GaN FETs + Driver Module Lowers Barriers To GaN-Based Power Design

Calling it a prototype, Texas Instruments (TI) has introduced an 80-V 10-A GaN FET half-bridge power stage that should make it easier for designers to experiment with GaN-based power converter designs today, and ultimately accelerate their adoption of GaN-based power conversion solutions. The new LMG5200 combines a high-frequency driver and two GaN FETs in a half-bridge configuration with all three die housed in a QFN package (Fig. 1.) This co-packaging of driver and GaN FETs has long been seen as a desirable step in the commercialization of GaN technology as it eliminates one of the trickier elements of the converter design—minimizing the parasitics in the interconnects between the driver and FETs. By lowering packaging parasitic inductance in this critical gate-drive loop, the LMG5200 increases power-stage efficiency and enhances dV/dt immunity while reducing EMI.

GaN-based power conversion solutions are expected to provide increased power density and efficiency in space-constrained industrial and telecom applications. According to the company, the LMG5200 delivers 25% lower power losses compared to silicon-based designs (Fig. 2), also enabling single-stage conversion in some applications where two power stages would normally be required when designing with silicon MOSFETs.

The LMG5200 is being introduced as the industry's first 80-V integrated half-bridge GaN FET power stage. But more to the point, it is likely the first integrated half-bridge GaN FET power stage of any rating to be released commercially, according to Grant Smith, business development manager and systems engineer for GaN Products at TI. Despite its novelty as a module, the semiconductors inside are a bit more familiar. The driver die is the same one used in TI's previously introduced LM5113, while the GaN FETs are previously introduced die from Efficient Power Conversion.

The description of this part as a prototype signifies that the product has not yet completed the full slate of lifetime performance and reliability testing that would typically be expected of commercially released silicon power devices. That status is reflected in the preliminary nature of the LMG5200 documentation, which the company refers to as a "technology guide" rather than a datasheet. In other words, this spec sheet omits the usual guarantees of device performance that would normally be indicated on a datasheet for commercially available silicon devices.

Indeed, customers have to sign a waiver acknowledging the preliminary nature of the device in order to access this technology. But all of this is in keeping with the purpose of the LMG5200, which is to enable power designers to become comfortable designing with GaN even as the company continues the process of developing and qualifying GaN power devices. For more information on TI's comprehensive GaN-specific quality program for reliability, see "A comprehensive methodology to qualify the reliability of GaN products."

"We don't want to hold back the technology," says Grant, who adds that the customers' feedback on the LMG5200 will contribute to what ultimately becomes the production version of this part. According to Smith, the timing on the introduction of the production part will also depend on customer feedback.

In addition, Smith comments that before this type of part is ready for high-volume production, "there needs to be more of an eco system with magnetics, design rules for PCBs," and other design support. For its part, TI is introducing PSpice and TINA-TI models for the LMG5200, enabling users to optimize the device's operating frequency from 10 kHz to 10 MHz in supply voltage ranges of 10 V to 80V, as well as an evaluation module.

At the upcoming APEC conference, the company will be demonstrating a 48-V to 1.8-V 40-A single-stage power converter that achieves over 92% efficiency. This particular board will also be offered later as another evaluation module. At APEC, TI will also be releasing an LMG5200 pcb layout application note, a reliability white paper, an LMG5200 design guide and a GaN FET Module performance versus Silicon white paper.

"One of the biggest barriers to GaN-based power design has been the uncertainties around driving GaN FETs and the resulting parasitics due to packaging and design layout," said Steve Lambouses, vice president of TI's High-Voltage Power Solutions business. "We help power designers realize the full power potential of GaN technology by offering them a complete, reliable power-conversion ecosystem of optimized integrated modules, drivers and high-frequency controllers in advanced, easy-to-design packaging."

Typically, designers who use GaN FETs that switch at high frequencies must be careful with board layout to avoid ringing and electromagnetic interference (EMI). TI's LMG5200 dual 80-V power stage prototype significantly eases this issue while increasing power-stage efficiency by reducing packaging parasitic inductances in the critical gate-drive loop. The LMG5200 features advanced multichip packaging technology and is optimized to support power-conversion topologies with frequencies up to 5 MHz.

The 6-mm by 8-mm QFN package requires no underfill, which significantly simplifies manufacturing. The reduced footprint solidifies the value of GaN technology and will help increase adoption of GaN power designs in many new applications, ranging from new high-frequency wireless charging applications to 48-V telecom and industrial designs.

Prototype samples of the GaN power stage are available to purchase now in the TI Store. The LMG5200 is priced at $50 each with a maximum purchase of 10 units. An evaluation module is available for $299. For more information, visit www.ti.com/lmg5200-pr. For more information on TI's complete GaN solution, visit www.ti.com/gan-pr.

