CoolCAD ELECTRONICS
SiC for the rest of us

Rethinking Power Conversion: Why SiC is the Future

At CoolCAD Electronics, we engineer advanced semiconductor solutions designed to meet the most demanding power electronics applications. As electric vehicles (EVs), industrial systems, and renewable energy platforms push toward higher power density, greater efficiency, and tighter thermal management, the choice of semiconductor material is more critical than ever.

In recent years, Gallium Nitride (GaN) devices have gained traction in power conversion circuits, especially in compact, high-frequency switching applications. Their small size and rapid switching characteristics made them appealing for low- to mid-voltage power stages, especially in the 600 – 750 V range common in automotive and industrial power converters.

However, a shift is underway. As system demands grow more complex and reliability takes precedence, Silicon Carbide (SiC) is increasingly emerging as a superior, and in many cases, drop-in, replacement for GaN and Si in a wide range of applications. For OEMs seeking long-term performance, thermal stability, and secure supply chains, SiC devices offer unmatched advantages that other devices struggle to deliver consistently.

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Why 650 V Applications Matter

In modern electric and commercial vehicles, DC-DC converters operate in critical roles. Two of the most common configurations include:

- **24 V to 12 V Step-Down Converters:** These support accessories such as sensors, radios, and cameras in commercial fleets. They operate continuously and must deliver stable current with minimal losses and heat generation.

- **600 V to LV Converters:** These manage high-voltage battery transitions in electric vehicles, powering subsystems ranging from control electronics to lighting and safety systems. These converters often use software-controlled or liquid-cooled configurations where thermal performance and reliability are non-negotiable.

In the latter case, designers historically gravitated toward Si and GaN for its switching speed and size advantage. But these come with tradeoffs: limited fault tolerance, stringent gate drive requirements, and a supply chain still maturing relative to SiC (in the case of GaN). Moreover, GaN's performance can degrade rapidly under thermal stress or when exposed to voltage surges or transients, common in automotive and industrial environments.

The CoolCAD SiC Advantage

Silicon Carbide solves many of these challenges. With higher thermal conductivity, superior breakdown voltage, and rugged avalanche performance, SiC MOSFETs thrive in high-temperature, high-stress environments. Our SiC solutions at CoolCAD Electronics are engineered to deliver consistent, reliable performance under the most demanding operating conditions, where others often falter.

Here's why SiC is the better fit for 650 V applications:

- **Thermal Management:** SiC offers over 3x the thermal conductivity of GaN, enabling higher power density with simpler cooling. This is especially critical in liquid and air-cooled DC-DC converters in EVs and military applications.

- **Voltage and Current Robustness:** SiC devices handle transient surges and overloads far more gracefully, thanks to avalanche ratings and rugged body diodes that allow safe energy dissipation, capabilities GaN often lacks.

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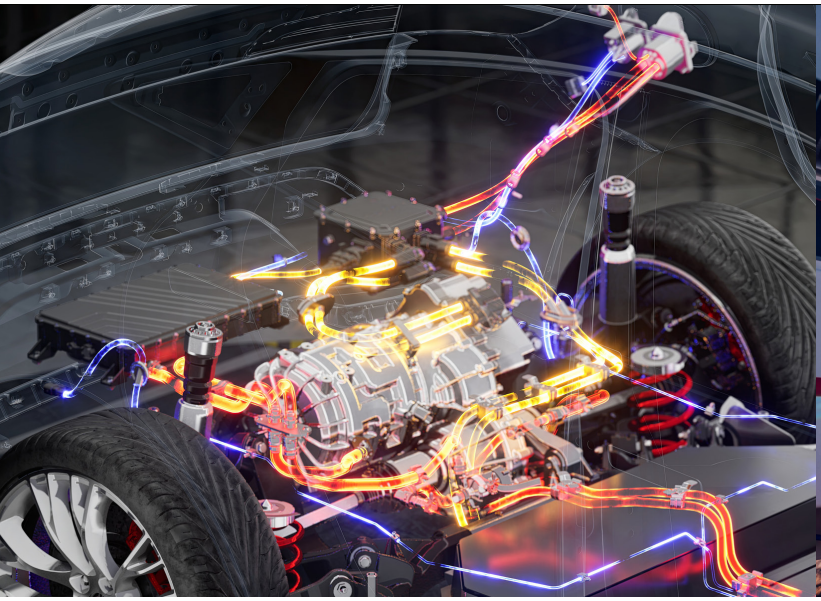
- **High Reliability in Harsh Conditions:** From under-hood temperatures in vehicles to the temperature swings of renewable energy inverters, SiC maintains high operability across temperature ranges, enabling better performance over time.
- **Simplified Design and Gate Drive:** SiC has a wider gate voltage window and higher noise immunity, making it easier to implement than enhancement-mode GaN, which requires strict control to avoid unintended turn-on.



Applications Ready for a Drop-In SiC Upgrade

CoolCAD's SiC technology is ideally suited to replace GaN devices in:

- **On-Board Chargers (OBCs)** for EVs and hybrid vehicles
- **High-voltage DC-DC converters** for 400 – 3000 V
- **Auxiliary motor drives** (e.g. HVAC, power steering) in commercial EVs
- **Industrial motor drives and variable-frequency controllers**
- **Solar inverters and battery energy storage converters**
- **Server power supplies and data center UPS systems**
- **Aerospace and defense-grade power modules** where failure is not an option

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These systems benefit not just from SiC's resilience, but from its ability to operate efficiently at higher frequencies and voltages, with fewer thermal constraints and lower EMI emissions.

