



Electronics
Solutions

IMAGINE: Drawing out Heat, Leaving in Performance and Reliability



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Dow Corning: A Silicone Pioneer

Electronics
Solutions

DOW CORNING

Dow Corning was established in 1943 specifically to explore and develop the potential of the silicon atom.

Today, more than 70 years later, synthetic silicone polymers formed from quartz and other products of nature are uniquely able to withstand nature's many extremes, and we continue to discover countless ways to exploit their capabilities.



CORNING

THERMAL LIVE 2015

Dow Corning: A Global Leader in Silicon-Based Innovation

- \$6.22 billion USD in sales
- \$513 million USD net income
- 7,000 products and services
- 25,000 customers
- 11,000 employees
- 4-5% investment of sales in R&D
- 5,066 active patents
- 62 offices and manufacturing locations
- Dow Corning is equally owned by The Dow Chemical Company and Corning Incorporated



*Approximate numbers as of December 31, 2014

Silicone Science Drives Innovation

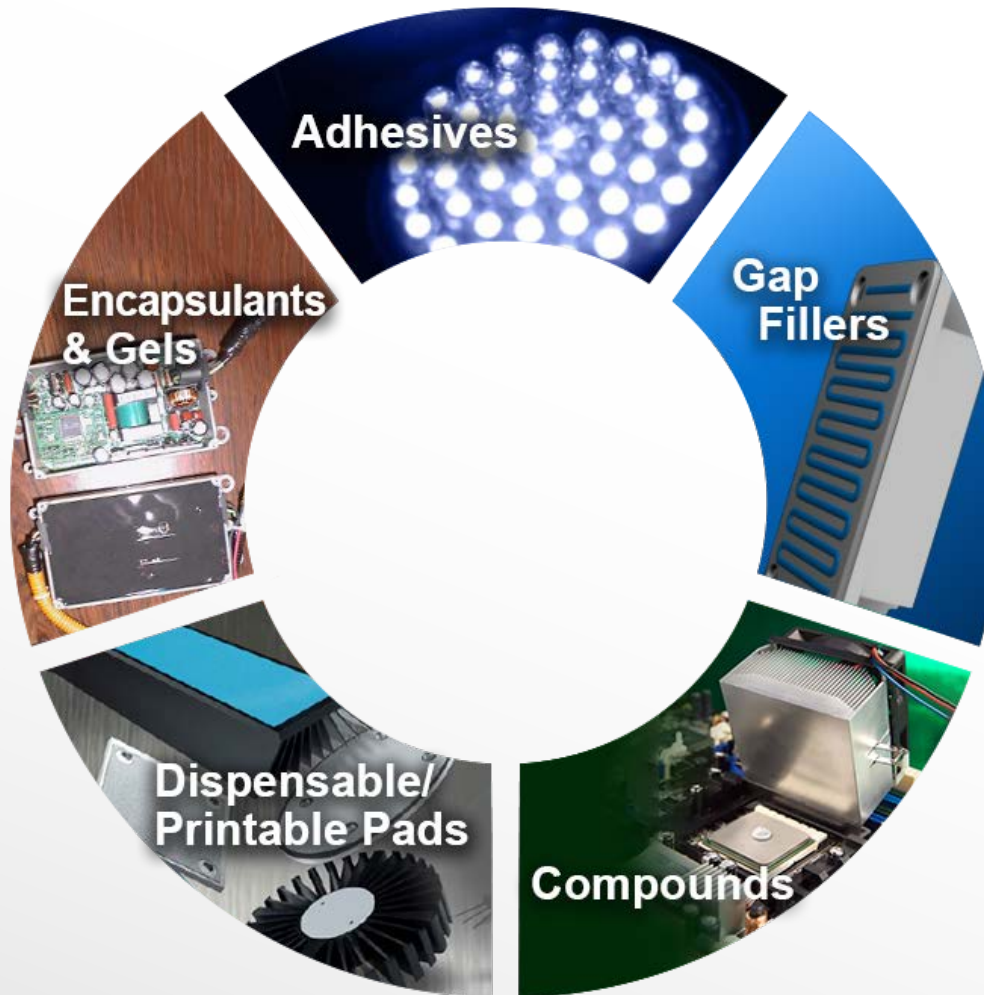


Silicone Thermal Interface Materials: TIMs Meeting Challenges

- Effective with key advantages
- Silicones are keeping pace with dramatic changes:
 - Converging computer, communications, consumer electronics
 - Microsystems integrating optical, digital, RF and MEMS systems
 - High-density packaging
- Thermal management solutions for diverse industry applications
 - Communications and consumer electronics
 - Transportation, industrial and energy industries
