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Automotive GaN FET Includes Driver, Protection And Active Power Management

Texas Instruments has expanded its high-voltage power management portfolio with the next generation of 650-V and 600-V gallium nitride (GaN) FETs for automotive and industrial applications. With a fast-switching, 2.2-MHz integrated silicon gate driver, the new families of GaN FETs help engineers deliver twice the power density, achieve 99% efficiency and reduce the size of power magnetics by 59% compared to existing solutions, according to the company.

The new devices for automotive are the LMG3522R030-Q1 and LMG3525R030-Q1 650-V, 30-mΩ GaN FETs, while the new devices for industrial applications are the LMG3422R050 and LMG3425R050 600-V, 50-mΩ GaN FETs and the LMG3422R030 and LMG3425R030 600-V, 30-mΩ GaN FETs. All of these devices feature integrated driver, protection and temperature reporting (see Fig .1)

The LMG3522R030-Q1 and LMG3525R030-Q1 are similar parts same except for the addition of an ideal diode mode in the '3525. This feature reduces third-quadrant losses. There's a similar distinction for the industrial-grade models—the '3425 parts offer the ideal diode mode.

TI developed these new FETs using its proprietary GaN materials and processing capabilities on a GaN-on-silicon (Si) substrate. This provides a cost and supply-chain advantage over comparable substrate materials such as silicon carbide (SiC).

Using TI's new automotive GaN FETs can help reduce the size of electric vehicle (EV) onboard chargers and dc-dc converters by as much as 50% compared to existing Si or SiC solutions, according to the vendor. This enables engineers to achieve extended battery range, increased system reliability and lower design cost. In industrial designs, the new devices enable high efficiency and power density in ac-dc power-delivery applications where low losses and reduced board space are important such as hyperscale and enterprise computing platforms as well as 5G telecom rectifiers.

"Industrial and automotive applications increasingly demand more power in less space, and designers must deliver proven power management systems that operate reliably over the long lifetime of the end equipment," said Steve Lambouses, vice president for High Voltage Power at TI. "Backed by more than 40 million device reliability hours and more than 5 GWh of power conversion application testing, TI's GaN technology provides the lifetime reliability engineers require in any market."

TI's new GaN FETs integrate a fast-switching driver, plus internal protection and temperature sensing, enabling engineers to achieve high performance while reducing board space for their power management designs. This integration, plus the high power density of TI's GaN technology, enables engineers to eliminate more than 10 components typically required for discrete solutions, says TI. Additionally, each of the new 30-mΩ FETs can support up to 4 kW of power conversion when applied in a half-bridge configuration.

GaN offers the advantage of fast switching, which enables smaller, lighter and more efficient power systems. Historically, the tradeoff with gaining fast switching capability is higher power losses. To avoid this tradeoff, the new GaN FETs feature TI's ideal diode mode (in the '3525 and '3425 models) to reduce power losses. For example, in PFCs, ideal diode mode reduces third-quadrant losses by up to 66% compared to discrete GaN FETs and SiC MOSFETs. Ideal diode mode also eliminates the need for adaptive deadtime control, reducing firmware complexity and development time.

Offering 23% lower thermal impedance than the nearest competitive packaging, according to the vendor, the TI GaN FET QFN packaging allows engineers to use smaller heatsinks while simplifying thermal designs. The new devices provide thermal design flexibility with the ability to choose from either a bottom- or top-side-cooled package. In addition, the FETs' integrated digital temperature reporting enables active power management, allowing engineers to optimize system thermal performance under varying loads and operating conditions.

Pre-production versions of the LMG3522R030-Q1 and LMG3525R030-Q1 650-V automotive GaN FETs and evaluation modules are expected to be available for purchase on TI.com in the first quarter of 2021. Engineering samples are available upon request at www.ti.com/autogan where you can also request datasheets. Or see the LMG3525R030-Q1 product page for more information. An evaluation module for the automotive GaN FETs, the LMG3525R030-Q1EVM, is also available (Fig. 2). For more information, see the EVM user guide.

Pre-production versions of the four new industrial-grade, 600-V GaN FETs are available now, only on TI.com, in a 12-mm-by-12-mm QFN package with U.S. pricing listed in the table below. These FETs target high-density industrial power supplies, solar inverters, industrial motor drives, and uninterruptable power supplies.

TI expects the industrial devices to ship in volume production in the first quarter of 2021. Evaluation modules are available for purchase on TI.com starting at U.S. $199 as shown in the table. For more information on these industrial-grade GaN FETs also see www.ti.com/autogan or click on the links for the product pages listed in the table.

