

GATE DRIVER MARKET AND TECHNOLOGY TRENDS

Market & Technology report - March 2017

Gate driver ICs will be challenged by greater integration demands and the arrival of GaN and SiC.

KEY FEATURES OF THE REPORT

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- Detailed discussion about the gate driver market, including gate driver ICs, Intelligent Power Modules (IPMs), and Plug-and-Play (PnP) driver boards
- Market size and market share information in US dollars for gate driver ICs, and IPMs
- Revenue forecast for gate driver market for 2017-2022
- Key application and sector size breakdown in each of the five key markets: automotive, consumer, computing, communications, industrial
- Market breakdown by type of driver IC, including single channel, half bridge, full bridge, and three phase, and by voltage, with ranges <400V, 400V-1,200V, and >1,200V
- Technology analysis, covering isolation technologies, high temperature gate drivers, solutions for SiC and GaN, and gate driver technology roadmaps
- Business models, supply chain evolution, and case studies of some key companies competing in the gate driver market

OBJECTIVES OF THE REPORT

- Access the gate driver market for ICs, IPMs, and Plug-and-Play gate driver boards, and new power semiconductor materials, specifically SiC and GaN
- Understand the market dynamics for gate driver applications
- Have a clear overview of current technologies for gate drivers
- Identify the key technology trends that will shape the market in the future
- Understand the main challenges and proposed innovations
- Provide an overall view of the competitive landscape of the gate driver market

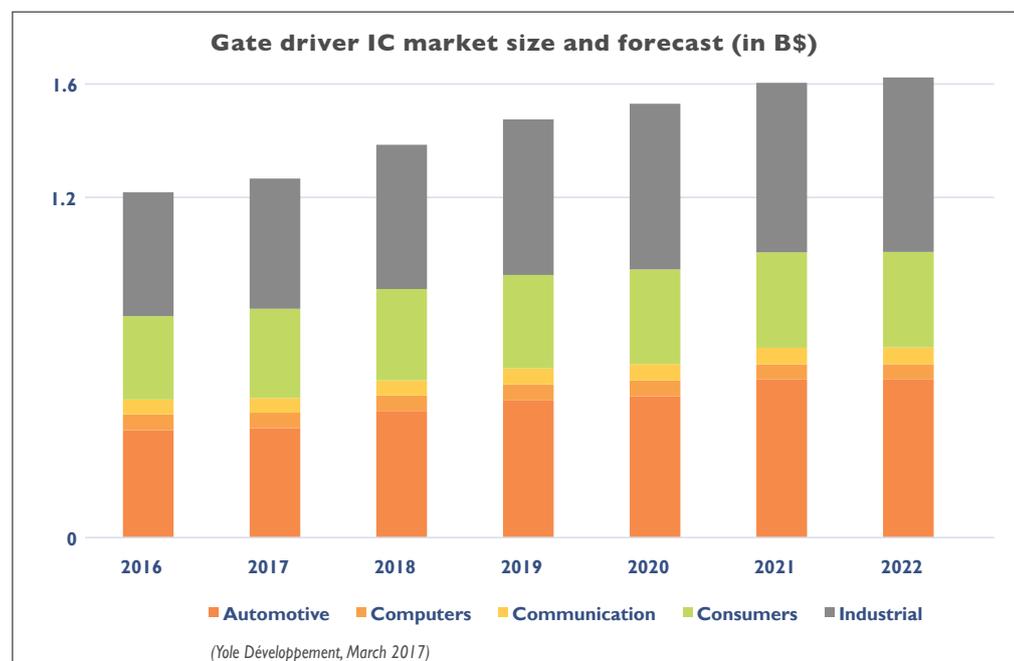
THE GATE DRIVER IC MARKET WILL BENEFIT FROM THE STEADY GROWTH OF THE POWER SEMICONDUCTOR INDUSTRY

In recent years, a much greater percentage of home appliances, electric vehicles, hybrid vehicles, including mild hybrids, and renewable energy products have implemented dedicated power semiconductor devices on-board. The majority of these applications utilize power MOSFETs and IGBTs as power switches, but the adoption rate of gate drivers and applications of IGBTs and MOSFETs are different. In 2016, more than 60% of the gate drivers used in power applications were attached to MOSFETs. Nevertheless, the revenue gap between MOSFET and IGBT gate drivers is quickly narrowing.

Yole Développement (Yole) forecasts gate driver ICs will benefit from power semiconductors delivering a 6.1% compound annual growth rate (CAGR) from 2017-2022. The gate driver IC market revenue, which was estimated to have been \$1.2B in 2016, is forecast to have a 5.1% CAGR for 2017-2022.

