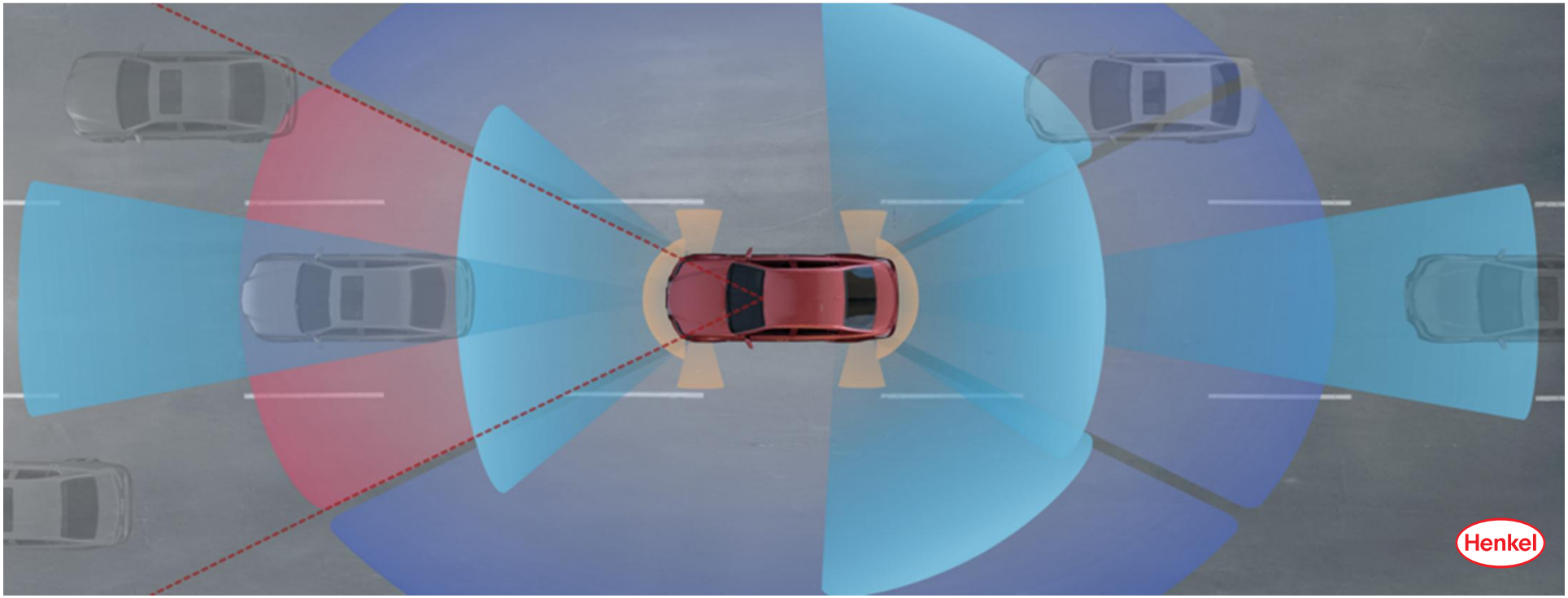
ADAS Camera and Radar Solutions

Automotive Electronics for Advanced Driver Assistance Systems

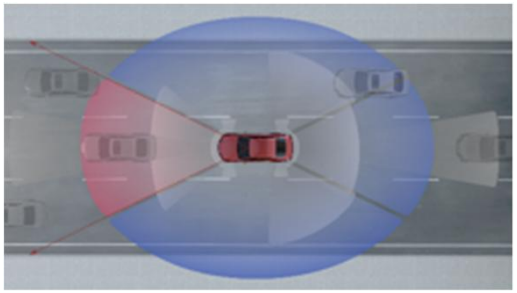


Agenda

1	Introduction to ADAS System
2	Materials Used in ADAS Cameras
3	Materials Used in ADAS Radars
4	Introduction to Technology

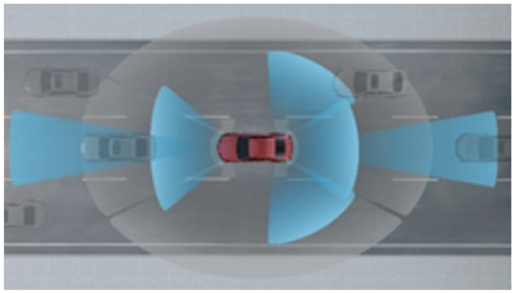
Introduction to ADAS Systems
Functionality of ADAS Sensors

Cameras



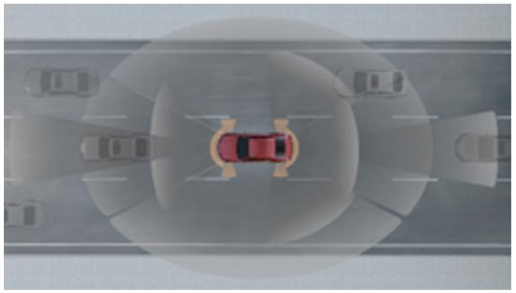
- Blind spot detection
- Lane assist
- Traffic sign recognition
- Lane departure warning
- Surround view
- Parking assistance

Radars/Lidars



- Adaptive cruise control
- Emergency braking
- Pedestrian detection
- Collision avoidance
- Cross traffic alert
- Blind spot detection
- Rear collision warning

Ultrasonic Sensors



- Parking assistance
- Blind spot detection
- Self/auto-parking
- Collision avoidance
- Object detection

Introduction to ADAS Cameras and Radar
ADAS Systems

Mono Camera

- Single-lens camera with 2D planar, single-sensor frame view
- Identifies traffic signs, as well as lanes, pedestrians and other vehicles in its path

Stereo Camera

- Dual-lens camera with dual-vision sensor, 3D frame view
- Identifies objects and calculates distance between the camera and the object

Surround Camera

- Full, 360° view enabled by multiple cameras and a central image processor
- Identifies objects surrounding the vehicle, including blind spots

Radar

- Radar systems that continuously sense vehicle distances in real time
- Detects objects position and velocity

Agenda

1	Introduction to ADAS System
2	Materials Used in ADAS Cameras
3	Materials Used in ADAS Radars
4	Introduction to Technology

Material Solutions for ADAS Cameras

Bonding

- Die Attach Adhesives
- Lens Bonding Adhesives
- Module Assembly Adhesives
- Thread Locking Adhesives

