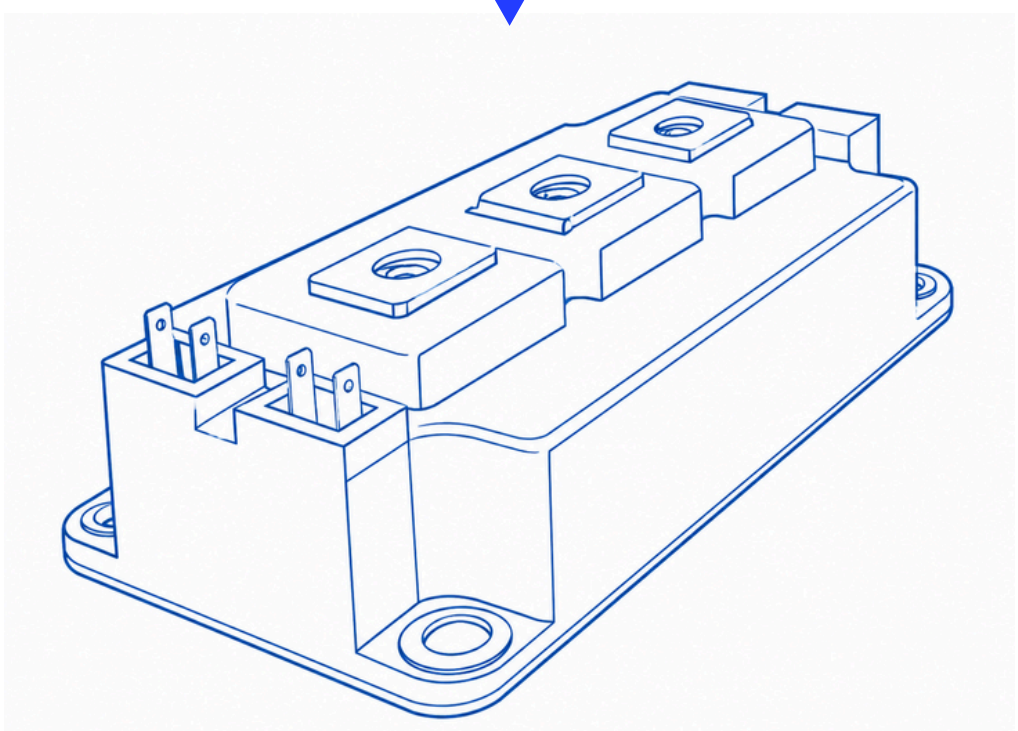
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Why SiC Power Modules Need New Packaging Technologies

SiC devices continue to redefine power electronics performance.

Yet many commercial available SiC Power modules still relay on conventional packaging methods.