 - Power electronics to semiconductor packaging
 - Advanced lighting technologies and more ...



Typical Silicone Thermal Interface Materials (TIM)



Adhesives

Provide strong bonds for assembly applications that require thermal management

- One- and two-part materials that are typically heat-cured
- Features:
 - Durable bonding
 - Thinner bond line thickness (BLT) for lower thermal resistance, providing better heat flow
 - High elongation to provide low stress in a thinner bond line
 - Good thermal conductivity (>3 W/mK)



Typical Use: Assembly Applications

- Ideally suited for automated dispensing with metered mixing equipment from approved equipment suppliers

High Performance Thermally Conductive Adhesives

- Higher thermal conductivity ($> 3 \text{ W/mK}$)
- Reach thin bond line thickness (BLT) for better heat flow
- High elongation



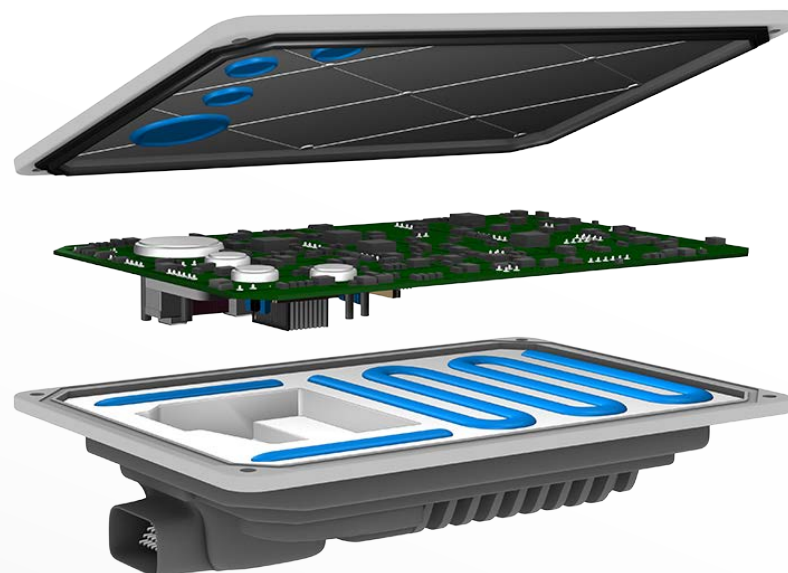
Gap Fillers

Thermal management plus vibration dampening

- Two-part curable
- Features:
 - For use in thick sections (0.15 to 5 mm)
 - Dispensable
 - High thermal conductivity ($\sim 2.6 \text{ W/mK}$)
 - Low stress
 - Easily reworkable

Typical Use: Localized Dispensing

- Ideally suited for automated dispensing with metered mixing equipment from approved equipment suppliers



Thermally Conductive Gap Filler

- Two-part curable, 1:1 mix
- Features:
 - Curable gel matrix
 - Optimized rheology for improved dispensability and minimized abrasion
 - Material stays in place after dispensing
 - High thermal conductivity (2.6 W/mK)
 - Soft – low stress
 - Good reliability
 - Reworkable