Connecting

- Electrically Conductive Adhesives
- Printed Inks
- Solder Materials

Protecting

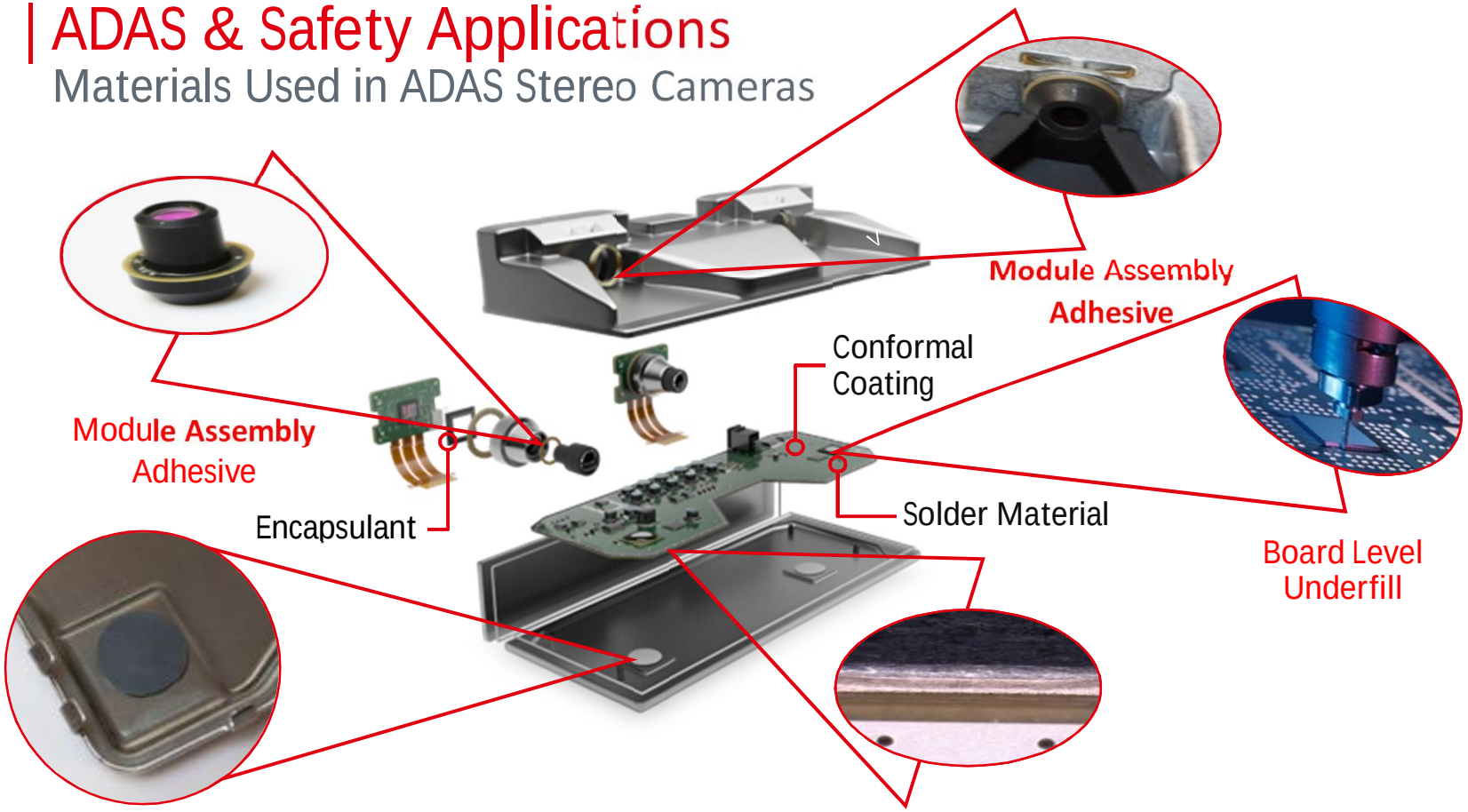
- Board Level Underfills
- Conformal Coatings
- EMI Shielding Materials
- Encapsulants
- Low Pressure Molding
- Potting

