




Power Module Design for Electric Vehicles

Addressing reliability and safety

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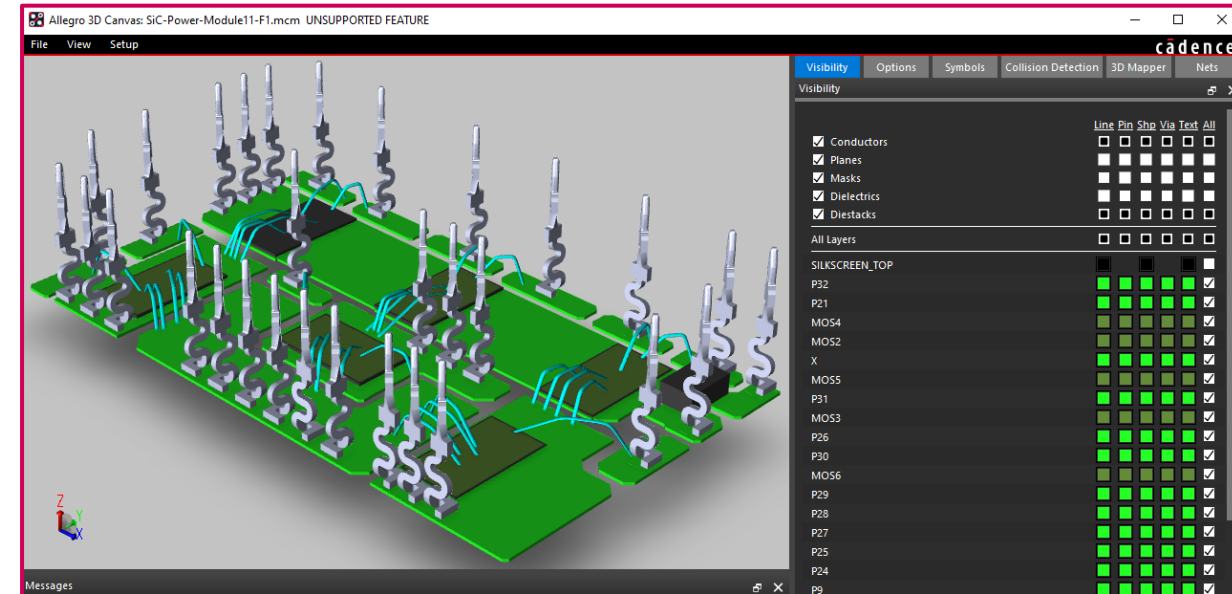
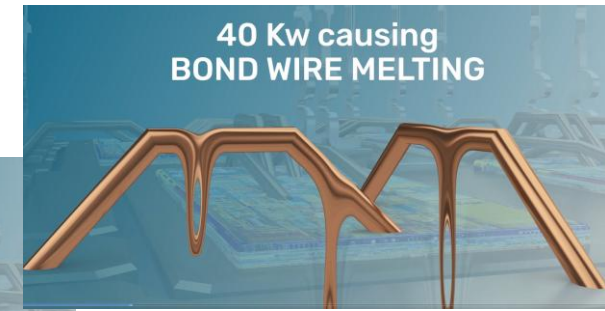
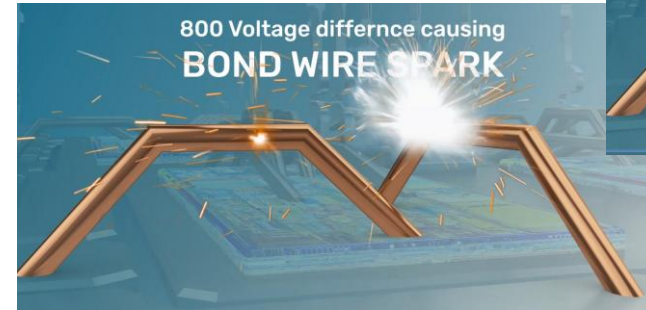
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EV Power Module Flow

