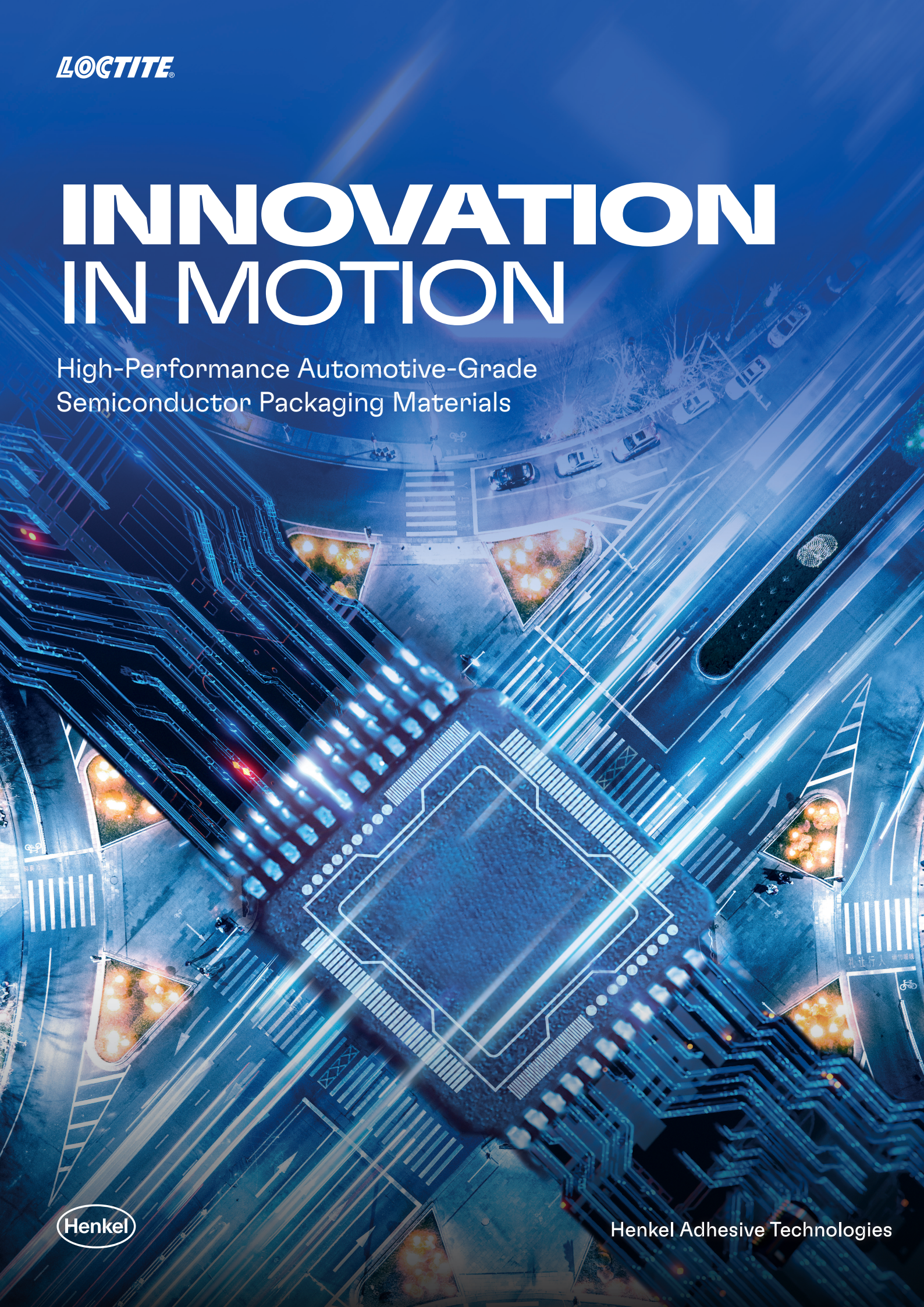
LOCTITE®

INNOVATION IN MOTION

High-Performance Automotive-Grade Semiconductor Packaging Materials



Henkel

Henkel Adhesive Technologies

DRIVING TOMORROW'S TECHNOLOGIES

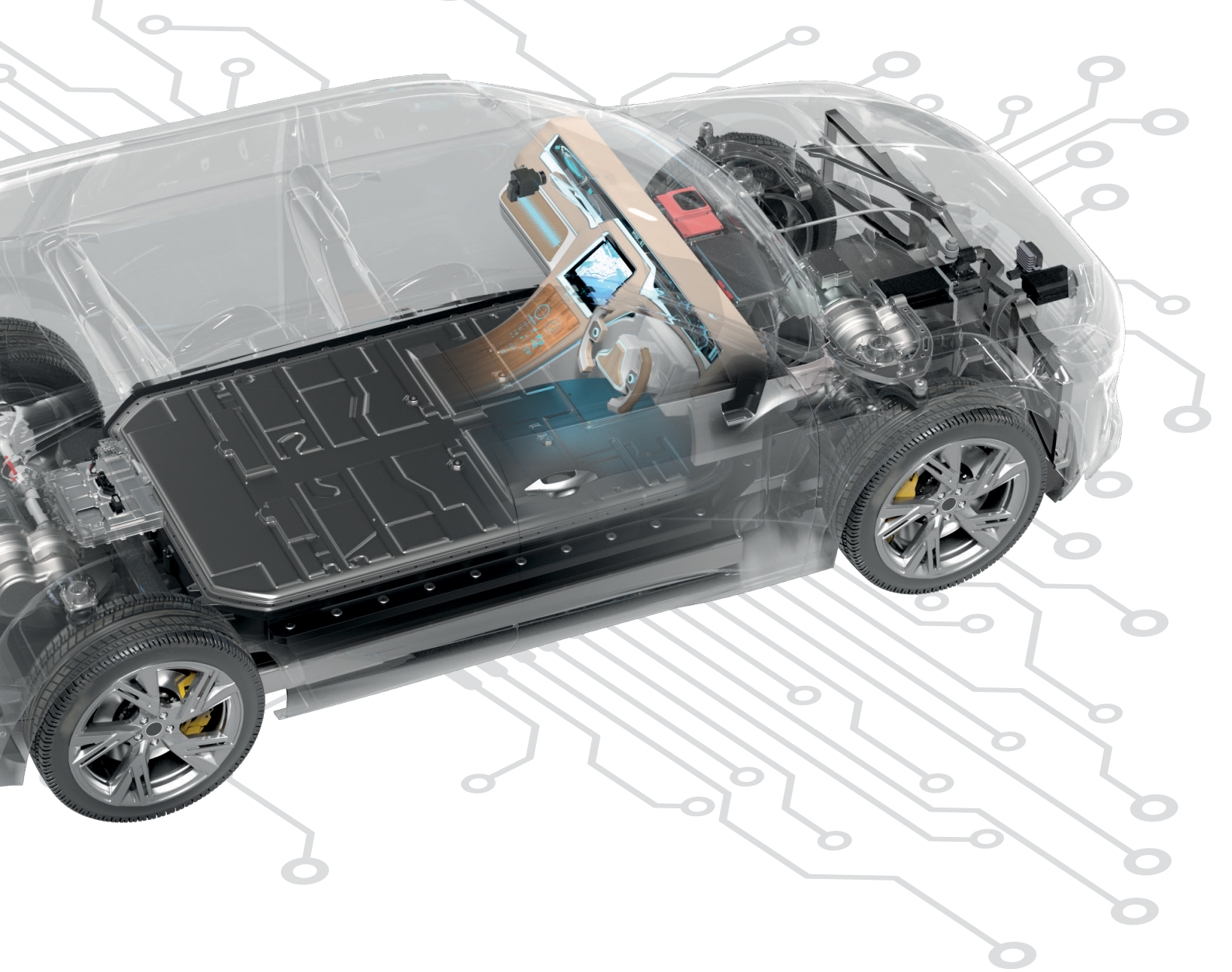
The automotive semiconductor market is set for substantial growth, with projections indicating a rise from USD 33.69 billion in 2023 to USD 42.14 billion by 2029, reflecting an annual growth rate of 3.8%. This growth is driven by increasing consumer demand, technological advancements, and shifting preferences. Henkel, recognizing these trends, positions itself as an enabler, providing critical materials that support this expansion.

By adapting to the industry's evolving needs with innovative IC designs, packaging techniques, and materials, Henkel facilitates the semiconductor industry's adaptation to automotive megatrends, enhancing vehicle safety, reliability, comfort, and connectivity.

Henkel's high reliability material for wirebond and advanced packaging technology are engineered to conform to the most rigorous industry standards for the next-generation automotive electronics devices.

To address the vital requirement for robust thermal control, Henkel has developed high thermal semiconductor packaging materials, ensuring efficient heat dissipation and resistance to high temperature environments, key for maintaining the performance and durability of automotive electronics under various operating conditions.

Scan this QR code to watch how Henkel's solutions are making a difference in the market.



ELEVATING THE ***ELECTRONICS ECOSYSTEM***

Driven by automaker demands for safety, reliability, and comfort, and propelled by key trends like electrification, autonomy, and connectivity, the automotive sector is undergoing a significant shift. This evolution is increasing semiconductor usage in vehicles and pushing the semiconductor industry toward new IC designs, packaging methods, and advanced materials. Henkel leads this change by supplying critical materials that support the industry's adaptation to these emerging requirements.

Henkel's semiconductor packaging formulations are used throughout the modern vehicle – from sensors to signal processors to energy management and control systems. Elevating the operational robustness and reliability of these devices enhances their contribution to a collaborative auto electronics ecosystem that delivers performance on the road and comfort in the cabin.

HIGH RELIABILITY

Henkel's advanced semiconductor materials, designed for wirebond and sophisticated packaging solutions, are tailored to address the evolving demands of next-generation automotive electronics, achieving unparalleled standards of reliability.

HIGH THERMAL

As thermal control becomes increasingly vital with the industry moving toward higher power analog process nodes and the resulting smaller die, Henkel's solutions provide high thermal conductivity for robust heat dissipation.

