High performance power transistors are used in power management IC's, where switching behavior is extremely important. However, due to their large distributed gate and active area structure, simulating switching activity to improve performance and minimize switching power loss can be challenging. Uncorrected current crowding from non-uniform current flows can cause chip failures and reliability issues.

PTM-TR integrates with Cadence Virtuoso ADE to fully model 3D current flow and non-uniform distributed device switching in power transistors that can affect performance in power conversion circuits. The PTM-TR's Fast3D models are derived from a 3D field solver model of the layout and allow co-simulation of power devices to predict: signal propagation in large gate nets, non uniform switching of device fingers, as well as shoot-through current and current-crowding.

To assist in optimization, PTM-TR can simulate high and low-side devices together with drivers and test benches including load models and parasitic inductances so that dead-time and switching power loss can be minimized in the familiar Virtuoso ADE environment with parametric and process corners capabilities.

PTM-TR's user interface also offers detailed visualization of power transistor transient behavior. PTM-TR improves reliability with EM violation and peak current density reporting for power devices during switching transients.

PTM-TR Field Viewer shows non-uniform switching Ids in a NMOS/PMOS low and high side pair at a specified time during switching.

PTM-TR Capability Highlights

- Virtuoso ADE based co-simulation solution for power transistors in conversion circuits
- Helps minimize dead-time and power loss in DC-to-DC converters and switching power supplies
- Predicts EM/IR issues in thick and wide metal caused by current crowding
- Analyzes signal propagation delays in gate nets
- Simulates non-uniform switching of device fingers
- Highlights shoot-through currents
- Determines Miller coupling to the Gate of a fast dV/dt transient in the Drain
Comprehensive Power Device Transient Simulation

PTM-TR combines 3D field-solver based extraction technology with power device models to create Fast3D models for transient analysis of power device circuits within Cadence Virtuoso ADE. All angle meshing delivers high accuracy in modeling complex 3D currents.

Fast3D Model (green) versus lumped (red)

**Features**

- Co-simulation in Virtuoso ADE with user test benches at all process corners
- True 3D simulation accuracy with state-of-the-art sparse matrix iterative solvers
- Efficient mesh generator for large, complex 3D structures containing transistors with channel widths of several meters
- Powerful 2D and cross-cut viewing of current densities and electric potentials. Display of Ids, Vds and voltage drops along wide channels, plus textual output in csv files
- Supports wedge-shaped, rounded & other non-Manhattan layouts, metal slotting, and circular and diamond shaped vias
- Simulation of active devices with Virtuoso Spectre simulator using industry standard device models
- Supports CMOS, DMOS (lateral and vertical) & IGBT power devices, honeycomb, serpentine and other layout architectures

Power Transistor Modeling Suite

PTM is part of a comprehensive family of tools available from Magwel for modeling all aspects of power transistor behavior and performance. Designing competitive power devices requires a thorough understanding of the timing, transient and electro-thermal behavior of power transistors.

**PTM - Power Transistor Modeler**

Using its 3D all angle mesh solver, PTM extracts Rdson for power transistors. It reports and graphically shows current densities, power dissipation and electromigration violations.

**PTM-GD - Gate Delay**

Switching in power transistors depends on the RC characteristics of the metal and poly gate interconnect. PTM-GD uses its highly accurate solver to create distributed RC models for the gate interconnect and device capacitance. This information is used to predict turn-on/off time for power transistors that have very large gate widths.

**PTM-TR - Transient**

Solving transient behavior in power transistors requires understanding both the metalization and the device physics. PTM-TR produces Fast3D models for Virtuoso ADE co-simulation to provide a complete picture of dynamic device switching behavior.

**PTM-ET - Electro-Thermal**

PTM-ET combines interconnect and device joule heating with other heat sources and sinks to determine device thermal behavior. PTM-ET concurrently and dynamically models device thermal and electrical performance for devices in their packaging using stimulus to provide an accurate view during circuit operation over time.

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