Challenges

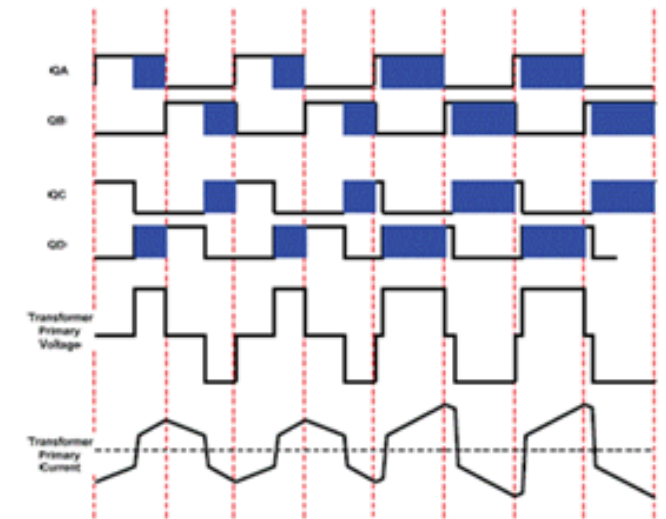
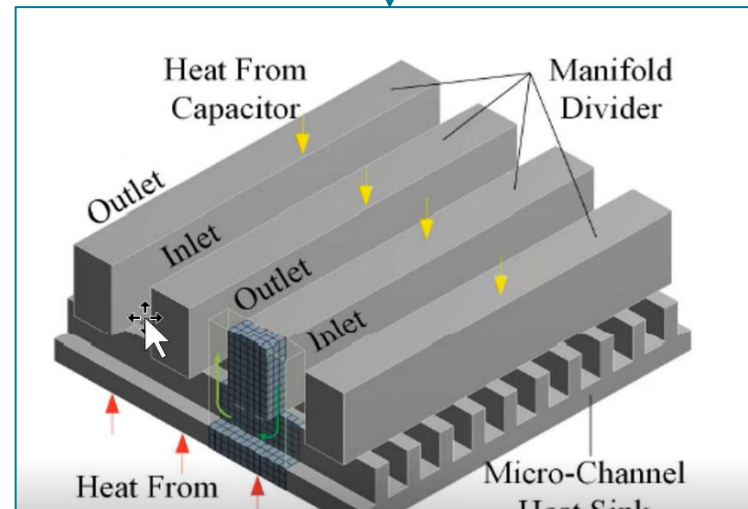
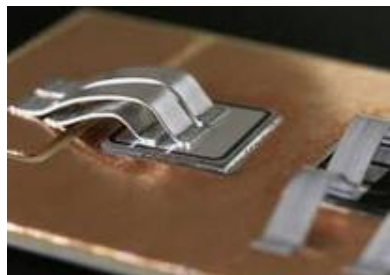
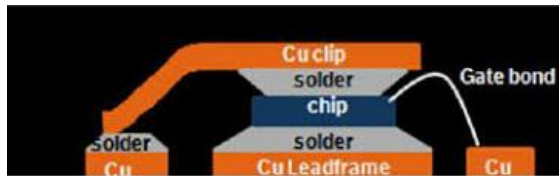
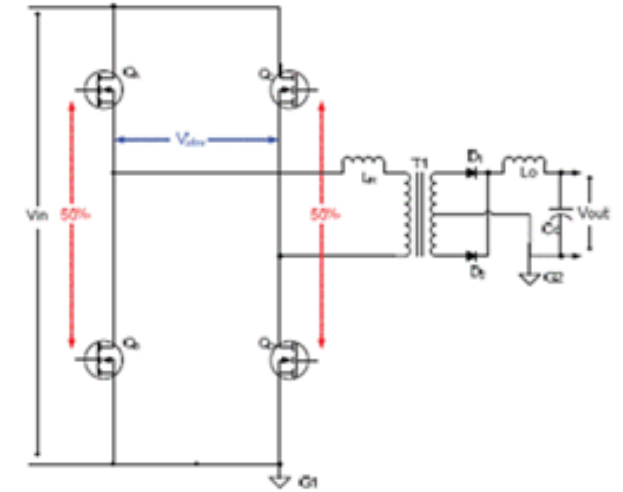
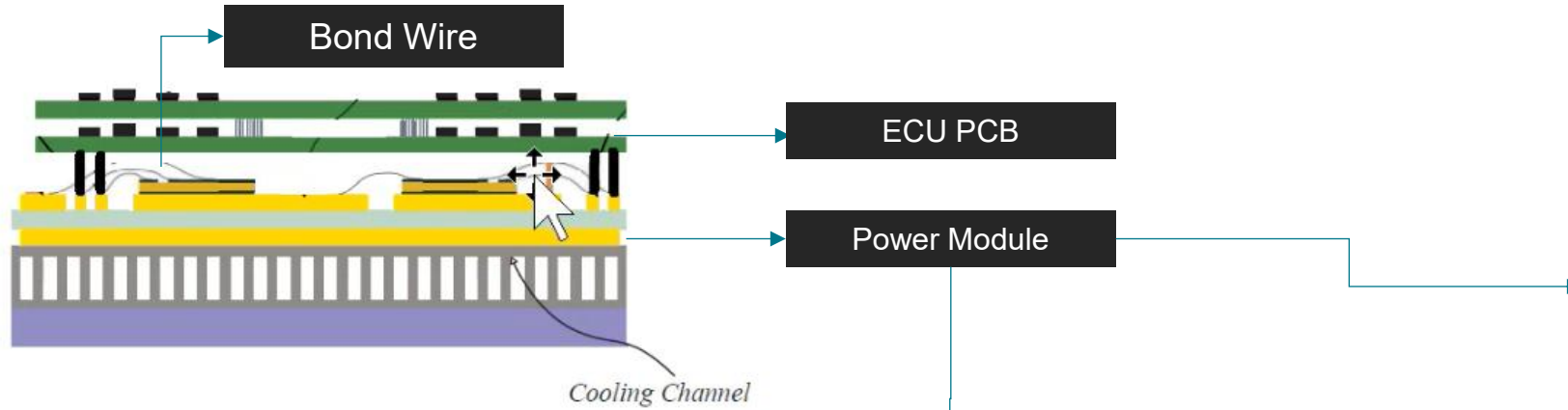
- High currents, voltages, and power
 - Hundreds of kilowatts, volts, and amperes
- High temperatures
 - 100-200° Celsius
- DC-DC switching frequencies increasing
 - Harmonics to hundreds of MHz
- Switching technology
 - IGBT, MOSFET...
 - SiC, Si/SiC...