Based on Yole's analysis, usage of single channel and half bridge gate driver ICs will increase over the next few years due to the need for isolation integration. Half bridge gate driver ICs are estimated to have accounted for over 40% of gate driver revenues in 2016. Single side gate driver ICs were the second most popular topology with about 30% of revenue. Full bridge and three phase gate drivers are mostly found in motor control and inverter applications for low-mid power.

In this gate driver report, Yole examines the difference in topologies and analyzes the market size, split by type: single channel, half-bridge, full bridge, and three phase. It also splits the market by application, into automotive, consumer, industrial, computers, and communication, and by voltage, into ranges <400V, 400V-1,200V, and >1,200V. Yole aims to provide a comprehensive understanding of market segments, opportunities, business models, and technology trends associated with the gate driver ICs in this report.



NEW TECHNICAL REQUIREMENTS RELATED TO ISOLATION OR THE USE OF GaN AND SiC POWER TRANSISTORS DEMAND ADVANCED DRIVER IC TECHNOLOGIES TO BE DEVELOPED

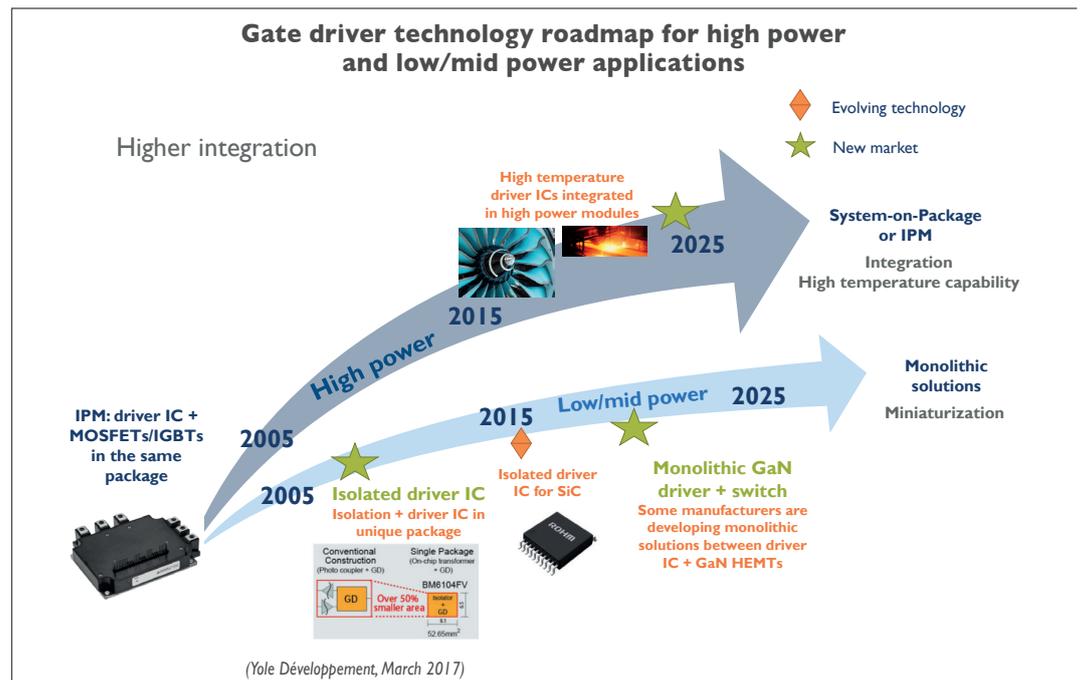
Over recent years, all major players have started providing isolation-integrated products, the coreless transformer being the main type. Having isolation in the same package as the driver IC

provides greater integration, which is sought by many system manufacturers. In this report, Yole provides an in-depth technical analysis regarding several main types of isolation techniques including

pulse transformers, level shifters, opto-isolators and coreless transformers, their primary applications, disadvantages and advantages, and how companies are positioned on the use and development of these technologies.

Besides isolation technologies, niche applications such as high temperature (HT) operation and other harsh environment requirements provide additional growth opportunities for gate drivers. SiC-based power switches can endure high temperature environments with the material's high T_j and T_e performance characteristics. Companies such as Cissoid and X-Rel Semiconductor are looking to capitalize on the potential of SiC in these niche applications.