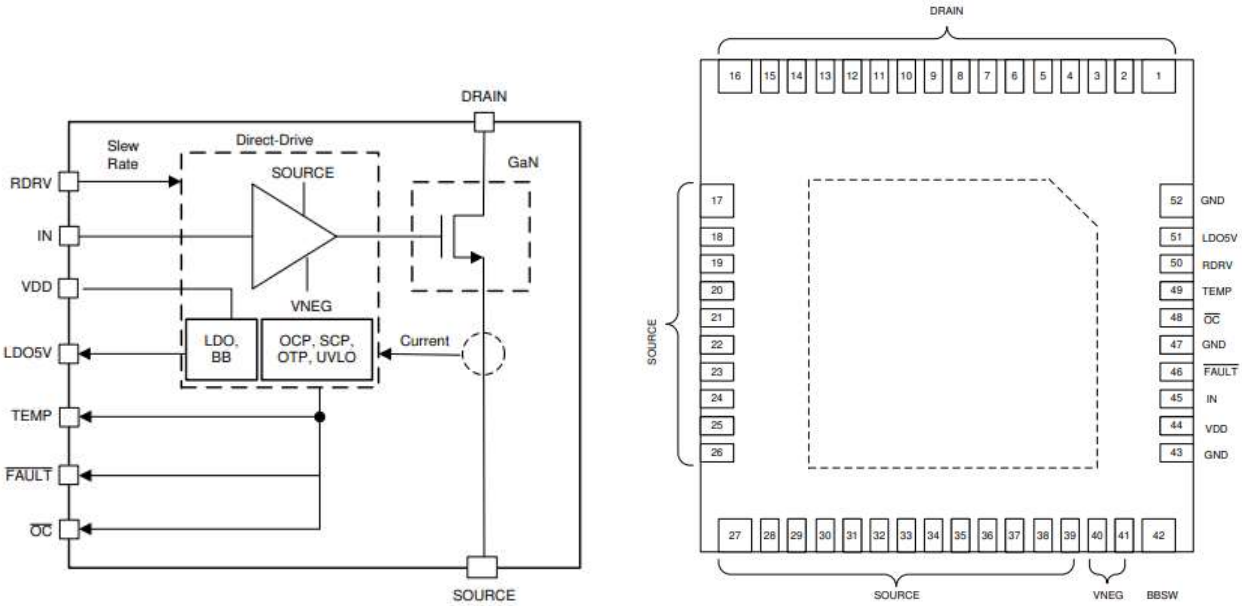

Fig. 1. Simplified block diagram for TI's 650-V automotive-grade and 600-V industrial-grade GaN FETs with integrated driver, protection and temperature reporting (a) and the pinout for the 52-pin VQFN package (b).

Table. Pricing for TI's new industrial-grade GaN FETs and the associated EVMs.

Product	Unit price (in 1000-unit quantities)	Evaluation module	Price
LMG3422R050	$8.34	LMG3422EVM-041	$199
LMG3425R050	$8.92	LMG3425EVM-041	$199
LMG3422R030	$13.72	LMG3422EVM-043	$199
LMG3425R030	$14.68	LMG3425EVM-043	$199

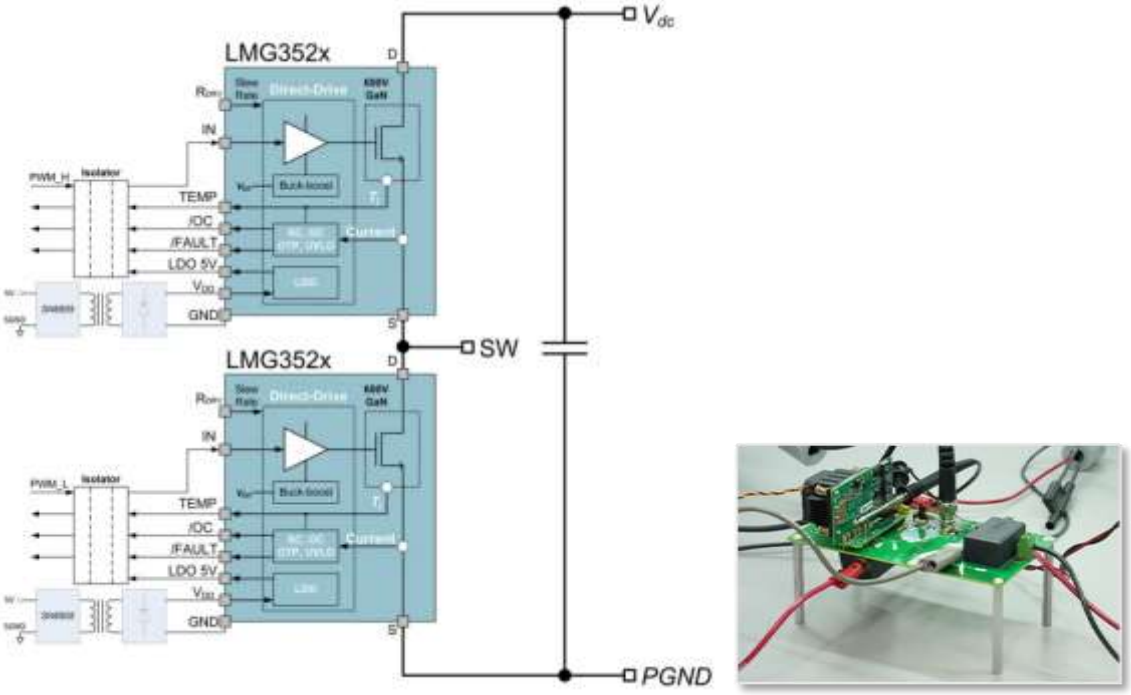

Fig. 2. An evaluation module (the LMG3525R030-Q1EVM) is available for the LMG3522R030-Q1 and LMG3525R030-Q1 650-V, 30-mΩ GaN FETs. The EVM contains the LMG3525R030-Q1 daughter card, which features two 650-V, 30-Ω GaN FETs with integrated driver and protection configured in a half bridge with all required bias circuit and logic/power level shifting. Essential power stage and gate driving high-frequency current loops are fully enclosed on the board—minimizing parasitic inductances, reducing voltage overshoots and improving performance. Configured to have a socket-style external connection for easy interface with external power stages to run the LMG3525R030-Q1 in various applications. A block diagram for the EVM is shown on the left and a photo of the EVM (both the daughter card and the motherboard) is shown on the right. Similar EVMs are available for the industrial models.