Integrated High-Level Performance

Sensors

Speed,
Light,
Position

Analog / Logic ICs

Processors

Process sensor
Data and execute
next steps

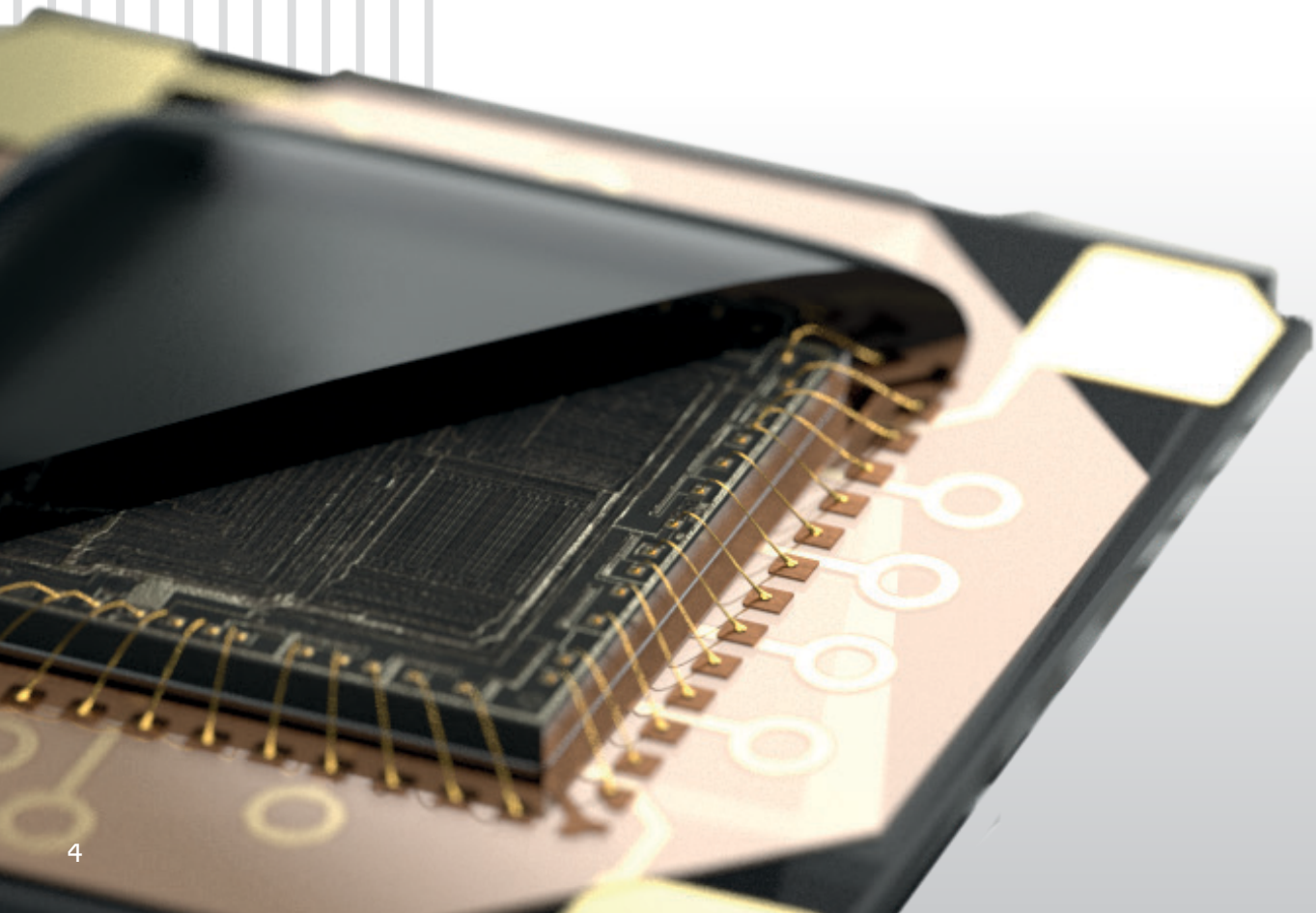
Power Semiconductors
Supplies power for all devices

RAISING IMAGE SENSOR RELIABILITY

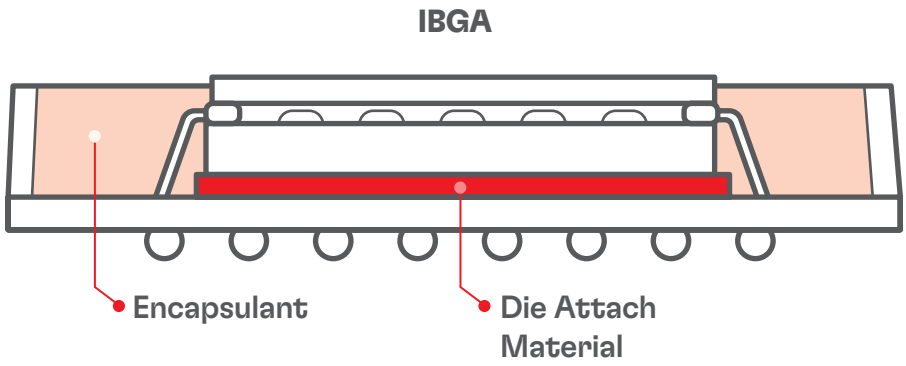
Henkel semiconductor packaging material has been instrumental in enabling advanced driver assistance system (ADAS) applications that keeps the operations of the vehicle safe.

Image sensors are crucial for the functionality of advanced driver assistance systems (ADAS), as well as electronic and autonomous vehicles. Henkel is dedicated to enhancing the dependability of these systems by developing new materials for encapsulation and die attach, which are vital components of automotive packaging and crucial for stress mitigation in imaging ball grid arrays (iBGAs).