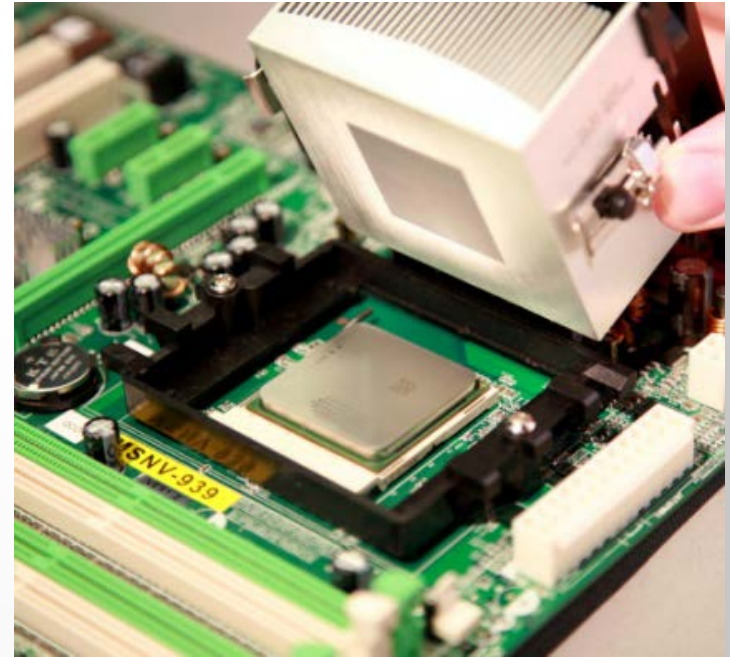
Thermally Conductive Compounds

Noncuring process helps achieve higher throughput

- One-part noncuring compounds
- Benefits:
 - For use in thin sections (<0.01 mm)
 - High thermal conductivity (>4 W/mK)
 - Low stress
 - Easily reworkable

Typical Use: Localized Dispensing

➤ Ideally suited for printing or dispensing

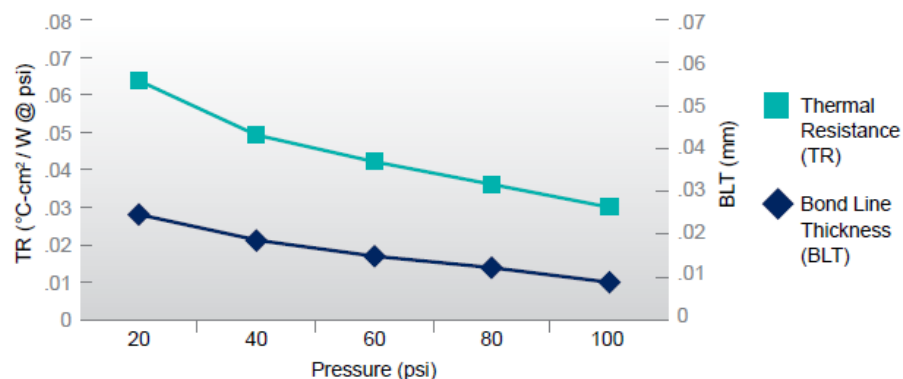


Thermally Conductive Compound

- One-part
- Features:
 - High thermal conductivity (4.3 W/mK)
 - Low viscosity for ease of application and good flowability during assembly
 - Thin bond line thickness (BLT) – 20 μm
 - Low thermal resistance – 0.06 $^{\circ}\text{C}\cdot\text{cm}^2/\text{W}$
 - Reworkable

Thermal Resistance / BLT vs. Pressure

(Dow Corning® TC-5622 Thermally Conductive Compound)



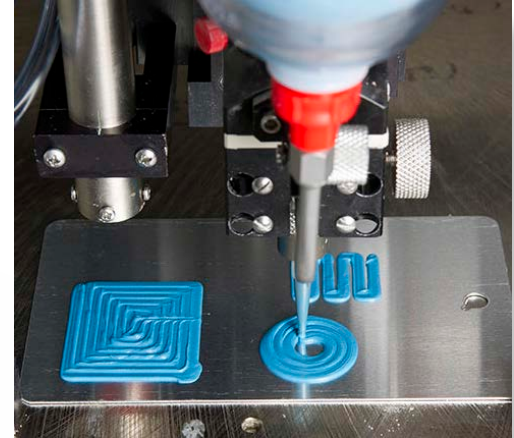
Dispensable/Printable Pads

For precise application and high process throughput

- Two-part room temperature or heat cure
- Benefits:
 - Printable or dispensable
 - Cost-effective
 - Cures/stays in place
 - Improved thermal performance
 - Easy rework
 - Beaded versions for bond line control

