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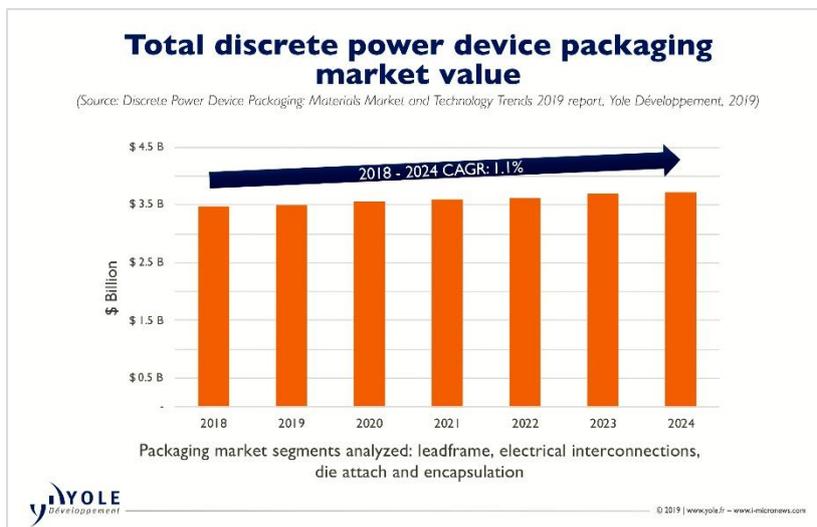
Discrete power device packaging, a big and slow-growing market

Extracted from: Discrete Power Device Packaging: Materials Market and Technology Trends report, Yole Développement, 2019 - Power Discrete Packaging Comparison, System Plus Consulting, 2018

LYON, France – May 28, 2019: The discrete power devices market represents almost US\$13.5 billion in 2018 with a 2.9% CAGR between 2018 and 2024. This industry is clearly well established and mature, confirms [Yole Développement \(Yole\)](#). Therefore, the discrete power device market is following the global rise of the power electronic industry.

In parallel, Yole's analysts announce a US\$3.7 billion market only for the packaging part, with a 1.1% CAGR during the same period. "The discrete power device packaging industry still offers business opportunities, especially for materials suppliers and packaging companies", comments **Milan Rosina, PhD. Principal Analyst, Power Electronics & Batteries, at Yole.**

Yole Group of companies including Yole Développement and [System Plus Consulting](#) proposes today a complete view of the discrete power devices packaging industry with two dedicated reports, [Discrete Power Device Packaging: Materials Market and Technology Trends](#) and [Power Discrete Packaging Comparison](#). Both companies combine their expertise to perform valuable and comprehensive analyses of the current packaging solutions taking into account the status of the power electronics industry. Discover today the status of the packaging technologies for discrete power devices.



Amongst the discrete power device industry's key characteristics and needs are low cost per device, a large selection of products and suppliers, and use of proven, highly standardized products and technologies, including packaging technologies.

"In fact, packaging technologies for discrete power devices including lead frame, die attach, electrical interconnections, and encapsulation should have the

forementioned characteristics," explains **Shalu Agarwal, PhD.**

Technology & Market Analyst, Power Electronics & Materials at Yole. *“It is difficult to match the high volume, standardized products and low cost required by device integrators with the acceptable additional costs equated to innovative packaging technologies”.*

Under this context, the combination of market growth and market size for different packaging solutions gives the complex result with many different variables, including device demand evolution, die size, package type and interconnection method used, device size following downsizing trends, semiconductor content per packaged device, and more. Some of these factors favor a market increase, others a market decrease, participating in a rather flat market evolution. As a consequence, the discrete power packaging market’s evolution remains pretty flat but is still growing grow between 2018 and 2024.

Major packaging innovations will be realized on the electrical interconnections level, due to the growing adoption of copper clips as a substitute for more conventional wire and ribbon bonding.