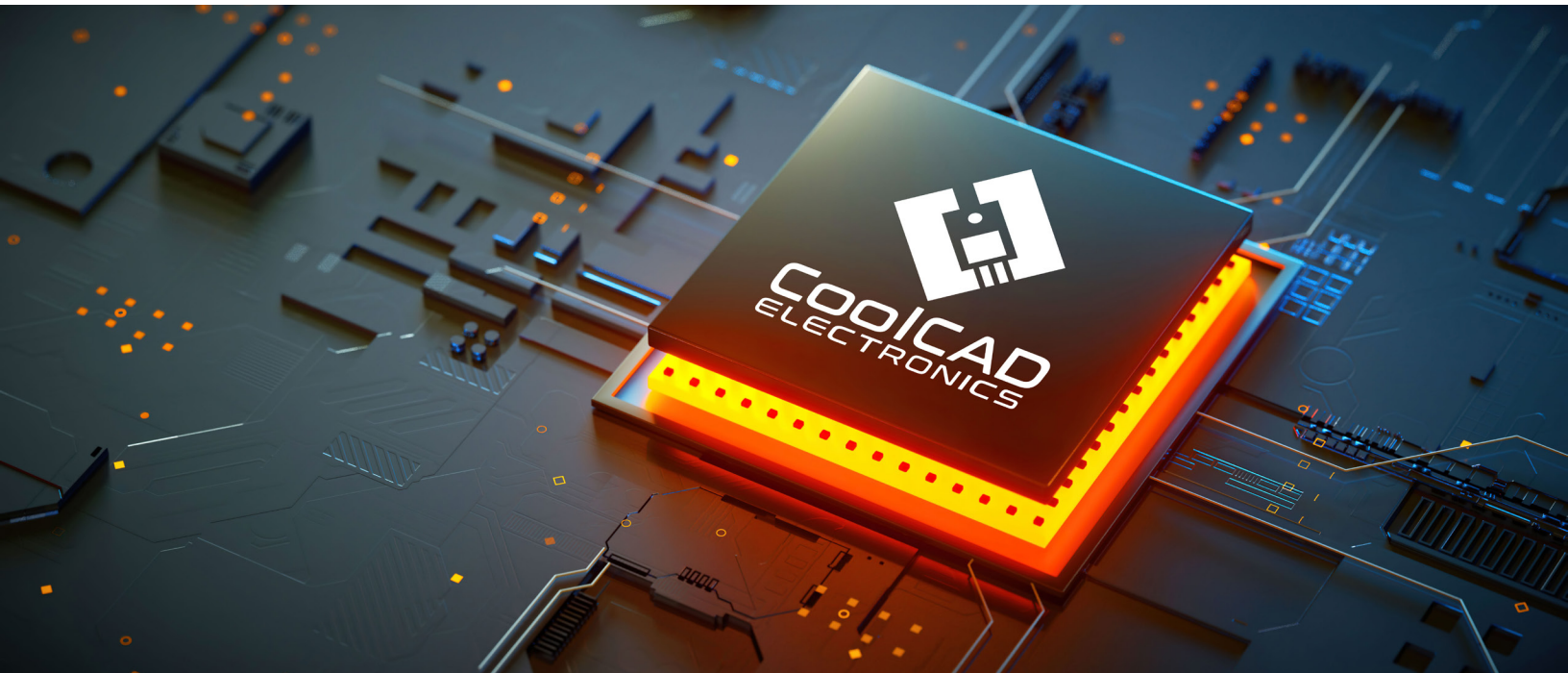
Engineering the Transition at CoolCAD

CoolCAD Electronics supports customers transitioning from other materials to SiC with custom device design, simulation, and application support. Whether you're designing for next-generation EVs, aerospace power modules, or rugged industrial drives, we provide SiC devices and development support tailored to your system needs.

With decades of experience in high-temperature electronics, radiation-hardened systems, and wide bandgap semiconductors, our team ensures that your SiC-based design is not only efficient but built to last.

Conclusion: Built for What's Next

As the industry pushes toward higher efficiency, higher voltage, and higher reliability, CoolCAD's Silicon Carbide devices offer a dependable upgrade path for systems. Whether you're looking to improve thermal performance, increase fault tolerance, or simply secure your component supply chain, SiC provides a future-ready foundation.



CoolCAD Electronics LLC

7850 Walker Drive, Suite 140,
Greenbelt, MD 20770

contact@coolcadelectronics.com

coolcadelectronics.com

About CoolCAD

CoolCAD Electronics is a leader in the development and fabrication of SiC-based power devices and high-temperature semiconductor electronics for aerospace, automotive, defense, geothermal development, green energy production, industrial furnace control, water purification, and oil and gas extraction. The CoolCAD team possesses a unique combination of expertise in electronics, semiconductor physics, fabrication, and design. They also excel at integrated and board-level circuit development and manufacturing. They have published 100s of research papers in professional scientific and engineering journals, and have multiple patents on their key discoveries in the area of wide bandgap SiC electronics.

To learn more about CoolCAD visit **coolcadelectronics.com**