Thermal

- Thermal Interface Materials

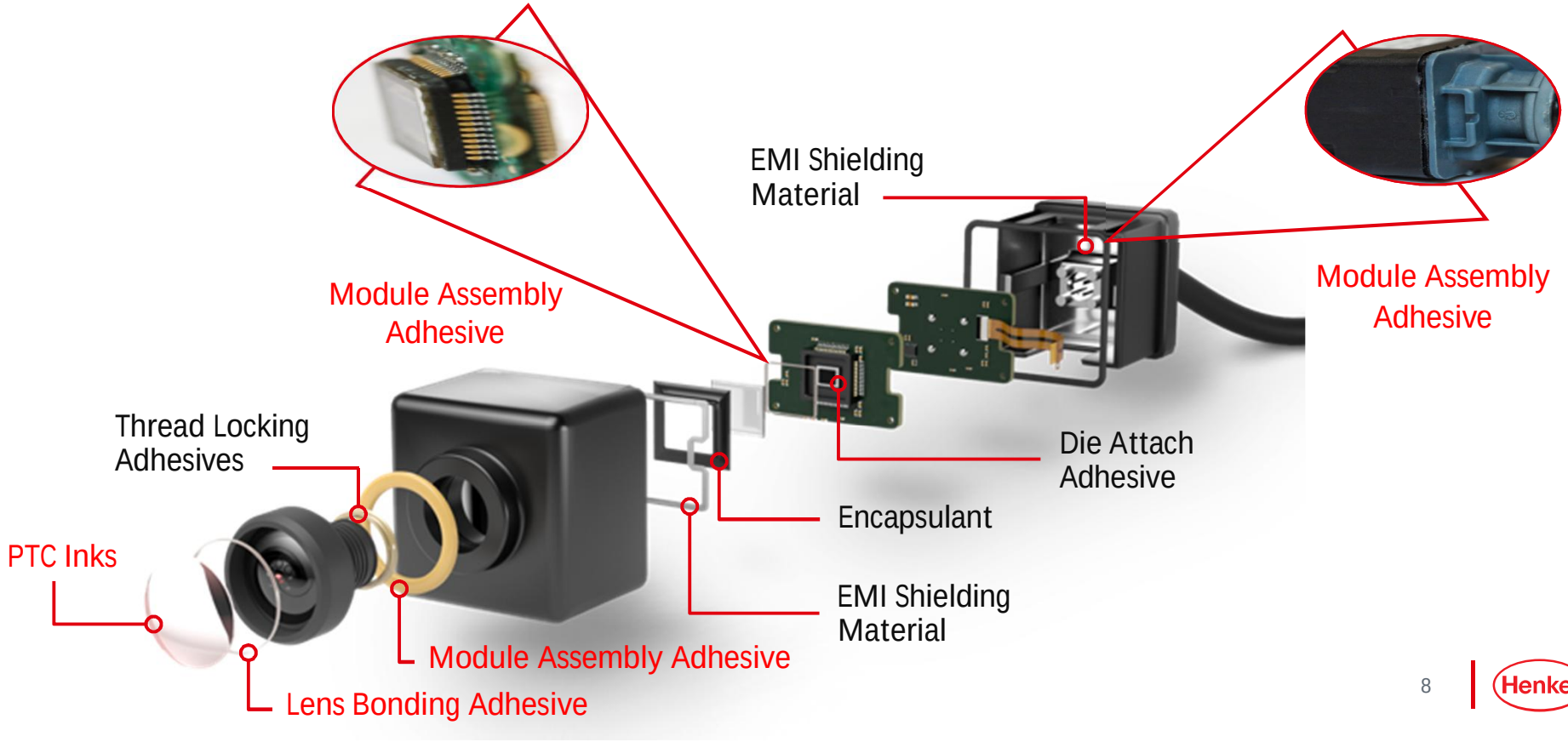
ADAS & Safety Applications

Materials Used in ADAS Stereo Cameras



ADAS & Safety Applications

Materials Used in ADAS Surround Cameras



Module & Lens Bonding for ADAS Cameras

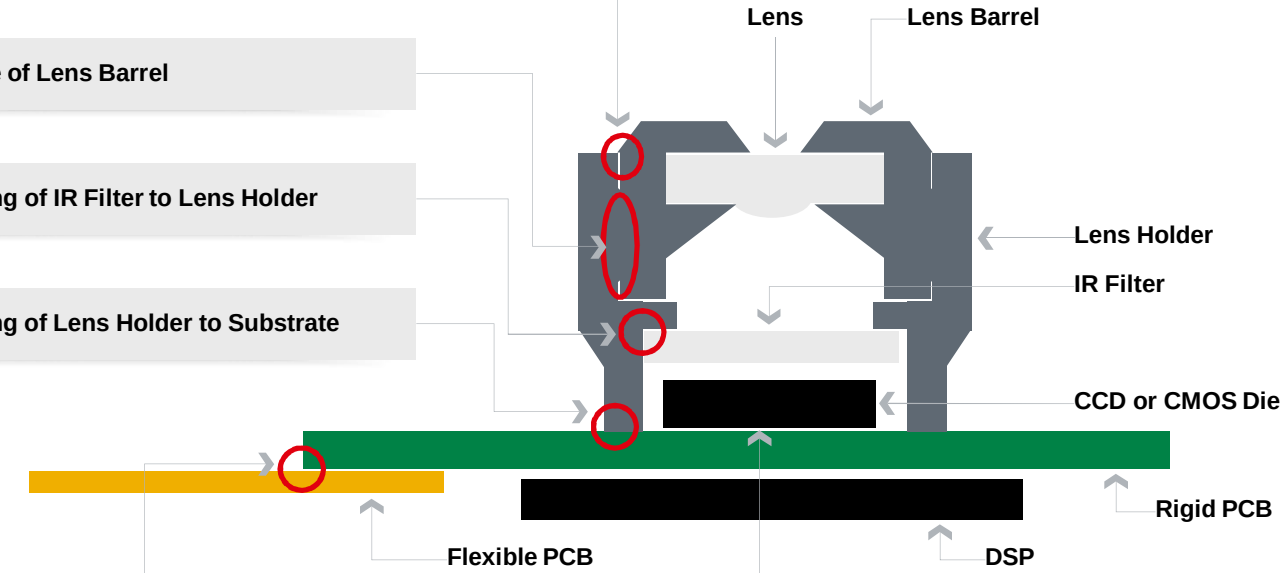
CCM Structure for Automotive

1 | Instant Bonding of Lens Barrel

2 | Fixture of Lens Barrel

3 | Bonding of IR Filter to Lens Holder

4 | Bonding of Lens Holder to Substrate



5 | Reinforcement of FPC

6 | Die Attachment

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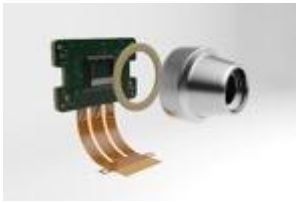
Bonding Solutions for ADAS Cameras

Non-Conductive Adhesives for Multiple Assembly Applications

Lens Barrel To
Lens Barrel Housing

Lens To Inside of
Lens Barrel



Lens Barrel Housing
To PCB

Lens Barrel To Lens
Barrel Housing

Lens Barrel Housing To
Camera Module Housing

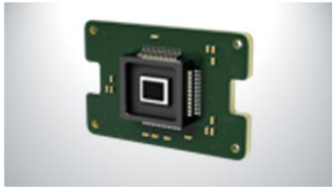
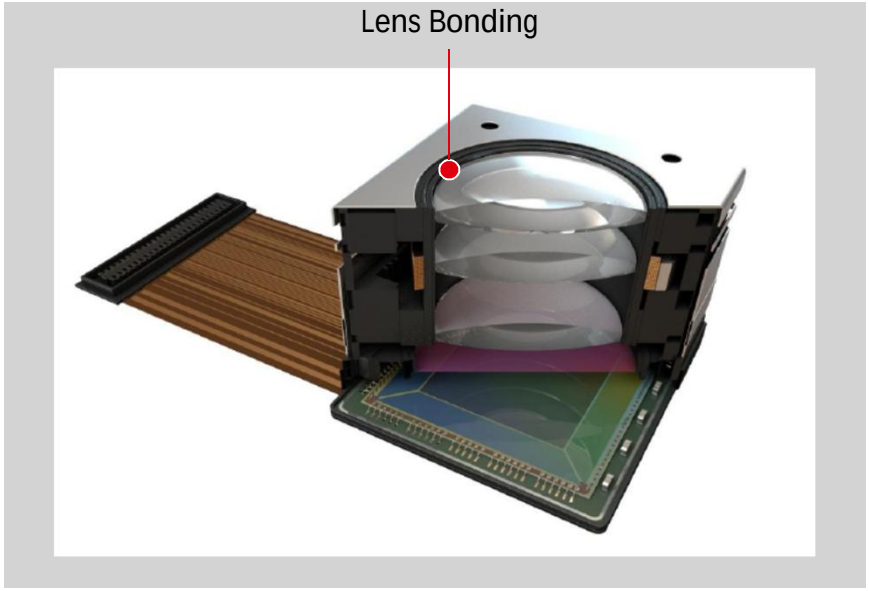


Image Sensor Die
to Substrate

Module & Lens Bonding for ADAS Cameras

Instant Bonding of Lens Barrel

Application: Instant Bonding of Lens Barrel



Key Requirements

- Very rapid cure that provides handling strength
- UV curing is preferable
- Good waterproof sealing
- Low weight loss

Material	Feature
Loctite 3103	Transparent to slight hazy
Loctite 3703	Bone white to beige translucent paste

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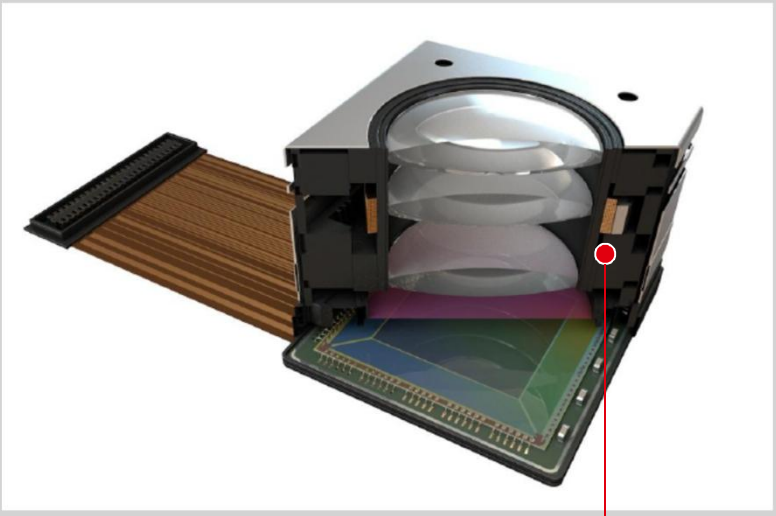
Module & Lens Bonding for ADAS Cameras