“In fact, the adoption of new material on device level and new markets application pushed the manufacturers to find new packaging technological solutions. These innovations came from sectors other than power, such as MEMS and advanced packaging and this pushed the old supply chain to adapt itself.”, asserts **Elena Barbarini, Head of Department Devices at System Plus Consulting.**



Discrete device makers such as Infineon Technologies, ON Semiconductor, ROHM Semiconductor and Fuji Electric can manufacture power devices internally or by subcontracting the packaging to OSAT¹ companies. Device makers and OSATs are both looking to offer innovative packaging solutions to their customers. Generally, during the first technology adoption phases, the innovative

products are made internally.

Once the demand for units becomes important, the devices manufacturers license the technology to other companies or use OSATs, which have huge manufacturing capacities. Die-attach materials, epoxy molding compounds, and interconnection materials are typically supplied by the same materials suppliers, which also

¹ OSAT : Outsourced Semiconductor Assembly & Test

provide these solutions to other markets. Lead frames are supplied primarily by numerous Asian materials suppliers, since low cost and high volumes are important factors.

With increasing application requirements (i.e. thermal cycling capability in electric vehicles), along with reducing device size and increasing device package-design complexity, players that can provide specific solutions and ensure tight angular and dimensional tolerances in high volume production are increasingly sought by device packaging companies.

“Advanced packaging companies like Amkor, ASE, Carsem, and UTAC have significant experience in the packaging of various complex devices for smartphones and microelectronic applications”, comments Milan Rosina from Yole. *“Indeed power electronics, especially at low and mid power range, represents a real opportunity for them to adapt and transfer their existing advanced packaging solutions to power devices, and thus enlarge their product and customer portfolio.”*

Advanced packaging solutions’ highest added-value is not in “rather simple” discrete devices, but in devices integrated with a driver, multichip devices, etc. Nevertheless, it is worth following the transformation trends in advanced packaging towards power devices, in order to not miss out on the growing business opportunities in discrete power device packaging.

Yole’s discrete power device packaging report is offering an overview of the main applications, along with market drivers and future trends. It also presents a deep analysis of each packaging component and examines the discrete power device supply chain. At the end, Yole’s analysts review the shifting business models, synergies with other industries, and opportunities for newcomers.

System Plus Consulting’s report is a detailed analysis of the current packaging solutions for discrete power devices. Analysts propose a complete review of the technologies with a detailed physical and manufacturing and cost analysis. Process used for the cost simulation are dedicated to wire bonded components, components with wire/ribbon bonding, components with clip and wire and components with clip bonding only.

The complete collection of power electronics reports powered by the whole Yole Group of Companies is available on [i-micronews.com, power electronics reports section](https://www.yolegroup.com/en/i-micronews.com/power-electronics-reports-section).

Yole Group of Companies announces its participation to two key conferences dedicated to the power electronics industry: SIA PARIS (June 12-13, 2019 in Paris) and 7th CORPE Symposium on June 13 in Aalborg, Denmark. Make sure to meet our experts and debate about the latest innovations and market status!

ABOUT THE REPORTS:

- [Discrete Power Device Packaging: Materials Market and Technology Trends 2019](#)

Despite the transition to SiP, SoC, and power modules, discrete device packaging still represents a big opportunity especially for materials suppliers. - Produced by Yole Développement

Companies cited in the report:

Ackotec Plating Ltd., Alpha Assembly Solutions, ABB, Alpha and Omega Semiconductor, Analog Devices, Amkor, ASE, Chang Wah Technology, Carsem, Cree, Delo, Diodes, Dialog- Semiconductor, Danfoss, Furukawa Electric, Fuji Electric, Hitachi, Heraeus, Henkel, Indium Corporation, Infineon, IXYS, Jentech Precision, JinLin Technology, Jinan Jingheng, Yamada Electronics Precision Technology Co., KCC, Kenly Precision Industrial Co. Ltd, Kyocera, and more ...

- [Power Discrete Packaging Comparison 2018](#)

A cost-oriented overview of evolutionary trends in power discrete packages, from mW to kW – Produced by System Plus Consulting

Through physical analyses, including chemical opening, cross-sections, and various measurements, this report tries to summarize the state of the art of packaging power semiconductors at a discrete level. With a cost-oriented viewpoint, we reveal the hidden details that make the difference between over 20 types of packages, ranging from mW to kW designs...

