LYON, France – September 6, 2018: Technical innovations in power module packaging are mainly driven by the challenging system requirements of the booming EV/HEV\(^1\) industry and the entrance of WBG\(^2\) materials.

The companies Yole Développement (Yole) and System Plus consulting, both part of Yole Group of Companies propose today, two dedicated analyses to get a better understanding of the market evolution and technical issues of the power module packaging industry: Power Module Packaging Report, 2018 edition and Automotive Power Module Packaging Comparison 2018 report.

Once again, both partners combine their expertise to provide a deep added-value study. Taking into account the whole value chain, the market issues and technical expectations, analysts propose you today a valuable vision of the tomorrow’s industry.

The introduction of the WBG semiconductors, SiC\(^3\) and GaN\(^4\) is today pushing the development of new power packaging solutions, announces the market research and strategy consulting company, Yole. SiC technologies become step by step an essential solution to answer the industrial requirements, with a market estimation reaching 29% CAGR\(^5\) between 2017 and 2023\(^6\). Actually, WBG devices can work at higher switching frequencies and higher junction temperatures. The latest Model3 inverter from Tesla is a good example of WBG penetration, showing the added-value of STMicroelectronics’ SiC.

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\(^{1}\) EV/HEV : Electric/Hybrid Electric Vehicle

\(^{2}\) WBG : Wide Band Gap

\(^{3}\) SiC : Silicon Carbide

\(^{4}\) GaN : Gallium Nitride

\(^{5}\) CAGR : Compound Annual Growth Rate

\(^{6}\) Source : Power SiC 2018: Materials, Devices and Applications report, Yole Développement, July 2018
Beyond the semiconductor industry, the EV/HEV industry's demand for high power density and mechatronics integration is also driving many power electronics innovations with dedicated packaging solutions. New standards in terms of electrical devices and systems become a reality, pushing electronic components to work in non-conventional environments for longer.

System Plus Consulting’s report, *Automotive Power Module Packaging Comparison 2018 report* details the physical composition and cost of ten modules for automotive applications from five different manufacturers. Analysts reviewed the different topologies and techniques used for the module packaging. Under this new report, System Plus Consulting’s analysts highlight the specificities of each solution, defined by the car makers.

“There is not yet a standardized package in automotive application” comments Farid Hamrani, Cost Engineer at System Plus Consulting.

Under a continuous process of innovations, the power module packaging industry is in a good shape. This market is showing a 8.2% CAGR during the period 2017-2023, reaching a global sector of almost US$ 2 billion at the end of the period.

With two major technical trends, over-molded double-side cooled modules for hybrid cars and single-side cooled modules with pin-fin baseplates for full electric cars, this industry is dominated by IGBT power modules:

“The IGBT power module market grew 18.1% in 2017”, announces Dr. Milan Rosina, Senior Technology & Market Analyst, Power Electronics & Batteries at Yole. “No doubt today, that IGBT modules are driving the power module packaging materials business.”

Indeed 2017 was an impressive year for the IGBT power module market. And 2018 perspectives are even better, with over 20% growth in the first half of the year. The main explanation of this drastic market explosion is the boost from the EV/HEV sector, especially in China. It has also been an exceptional year for industrial motor drives in Asia. In parallel, other device modules, like those based on MOSFETs and bipolar transistors, show a slight decrease.
Consequently the overall power module market is expected to be over US$5.5 billion in 2023. This promising market is directly beneficial for the packaging material business.

The power module packaging material business is worth US$1.2 billion, a little more than a third of the total power module market.

“It is a very dynamic market, where continuous innovations and material enhancements and a lot of R&D investment are needed”, comments Alejandra Fuentes Suarez, Technology & Market Analyst at Yole.

This power module packaging material market’s CAGR for 2017-2023 will be 8.2%, coming close to a US$2 billion business opportunity by 2023…

*Power module packaging report* from Yole highlights the market trends and forecasts and provides a comprehensive analysis of the package designs and materials. In addition, it describes the current packaging challenges, especially for SiC and GaN technologies. Key technology trends are also well detailed in this report, showing the impact of the market evolution. Yole Group of Companies including Yole Développement and System Plus Consulting proposes a detailed description of its reports on the following websites: i-micronews.com and http://www.systemplus.fr

In addition to a dedicated power electronics webcast powered by Yole and welcoming invited industrial speakers (More info.), Yole Group of Companies looks forward seeing you at Semicon Europa and Electronica in November, in Munich, Germany.

Yole will present two key power electronics & compound semiconductor presentations:

- "How battery pack evolutions create opportunities for power electronics companies" on Nov. 15 at 12:20 PM during the Battery Session.
- "GaN power HEMT reliability research within the POWERBASE" taking place the same day at 2:00 PM during the Power Electronics Session.

