

Si IGBT is leading the power electronic industry¹

OUTLINE:

- Market forecasts:
The global power electronics market accounts for US\$17.5 billion in 2019, with a 4.3% CAGR² from 2019-2025.
The IGBT³ modules represented US\$3.7 billion in 2019.
The increase demand of power IGBT modules is driven by EV/HEV⁴. Yole announces an expected growth of 18% from 2019 to 2025.
- Technology trends:
The IGBT module market is boosted by growth in EVs/HEVs and industrial motors.
- Supply chain:
Si IGBT players offer different approaches for device design...
Leading power electronics companies are big companies with revenues in the billion-dollar range.
Chinese companies such as BYD and CRRC are amongst the leading power electronics players worldwide.
In 2019, Infineon led the IGBT power module market with a 28% market share. Infineon remains one of the biggest players in China.

“Silicon devices such as IGBTs are benefiting from mature infrastructure and processes. New device generations are coming to the market. In addition to performance improvements, Si⁵ IGBT costs will further be reduced thanks to a 12-inch Si wafer transition that will make the competition with WBG⁶ materials even tougher.” asserts **Amine Allouche, Technology & Cost Analyst at System Plus Consulting.**

¹ Extracted from:

[Silicon IGBT Comparison 2021](#), System Plus Consulting, 2021

[Status of the Power Electronics Industry 2020](#), Yole Développement
[Infineon EasyPACK™ FS100R12W2T7](#), System Plus Consulting, 2020

² CAGR: Compound Annual Growth Rate

³ IGBT: Insulated-Gate Bipolar Transistor

⁴ EV/HEV: Electric Vehicles / Hybrid Electric Vehicles

⁵ Si: Silicon

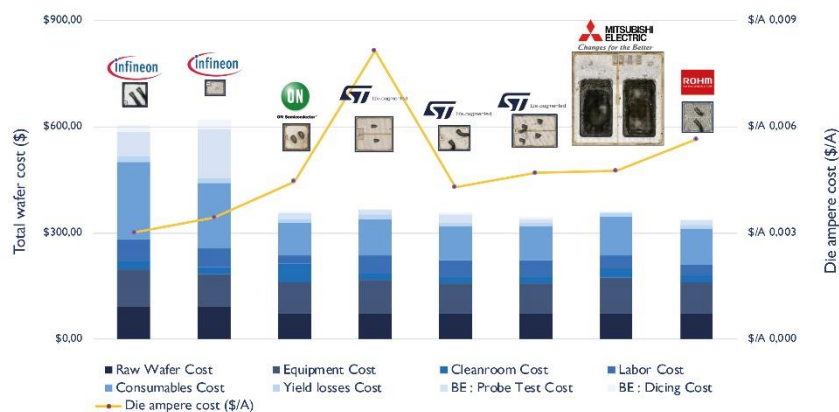
⁶ WBG: Wide-Band Gap

According to System Plus Consulting’s partner, Yole Développement (Yole), in its Status of the Power Electronics Industry 2020 report, Si devices represent the majority of the power electronics devices market.

Looking back in 2019, the whole power semiconductor device market segment was worth US\$17.5 billion, with a CAGR for 2019-2025 of 4.3%. IGBT modules, which represented US\$3.7 billion in 2019, are traditionally used in applications such as industrial or renewable energy converters. These applications are today driven by efficiency regulations or increasing clean energy goals, and they account for 46% of the total IGBT module market. Nevertheless, the key application for power IGBT modules is undoubtedly EV/HEV, with an expected growth of 18% from 2019 to 2025.

IGBT total wafer cost & die ampere cost breakdown

(Source: Silicon IGBT Comparison report, System Plus Consulting, 2021)



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In this dynamic context, Yole and System Plus Consulting, both part of Yole Group of Companies, investigate disruptive power electronics technologies and related markets in depth. Both companies point out the latest innovations and underline the business opportunities.

- In its Silicon IGBT Comparison 2021 report, System Plus Consulting presents the state of the art of 3 I Si IGBT transistors of eight voltage classes from 11 leading IGBT players.

The report highlights the main differences and common points in device design and manufacturing processes. System Plus Consulting’s analysts point out IGBT technologies and their impact on device size and production cost.

