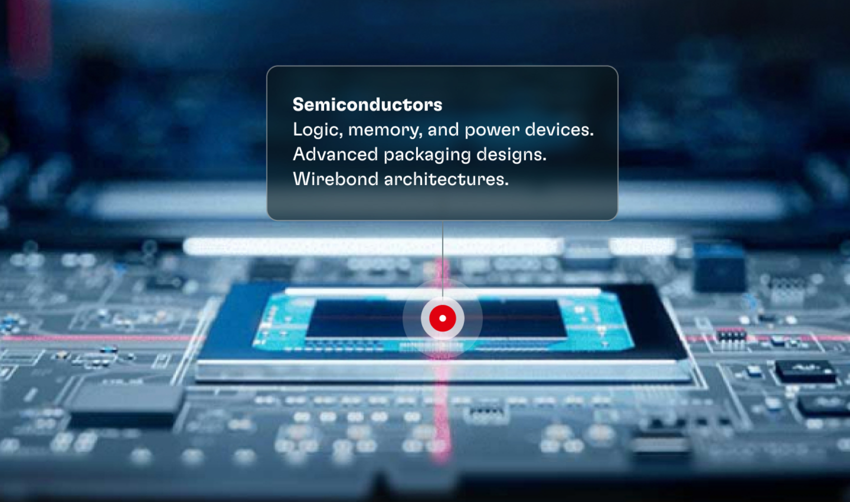
Henkel Adhesive Technologies

TOMORROW’S SEMICONDUCTORS:

Why today’s vital material innovations matter



Semiconductors
Logic, memory, and power devices.
Advanced packaging designs.
Wirebond architectures.

Highly engineered material innovations are ushering in the next generation of semiconductors and packaging designs.

Across industries, semiconductor packaging must answer the demand for more miniaturization, high performance, high functionality, and increased reliability.

Novel, component-level materials help manage heat, provide protection, enhance reliability, and maximize performance.

The result? Higher power densities in advanced packaging designs and wirebond architectures.

HIGHLY ENGINEERED MATERIAL SOLUTIONS

- Underfills
- Lid and stiffener attach adhesives
- Die attach pastes
- Die attach films
- Wirebond encapsulation
- Wafer backside coatings
- Wafer-level encapsulation

PERFORMANCE

FUNCTIONALITY

RELIABILITY

A LOT HAS HAPPENED SINCE

1948

Semiconductors are built on millions of transistors and are fundamental to every electronic device.

1948. The first transistor. 100 could fit in the palm of your hand.

Today. Over 100 billion transistors can fit in the palm of your hand.

Since 1948, about 13 sextillion (21 zeros or a trillion billion) transistors have been manufactured. What's a sextillion? Jeremy Harper counted to a million in 89 days using 16 hours per day. At that pace, it would take more than **243,000,000,000,000 years** to count to a sextillion.