Need for Reliable and Safe Designs



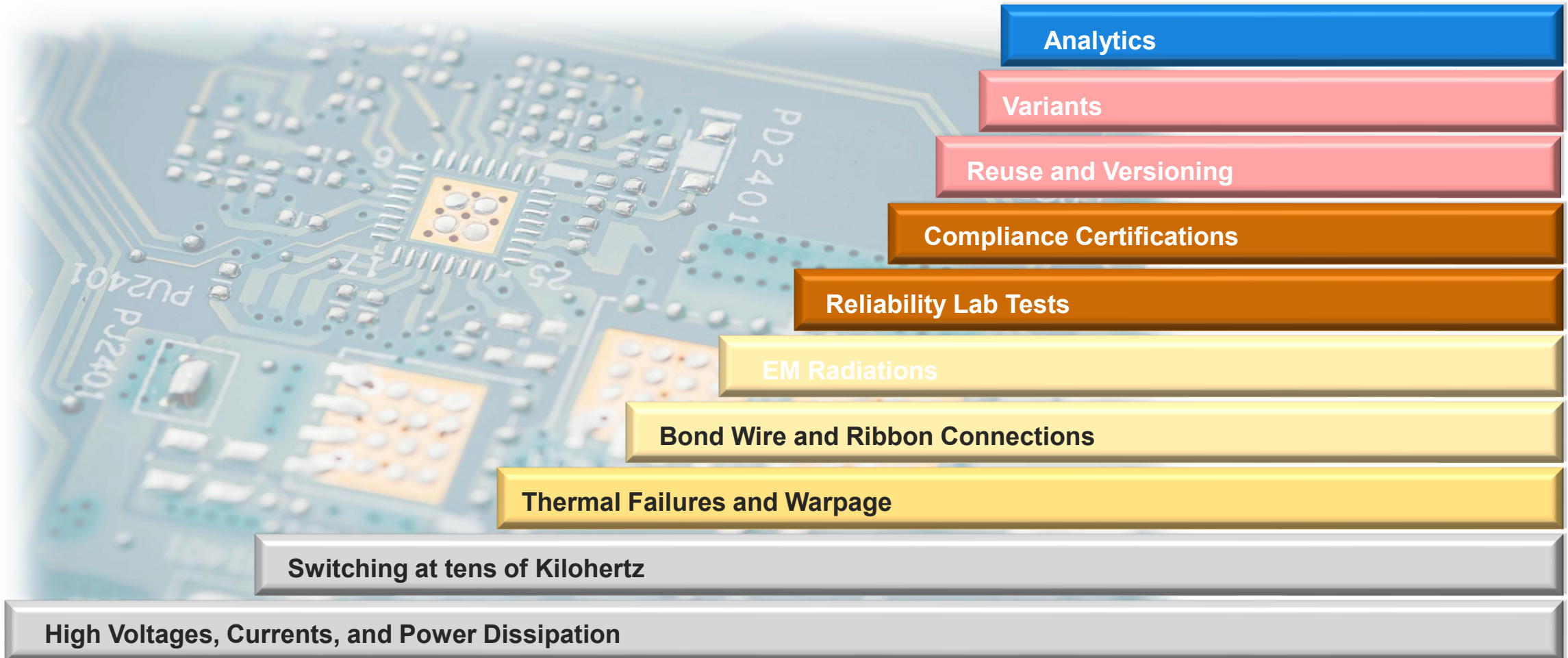
Automotive Vehicle Design

Power modules



Automotive Vehicle Design

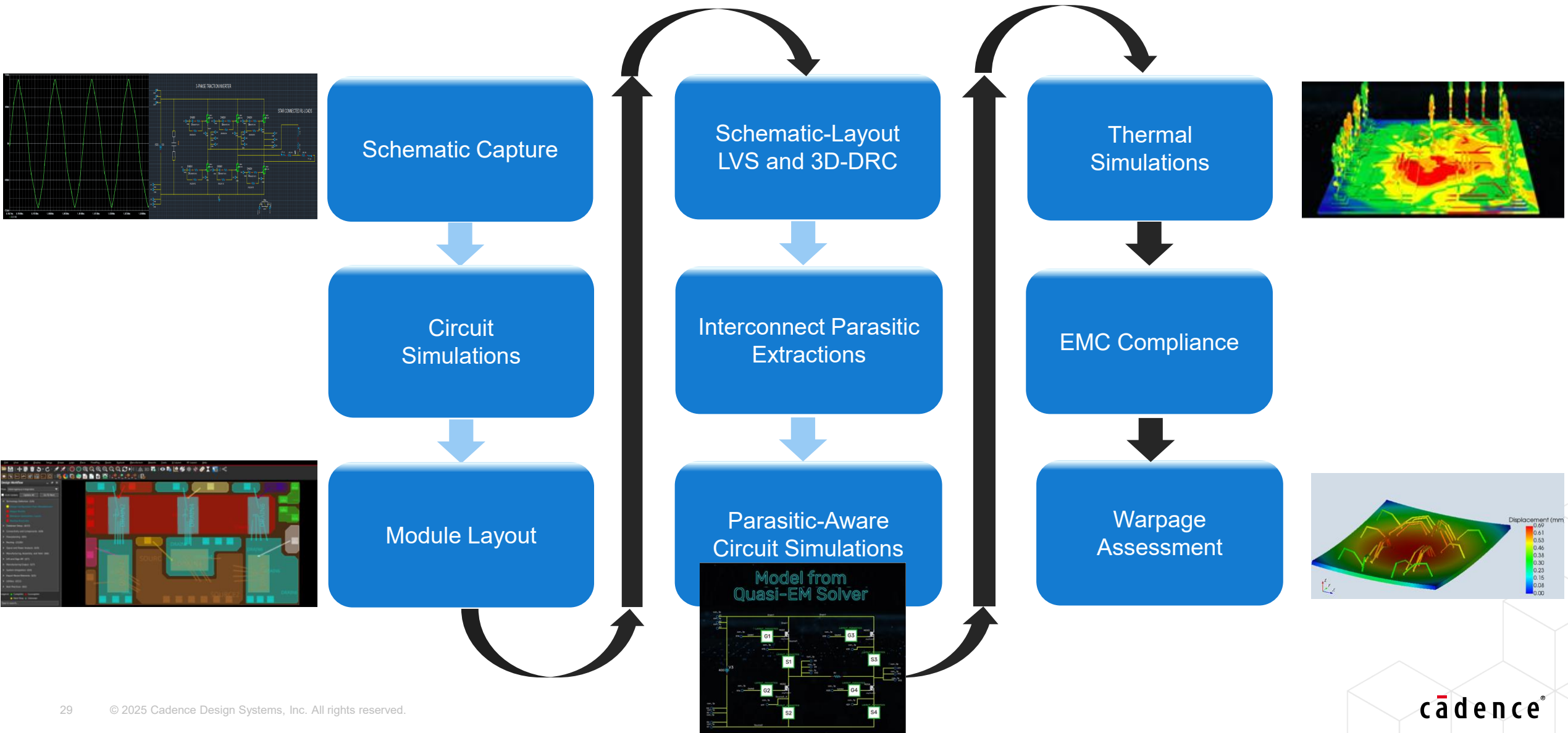
Power modules



Use of MCAD tools and repeated lab testing causes costly re-spins and a non-optimized design