System Plus Consulting provides an exhaustive analysis including physical, technical, and manufacturing cost comparisons. Power electronics analysts also propose a comprehensive understanding of the technical trends related to current densities and add a dedicated section focused on die Ampere cost comparisons with SiC transistors.

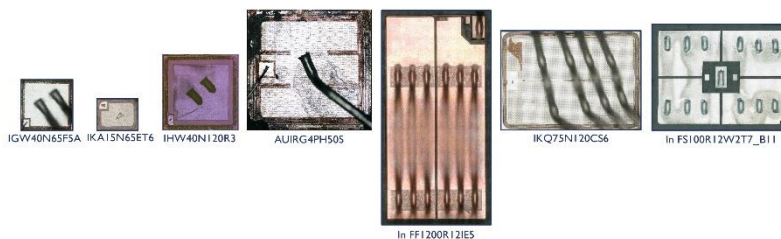
- In parallel, System Plus Consulting analyses in details a selection of key power electronics components all year long. The Infineon EasyPACK™ FS100R12W2T7 is part of this selection. Supported by a full teardown of the module, the Infineon EasyPACK™ FS100R12W2T7 report reveals the technological choices made by the leading power electronics company, in its new IGBT7 chip. It details the design of its diode, and the module packaging structure. It also provides insights on technology data, manufacturing cost and selling price of all module components, and includes an accurate comparison of technologies and costs of Infineon IGBT technologies: IGBT3, IGBT4, IGBT5, and IGBT7.

System Plus Consulting company is closely working with the market research and strategy consulting company, Yole to get a deep understanding of the technology evolution and market trends. In addition to System Plus Consulting’s reverse engineering and costing analyses, Yole recently released the Status of the Power Electronics Industry 2020 report to deliver an overview of the power electronics industry. Therefore, including supply chains, market trends and forecasts, player ranking and technology trends, this study examines the status of the entire power market, explore the market shares of the different device types and materials and much more...

What is the status of the IGBT technologies and their applications? What are the main market segments? What are the technological choices made by the industry leaders? System Plus Consulting presents today its latest reverse costing and engineering analyses of the IGBT technologies.

Silicon IGBT overview: Infineon Technologies devices focus

(Source: Silicon IGBT Comparison report, System Plus Consulting, 2021)



Manufacturer	Device Code	Automotive	Technology	Packaging	Vce (V)	Ic (A)	Vce_sat (V), typ.	Qg (nC)
Infineon	IGW40N65F5A	x	TRENCHSTOP™ S High speed Fast	TO-247-3	650	46	1.60	95
Infineon	IKA15N65ET6		TRENCHSTOP™ IGBT6 + Diode	TO-220-3	650	21	1.50	37
Infineon	IHW40N120R3		TRENCHSTOP™ IGBT3 with monolithic diode	TO-247-3	1200	40	1.55	335
Infineon	AIJRG4PH505	x	PT Planar IGBT4	TO-247AC-3	1200	81	1.47	151
Infineon	FF1200R12IE5		TRENCHSTOP™ IGBT5	Module	1200	150	N/A	N/A
Infineon	IKQ75N120CS6		TRENCHSTOP™ IGBT6 + Diode	TO-247-3	1200	75	1.85	530
Infineon	FS100R12W2T7_B11		TRENCHSTOP™ IGBT7	Module	1200	100	1.50	1800

Also included in this report:
Termination, Pitch, Wafer thickness, Si epitaxy, Frontside doping number, Lithography mask number, Wafer Dicing type, current density, die size, figure of merit, technology introduction year.

As analyzed by System Plus Consulting’s team in the new Silicon IGBT Comparison 2021 report, Si IGBT players offer different approaches for device design. Therefore, technical choices are clearly depending on the targeted electrical performance and applications. Most

of them have adopted the FS⁷ trench structure, highlights System Plus Consulting in its Silicon IGBT Comparison 2021 report.

In this regard, Infineon Technologies introduced the new IGBT7 technology for its Easy housing platform in March 2019. Based on the new micro-pattern trench technology, the TRENCHSTOP™ IGBT7 chip has a new cell structure in contrast to the formerly used square trench cells in IGBT3 and IGBT4. This is the case for the full reverse costing study of the Infineon EasyPACK™ FS100R12W2T7, **Amine Allouche** explains: “This power module uses the newest IGBT and Diode technologies from Infineon: TRENCHSTOP™ IGBT7 and EC7 Diode. It drives a nominal current of 100A with a voltage rating of 1200V”.