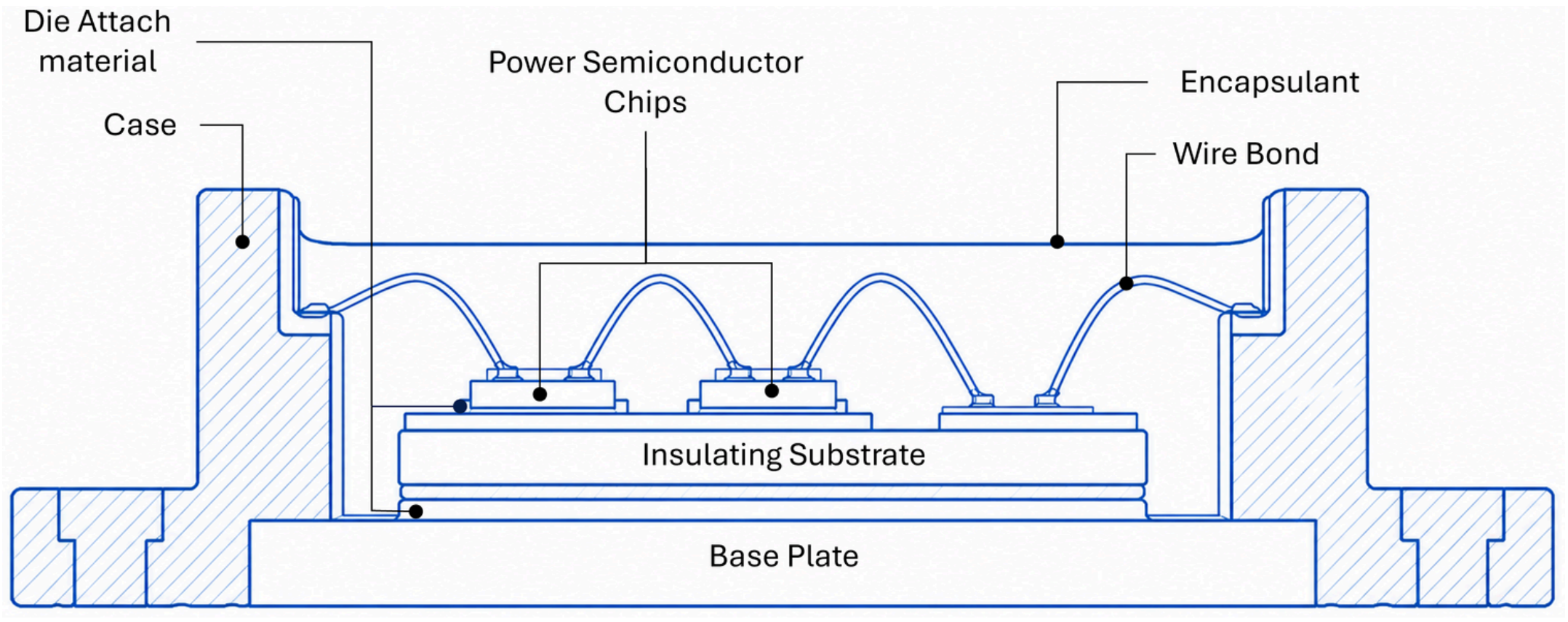


The packaging must evolve to fully unlock the potential of SiC.

The package - not only the semiconductor - determines overall module performance.

How are SiC Power Modules Packaged Today?

Most commercially available SiC power modules use the standard packging approach



Cross-sectional view of a conventional wire-bonded power module.

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Why Does Conventional Packaging Limit SiC Performance.

The review identifies four key packaging challenges.



High Speed Switching
Parasitic inductance causes Voltage overshoot, ringing, EMI and limits switching speed.



Thermal Managment
High thermal resistance leads to higher junction temperatures and thermally induced reliability problems.



High Temprature Operation
Conventional materials and components often lack long-term stability above ~200 °C.



High Voltage Insulation
Higher voltage ratings result in higher electric field stress and increase the risk of dielectric breakdown and aging.

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What Does Future SiC Packaging Need To Achive

To fully realize the advantage of SiC devices, packaging Technologies must meet the following key requirements.



Lower Parasitic Inductance
Minimize parasitic inductance through optimized layout and shorter current paths.



Lower Thermal Resistance
Reduce thermal resistance and improve heat dissipation to limit peak temperature rise.



High-Temperature Stability
Use materials, interconnections and components that remain reliable during high-temperature operation.



Improved Electrical Insulation
Ensure reliable insulation through improved electric-field management and high-performance encapsulation materials.

Engineering Insight

Realizing the full advantages of SiC devices depends increasingly on advanced packaging technologies.



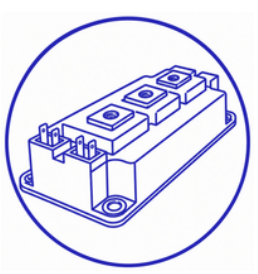
SiC Devices

High switching frequency, high operating temperature and low losses.



Packaging Technology

Determines parasitic inductance, thermal resistance and electrical insulation.



Power Module Performance

Efficiency, reliability and power density at the module and system level.

Conventional packaging has become one of the main factors limiting the full utilization of SiC device advantages.

Electrical, thermal and reliability performance are strongly influenced by package design and interconnection technologies.

To fully utilize the advantages of SiC devices, packaging technologies must continue to evolve.

Summary based on the review

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Research Behind This Engineering Insight

Haksun Lee • Vanessa Smet • Rao R. Tummala

A Review of SiC Power Module Packaging Technologies: Challenges, Advances, and Emerging Issues

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