Typical Use: Localized Dispensing

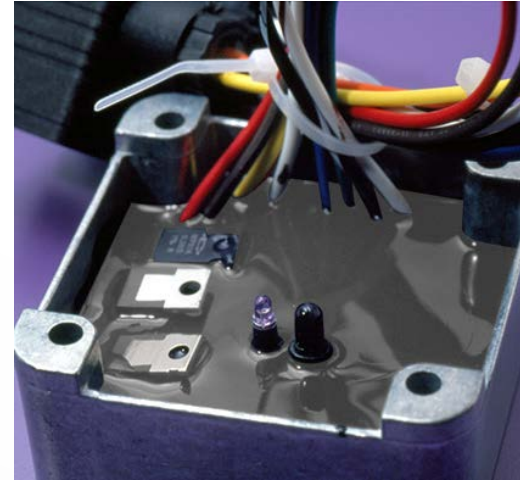
➤ Ideally suited for printing or dispensing



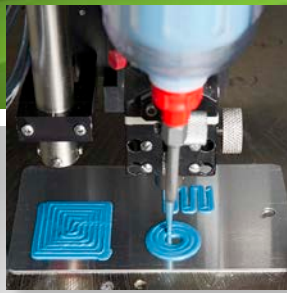
Encapsulants and Gels

Thermal management with environmental protection

- Soft two-part materials that are room temperature or heat cured
- Features:
 - Low viscosity for easy filling
 - Stays in place once cured
 - Low stress
 - Remove heat from components
 - Thermal conductivity up to ~1.4 W/mK