About the authors:

- **Shalu Agarwal**, PhD. is an Analyst specializing in Power Electronics & Materials at Yole Développement (Yole). Based on Seoul, Shalu is engaged in the development of technology & market reports as well as the production of custom consulting studies, within the Power & Wireless Division.
Shalu has more than 10 years' experience in Electronic Material Chemistry. Before joining Yole, she worked as a project manager and research professor in the field of electronic materials, batteries and inorganic chemistry.
Shalu Agarwal received her master's and Ph.D. degree in Chemistry from the Indian institute of Technology (IIT) Roorkee (India).
- As Head of Department Devices at System Plus Consulting, **Elena Barbarini** is in charge of costing analyses for MEMS, IC and Power Semiconductors. She has a deep knowledge of Electronics R&D and Manufacturing environment. Before System Plus Consulting, she worked as R&D researcher and project manager in the field of semiconductors manufacturing and assembling. Elena holds a Master in Nanotechnologies and a PhD in Power Electronics.
- **Milan Rosina**, PhD, is Principal Analyst, Power & Wireless / Batteries, at Yole Développement (Yole), within the Power & Wireless division. He is engaged in the development of the market, technology and strategic analyses dedicated to innovative materials, devices and systems. His main areas of interest are EV/HEV, renewable energy, power electronic packaging and batteries.
Milan 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 and devices. He received his PhD degree from Grenoble Institute of Technology (Grenoble INP) in France.
- Milan Rosina previously worked for the Institute of Electrical Engineering in Slovakia, Centrotherm in Germany, Fraunhofer IWS in Germany, CEA LETI in France, and utility company ENGIE in France.
- **Véronique Le Troadec** 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 YOLE GROUP OF COMPANIES

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. More info on www.systemplus.fr and on [LinkedIn](#) and [Twitter](#).

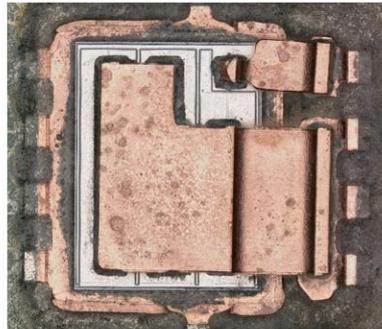


Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS and image sensors, Compound Semiconductors, RF Electronics, Solid-state lighting, Displays, software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management. 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 and follow Yole on [LinkedIn](#) and [Twitter](#).

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SON 3x3 – Opening and Cross-Section



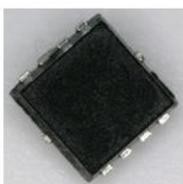
Top View After Chemical Opening



Cross-section View

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3x3mm² Summary

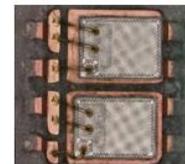


SON 3x3

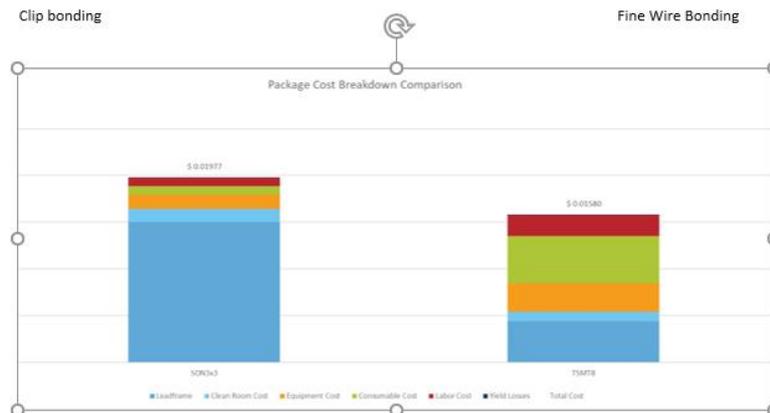


Clip bonding

TSMC8



Fine Wire Bonding



- The influence of the copper clip configuration (inducing a bigger leadframe price) is a key factor of the price difference between the two packages.