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Future Power Packaging Technologies Needed for the Next Generation Electric Grid

Sandia Power Electronics Workshop: **Enabling Advanced Power Electronics Technologies for the Next Generation Electric Utility Grid Workshop**

July 17th, 2018

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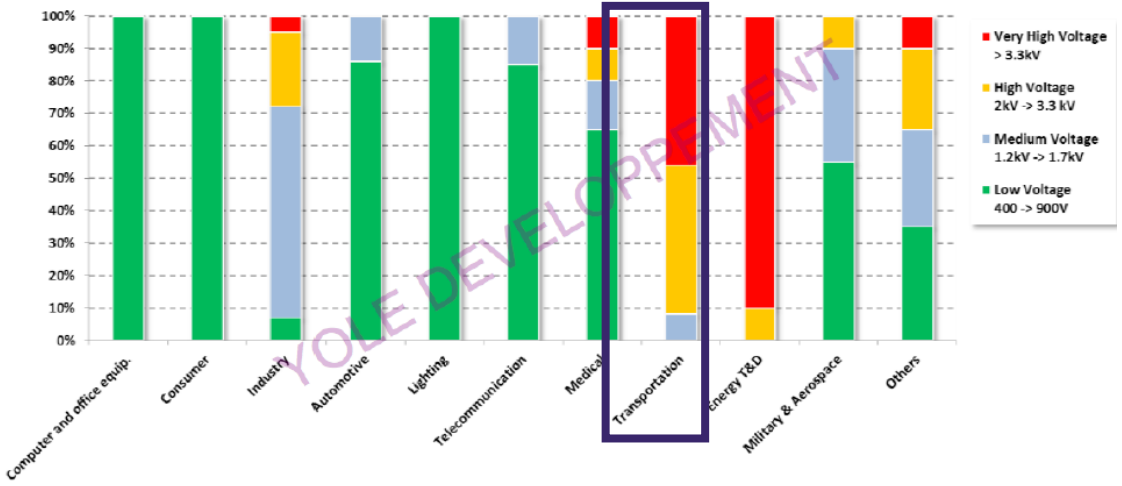
Advantages of Medium Voltage SiC Power Modules

- Reduced volume/weight → **Reduced BOM / Lower cost**
- High speed switching → **Lower Loss / Higher Efficiency**
- Higher voltage (> 6.5 kV) → **Less levels / Simplified system**
- Higher frequency → **Smaller magnetics and filter capacitors**
- Higher operation temperature → **Higher current / less cooling**

Market Segment in Power Electronics by Application and Voltage



Commercially available, qualified medium voltage (3.3 kV – 15 kV) SiC power modules are needed to revolutionize next generation grid applications

Needs for Medium Voltage SiC Power Module Technology

Design/Modeling Capabilities

- Industry standard design rules for spacings internal and external to the modules
- Industry standard footprints for modules greater than 6.5 kV
- Improved electric field analysis modeling tools (PD and AC breakdown)
- Medium voltage long-term reliability modeling tools

Advanced materials

- Power substrate technologies → **lower thermal resistance** and **higher dielectric strength**
- Silicone gel encapsulation materials → higher dielectric strength, less susceptibility to partial discharge, and higher temperature
- Polymers → higher dielectric strength, less susceptibility to partial discharge, and higher temperature
- Coatings → higher dielectric strength, less susceptibility to partial discharge, and higher temperature

Standards

- Application-focused qualification and reliability standards
- Updated creepage and clearance standards