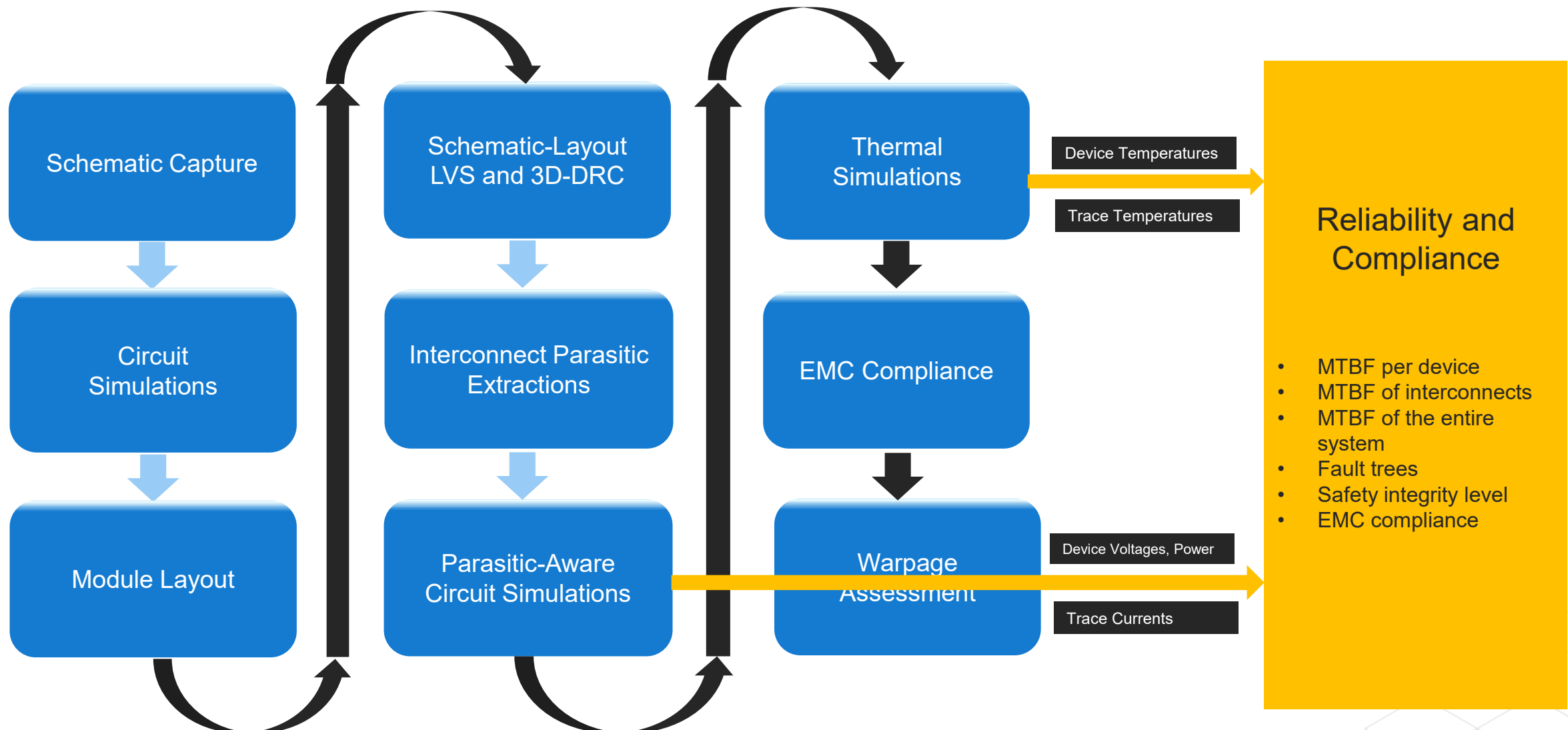
EV Power Module Flow

Schematic-driven chip-on-board/module powered by in-design analysis



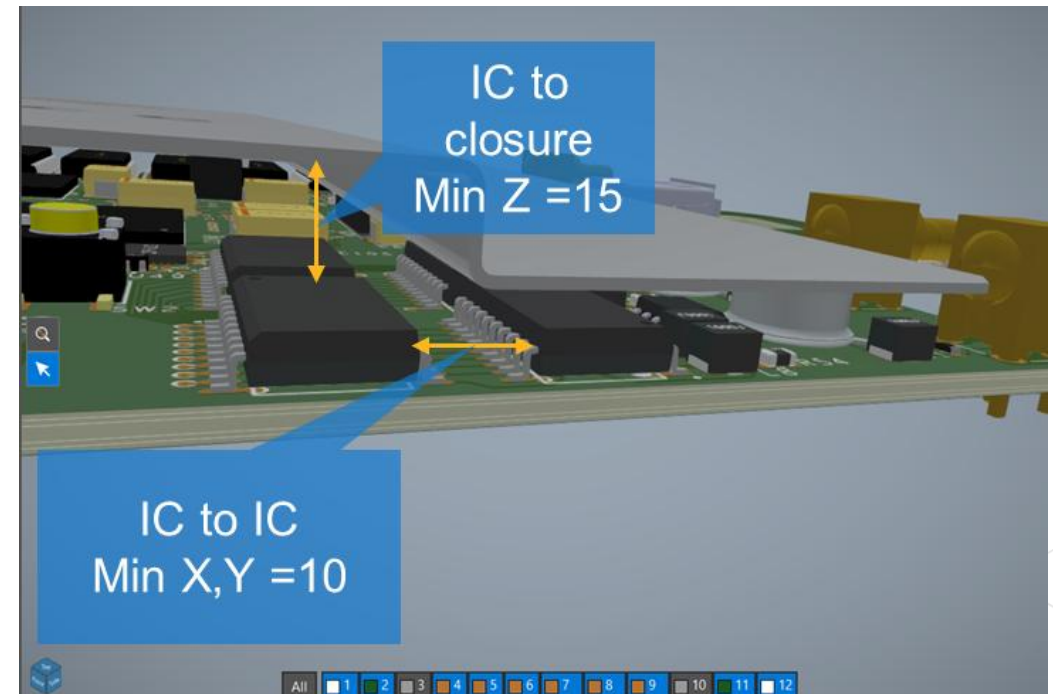
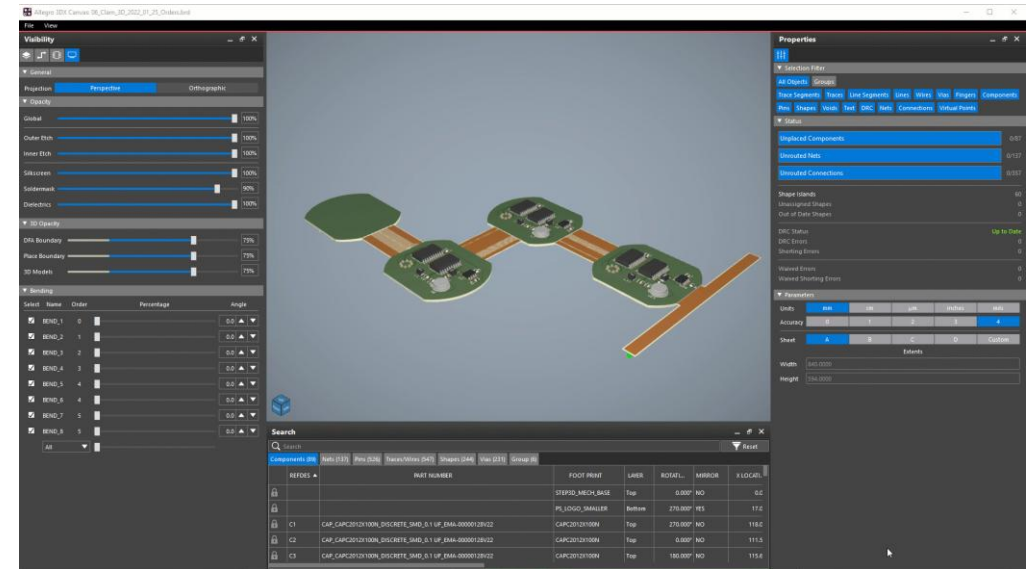
EV Power Module Flow