Fixture of Lens Barrel

Application: Fixture of Lens Barrel



Key Requirements

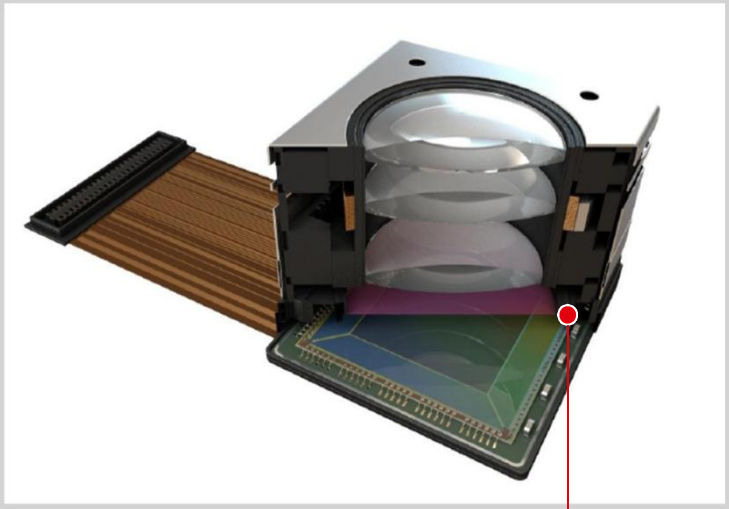
- Low temperature and fast cure, 80ºC curing
- High adhesion

Material	Feature
Loctite NCA2350	Fast cure, flexible, high adhesion, high viscosity
Loctite NCA2360	Fast cure, flexible, high adhesion, low viscosity

Module & Lens Bonding for ADAS Cameras

IR Filter to Lens Holder

Application: IR Filter to Lens Holder



Key Requirements

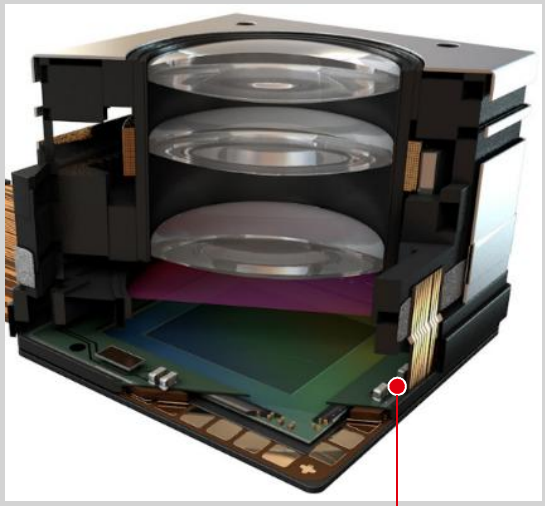
- Fast Cure
- UV curing is preferable
- High adhesion

Material	Feature
Loctite 3703 (190024)	Rapid cure UV adhesive / good TI property
Loctite NCA2350	Fast cure, flexible, high adhesion, high viscosity
Loctite NCA2360	Fast cure, flexible, high adhesion, low viscosity

Module & Lens Bonding for ADAS Cameras

Lens Holder to Substrate

Application: Lens Holder to Substrate



Key Requirements

- Fast Cure
- Low temperature cure, 80°C
- Adhesion to a variety of substrates (LCP, PA, PPS or AnAl)

Material	Feature
Loctite NCA2350	Fast cure, flexible, high adhesion, high viscosity
Loctite NCA2360	Fast cure, flexible, high adhesion, low viscosity

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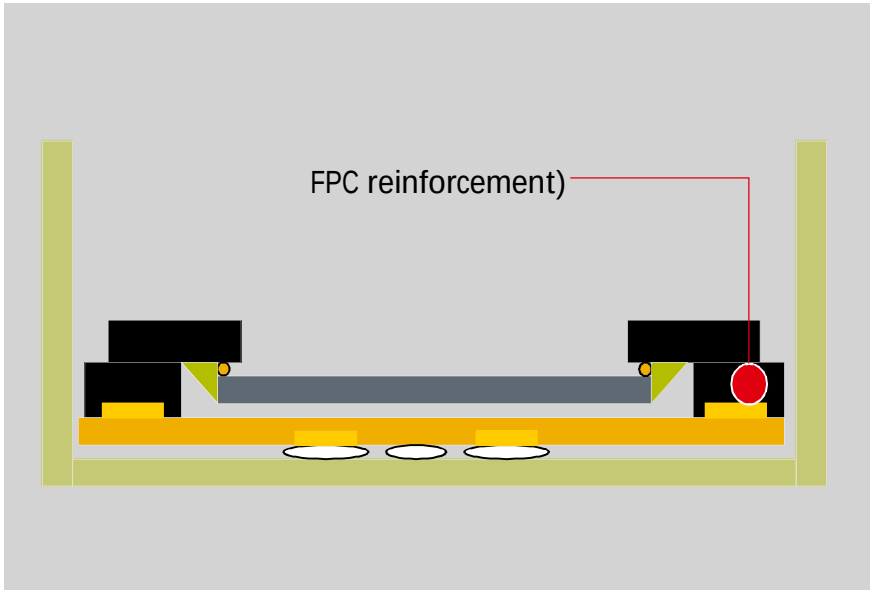
Module & Lens Bonding for ADAS Cameras

Reinforcement of FPC

Application: Reinforcement of FPC



Key Requirements

- Fast Cure
- Flexible product to accommodate stress
- High adhesion

Material	Feature
Loctite 3220	Thermal cure type, highest adhesion
Loctite 3703 (190024)	Rapid cure UV adhesive / good TI property

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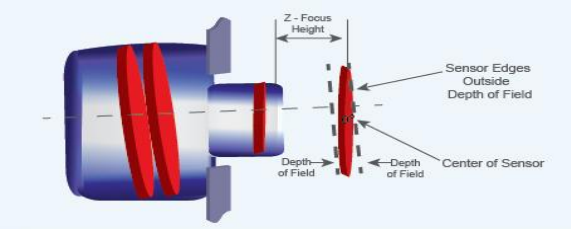
Module & Lens Bonding for ADAS Cameras

Active Alignment Process

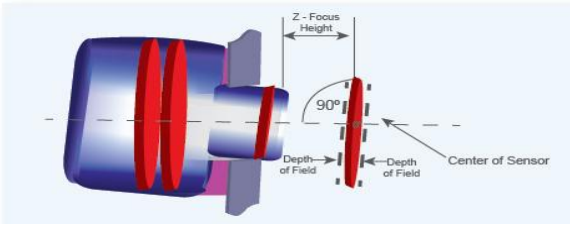
Off-Centered Optical Path



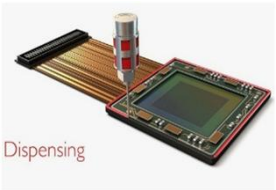
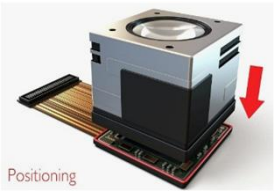
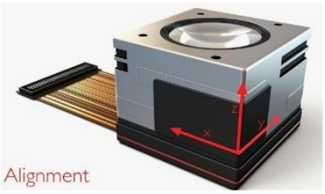
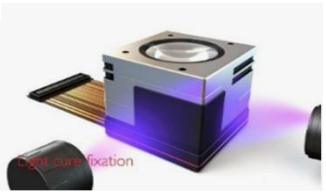
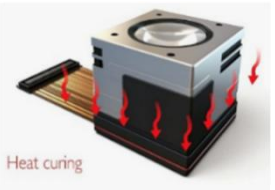
Causes – Lens & barrel manf. Tolerances
Sensor placement tolerances

Active Alignment process

Corrected Optical Path



Active alignment during assembly

1. Dispensing	2. Holder Attach	3. Focus & Align	4. Light Cure	5. Thermal cure & Finish
				
Adhesive applied to substrate	The lens holder is positioned	lens holder aligned to active camera module	Position is temporarily locked with a UV adhesive cure	The thermal oven creates a full cure.

