Bus Converter Reference Design Packs 1 kW Into Eighth-Brick Footprint

Efficient Power Conversion's EPC9149 is a reference design and demo board for a 1-kW-capable 48-V to 12-V LLC converter that operates as a 4:1 dc transformer, making this an unregulated but isolated dc-dc converter, also referred to as a bus converter. This demonstration board leverages the company's 100-V EPC2218 and 40-V EPC2024 GaN FETs to deliver 1 kW of output in a standard eighth brick (2.3 in. x 0.9 in.) format, which represents an exceptionally high power rating for this size of converter (Fig. 1).

The EPC9149 demo board measures 58.4 mm by 22.9 mm x 10-mm high (without heatsink), which equates to a power density of 1,226 W/in^3. As a point of reference, Vicor's BCM48Bx120y300A00, 48-V to 12-V bus converter delivers 300 W in the company's 1.28 x 0.866 x 0.265 Full-Chip package, which results in a power density of 1,021 W/in.^{3}. (1.28 x 0.866 is essentially a sixteenth-brick footprint). Note that Vicor's converter uses the company's proprietary sine-amplitude converter topology and proprietary packaging.

For additional market perspective, consider another power converter offered by Flex Power Modules. This company offers a version of its BMR492 48-V to 12-V intermediate bus converter that is rated to deliver 800 W of continuous output (and 1100 W in bursts) in an eighth-brick form factor.

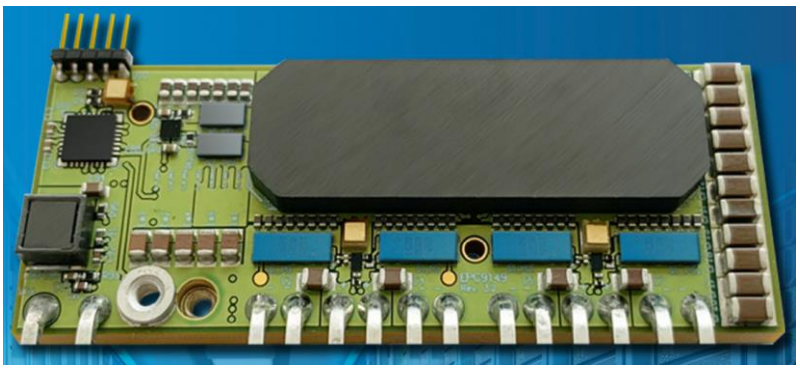
Naturally, these are rough comparisons (for ex. heatsinks and deratings may affect the power density figures), and designers should consult the respective data sheets for details on performance and test conditions. Nevertheless, these numbers suggest that the EPC9149 demo board offers power supply designers access to cutting-edge power density using GaN FETs in a standard topology and standard board-level assembly. This reference design also makes it simple for a power supply designer to replicate this design, providing all supporting materials for this board including schematic, bills of materials, and Gerber files on the EPC website.

The high-power density of the EPC9149 is achieved thanks to EPC GaN FET technology. eGaN FETs enable high switching frequency, in this case 1 MHz, and they are very small, one-third the size of silicon MOSFETs with similar on resistance. The EPC9149 board features four 100-V rated EPC2218 eGaN FETs for primary-side rectification, and eight 40-V rated EPC2024 eGaN FETs for the secondary-side synchronous rectification. The board also features a 4-mm x 4-mm Microchip dsPIC33CKMP102T-I/M6 microcontroller for flexibility, configuration, communications and programmability.

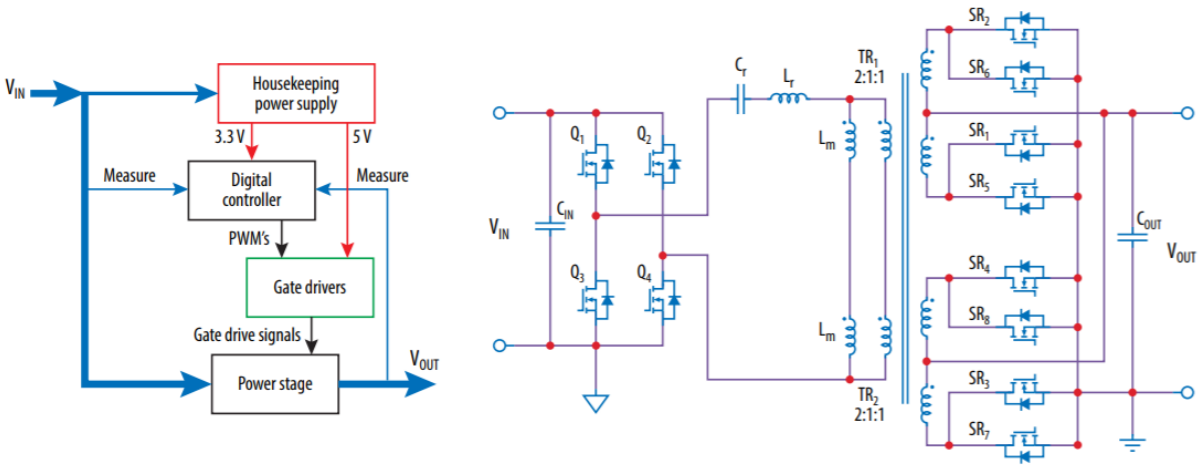
This new demonstration board can operate from an input voltage between 36 V and 60 V and delivers up to 83.3 A of load current. The peak efficiency from 48 V to 12 V is 98% and the full load efficiency, at 12 V when delivering 1 kW, is 97% (Figs. 2 and 3). The highest temperature in steady-state operation at maximum load with 400 LFM airflow is 88°C, which relates to a maximum junction temperature of 95°C.