Schematic-driven chip-on-board/module powered by in-design reliability



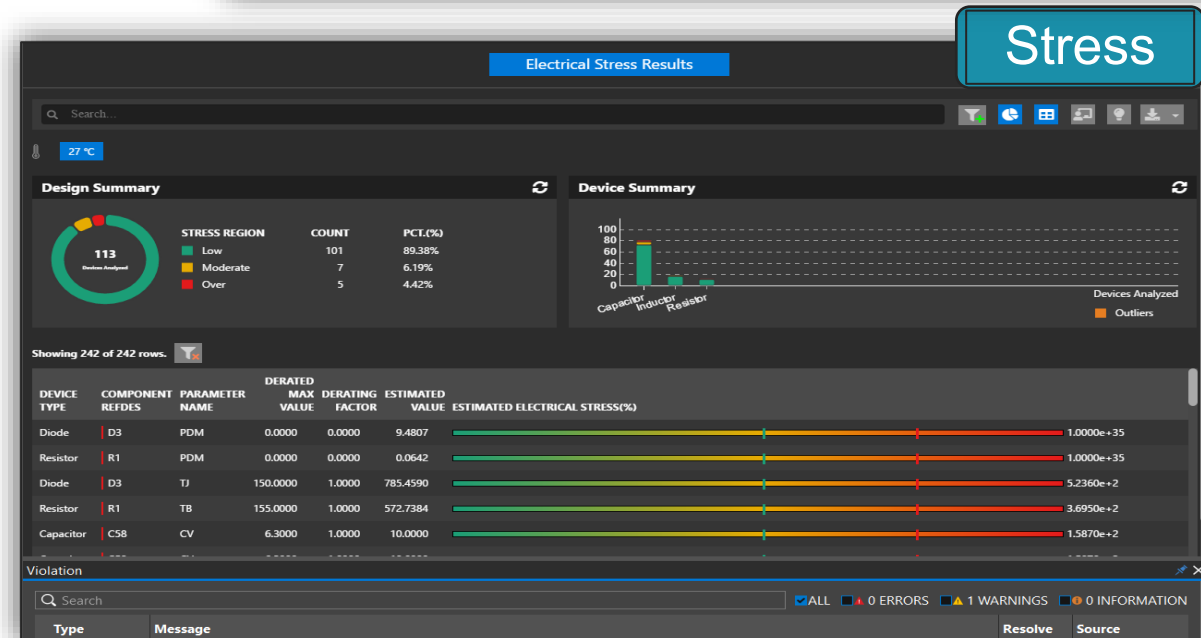
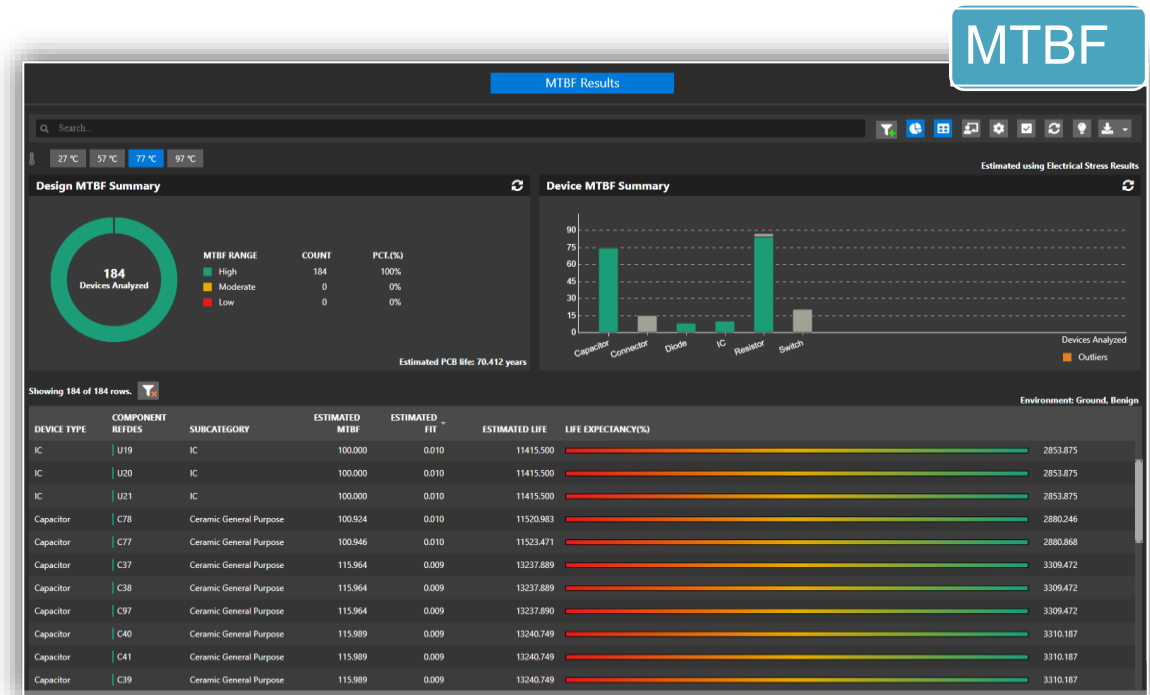
Chip-On-Board Layout

- Circuit-driven layout
- ECAD/MCAD interface
- High-performance 3D visualization and incremental updates
- 3D placement DRCs
- 3D interconnects: Bond wires, ribbons