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Active Alignment Solution for ADAS Cameras

High Tg dual cure system – Value Proposition

- Tg> 130ºC
- Single component
- Dual cure system (UV or LED + thermal)
- High thixotropic index
- Fast cure at low temperature
- Good adhesion to LCP and AnAl (Liquid Crystal Polymer)
- Low moisture absorption < 1%
- Low cure shrinkage < 3 %
- Low weight loss or outgassing @260C < 0.5%

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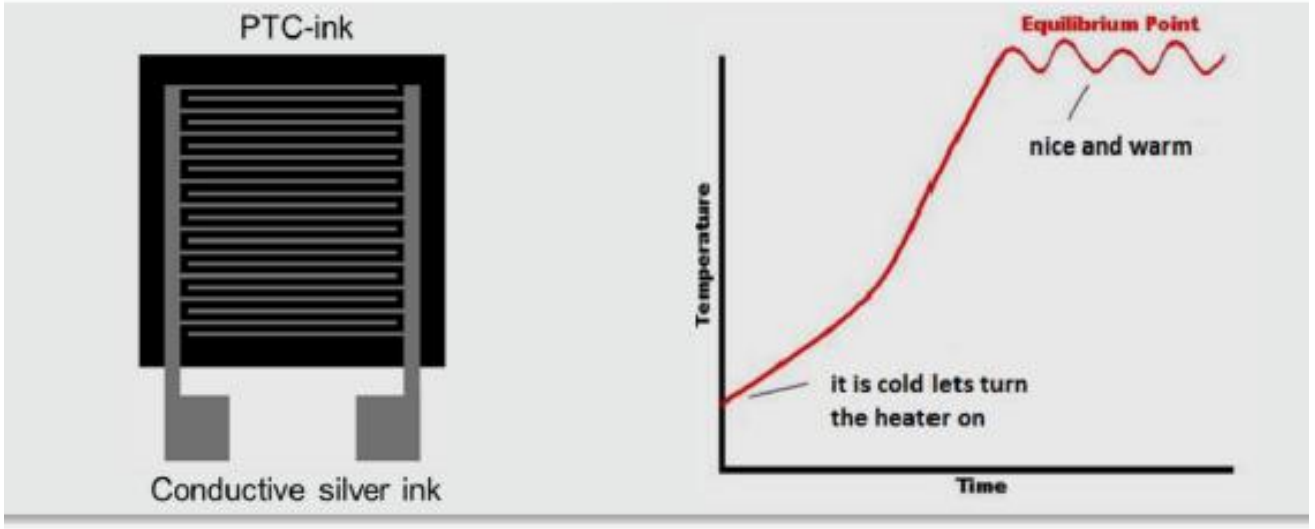
PTC Ink Solutions for Automotive

How Can They Be Used?

- A PTC heating element has a certain resistance and when a voltage is applied a current will flow and power is generated.
- As the heater heats up, the resistance of the PTC-coating will increase
- At a certain T, an equilibrium is reached, a self regulating heater



Agenda

1	Introduction to ADAS System
2	Materials Used in ADAS Cameras
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4	Introduction to Technology

Materials used in ADAS Radars

Connecting

- Electrically Conductive Adhesives
- Solder Materials

Protecting

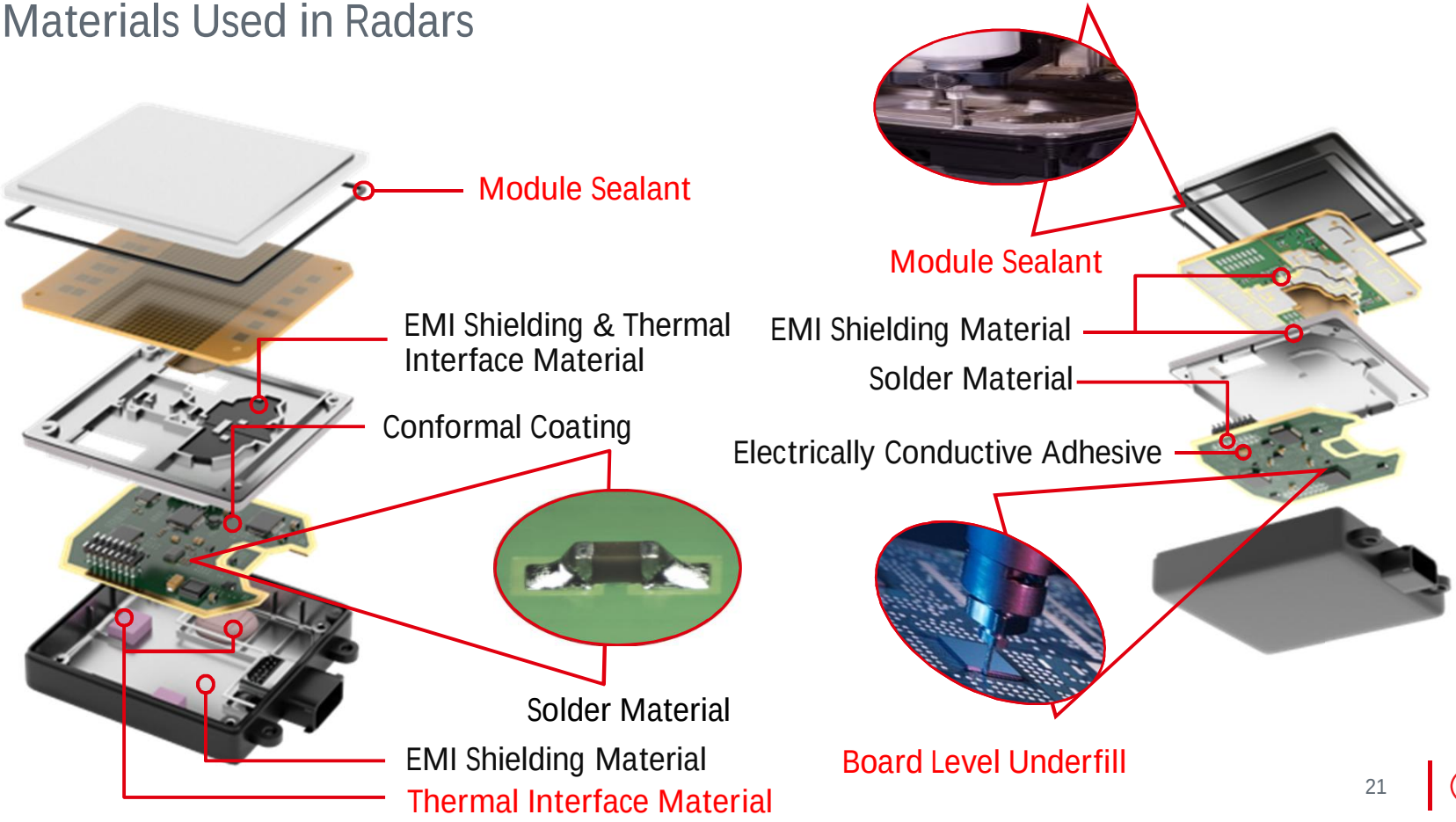
- Board Level Underfills
- Conformal Coatings
- EMI Shielding Materials
- Module Sealants

