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Fuji Electric and Cadence

"With Virtuoso Accelerated Parallel Simulator, we reduced our design lead time by approximately 25%. We released a higher-quality product to the market earlier than we would have been able to achieve without Cadence."

Dr. Naoto Fujishima, General Manager, Device Development Department, Electronic Device Laboratory, Fuji Electric

The Company

Fuji Electric (FE), a global company based in Japan, supplies advanced, innovative power device and power modules that save energy while offering high performance, downsizing, and high reliability to the new energy, green Internet Data Center (IDC), and automotive markets.

With the growth of new energy sectors, such as wind power and mega solar, FE's large-capacity modules are gaining popularity. The company has a wide range of products with insulated gate bipolar transistor (IGBT) modules that include up to 3,300 volts for maximum rated voltage and up to 3,600 amps for maximum rated current. These high-speed IGBTs offer fast switching to enhance high-efficiency equipment.

"Our power-supply–control integrated circuits (ICs) use a proprietary control method that's more energy-efficient and offers smaller size and lower noise than other solutions on the market," says Dr. Naoto Fujishima, General Manager, Device Development Department, Electronic Device Laboratory, FE. "Our ICs are used in high-performance automotive devices such as intelligent power switches (IPSs) and pressure sensors."

The Challenge

Recently, FE began developing a new driver IC for its power modules and power ICs. The company needed a control function that could meet the specifications of a new power-management system.

"The major features of our power modules and power ICs are low power and low noise," Dr. Fujishima explains. "These features reduce the need for external parts and enable a reduced-cost system."

Business Challenges

- Aggressive time-to-market requirements for a new low-power, low-noise, low-cost power-supply IC

Design Challenges

- Required complex verification items
- Needed to increase efficiency of concept design

Cadence Solutions

- Virtuoso Multi-Mode Simulation with the Accelerated Parallel Simulator
- Virtuoso Analog Design Environment

Results

- Reduced design lead time by approximately 25% with SPICE-accurate simulation
- Met time-to-market goals with a high-quality product
- Achieved scalable performance and capacity
- Improved verification performance by 26x
- Improved simulation performance by 2x

As the FE design team began to explore the new control algorithm, including the design concept for the new power-management system, it knew the IC would need to support many functions. One example was a protection function to stop the system in case of unusual conditions, such as high or low voltage during a lightening storm.

"We knew verification would be complex and our verification items would increase," Dr. Fujishima says. "We also knew time to market would be very important. For these two reasons, we turned to Cadence."

The Solution

To improve the efficiency of its concept design, the FE design team decided to use Verilog-A for this project. The team adopted Cadence® Virtuoso® Accelerated Parallel Simulator, part of Virtuoso Multi-Mode Simulation, to develop the driver IC for its power modules and power ICs.

> *"We achieved about a 26x improvement in our verification performance by using Verilog-A for our power IC. We then added more than 2x improvement in our simulation performance for our power system with the same accuracy using Virtuoso Accelerated Parallel Simulator."*

Virtuoso Accelerated Parallel Simulator performs advanced, SPICE-accurate simulation for faster convergence on design goals while offering scalable performance and capacity. It's tightly integrated with the Virtuoso Analog Design Environment, which enables FE engineers to capture and pass design intent in the same environment, and it provides all the transistor-level analysis capabilities of Virtuoso Spectre® Circuit Simulator.

Virtuoso Accelerated Parallel Simulator's proprietary full-matrix–solving technology delivers unparalleled scalability and multi-threading capability using modern multi-core compute platforms. These features, and more, ensure precise simulation without sacrificing accuracy of results.

When the FE design team first considered Virtuoso Accelerated Parallel Simulator, it weighed the overall cost of adopting the solution, including the learning curve for the new technology, compatibility of infrastructure (such as with the SPICE model), additional investments, and accuracy of results.

"Virtuoso Accelerated Parallel Simulator offered high-speed simulation that satisfied our efficiency criteria while offering many additional benefits," Dr. Fujishima says. "We achieved about a 26x improvement in our verification performance by using Verilog-A for our power IC. We then added more than 2x improvement in our simulation performance for our power system with the same accuracy using Virtuoso Accelerated Parallel Simulator. Because this Cadence solution supports the same use model and infrastructure as Spectre technology, the migration was easy."

The proof is in the results. "With Virtuoso Accelerated Parallel Simulator, we reduced our design lead time by approximately 25%," Dr. Fujishima says. "We released a higher-quality product to the market earlier than we would have been able to achieve without Cadence."

Summary and Future Plans

Virtuoso Accelerated Parallel Simulator helped the Fuji Electric design team improve the efficiency of its verification environment for a device-level power-management system that required fast time to market without sacrificing quality.

In the future, the team plans to continue working with Cadence solutions. Dr. Fujishima and the Cadence team are discussing a completely automated migration to take the team's efficiency improvements to the next level. The companies are also collaborating on ways to further improve interoperability between the Virtuoso custom design environment and Cadence Allegro® PCB Designer to enable co-design between large-scale integration logic and printed circuit boards (PCBs).