SOLUTION BRIEF

6 kW Compact GaN-Based HV-IBC Module for AI Data Center

REF_6KW_800V_50V_HB

As AI-optimized accelerators like GPUs and TPUs scale exponentially, their power demands have shattered the limits of conventional delivery architectures, precipitating a critical “density wall”. This solution brief introduces a breakthrough High-Voltage Intermediate Bus Converter (HV-IBC) module. By leveraging GaN technology and an advanced stacked LLC topology, this module delivers 6 kW of power in a compact half-brick form factor with a record-breaking power density of > 2000 W/in^3 and peak efficiency of 98.5%.

To mitigate the thermal and voltage stresses associated with such high-power delivery, the design employs a symmetric stacked half-bridge LLC topology. By utilizing a ± 400 V dual-bus input, the architecture partitions the 6 kW throughput into two interleaved 3 kW stages, allowing for the use of optimized 650 V GaN FETs on the primary side while maintaining voltage stress within a manageable range. Also, lies in the 90-degree interleaved control strategy which is phase-shift operation effectively doubles the apparent ripple frequency at both input and output nodes, significantly suppressing current ripple and enabling a drastic reduction in the footprint of EMI filters and output decoupling capacitors. This approach not only shatters the density wall but also ensures a balanced thermal gradient across the module, which is vital for the reliability of high-density server environments.

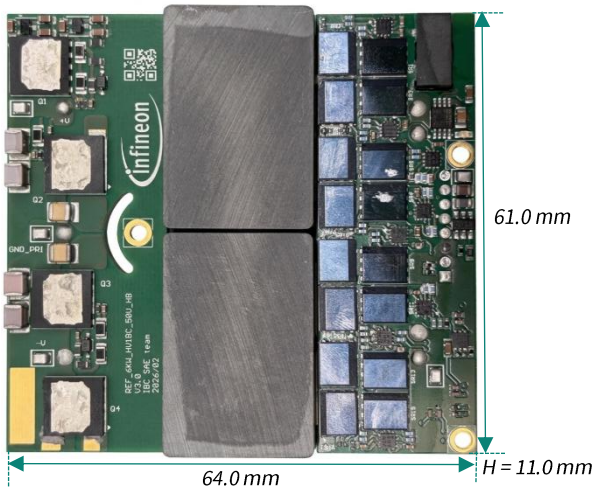
The module achieves industry-leading performance through the synergy of high-frequency GaN devices and advanced planar magnetics. Operating at 800 kHz in open-loop, the LLC is designed to remain fixed at the resonant point. A custom EI-core transformer leverages PCB leakage inductance to maximize power density. Prototypes demonstrate 98.5% peak efficiency and stable operation from 10% – 100% load. The design enables scalable high-voltage DC distribution in advanced electronic systems.

Key features

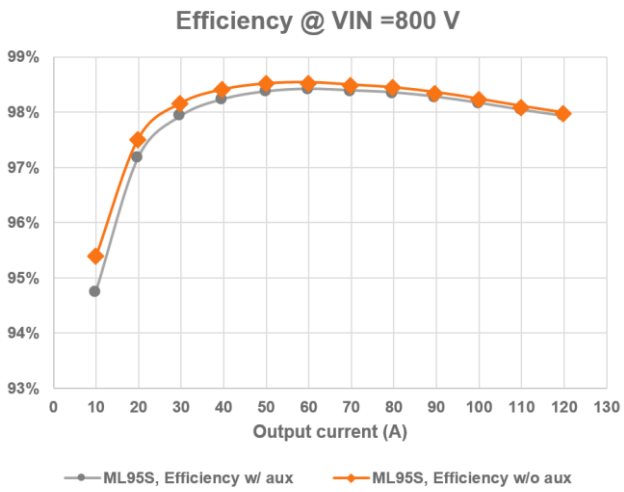
- Full-GaN Implementation
- Custom magnetic design
- 800 kHz switching frequency
- 6 kW in a half brick footprint (64 x 61 x 11 mm)
- High conversion ratio (16:1)
- Fully digital control based on 32-bit, ARM® Cortex® M0
- System configuration, monitor and control with the PMBus 1.3 compliance
- Advanced stacked LLC topology