Thermal

- EMI Shielding & Thermal Interface Materials
- Thermal Interface Materials

ADAS & Safety Applications

Materials Used in Radars



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Agenda

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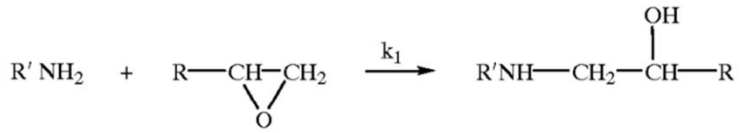
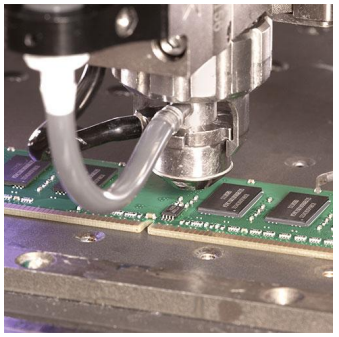
Board Level Underfill for ADAS System

Definition

- Underfill is an epoxy based thermo-set material which contains in most cases fillers (commonly silica) and is designed to flow in the gap between the board and the component.



- Underfill materials are applied after solder reflow and require heat cure.
- Underfill materials have a low viscosity to allow it to flow under the components by capillary force.
- Underfill is used to improve the reliability of a solder joint.



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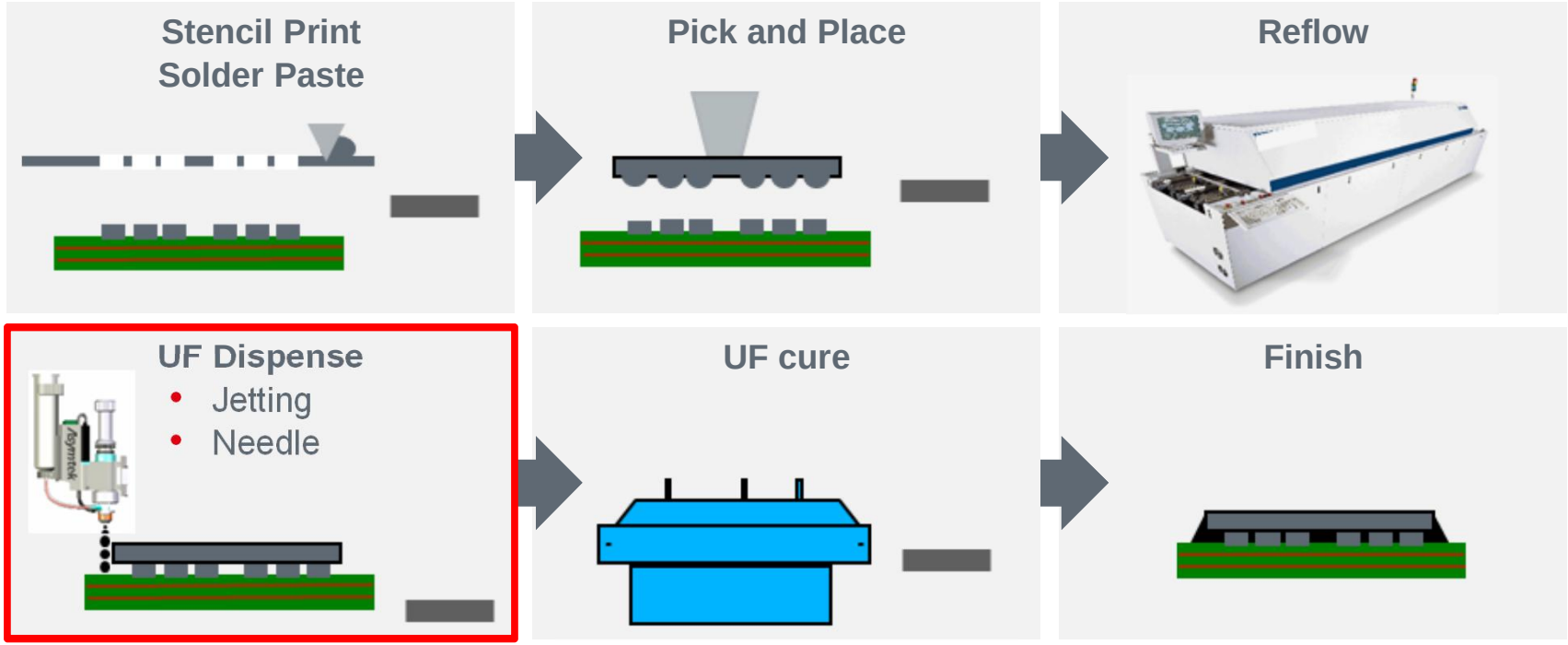
Board Level Underfill for ADAS System

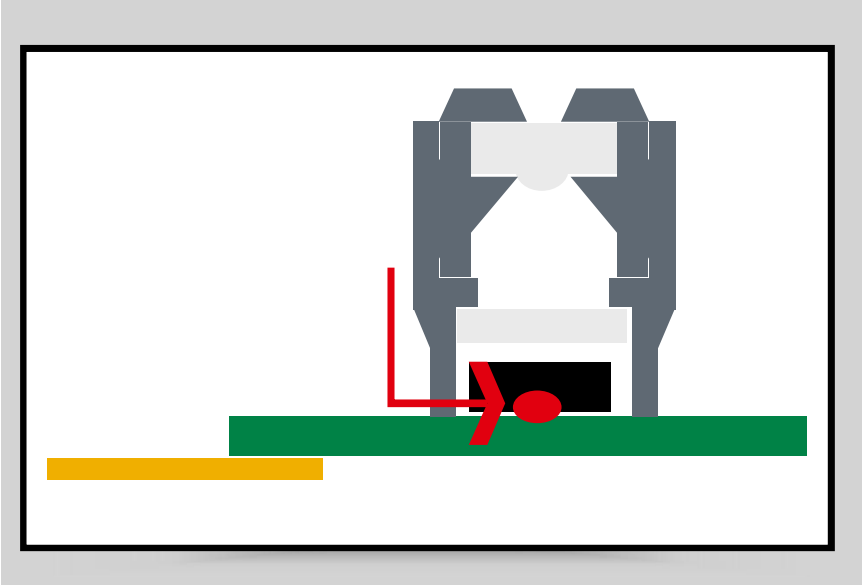
SMT Process



Board Level Underfill for ADAS System

Application

Application: UF for CSP Die



Design Feature

- High Tg > 150°C
- Low CTE, CTE1<30 ppm / °C
- Fast Curing 160°C 7mins
- High thermal shock performance, -40 ~ 150°C 3000 cycles