"eGaN FETs and integrated circuits increase power density for 48-V to 12-V converters and address data center application demands for higher power in a small size," said Alex Lidow, CEO of EPC. "The use of a Microchip digital controller allows flexibility for programming and configuration of the EPC9149 demonstration board."

The EPC9149 demonstration board is priced at $381.60 each and is available for immediate delivery from Digi-Key. The EPC9149 ships with a motherboard to simplify testing. For more information see the "EPC9149 – Evaluation Kit" page.



(a)



(b)

Fig. 1. EPC's EPC9149 reference design and demo board (a) for a 48-V to 12-V bus converter exploits the efficiency of the company's GaN FETs to deliver 1 kW in an eighth-brick format, achieving a power density of 1,226 W/in^3. A simplified schematic of the LLC converter design is shown in (b).

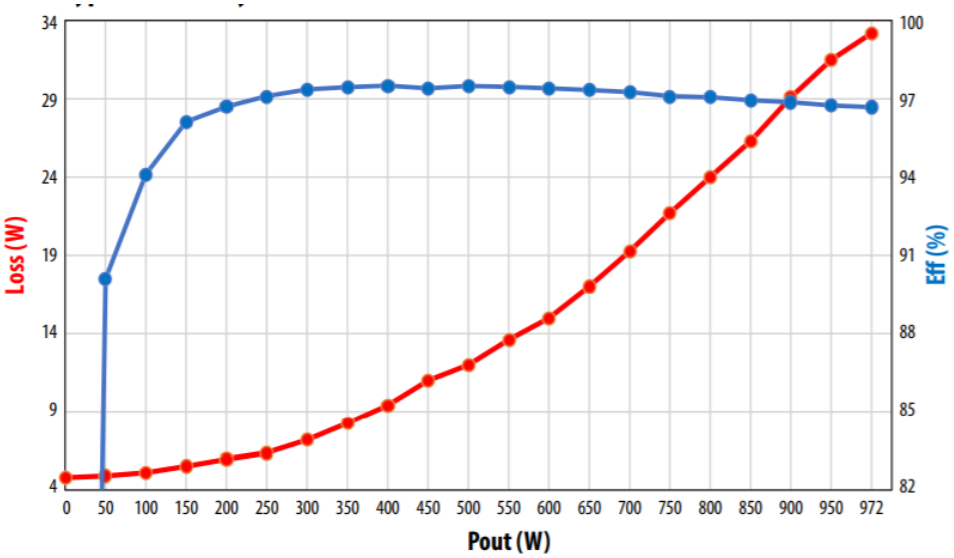
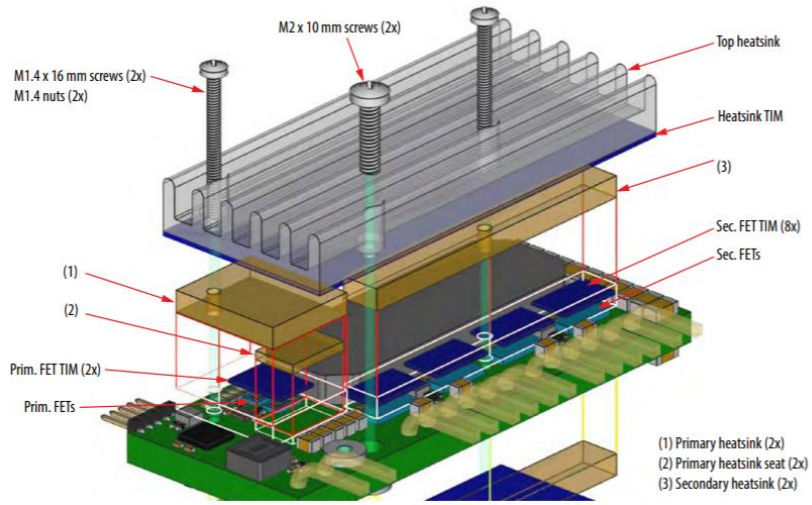


Fig. 2. Total system efficiency and loss for the EPC9149 at 48-V input and 12-V output with 400 LFM of forced air cooling applied and a heatsink kit installed. The kit consists of heatsinks and heat spreaders installed on top and bottom sides of the demo board as pictured in Fig. 3.



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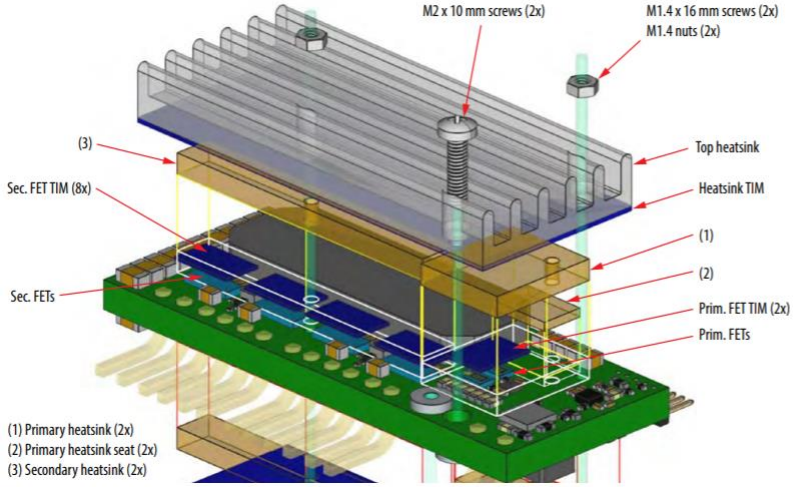

(b)

Fig. 3. Thermal solution assembly process for the EPC9149 module. Assembly of topside (a) and bottomside (b) heatsinks, thermal interface materials, heat spreaders and hardware are shown here.