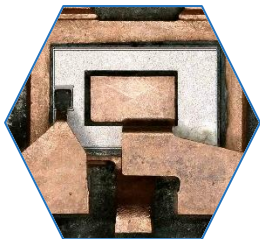
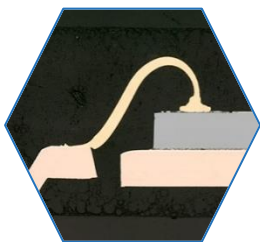


Discrete Power Device Packaging Comparison 2021

Comprehensive technology and cost comparisons of 29 discrete packages of power devices from 12 manufacturers including Infineon, STMicroelectronics, and ROHM.



Title: Discrete Power Device Packaging Comparison 2021

Pages: 138

Date: October 2021

Format: PDF & Excel file

Price: EUR 6,490

Reference: SPR21596

The discrete power devices market represented US\$12.3 billion in 2020 with a 4.9% CAGR between 2020 and 2026 according to Yole Intelligence, strongly driven by Automotive and Industrial applications.

Several key aspects drive this industry: a wide selection of products and suppliers, the use of standardized products and technologies, lower cost per device, and more.

To succeed in the innovation and efficiency race, discrete power device manufacturers should not rely on the semiconductor aspect only. In fact, when chasing the optimum configuration for electrical, thermal, and mechanical performance, they must battle with the reliability and cost of packaging that are also very important parameters. More than a simple “shell”, the packaging can make or break a design, and thus it should be adapted to the dies and not deteriorate their properties.

Different technology variables are tackled: package type, interconnection method, die attach, miniaturization trend, targeted application, and more.

In this context, System Plus Consulting presents an overview of 29 state-of-the-art discrete packages of power devices from Infineon, STMicroelectronics, ROHM, onsemi, Toshiba, Vishay, Microchip, Nexperia, Littelfuse, Taiwan Semi, Texas Instruments, and Nuvoton.

The 29 devices include 14 automotive-

qualified AEC-Q101 MOSFETs, 26 Si MOSFETs, 2 Si Superjunctions, and one SiC MOSFET. They cover 9 voltage classes (from 12V to 1200V).

This report highlights the differences in their technology parameters and design and their impact on production cost, along with providing optical pictures of the device’s opened-package and cross-sections. The focus of the report is packaging technology, and hence the devices are analyzed and costs are simulated at packaging level. Yet some aspects of the dies that are linked to their assembly in package are highlighted.

Finally, this report provides a comprehensive physical and technological comparison as well as manufacturing cost comparisons of the analyzed discrete packages.

COMPLETE TEARDOWN WITH:

- Detailed optical photos
- Precise measurements
- Manufacturing process flow
- Manufacturing cost analysis
- Comparisons of packaging technology and design parameters
- Comparisons of packaging cost

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Technology & Market

- Market overview
- Technology choices of analyzed packages

Physical Analysis

- Per body size (mm²):
- (1×1): CSP
- (3×1): SOT-23
- (3×2): TSOP-6, TSMT8
- (3×3): SOT1210, SON3x3
- (5×3): SOT-89
- (5×4): SOIC-8
- (5×5): SOP/DSOP Advance
- (5×6): PDFN56U, SSO8, SO-8FL, PowerFLAT™ [5x6, 5x6 Double Island, 5x6 DSC]
- (7×6): DPAK+, DPAK-5, DPAK
- (7×7): sTOLL
- (8×8): ThinPAK 8x8
- (10×9): TOLG, D²PAK, D²PAK7, H²PAK-6
- (15×6): DDPAK
- (10×10): TOLT, H-PSOF8L
- (20×15): TO-247

Technology and Physical Comparison

- Overall molded package volume – breakdown (wires, die, attaches, leadframe, clips, ribbons, molding)

- Dies vs. copper volume – % of molded package volume
- Dies' volume – % of molded package volume

Manufacturing Process Flow

- Hypotheses
- Process 1: CSP (Unmolded)
- Process 2: wires
- Process 3: clips
- Process 4: wires + ribbon
- Process 5: wires + clips

Cost Analysis

- Yields explanation & hypotheses
- For each of the 29 packages:
 - ✓ Assembly cost per process step
 - ✓ Assembly cost breakdown per equipment, cleanroom, labor, consumable, and yield losses
 - ✓ Packaging cost breakdown per BOM, assembly, final test, and yield losses

Cost Comparison

- Comparisons include packaging cost breakdown (BOM, assembly, etc.)
- Package cost per volume

AUTHORS



Amine Allouche serves as a Technology & Cost Analyst, Power Electronics. 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).



Tom Herve has joined System Plus Consulting as a Microelectronic Laboratory Technician in order to strengthen the laboratory team. In 2020, Tom was graduated from the University of Blois where he obtained a Technical degree (DUT) in Physical Measurements. He previously worked on different subject among which precipitation of zinc oxide.

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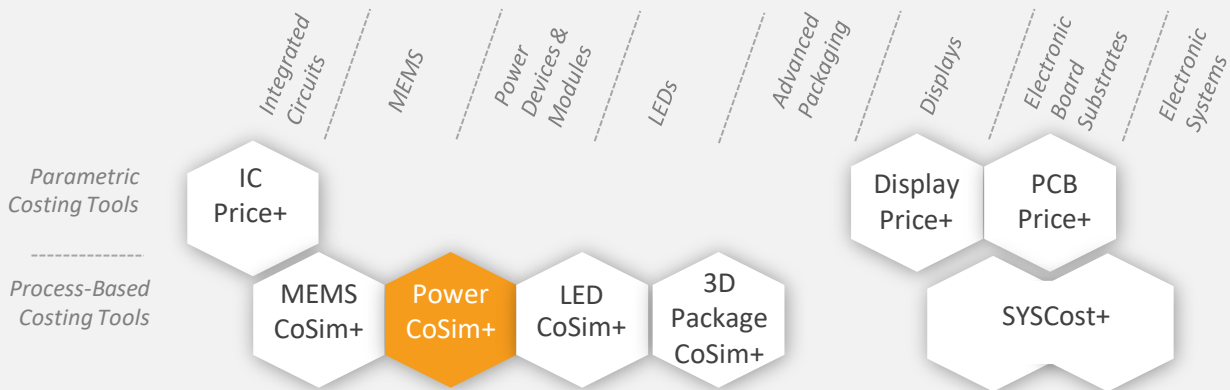
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Power CoSim+

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