Selected Material

Loctite FP4531

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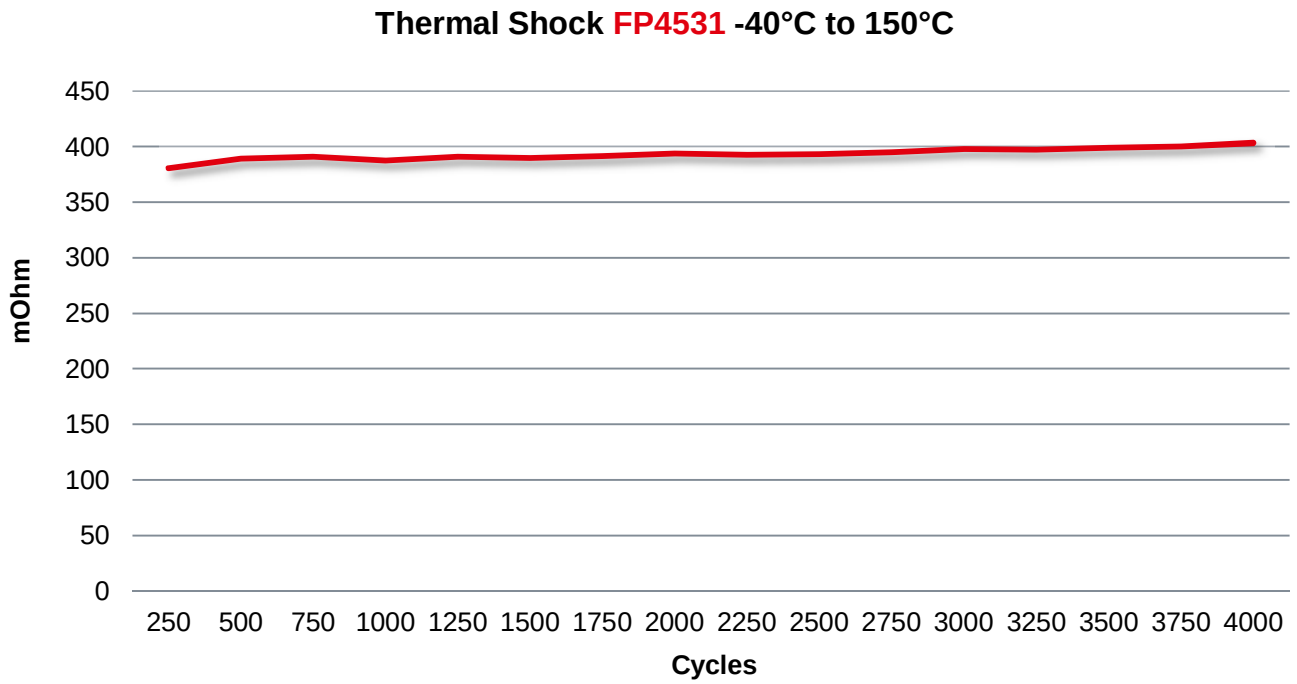
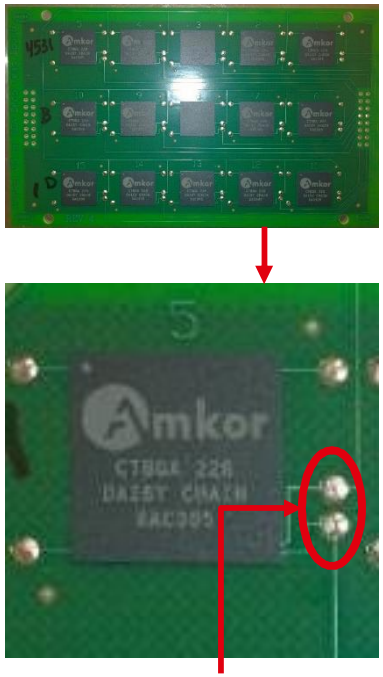
Board Level Underfill for ADAS System

Loctite FP4531





Probing points

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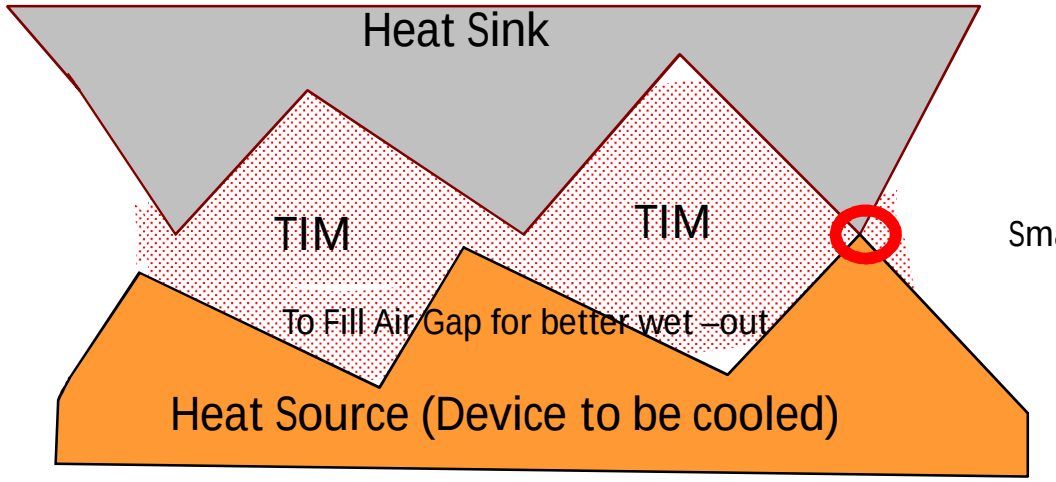
Thermal Interface Materials for ADAS System

Air Replacement for Lower TR

Concept – Why you need Thermal Interface Material (TIM) ?

Air : 0.0241 W/m-k



Small are for Thermal pass

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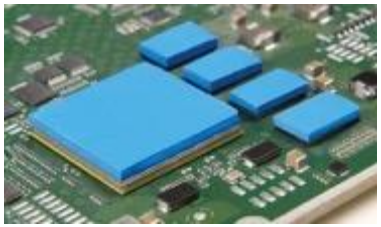
Thermal Interface Materials for ADAS System

Gad Pad



- An effective thermal interface between metal module housing and components where air gaps and rough surface textures are present

Liquid Gap Filler

- Low stress, liquid material for interfacing fragile components with high topography to metal module housing

Phase Change

- Material changes from solid to liquid at certain temperatures
- Outstanding thermal impedance between components and metal module housing

EMI Gap Pad

- Robust thermal management control with the added benefit of EMI protection

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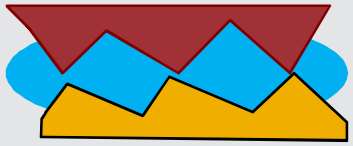
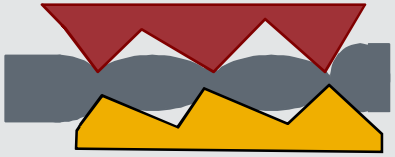
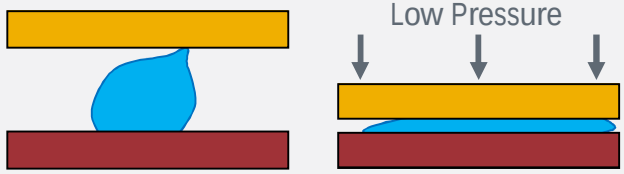
Thermal Pads vs Liquid Solutions