Henkel's material portfolio continues to be a key enabler of established sensor platforms like cameras and radars, even as they evolve. Building on our proven solutions for this space, Henkel aims to advance material innovation for LiDAR packaging to expand automotive capability.



PRODUCT OVERVIEW



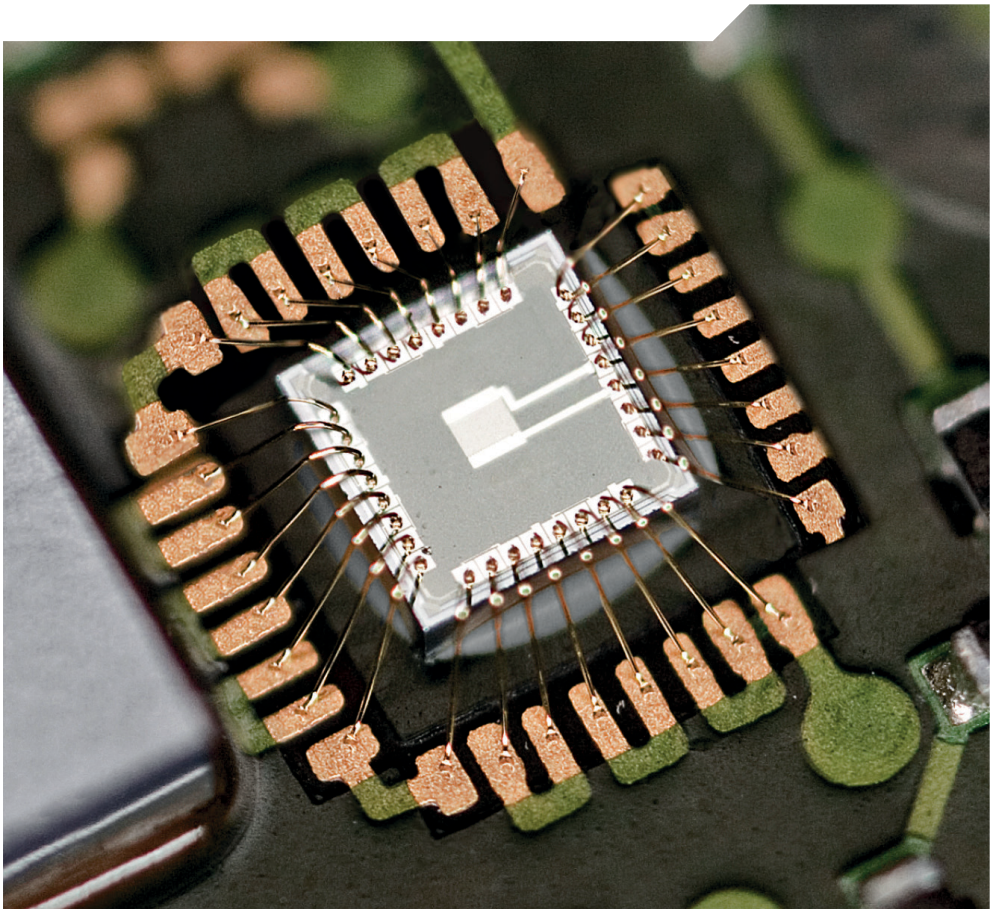
PRODUCTS	PORTFOLIO HIGHLIGHTS	FEATURES & BENEFITS
Non-Conductive Die Attach Paste	Robust adhesion to various surfaces and proven low-bleed formulas provide the reliability and performance today's leadframe and high-density laminate packages demand.	▪ Extremely low warpage for large single die ▪ Higher adhesion to the printed circuit board (PCB) ▪ Low bleed on various surfaces ▪ Good Moisture Sensitivity Level (MSL) performance ▪ Good Pressure Cooker Test (PCT) performance
Encapsulation	Optimised for fast dispensing with flexible cure profiles, JEDEC-compliant, high-purity epoxy encapsulants help protect chips from mechanical damage and corrosion.	▪ Lower stress ▪ Better reliability performance ▪ Low coefficient of Thermal Expansion (CTE) and high Tg