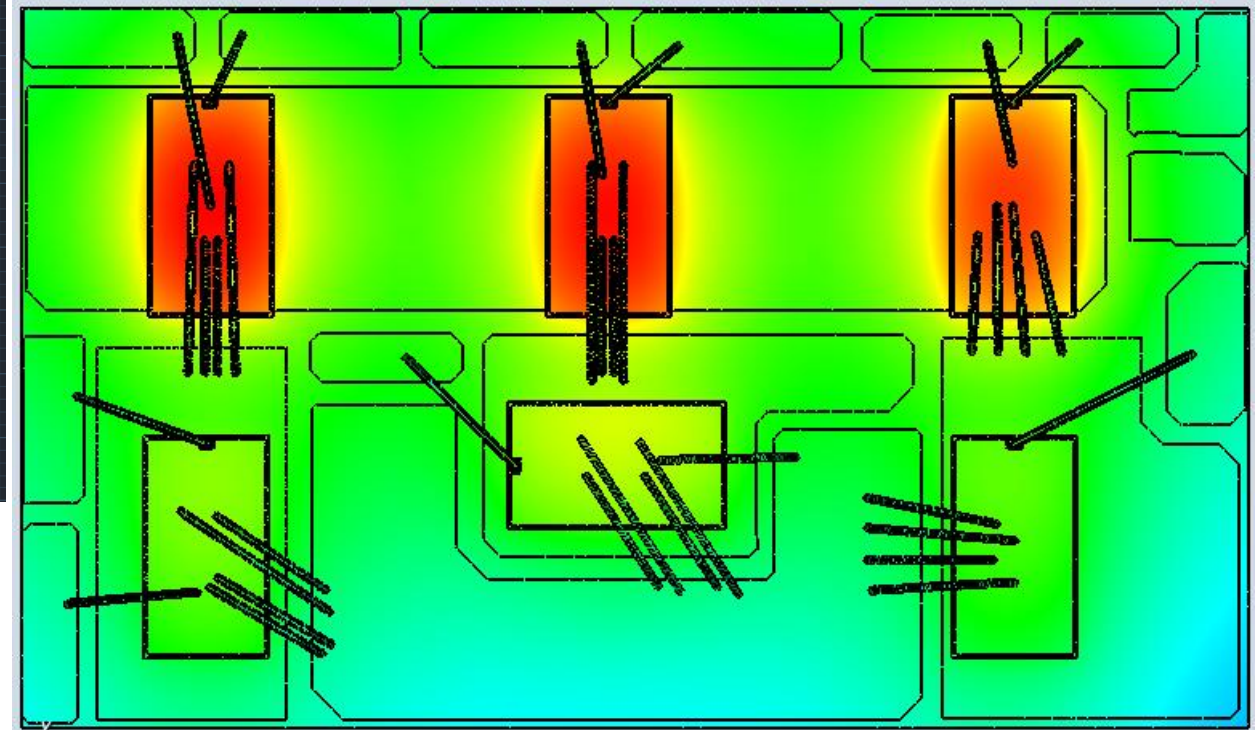
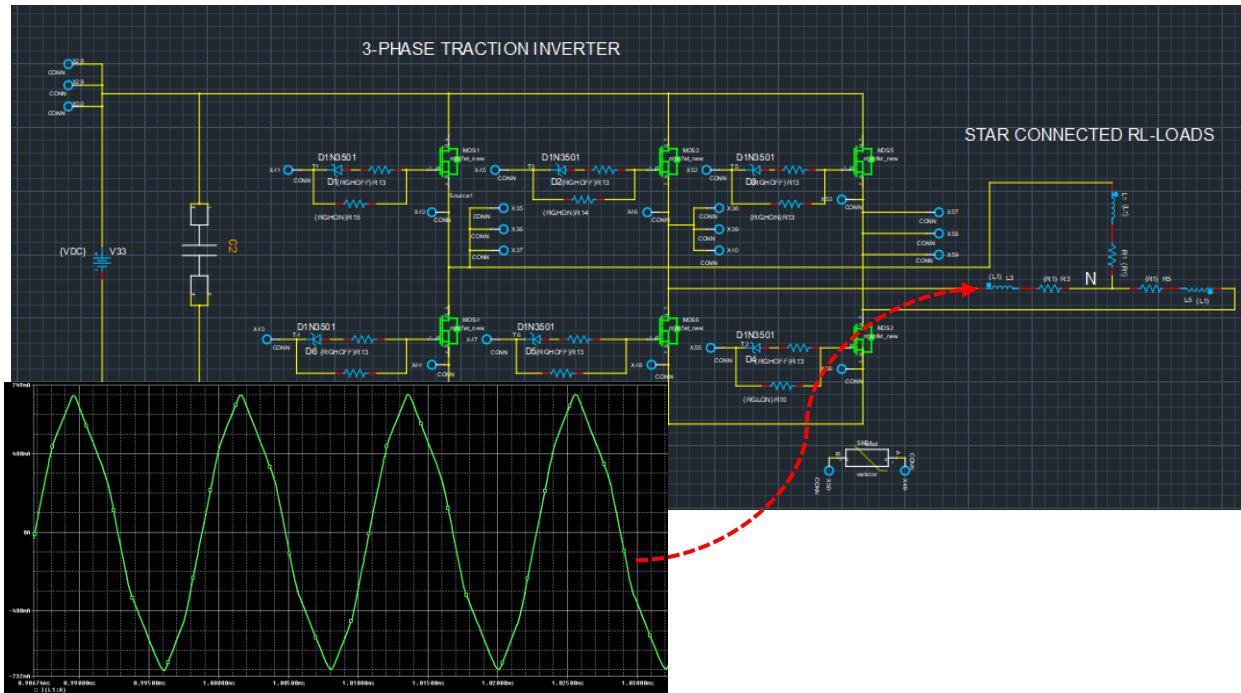


In-Design Analysis/Reliability

- Schematic analysis
 - Circuit simulations
 - Models
- Layout analysis
 - Quasi-extraction of interconnects
 - Thermal, EM, and warpage
- Reliability
 - Electrical overstress: Identify overstressed devices
 - MTBF: Estimate the module's life based on device/trace stress