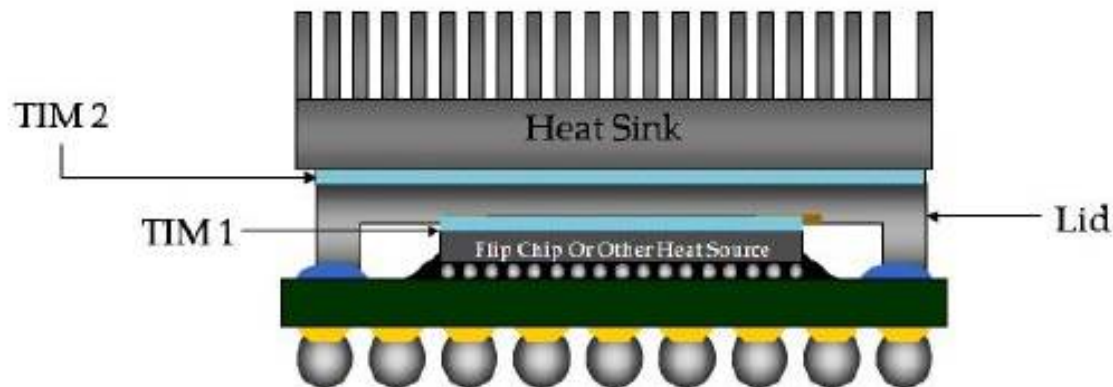


APPLICATIONS

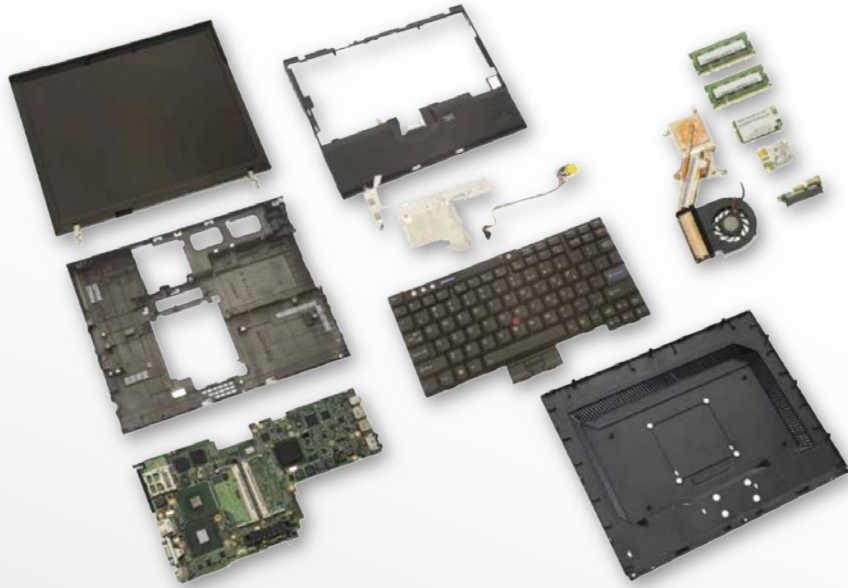


Semiconductor Packaging

- TIM1 is the primary-level interface between the chip device (heat source) and the metal lid
 - Thermally conductive adhesives
 - Thermally conductive gels
- TIM2 is the secondary-level interface between a lidded device and a heat sink
 - Thermally conductive compounds
 - Dispensable/printable pads
 - Thermally conductive gap fillers



Consumer Electronics/Server



Thermally conductive compounds
for laptop CPU/GPU



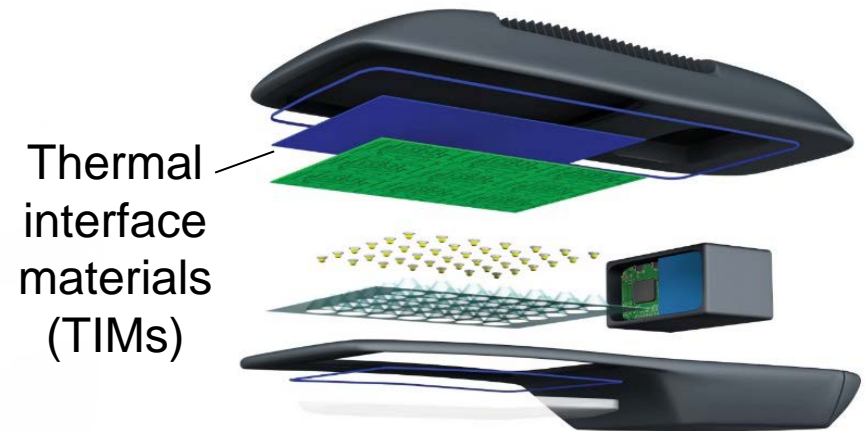
Thermally conductive adhesives/
compounds for server/CPU

Advanced Lighting

LED bulbs and luminaires



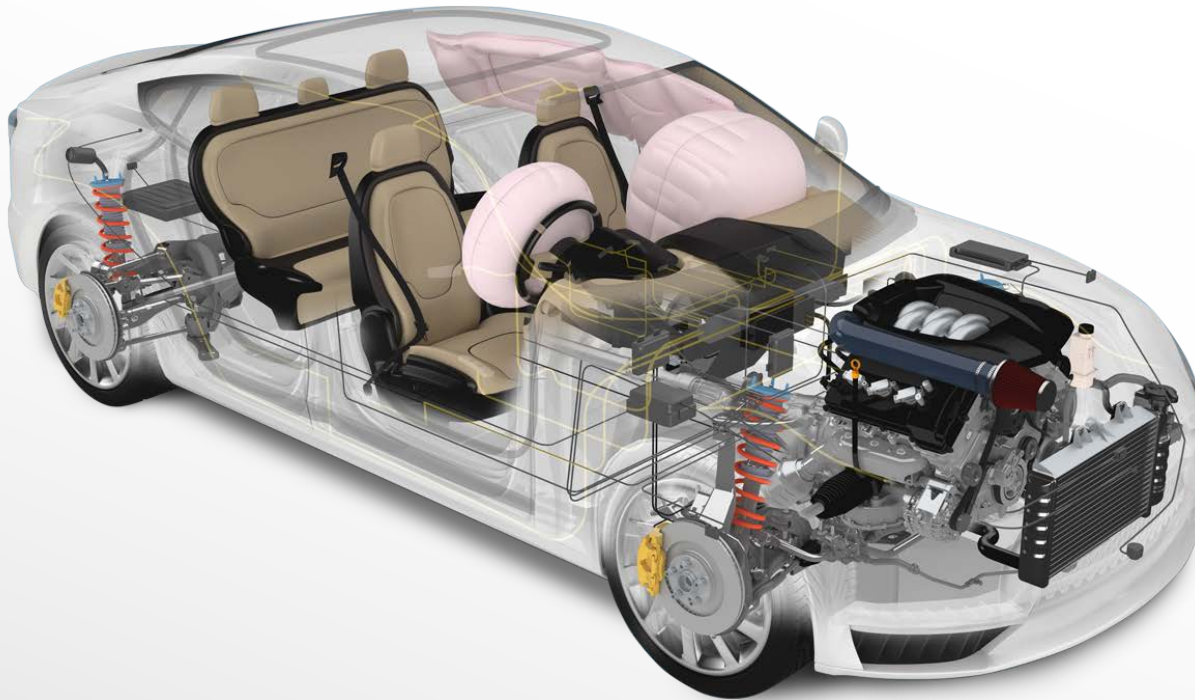
Thermal potting materials
for heat control