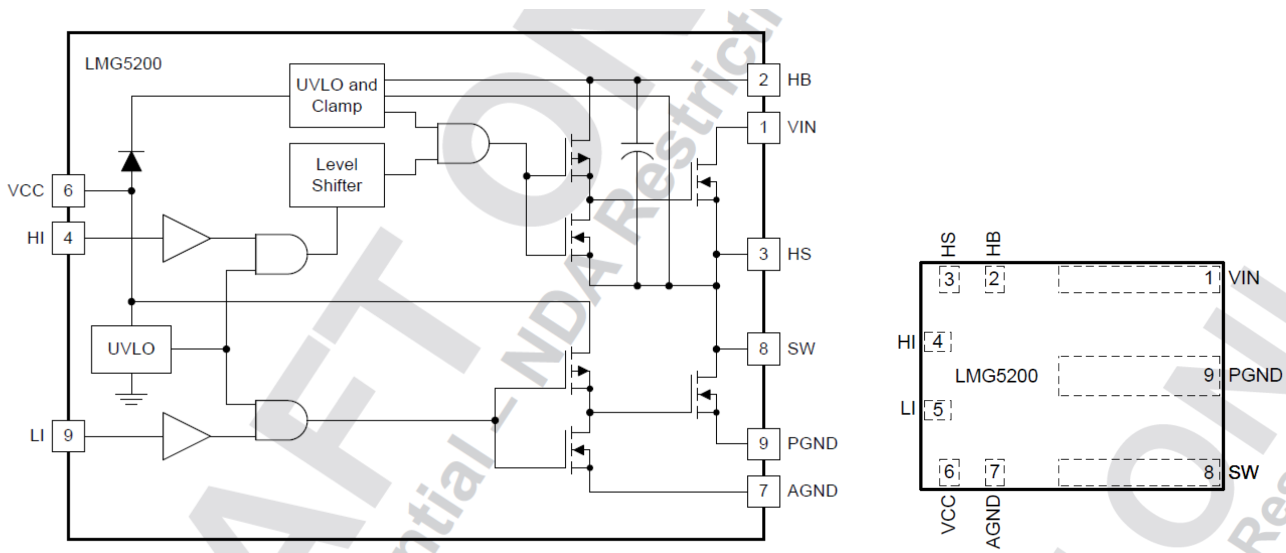

Fig. 1. TI's LMG5200 80-V integrated half-bridge GaN FET power-stage co-packages a gate driver die with two enhancement-mode GaN FETs from EPC in a QFN package (pin out is shown on the right.)

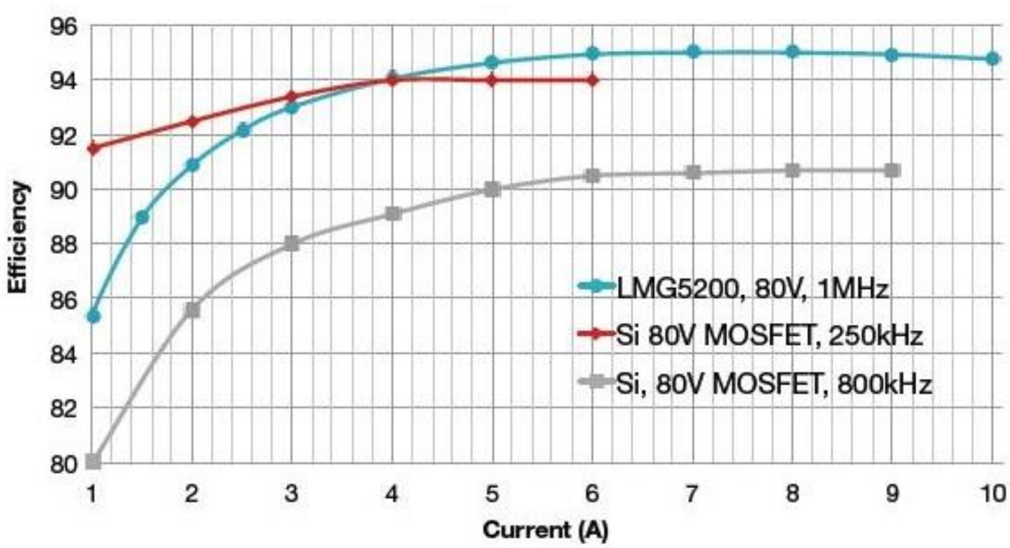

Fig. 2. Efficiency of an LMG5200-based design versus silicon-based design across the load range and at different frequencies.