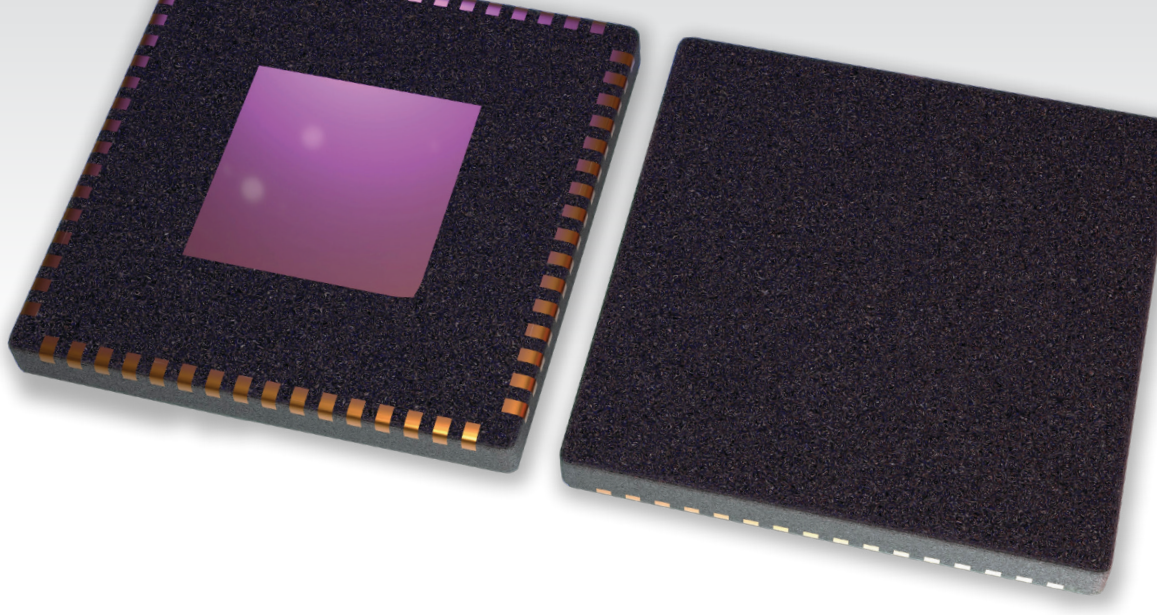
BRIDGING SENSORS, PROCESSORS, AND POWER FETS

Analog IC and Power IC Packaging

The automotive transformation toward electrification, connectivity, and advanced safety management features has underscored the vital role of reliable, efficient power devices. Packaging trends in the power IC sector include integrated FET drivers to improve switching performance, SiC- and GaN-based isolated drivers that bridge high- and low-voltage components, fan-in and fan-out wafer level-packaging, and embedded packaging designs that enable smaller form factors.

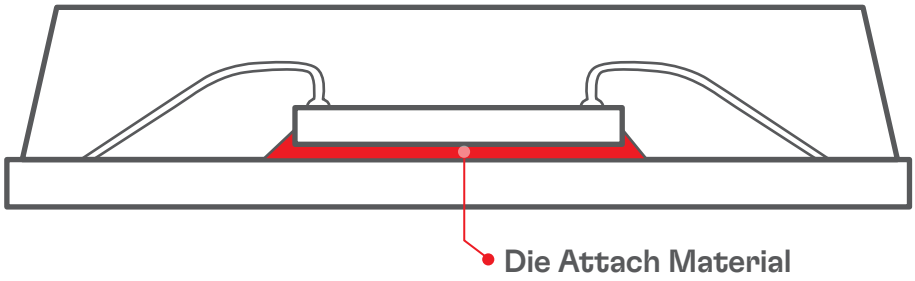
Lower power analog process nodes and the continual reduction in die size have contributed to higher power densities and increased heat generation versus previous-generation designs. To enable device innovation alongside these realities, Henkel is focusing on die attach paste and film materials that provide efficient and thorough heat dissipation, as well as advanced packaging materials to boost reliability and performance for new device architectures.