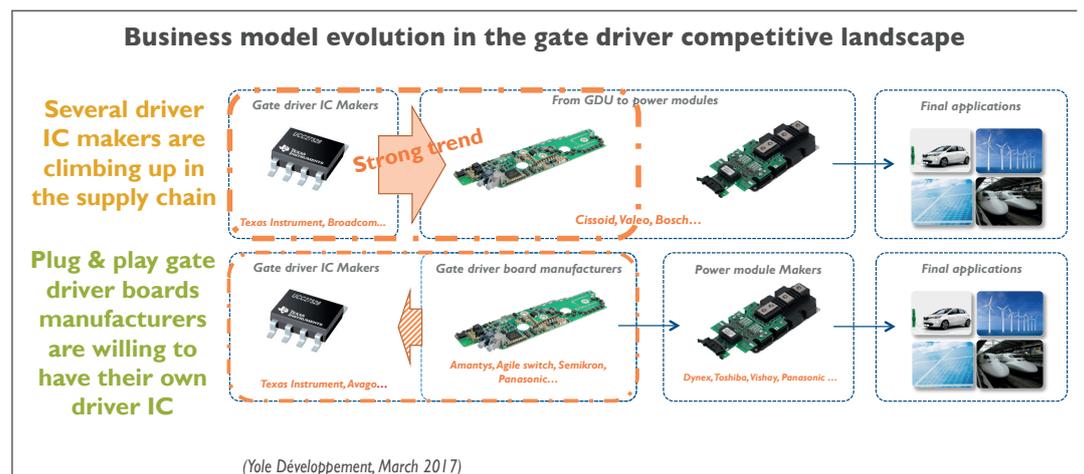
GaN FETs can switch at a much higher frequency than silicon-based MOSFETs. Higher frequency provides advantages but also challenges. Yole provides a case study of Navitas, a company trying to incorporate a GaN FET with GaN controllers on the same substrate. This monolithic solution, integrating the power transistor and its driver, shows the level of involvement of several GaN and SiC players, in order to get adequate drivers to facilitate the use of wide band gap devices in the new generation of converters. This report includes a complete chapter on the new requirements needed for GaN and SiC power transistor gate drivers.



THE SUPPLY CHAIN OF THE GATE DRIVER IS EVOLVING, PUSHED BY HIGHER INTEGRATION NEEDS, AS WELL AS AN INCREASING NEED FOR MORE COMPLETE PRODUCT SOLUTIONS

In addition to gate driver IC manufacturers, other players emerged along the supply chain to offer alternative solutions for various power management needs. Two of the more notable solutions are Intelligent Power Modules (IPMs) and Plug-and-Play (PnP) gate driver boards. An IPM integrates control,

protection, gate driver, and power switching devices in a single package to address the need for compact, efficient, and application-specific power management needs. Over 70% of all IPMs are in white goods and motor control. Some notable players such as Mitsubishi, ON Semiconductor, Semikron, and



Infineon compete fiercely in the IPM market. Based on Yole's analysis, high voltage IPMs are forecast to slowly replace discrete solutions in several key markets, such as automotive, industrial, and consumer.

The gate driver report describes the detailed competitive landscape and supply chain evolution for coming years. The top take-away messages are:

- The top five gate driver IC suppliers control more than 50% of the market, with most of them also competing in the power semiconductor segment, including NXP, Infineon, and STMicroelectronics. Compared to other semiconductor segments such as memory, CPU, and sensors, the power semiconductor sector is less consolidated and can still provide opportunities for companies to grow with the right business model and strategy.
- Various business models can be successful in addressing diverse customer needs in the gate driver market. Companies change their business models periodically to address fast growing

markets. For instance, Texas Instruments, traditionally an IC supplier, increased its focus on providing system level solutions by integrating multiple chips in the same package or board.

- New materials such as SiC and GaN will increase the level of integration. Both SiC and GaN devices have been in development for years. To recoup the cost and maximize the profit, companies are gearing towards offering system level solutions instead of components. Other companies traditionally not invested in these two materials can get product portfolios and expertise by acquiring other companies.

Lastly, company profiles, gate driver offerings, and revenue breakdowns are included for Broadcom, Infineon, Renesas, NXP, Texas Instruments, and other top suppliers. The gate driver report from Yole aims to provide the most up-to-date information of gate drivers, power semiconductors, competitive landscapes, and major power applications.

COMPANIES CITED IN THE REPORT (non exhaustive list)

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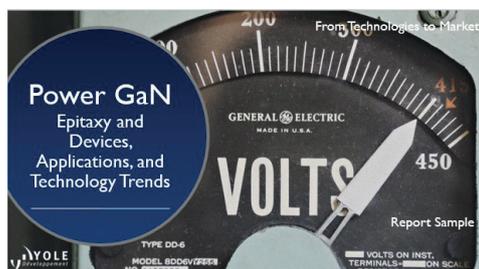
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