In-Design Analysis

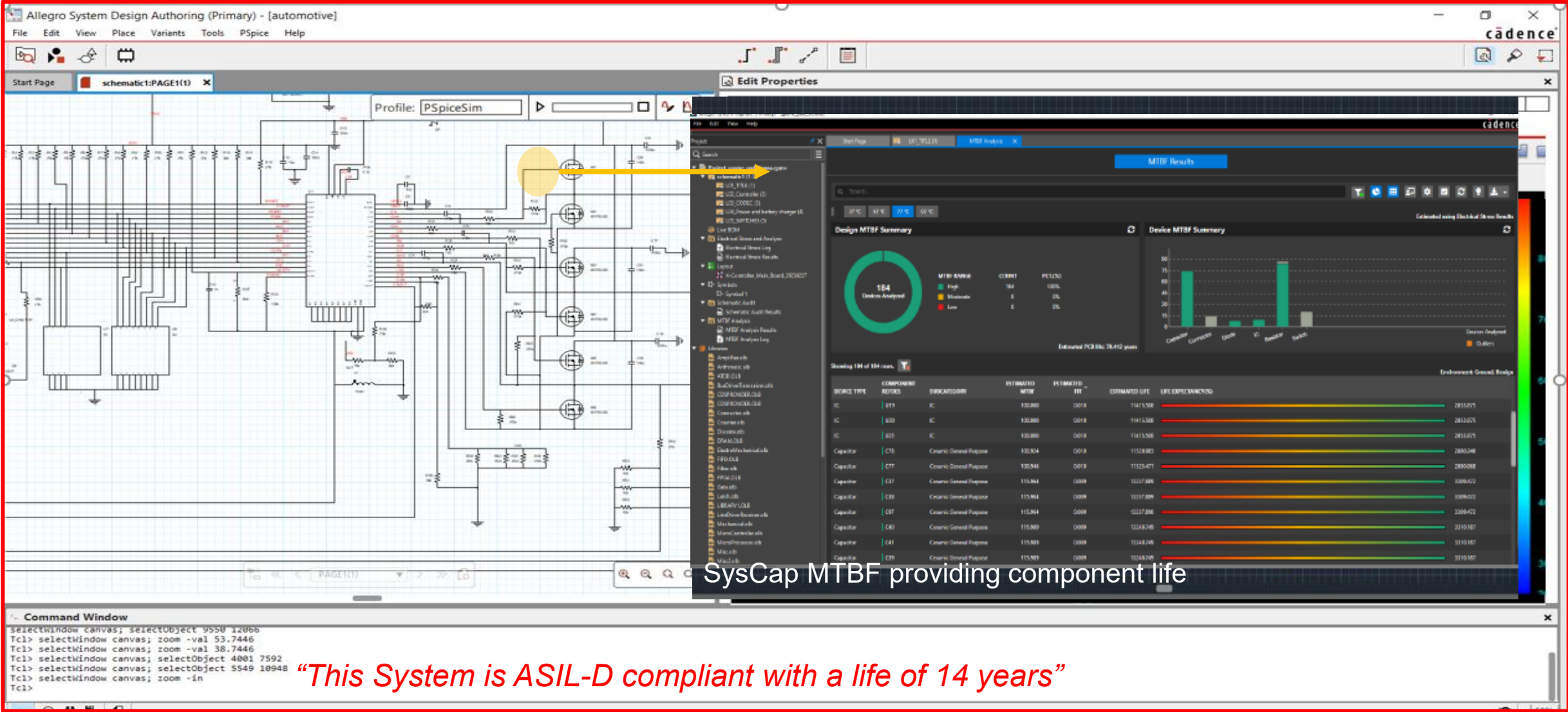


Simulate the schematic in the context of interconnect parasitics

Power dissipation numbers drive thermal analysis

Effort of several months to weeks

In-Design Reliability



Cadence Intelligent System Design Strategy



Consumer



Hyperscale



Mobile



Communications



Automotive



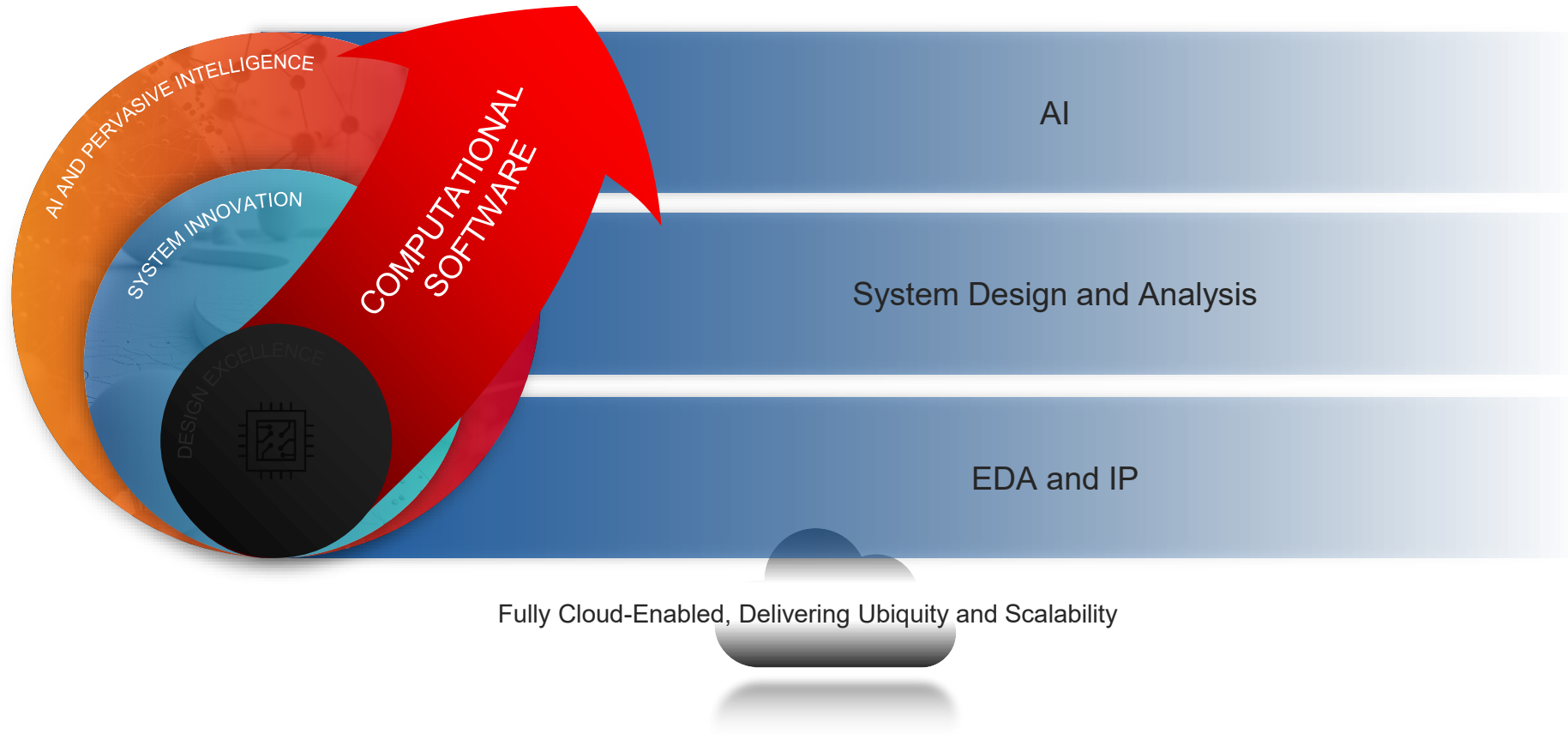
Aero/Defense



Industrial



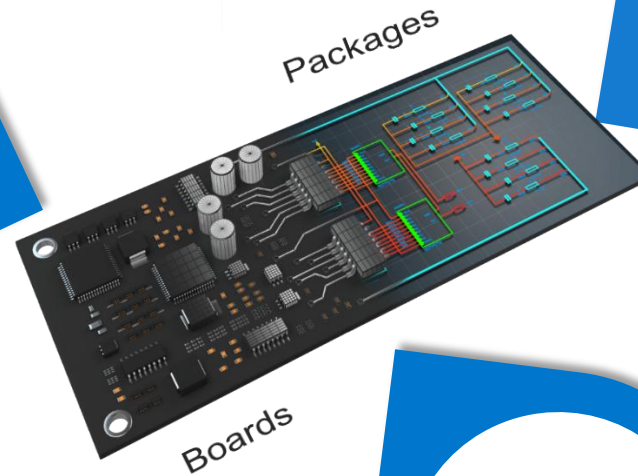
Life Sciences



Three Strategies for the Fastest TAT and Best QoR

Deliver
differentiated TTM and
eliminate iteration
leveraging Total
Cadence and Partner
Solutions

**High-Impact
Integration**
*Ecosystem and
Cadence*



**Automation
and QoR**