Key benefits

- Industry leading power density which is > 2000 W/in^3
- 98.5% peak efficiency
- Fixed-frequency, open-loop for predictable operation
- Fully integrated control, drivers, protection, and aux power in one module



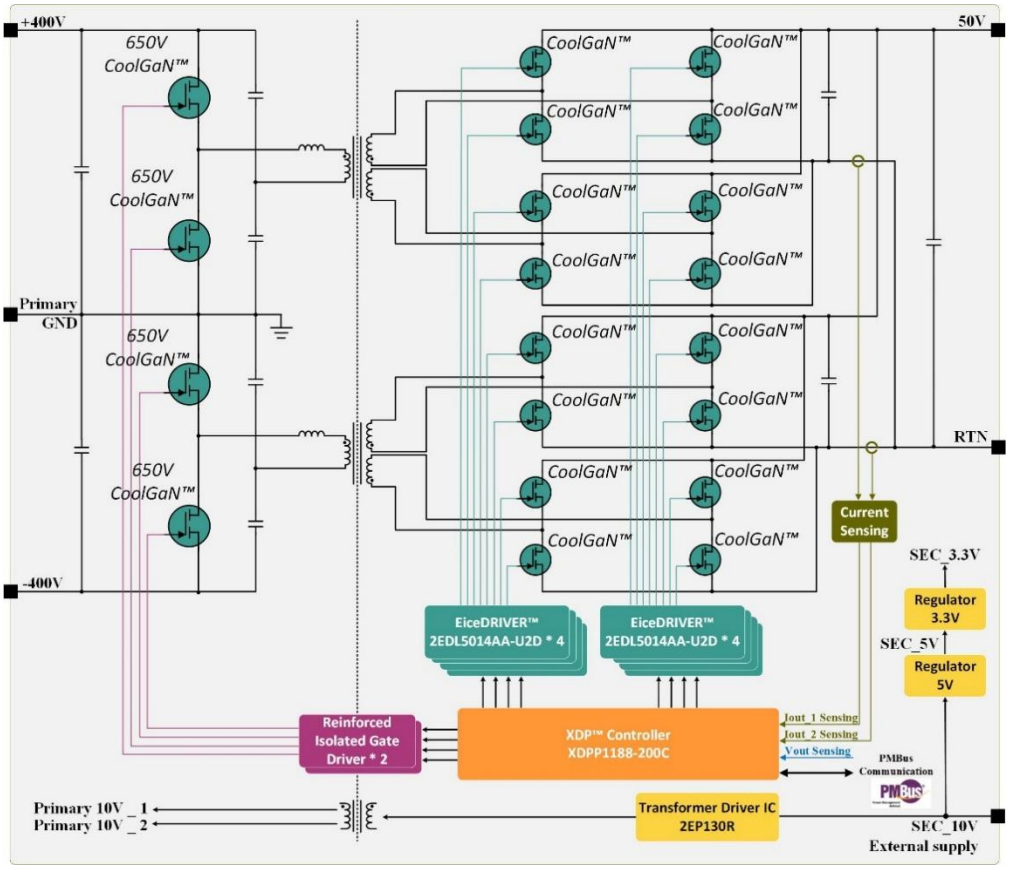
Photograph of the prototype



Measured efficiency versus output power

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Module architecture



Highlighted key products

No.	Product Group	Part Number	Description
1	HV CoolGaN™	IGLC65R020D2	CoolGaN™ Transistor 650 V G5, $R_{DS(on)}$= 27 mΩ, Q_{oss} = 82 nC @400 V
2	MV CoolGaN™	IGD01xK10S2	CoolGaN™ Transistor 100 V G5, $R_{DS(on)}$= 0.9 mΩ, Q_{oss} = 90 nC @50 V
3	EiceDRIVER™	2EDR7259X	Reinforced isolated gate driver IC
4	EiceDRIVER™	2EDL5014AA-U2D	Half-bridge GaN driver IC, bootstrap voltage of 120 V
5	XDP™	XDPP1188 - 200C	32-bit, ARM® Cortex® M0, fully programmable digital controller

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