Feel free to visit System Plus Consulting and Yole at booth # A4667. Stay tuned!

ABOUT THE REPORTS:

POWER MODULE PACKAGING 2018: MATERIAL MARKET AND TECHNOLOGY TRENDS

Power packaging is continuously adapting to power application market trends –
Produced by Yole Développement (Yole).

Companies cited in the report:


Authors:

Mattin Grao Txapartegi, Dr. Milan Rosina and Alejandra Fuentes Suarez, all part of the Power & Wireless division at Yole Développement co-authored the Power Module Packaging report:

- Mattin Grao Txapartegi investigates power packaging solutions to analyze the latest technical challenges, market growth and competitive landscape. Getting a deep understanding of the technology evolution, the market trends and the strategies of each player are part of his mission at Yole. Previously he acquired a comprehensive expertise in the design of power converters for EV at Renault (France). As an engineer, Mattin graduated from Grenoble INP (FR) with specialization in embedded systems for transportation. He has also an advanced master in aeronautics from the Arts & Métiers ParisTech (FR).
- Dr. Milan Rosina has 20 years of scientific, industrial and managerial experience involving equipment and process development, due diligence, technology, and market surveys in the fields of renewable energies, EV/HEV, energy storage, batteries, power electronics, thermal management, and innovative materials. He previously worked for the Institute of Electrical Engineering in Slovakia, Centrotherm (Germany), Fraunhofer IWS (Germany), CEA LETI in France, and utility company ENGIE in France. Dr. Rosina received his Ph.D. degree from National Polytechnical Institute (Grenoble, France)
- Alejandra Fuentes Suarez daily researches the latest developments in power converter topologies, passive components, power modules packaging and EV/HEV. Previously Alejandra acquired extensive expertise in the design of power converters for solar, wind, hydro and motor drive applications at Semikron (France). Alejandra graduated from UJF (Grenoble, FR) and INP (Grenoble, FR) as an electrical engineer, specializing in design of power electronics system. She also holds an advanced master’s in the field of Marketing and Management of Energy from the Grenoble Business School (Grenoble, FR).

AUTOMOTIVE POWER MODULE PACKAGING COMPARISON 2018

A cost-oriented review of power module packaging technologies for the automotive market. – Produced by System Plus Consulting

Complete teardown with detailed photos, precise measurements, manufacturing process flow, manufacturing cost analysis, technological and cost comparison …

Full description

Authors:

- Farid Hamrani joined System Plus Consulting in 2016 as a system cost engineer. He’s in charge of systems reverse cost analysis with a focus on embedded systems. He previously worked in the high reliability packaging field. Farid holds a master degree in microelectronics and material from the University of Nantes.
- Yvon Le Goff has joined System Plus Consulting in 2011, in order to setup the laboratory of System Plus Consulting. He previously worked during 25 years at Atmel Nantes Technological Analysis
Laboratory as fab support in physical analysis, and 3 years at Hirex Engineering in Toulouse, in a DPA lab.

- Véronique Le Troade has joined System Plus Consulting as a laboratory engineer. Coming from Atmel Nantes, she has extensive knowledge in failure analysis of components and in deprocessing of integrated circuits.

### ABOUT SYSTEM PLUS CONSULTING

System Plus Consulting specializes in the cost analysis of electronics, from semiconductor devices to electronic systems. Created more than 20 years ago, System Plus Consulting has developed a complete range of services, costing tools and reports to deliver in-depth production cost studies and estimate the objective selling price of a product. System Plus Consulting engineers are experts in Integrated Circuits – Power Devices & Modules – MEMS & Sensors – Photonics – LED – Imaging – Display – Packaging – Electronic Boards & Systems. Through hundreds of analyses performed each year, System Plus Consulting offers deep added-value, reports to help its customers understand their production processes and determine production costs. Based on System Plus Consulting’s results, manufacturers are able to compare their production costs to those of competitors. System Plus Consulting is a sister company of Yole Développement (Yole). More info. on [www.systemplus.fr](http://www.systemplus.fr)

### ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement (Yole) has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS & Sensors - Imaging - Medical Technologies - Compound Semiconductors - RF Electronics - Solid State Lighting - Displays - Photonics - Power Electronics - Batteries & Energy Management - Advanced Packaging - Semiconductor Manufacturing - Software & Computing - Memory and more...

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business. For more information, visit [www.yole.fr](http://www.yole.fr) and follow Yole on LinkedIn and Twitter.

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Yole Développement, System Plus Consulting, Knowmade, PISEO and Blumorpho are part of Yole Group of Companies.

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