Thermal
interface
materials
(TIMs)

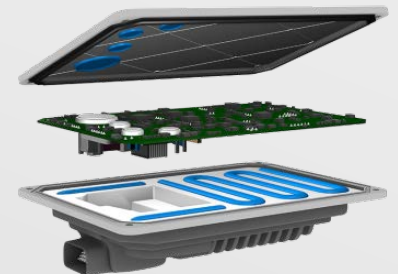
Thermal potting materials
for heat control

Transportation/Mobility



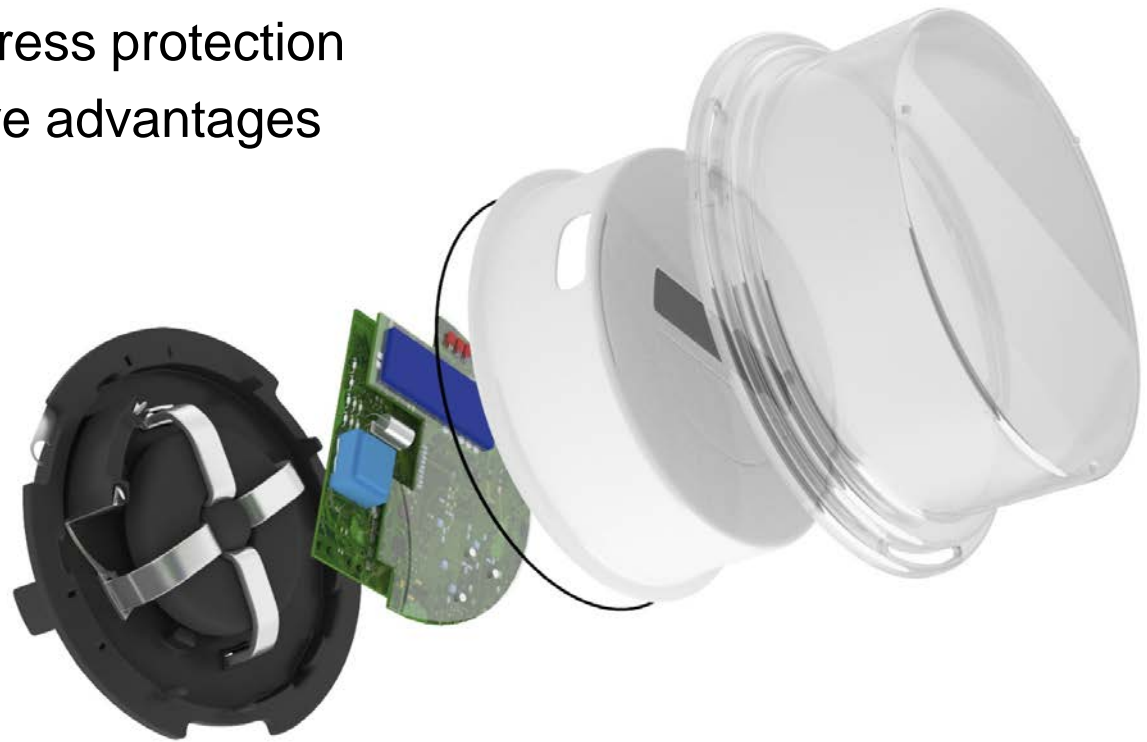
CONTROL UNITS

- Power; IC, HEV, EV
- Engine
- Transmission
- Brakes
- Lighting
- Safety
- Steering
- Seating & comfort
- Entertainment
- Navigation

