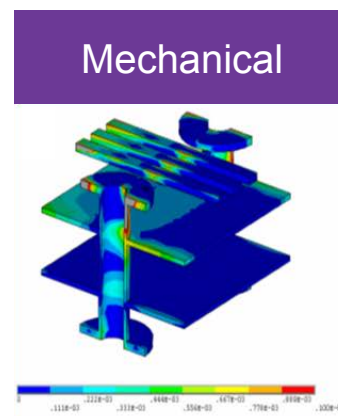
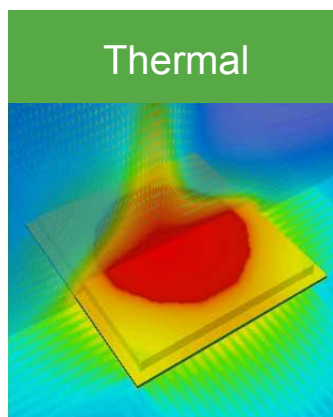
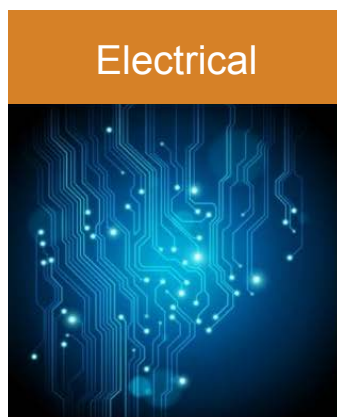
- Highly trained and experienced staff members
- High quality, reliable and accurate designs
- Design for Performance (DFP), Design for Cost (DFC) and Design for Manufacturing (DFM)
- Excellent customer design collaboration to meet electrical, thermal and mechanical requirements



### Going Beyond the Basics

With rapidly increasing data transfer rates, the need to optimize package layout and electrical performance is ever more crucial. Delivering an optimum package design requires more than just a robust layout and post-layout electrical simulation; it requires close interaction with customers and substantial engineering support during the entire layout phase. Amkor's electrical engineering team works closely with customers and package designers to make sure the package layout meets the required signal integrity (SI) and power integrity (PI) performance specifications. Our electrical analysis tools are tightly integrated with package layout tools and the assistance of our design automation team. As a result, electrical constraints can be passed to the design team during the design process, thus minimizing electrical design rule violations. This allows for quicker design turnaround times while delivering a reliable and cost effective solution.

Comprehensive design optimization is possible by using electrical, thermal and mechanical characterization. With Amkor's co-design methodology, signal and power integrity issues can be predicted in a timely manner and fixed well before expensive prototypes are built. Amkor's experts can also help identify and optimize cost-effective thermal and mechanical solutions that satisfy our customers' operating conditions and reliability expectations.



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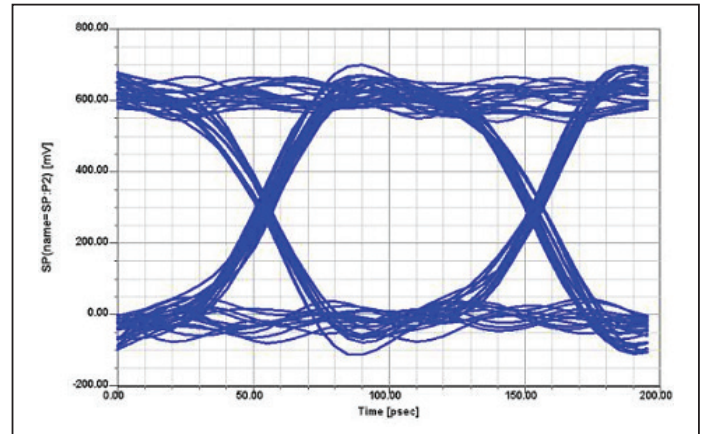
## Signal and Power Integrity

With every shrinking silicon node, faster I/O buffers and decreasing operating margins, signal and power integrity is a critical element of package design. Voltage fluctuations in the power distribution network due to IR drop, Ldi/dt noise or LC resonance seriously impact package performance. At Amkor, we have highly integrated signal and power integrity analysis capabilities. Packages are characterized with multiple simulations by exercising various bus/signal channels with their respective driver/receiver and associated power/ground domains. Amkor uses highly accurate, industry-standard 2D, 3D, quasi-static and full-wave field solvers.

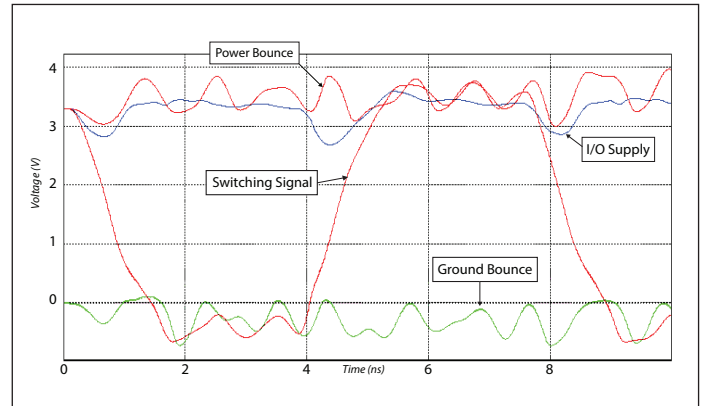
## Package Layout, Electrical Modeling and Simulation Tools

- Cadence APD and SiP
- Cadence/Sigrity UPD
- Mentor xPedition
- AutoCAD
- Ansys Q3D
- Ansys HFSS
- Ansys SIwave
- Ansys Designer
- Ansys Sentinel-NPE
- Keysight ADS
- Keysight Momentum
- Cadence/Sigrity Tool Suite - PowerSI, BBSpice, Speed2000, PowerDC, XtractIM, 3D-EM, T2B, System SI
- Synopsys HSPICE

Eye Diagram



Simultaneous Switching Noise



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