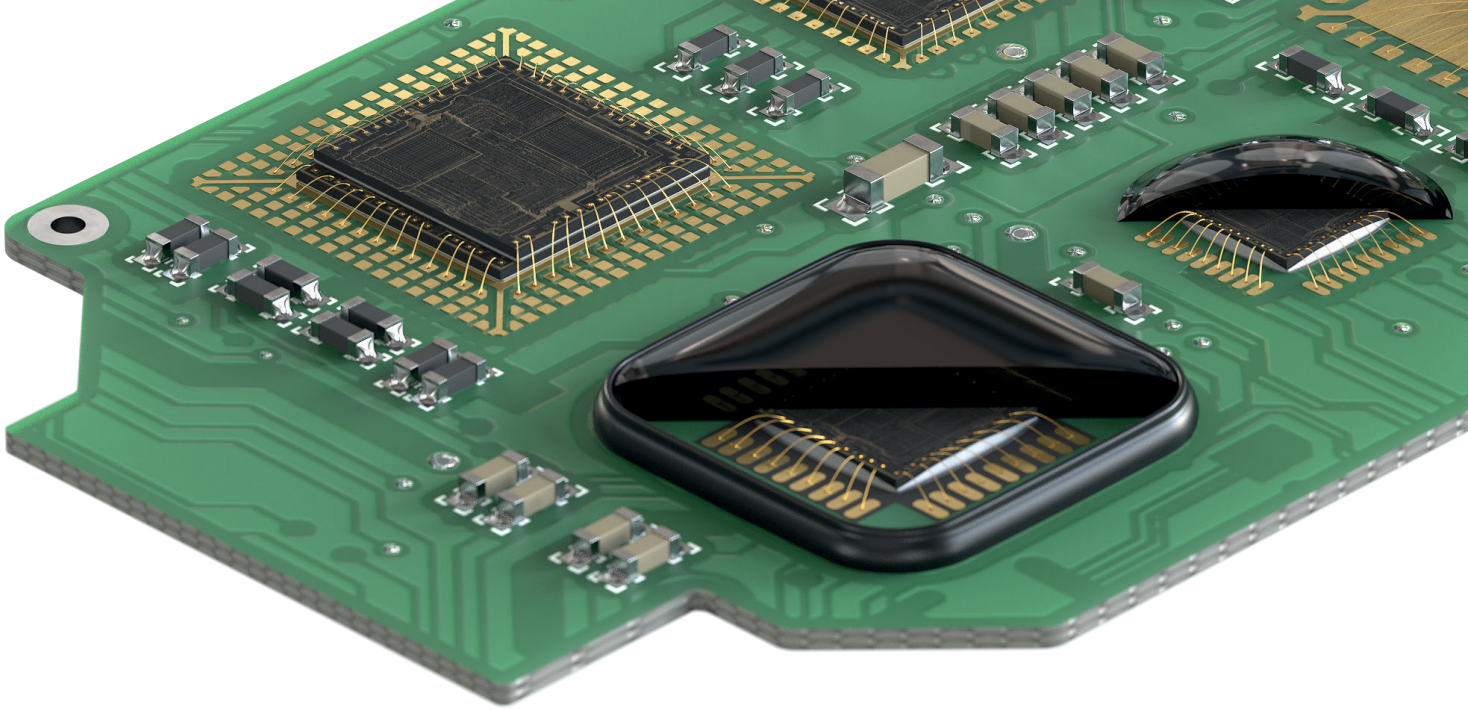


Analog IC PRODUCT OVERVIEW

QFN/SOT



PRODUCTS	PORTFOLIO HIGHLIGHTS	FEATURES & BENEFITS
Die Attach Paste	Excellent dispensing and workability performance, ideal for high-density leadframe design due to its long open and stage time.	▪ Excellent Resin Bleed Out (RBO) performance ▪ Meets MSL1 and automotive grade 0 reliability standards
Die Attach Film	Well-suited for high-density designs and challenging dimensions.	▪ Controlled thickness and flow ▪ No Resin Bleed Out (RBO) ▪ Uniform and minimal fillet formation ▪ Bond line stability

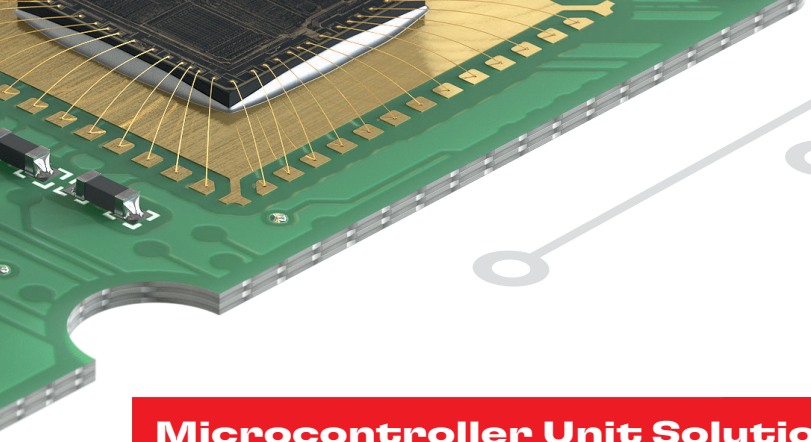


ENSURING HIGH RELIABILITY IN MCU THERMAL MANAGEMENT

Microcontroller Unit (MCU) Packaging

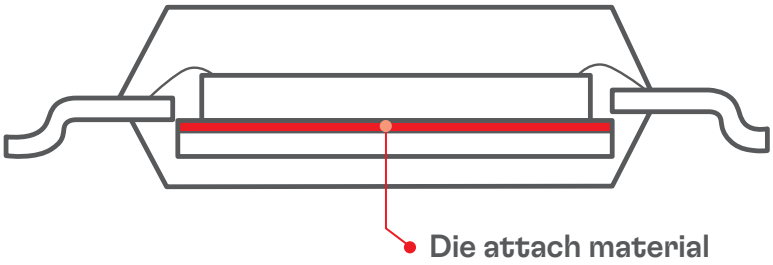
MCUs are responsible for many critical functions within today's automobiles, including navigation and engine management; they are fundamental to modern vehicle operation and safety.

Because of their essential role, MCUs must be built to endure the heat, vibration, and other environmental stresses inherent in the automotive environment. Henkel's semiconductor materials portfolio offers a broad range of formulations for high I/O MCUs that prioritize reliability and align with new designs aimed at reducing cost.

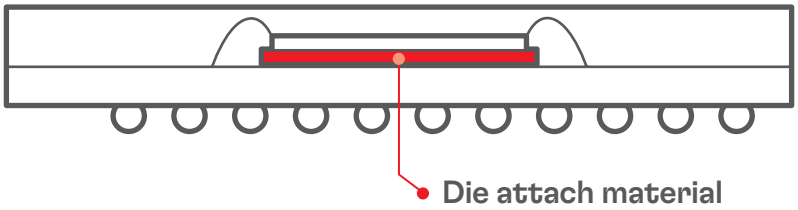


Microcontroller Unit Solutions PRODUCT OVERVIEW

QFP Chip



Wirebond BGA



PRODUCTS	PORTFOLIO HIGHLIGHTS	FEATURES & BENEFITS
Die Attach Paste	Designed with stress control in mind for large body standard QFPs/TSSOPs.	▪ Uniform stress distribution during processing and in application ▪ High thermal conductivity of 10W/m-K
Die Attach Film	Created to control stress in large body standard QFPs/TSSOPs; incorporates silver (Ag) designed for optimal Z-axis performance.	▪ High toughness that increases adhesion and Moisture Sensitivity Level (MSL) performance

