Service Solutions

Electrical Characterization

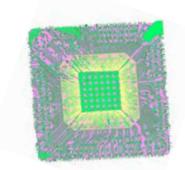
Electrical Package Characterization

The success of today's high-speed digital and RF circuit designs highly depends on model and measurement accuracy including package characterization. Since the package operates in a complex electrical environment, accurate characterization requires a multi-level approach. Amkor's approach consists of a mix of electrical models based on 2-D, 3-D and Full Wave 3-D package simulations in addition to time and frequency domain measurements. Simulation and measurement based design guidelines are used for pre-layout feasibility and design rule generation. 3-D lumped, Full Wave 3-D and measurements can be used for post-layout performance characterization and verification to ensure the design meets electrical specifications. Our analysis capabilities range from a simple lumped parameter (R,L,C) extraction to more elaborate PDS (Power Delivery System) analysis using your own IBIS or Spice buffer models. Whether your silicon is RF, mixed signal, high speed digital or if you are just trying to understand the shielding effectiveness of various shielding options, Amkor has the toolset and experience to optimize and fully characterize your package design.

Electrical Package Co-design and Optimization

As the data transfer rate, gate count and circuit density continue to grow, the impact of package electrical performance on overall system performance is becoming more critical. Today, delivering an optimum package design requires more than just a robust layout and post-layout electrical simulation; it requires close interaction with our customers and substantial engineering support during the layout phase. Amkor's application engineering and characterization group works closely with the package designer to make sure the package layout meets all signal integrity and power integrity performance specifications. Since our electrical analysis tools are tightly integrated with the package and SiP layout tools, electrical rules can be passed to the design team during the design process restricting electrical rule design violations. This allows for quicker design turnaround times while delivering a reliable and cost effective solution.

With Amkor's co-design methodology, signal and power integrity issues such as rise time degradation, crosstalk, I/O bandwidth, IR drop, power ground noise, time delay and ringing can be predicted before expensive prototypes are built.



Signal and Power Integrity

With ever shrinking silicon node, faster I/O buffers and decreasing operating margins, signal and power integrity has become one of the most challenging elements of silicon and package design. This trend causes correspondingly larger voltage fluctuations in the power distribution network due to IR drop, L di/dt noise, or LC resonance. At Amkor, we have highly integrated signal and power integrity analysis capabilities to perform board/system level simulations. Packages are characterized with multiple signal integrity runs by exercising various buss/signal channels with their respective driver/receiver and associated power/ground domains. Amkor uses highly accurate 2-D/3-D-field solvers and integrated methodologies for signal and power integrity analysis.

Our capabilities include:

- Interface to most CAD package design databases including DXF
- · Generate propagation delay reports for entire net or buss
- Perform SPICE simulations on individual nets in coupled and un-coupled analysis
- · Perform crosstalk, reflection, over/under shoot and timing analysis
- Supply customers with package IBIS or SPICE package models for system level analysis
- · Analyze and report skew timing between multiple drivers
- Generate IR drop and current density reports for each power domain
- Generate effective inductance and impedance plots versus frequency
- · Generate SSN waveforms including eye diagrams
- Supply customers with Spice PDS package models for system level analysis
- Select right de-coupling capacitor values and optimize location for best performance

Visit Amkor Technology online for locations and to view the most current product information.



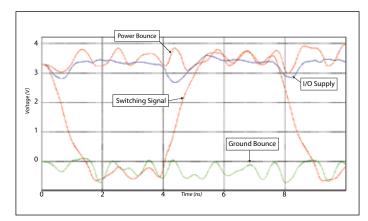


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Modeling and Simulation Tools

- · Ansoft Q3D and 2D Extractor
- Ansoft Physical IC modeler (ParICs)
- · AnsoftLinks for CAD database import
- · Ansoft Slwave
- · Ansoft HFSS (High Frequency Structure Simulator)
- · Apache Design Solutions PakSi-E High Speed 3D Field Solver
- Agilent ADS (Advanced Design System)
- · Agilent Momentum
- Agilent Picosecond Interconnect Modeling
- Synopsys Hspice and Spice Explorer
- · Cadence Advanced Package Engineer (APE)
- TDA Systems I-Connect
- Sigrity PowerSI, PowerDC, Speed2000 and Broadband Spice



Simultaneous Switching Noise

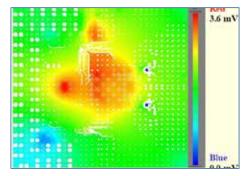
Measurement Equipment

- · Giga-Test Micro Probe Station
- HP-8720D Network Analyzer (50 MHz 20 GHz)
- HP-4285A Precision LCR Meter
- Tektronix TDS800 Digital Sampling Oscilloscope with 80E04 Differential TDR head
- · EMI shielding measurements

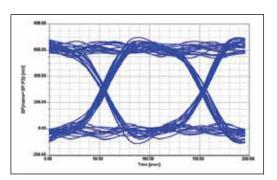
Amkor's electrical characterization lab offers complete and accurate high frequency package characterization services. Amkor employs real time data acquisition either from a network Analyzer or TDR (Time Domain Reflectometry) and uses a variety of high frequency EDA tools such as Agilent-ADS (Advanced Design System) and TDA Systems I-Connect to generate interconnect models based on measurement data.

Capability to Provide Customers With the Following Data

- · Lumped RLC and coupling
- S-parameter data in tabular and graphic format
- · Impedance (Z) and Time Delay
- · IBIS and Spice package models
- Power and ground IR drop, current distribution and DC resistance
- Simultaneous switching noise (SSN)
- · Power Delivery System (PDS) analysis



Power/Ground Current Distribution



Eye Diagram



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