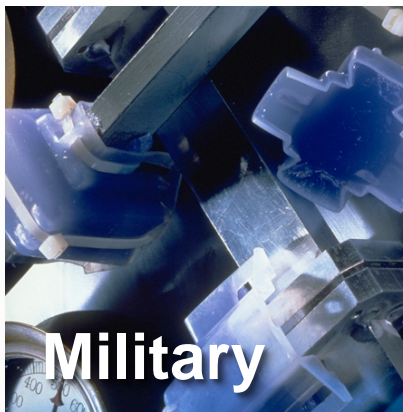


Industrial and Energy

- Improve reliability and durability
- Process efficiency, heat dissipation
- Thermal-cycling stress protection
- Notable competitive advantages

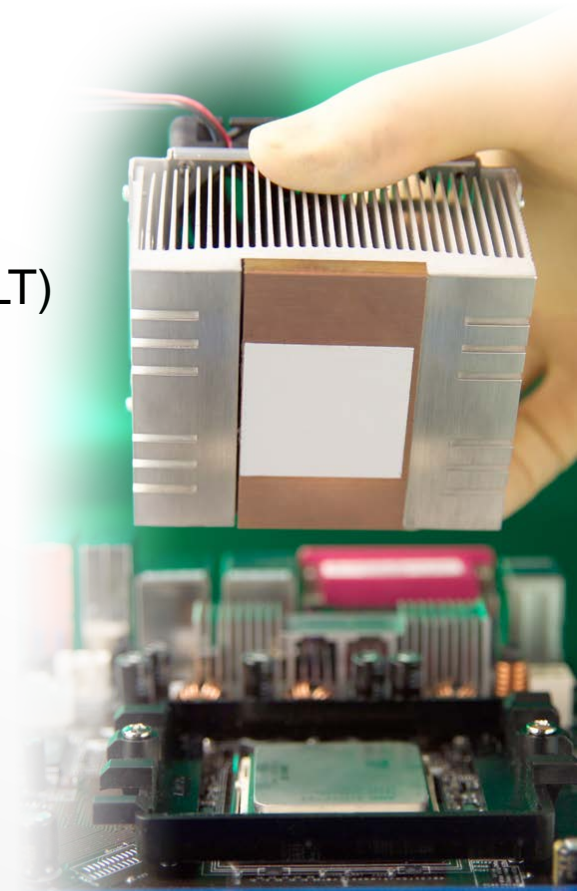


Other Thermal Applications



Silicone Interface Materials: Innovations with Impact

- Wide selection of key material properties:
 - Long-term thermal performance and stability
 - Thin films to compressible fillers
 - Application-matched process/production options
 - High conductivity and low contact resistance
 - Viscosities/fillers for precise bond line thickness (BLT)
- Proven, effective solutions to meet key design requirements:
 - Reduce total cost of ownership
 - Reduce system cooling power consumption
 - Maintain as-designed performance
 - Enhance reliability and service life