All year long, Yole Group of Companies, including System Plus Consulting and Yole Développement publishes numerous power electronics & compound semiconductors reports and monitors. In addition, experts realize various key presentations and organize key conferences. More info
Throughout the year, discover the numerous power electronic-related reports and make sure to be aware of the latest news coming from the industry and get an overview of our activities, including interviews with leading companies and more on i-Micronews.
Stay tuned!

Press contacts

Sandrine Leroy, Director, Public Relations, leroy@yole.fr

Marion Barrier, Assistant, Public Relations, marion.barrier@yole.fr

Le Quartz, 75 Cours Emile Zola – 69100 Villeurbanne – Lyon – France – +33472830189
www.yole.fr - www.i-micronews.com – [LinkedIn](#) – [Twitter](#)

⁷ FS: Field-Stop

About our analysts

Amine Allouche serves as a Technology & Cost Analyst, Power Electronics, at System Plus Consulting, part of Yole Développement. With strong expertise in the field of power electronics, Amine produces reverse engineering & costing analyses while also working on custom projects. He collaborates closely with the laboratory team, and together they define the objectives of the analyses and determine the methodologies necessary to reveal the structure of a device and all materials required for its development and production. Amine's aim is to determine the technology choices made by the leading companies. In addition, Amine runs a daily technology watch to identify innovative power electronics components and related manufacturing processes. His objective is to gain a comprehensive understanding of the evolution of power electronics technologies and to identify the technological strategies of the leading players in this field. Amine attends numerous international trade shows & conferences where he meets the power electronics companies and discovers the latest innovations. He also presents key results of his studies during webcasts. Amine holds a master's degree in Micro & Nanotechnologies with a focus on integrated systems from Grenoble's Polytechnic Institute (France). He also graduated from the Ecole Polytechnique Fédérale de Lausanne (EPFL) (Lausanne, Switzerland) and the Politecnico di Torino (Italy).

Véronique Le Troadec is Senior laboratory analyst at System Plus Consulting. Veronique has extensive knowledge in reverse engineering of advanced technologies. She previously worked at Atmel Nantes where she was in charge of failure analysis of devices.

Peggy Gallois joined System Plus Consulting's laboratory of microelectronics team in July 2019. She previously worked in the laboratory of metallographic expertise for Dassault Aviation near Paris.

Ana Villamor, PhD Technology & Market Analyst, Power Electronics & Compound Semiconductors, is involved in many custom studies and reports focused on emerging power electronics technologies including device technology and reliability analysis. Previously Ana was involved in a high-added value collaboration related to SJ Power MOSFETs, within the CNM research center for the leading power electronic company ON Semiconductor. She holds an Electronics Engineering degree completed by a Master and PhD in micro and nano electronics from Universitat Autònoma de Barcelona (SP).

Milan Rosina, PhD, is Principal Analyst, 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. 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.

Abdoulaye Ly is Technology & Market Analyst specializing in Electronic Power Systems at Yole. His expertise is focused on power electronics system design. Abdoulaye graduated with a technical degree in 2014 from Bethune University Institute of Technology and in 2017 received an electrical engineering degree from Grenoble Institute of Technology. Abdoulaye LY previously worked for Centum Adetel Transportation as a system engineer and junior product manager for railway application.

About the reports

Silicon IGBT Comparison 2021

Exhaustive technology and cost comparisons of 31 Silicon IGBTs from Infineon, ON Semiconductor, STMicroelectronics, Mitsubishi, Rohm, Toshiba, Fuji Electric, Littelfuse, ABB, Microsemi, and the IGBT in StarPower's module. – Performed by System Plus Consulting

Status of the Power Electronics Industry 2020

China is reshaping the power electronic industry – Performed by Yole Développement

Infineon EasyPACK™ FSI00R12W2T7

Discover the newest IGBT technology from Infineon: TRENCHSTOP™ IGBT7 with EC7 diode in EasyPACK™ module. – Performed by System Plus Consulting

About Yole Développement

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... [More](#)

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... [More](#)

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