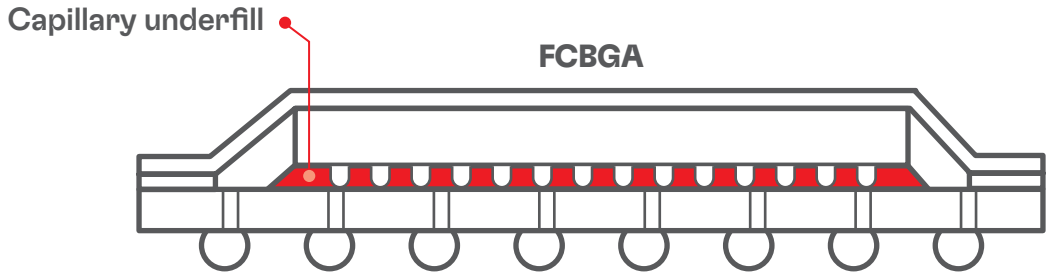
ENABLING THE SHIFT TOWARD DCUs

System-on-Chip Packaging

Henkel's advanced System-On-Chip (SoC) packaging solutions are crafted to satisfy the demands for scale and exceptional reliability while delivering outstanding operational performance.

In 2019, domain controller units (DCUs) made up less than 1% of the combined ECU/DCU market, but that number is expected to increase to 43% by 2030. The shift towards centralised electric/electronic (E/E) architecture is anticipated to fuel the need for high-performance DCUs, diminishing the prevalence of ECUs.

SoC Packaging PRODUCT OVERVIEW



PRODUCT	PORTFOLIO HIGHLIGHTS	FEATURES & BENEFITS
Capillary Underfill	Balance high filler loading and fast flow capabilities.	▪ High filler loading ▪ Fast flow capability ▪ Supports a large die size
Lid Attach	Designed for dispense applications, based on Henkel's proprietary silicone technology.	▪ High adhesion to different metal lid surfaces ▪ Low viscosity for easy dispensing and ultra-low moisture absorption

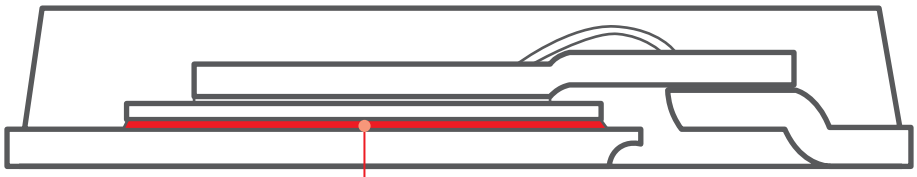
HIGH-RELIABILITY SINTERING SOLUTIONS WITH HIGH THERMAL EFFICIENCY

Power FET Solutions

Henkel's pressure-less and pressure-assisted sintering formulations for power FETs deliver excellent thermal performance, good electrical conductivity, and high reliability.

The portfolio is compatible with traditional Si, as well as wide band gap SiC and GaN semiconductors, which are now favored for certain MOSFETs and power modules. Henkel's pressure-less and pressure-assisted materials deliver very high thermal conductivity for excellent heat dissipation, good thermal and power cycling performance, low die stress, and high UPH across all die substrates and device types for mid-/high-voltage applications.

Power FETs PRODUCT OVERVIEW



Pressure-less sintering die attach

PRODUCT	PORTFOLIO HIGHLIGHTS	FEATURES & BENEFITS
Pressure-less sintering	Superior thermal conductance and compatibility with traditional and newer semiconductors.	▪ Delivers thermal performance at up to 200 W/m-K bulk thermal conductivity ▪ Demonstrates excellent adhesion on Cu, PPF, Ag, and Au leadframes and robust electrical conductivity ▪ Stable RDS (on) after 2,000 hours of thermal cycling

Scan this QR code to watch a demonstration of our Power FETs solutions.