*>10X TAT
Key to Enabling
Best QoR*

Automate Complex TTM
Bottlenecks and Change the
Game

PPE
*Performance
Productivity
Ease-of-Use*

Reduce TAT
comprehensively,
enable productive
collaboration

Turnaround Time

System and Mechanical

Schematic

Layout

Analysis

Manufacturing

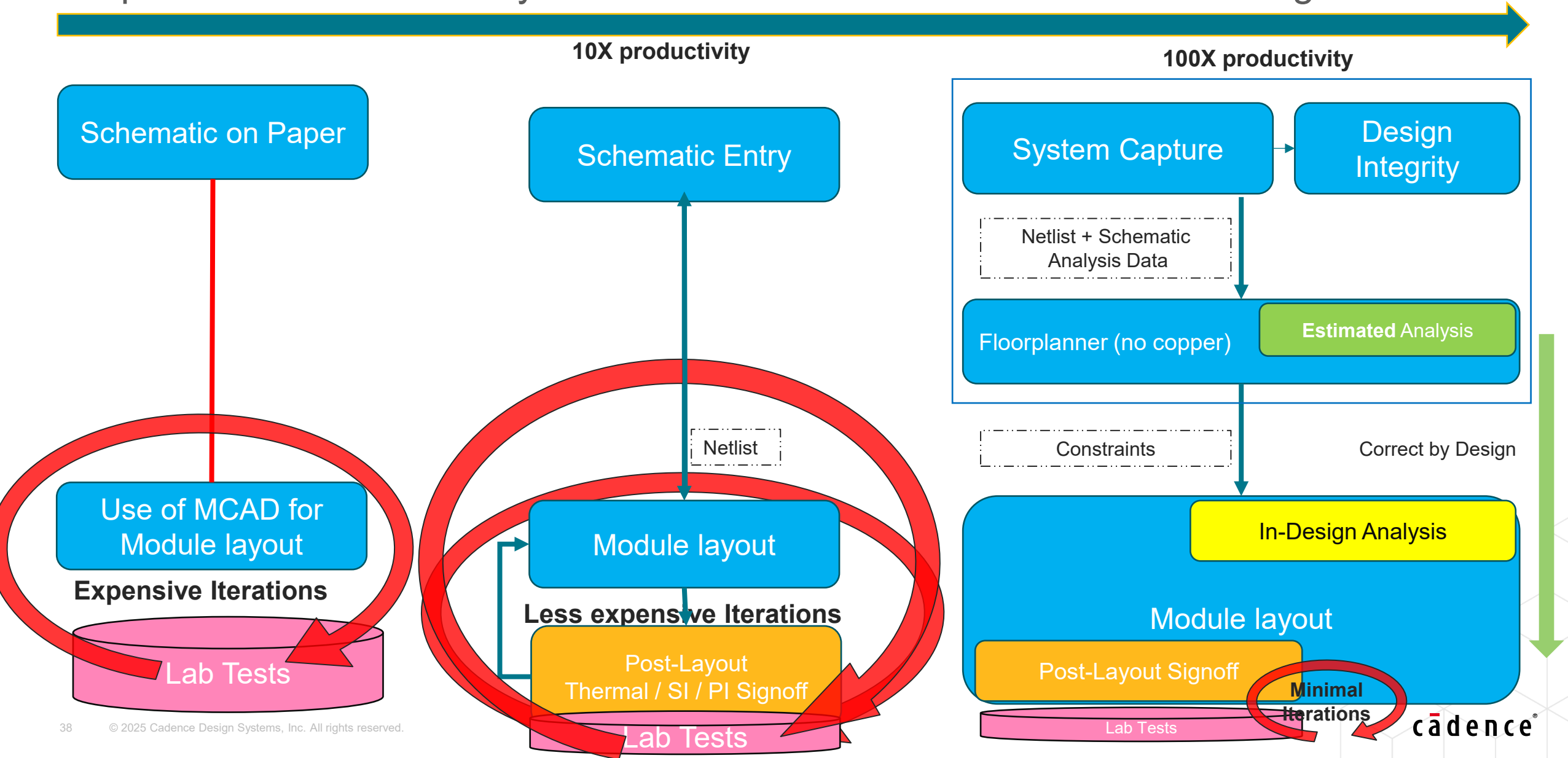
Summary

EV power modules need systematic EDA flow for reliable and safe design

- Schematic-driven layout powered by in-design analysis and reliability
- Shift-left to ensure correct-by-design
- Functional Safety and ASIL compliance to minimize lab cycles

Summary

EV power modules need systematic EDA flow for reliable and safe design





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