	Liquid Gap Fillers	Gap Pads
Key features	• Low component stress • Highly conformable • Reduced waste / efficient mfg. • Manual, semi-, or fully automated dispense • Simplified logistics (part no.) • 1k for mfg. process simplicity • 2k for bleed control and shock & vib. performance	• Soft TIM surface • Thick, compliant • Applied manually / fast & simple implementation • With or without adhesive
Main Applications	• Thin, flat interfaces • Fragile / delicate components • Intricate topographies	• Uneven topography • Large gaps
Wet out & Conformability	 Liquids have better wet out & conformability	
Component Assembly Stress		

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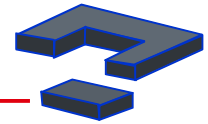
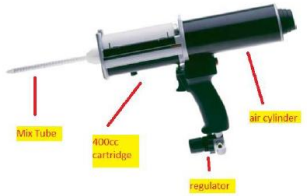
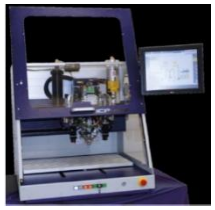
Manufacturing & Waste Elimination

- Liquids allow precise amount of material to be dispensed directly in key areas:

- Gap pads produce waste material (design dependent) and open to human error:



Manufacturing options:

Gap Pads	Gap Fillers / Liquids		
Manual Placement	Hand Guns	Desktop Dispensing	In-line Dispensing
			

Liquid solutions typically produce less waste and enable more efficient assembly

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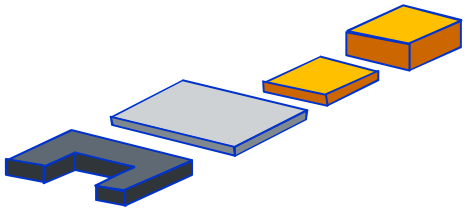
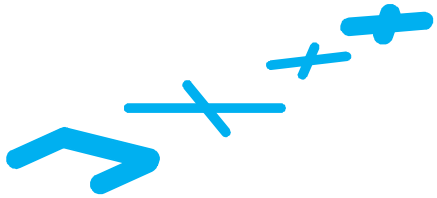
Logistics & Inventory Management

Gap Pads	Gap Fillers / Liquids
▪ Must specify different materials to manage stress versus thermal conductivity	▪ Same material can be used for multiple platforms/programs
▪ Different cut shapes = different part numbers	▪ Single qualification process
▪ Qualification of each material	▪ One part number





› Liquid solutions enable simplified logistics

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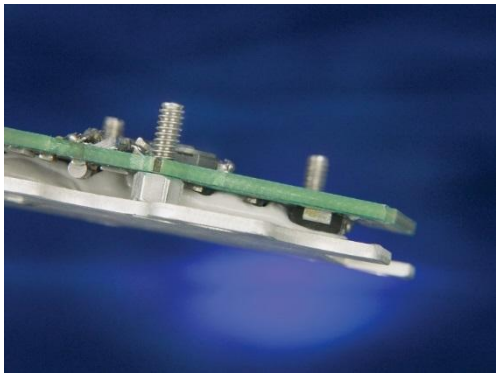
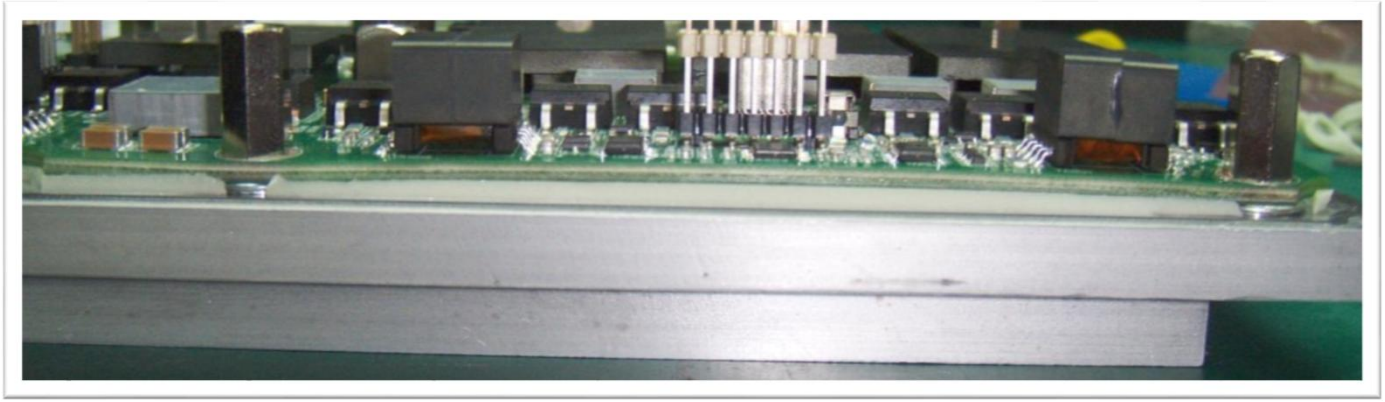
Thermal Interface Materials for ADAS System

Benifits of Cure in Place Liquids

- Low Assembly Stress
- Conformability





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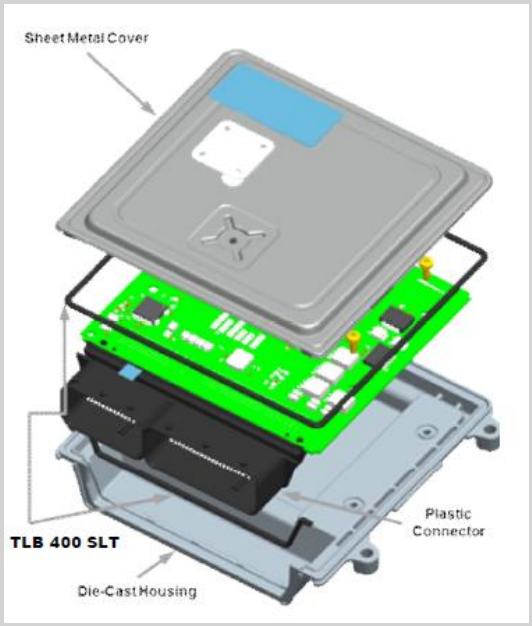
Module Sealants Solutions for Engine Control Unit

Application: ECU



Design Feature

- Fast cure at 85C (5mins)
- Eliminate WIP.
- Continuous salt mist.
- High performance for critical reliability test.
- Achieve automatic process

Material	Benefits
2K Silicone (1:1)	Excellent adhesion to various substrates, long work life and low modulus.

Module Sealants Solutions

TLB 400 SL

Color	Part A: Off-white, Part B: Black, As mixed: Black
Chemistry	Silicone, addition cure
Elongation to Break	400%
Lap Shear Strength	300 psi, 2.1 MPa
Shore Hardness (Shore A)	40
Dielectric Strength	250 V/mil
Working Time	60 minutes
Cure Temperatures	25 to 180° C
Shelf Life	6 months at room temperature
Available As	400cc cartridges, 1200cc kit and 10 gallon kit

Henkel

Module Sealants Solutions

TLB 400 SL – Target Market

Automotive Application

- Engine Control Unit Module
- HEV and EV Power Conversion Modules
- Integrated Brake Control modules
- Drive Line Control Module (ECU and TCU)
- Any Under-hood Modules

Thank you!