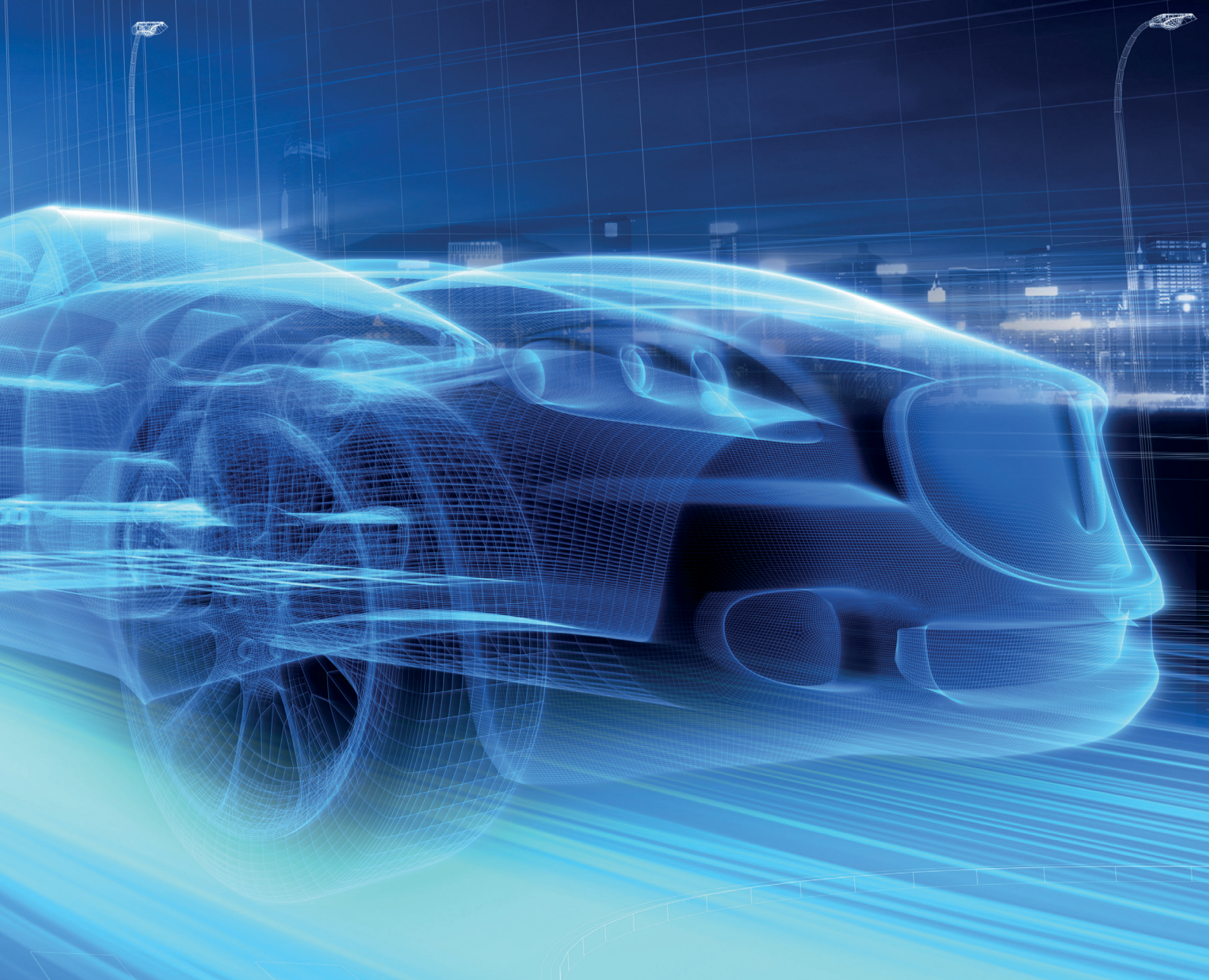
THINK INNOVATION, **THINK HENKEL.**

Henkel is committed to driving the future of automotive progress through formulation ingenuity, customer collaboration, and deep scientific discovery. Our significant investment in global technical resources ensures access to a broad knowledge base, while delivering regional and local support to offer a personalised experience.

Scan this QR code to download product specification list for our automotive-grade material

Henkel's semiconductor portfolio and our experienced team are meeting the demands of the dynamic automotive electronics industry head-on with innovation, agility, fast time-to-market, and unmatched service and commitment.

Connect with us to learn more about Henkel's semiconductor packaging solutions.



LOCTITE®

AMERICAS

UNITED STATES
Henkel Corporation
14000 Jamboree Road
Irvine, CA 92606
United States
Tel: +1.888.943.6535
Fax: +1.714.368.2265

Henkel Corporation
20021 Susana Road
Rancho Dominguez, CA 90221
United States
Tel: +1.310.764.4600
Fax: +1.310.605.2274

Henkel Corporation
18930 W. 78th Street
Chanhassen, MN 55317
United States
Tel: +1.952.835.2322
Tel: +1.800.347.4572
Fax: +1.952.835.0430

BRAZIL
Henkel Brazil
Av. Prof. Vernon Krieble, 91
06690-070 Itapevi, Sao Paulo
Brazil
Tel: +55.11.3205.7001
Fax: +55.11.3205.7100

ASIA-PACIFIC

CHINA
Henkel Management Center
Building 7, No. 99 Jiang Wan Cheng Road
Shanghai 200438,
China
Tel: +86.21.2891.8000
Fax: +86.21.2891.8952

ABLESTIK (Shanghai) LIMITED
No. 332 Meigui South Road
WaiGaoQiao Free Trade Zone, Pu Dong
Shanghai 200131,
China
Tel: +86.21.2702.5888
Fax: +86.21.5048.4169

JAPAN
Henkel Japan Ltd.
27-7, Shin Isogo-cho
Isogo-ku Yokohama, 235-0017
Japan
Tel: +81.45.286.0161
Email: jp.ae-csdesk@henkel.com

KOREA
Henkel Korea Co Ltd.
18th Floor of tower B, BYC High City Bldg
Gasan Digital 1-ro, Geumcheon-gu,
Seoul, 08506
South Korea
Tel: +82.2.6150.3000
Fax: +82.2.6947.5203

SINGAPORE
Henkel Singapore Pte Ltd.
401, Commonwealth Drive
#03-01/02 Haw Par Technocentre,
Singapore 149598
Tel: +65.6266.0100
Fax: +65.6472.8738 / +65.6266.1161

TAIWAN
Henkel Taiwan Ltd.
10F, No. 866, Zhongzheng Road,
Zhonghe District, New Taipei City, 23586
Taiwan
Tel: +866.2.2227.1988
Fax: +866.2.2226.8699

EUROPE

BELGIUM
Henkel Belgium N.V.
Nijverheidsstraat 7
B-2260 Westerlo
Belgium
Tel: +32.1457.5611
Fax: +32.1458.5530

UNITED KINGDOM
Henkel Ltd.
Adhesives Limited Technologies House
Wood Lane End
Hemel Hempstead
Hertfordshire HP2 4RQ
United Kingdom
Tel: +44.1442.278000
Fax: +44.1442.278071

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henkel-adhesives.com/electronics