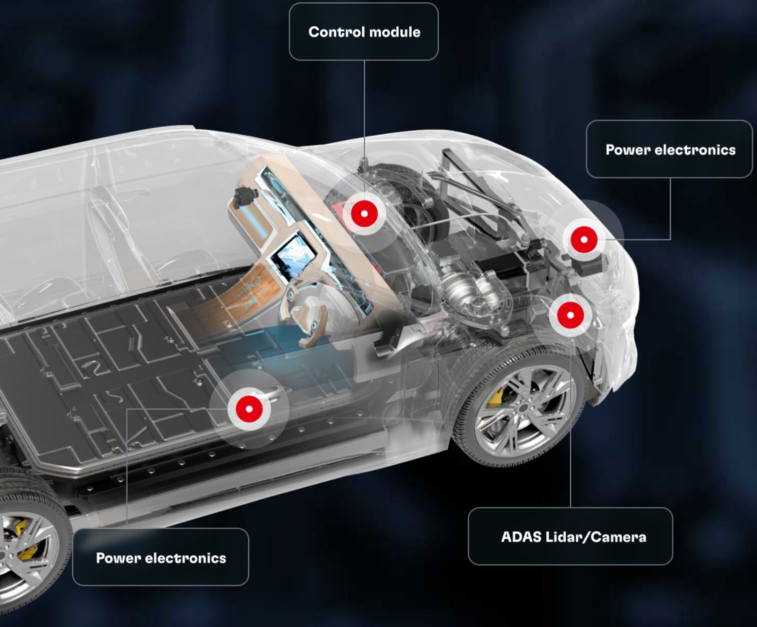
TRADITIONAL, ELECTRIC, AND AUTONOMOUS VEHICLES

Semiconductors are the basis of electric vehicles (EV), autonomous vehicles (AV), and essential elements in traditional internal combustion engine (ICE) automobiles. The devices enable operation and improve safety, performance, and comfort.

An average **ICE car has about 1500 semiconductor chips** while an average electric vehicle with **L3 automation has at least 3,000 chips.**

Application

- Advanced driver assistance systems (ADAS): sensors, cameras, connectivity
- Vehicle-to-everything (V2X) connectivity
- Power steering
- Engine control units (ECU)
- Automotive displays



Top 5 challenges in traditional, electric and autonomous vehicles

- Power density and power conversion efficiency
- Denser packaging and thermal management
- Manufacturing complexity and costs
- Longer reliability and automotive-grade solutions
- Application sophistication and application-specific solutions

DATA CENTER WITH AI/HPC

Application

- Routers and switches
- Storage devices
- Servers (motherboards, processing units)
- Power supply units

AI and HPC enabled data centers

High-power semiconductors are vital to modern data centers. Highly engineered material solutions must facilitate novel features and requirements--—protection, toughness, and stiffness--in the advanced packaging designs and wide bandgap GaN and SiC semiconductors increasingly used in high-power semiconductors.

Top 5 challenges in data center with AI/HPC

Power density and heat can create reliability issues

Wafer-level handling of large, thin dies can create warpage and cracking

Larger packaging gaps must be properly filled to ensure robust performance

Unstable packages can decrease operational yields

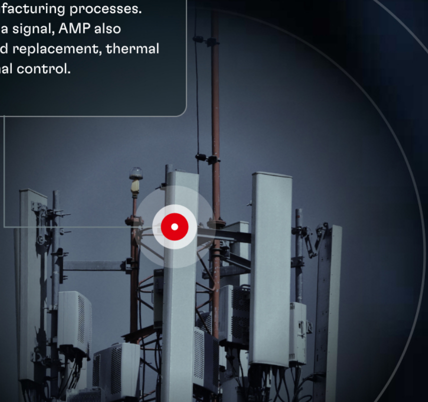
Complex assembly and integration can hinder productivity

APPLICATIONS

- 5G base stations (radio frequency technology)
- Smart homes and appliances
- Intelligent factories
- Autonomous driving
- Remote surgery and patient monitoring

5G mobile antenna

In 5G mobile antenna applications, recent innovations in mold compounds—known as active mold packaging (AMP)--add active electrical functionality to facilitate expanded performance requirements without increasing antenna real estate. In addition, AMP seamlessly integrates with existing manufacturing processes. Beyond the antenna signal, AMP also enhances wire bond replacement, thermal control, and thermal control.



Top 5 challenges in 5G, Wi-Fi, and telecommunications

Power density and device size

Data loads and energy efficiency

Processing and transmit speeds and complex signal processing

Resistance to environmental conditions

Stable, fast and reliable signals

Summary

Semiconductors are the essential elements that power our world. Highly engineered component-level materials elevate and extend semiconductor design, manufacture, and performance. At Henkel, we are always innovating to advance possibilities, working together in close collaborations to craft purpose-built, highly engineered material solutions to build a better future for all.

Please visit: semiconductor.henkel-adhesives.com