Customer-Driven Innovation

ENERGY

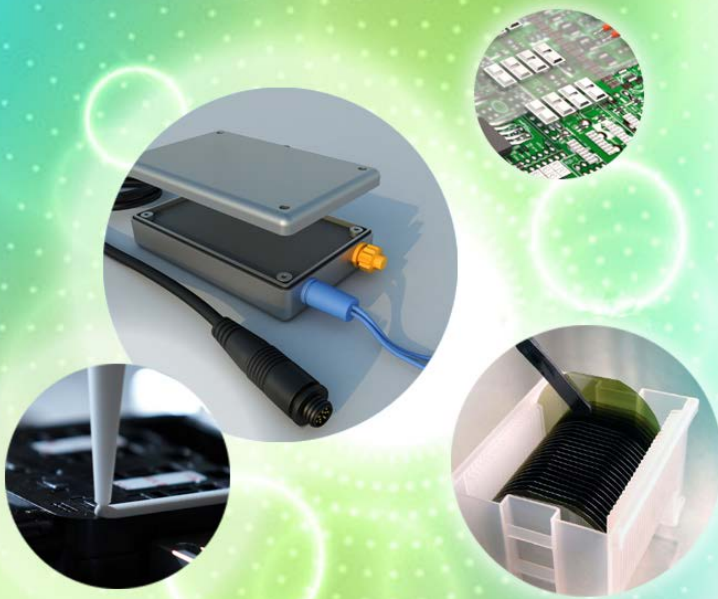
ENVIRONMENT

DEMOGRAPHICS

TECHNOLOGY

Directions for Future Solutions

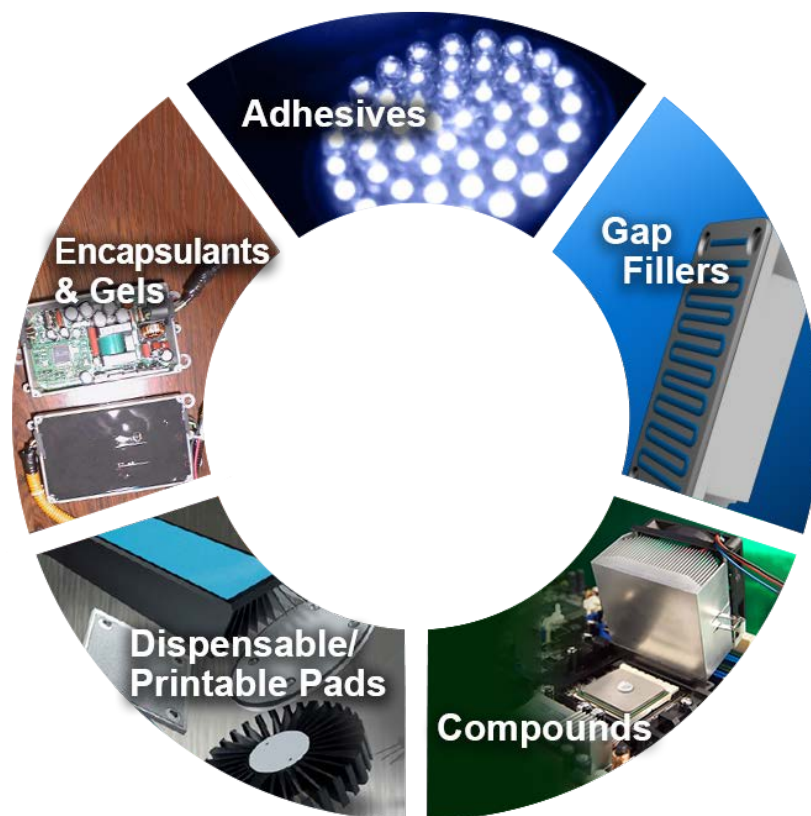
- Increasing adhesion enabling a wider range of materials, reduced weight, faster assembly
- Wider range of cures to improve production
- Consumer electronics for automotive use
- Greater temperature range and stability
- Higher thermal conductivity for improved thermal management
- Semiconductors enabling higher efficiency and smaller systems
- Lighting enabling greater design options, reduced size, extended life
- Lower material density for reduced weight



Next-Generation Thermal Management Materials – Today

IMAGINE: Converting challenges into opportunities

- Dow Corning® TC-2030/TC-2035 Thermally Conductive Adhesives
- Dow Corning® TC-4525 Thermally Conductive Gap Filler
- Dow Corning® TC-5622 Thermally Conductive Compound
- Dow Corning® TC-4015/TC-4016/TC-4026 Dispensable Thermal Pads
- Dow Corning® TC-4605 and TC-4605HLV Thermally Conductive Encapsulants



IMAGINE: Drawing out Heat, Leaving in Performance and Reliability



**Identify your challenges.
Get Dow Corning help.**

Website: dowcorning.com/electronics

Email: electronics@dowcorning.com

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