

Unique Challenges for Automotive Electronic Adhesives & Thermal Interface Materials

While the functional aspects of the typical die-attach, component attach, substrate attach and thermal management are the same for all automotive electronics, automotive electronics operational temperature tends to be a lot higher and conditions a lot harsher. The temperatures of power electronics like insulated gate bipolar transistors (IGBTs) can operate around 150°C. Some electronics may be exposed to solvents (fuels) and other chemicals. With over 30 years of experience in inventing and formulating specialty adhesives for electronic applications, AIT provides the most comprehensive line of thermal interface solutions that are engineered to facilitate manufacturability and throughput. Feature products include:

- High thermal electro-thermal die-attach pastes
- Compressible pressure sensitive thermal film that is the industry's best to provide instant bonding and lowest thermal resistance for large area sub-mounting
- Conformal compressible phase change or pressure sensitive thermal interfaces for modules to heat-sink for large displays
- Camber-free insulated metal thermal substrate for MCPCB

AUTOMOTIVE ELECTRONIC THERMAL INTERFACE MATERIAL (TIM) AND ADHESIVES

*INSTANT BONDING PRESSURE SENSITIVE THERMAL TAPE ADHESIVE FOR POWER MODULE
COMPRESSIBLE, CONFORMAL PHASE-CHANGE THERMAL INTERFACE MATERIAL (TIM) PAD
CAMBER-FREE MCPCB SUBSTRATE WITH 2X THERMAL CONDUCTIVITY*



ADHESIVES & THERMAL INTERFACE MATERIALS FOR AUTOMOTIVE ELECTRONICS

What distinguishes AIT automotive electronic adhesive and thermal management material solutions?

In addition to unparalleled and proven low thermal resistance, AIT's die-attach, module mounting and heat-sink thermal interfaces offer long-term reliability and consistent performance after years of thermal shock and cycling. AIT products have built-in stress relief and molecular structures that are engineered to prevent "drying" or cracking inside the materials and along the interface surfaces. Additional features include:

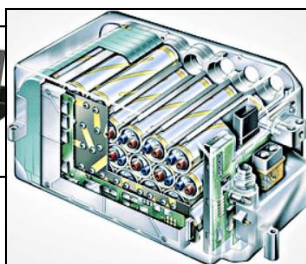
- Ultra-low electrical and thermal resistance between dies and sub-mount or substrate. Flexibility to produce camber-free and stress-free modules.
- For sub-mounting, molecular flexibility is specifically engineered in the thermal adhesive to provide stress absorption even in the most mis-matched CTE substrates and surfaces that extends to below -55°C. Depending on the assembly process, module mounting can employ pressure sensitive thermal adhesives or melt-bonding thermal film adhesives.
- In the heat-sink interface layer, AIT provides a patented and proven compressible and conformable interface pad to eliminate trapped air and accommodate irregularity in gaps.
- Ultra-low thermal resistance gels and greases that are silicone free from drying and "pumped out."



Sub-Mount Melt-Bonding or Pressure Sensitive Thermal Adhesives



Electro-thermal Die, Component, and Substrate Adhesives



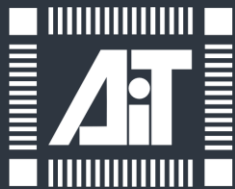
Thermal Interface Spreader for Battery Packing Heat Dissipation



Compressible Phase-Change or Pressure Sensitive Thermal Interface Materials



Insulated Metal Thermal Substrate for Camber-Free Power Electronics



ELECTRO-THERMAL & DIELECTRIC-THERMAL DIE-ATTACH

LOW THERMAL RESISTANCE FOR HIGHER POWER AUTOMOTIVE ELECTRONICS

MODIFIED EPOXY FOR CAMBER-FREE BONDING

MAINTAIN STABLE BOND STRENGTH FOR EXTREME THERMAL SHOCK AND CYCLING

Lowest Possible Die-Attach Thermal Interface is the Foundation of LED Thermal Management

Die-Attach thermal management is the first and most critical layer of the thermal stacks in a LED module device. Highest thermal conductivity with thin and void-free bond-line of the die-attach adhesive is critical in dissipating the heat quickly to the broader sub-mount and eventually to the heat-sink.

- ME8512 is a popular choice of void-free die attach with low electrical and thermal resistance.
- ME8638-UT represents the ultimate die-attach adhesive that enables one of the highest thermal conductivity and lowest thermal resistance interface between the die and sub-mount.
- ME7519-LB is a thermally conductive and electrically insulating die-attach adhesive.
- For dielectric die-attach, ME7635-LED has been engineered to have both high thermal conductivity and dielectric strength.
- MC7885 and MC8880 are ideal for temperature operation of 250°C and beyond.



THERMAL CONDUCTIVE DIE-ATTACH

Properties of COOL-BOND™ Die-Attach for Power Electronics

PROPERTY	ME8512	ME8456-DA	MC8880	ME7519-LB
Electrical Resistivity	<0.0003 ohm-cm	<0.0003 ohm-cm	<0.003 ohm-cm	>10 ¹⁴ ohm-cm
Viscosity @5.0 rpm/Thixotropic Index	10,000 cps/4.0	20,000 cps/4.0	10,000 cps/4.0	20,000cps/>3
Glass Transition Tg (°C)	52	-20	220	52
Device Push-off Strength	>3000 psi	>2000 psi	>3000 psi	>3000 psi
Hardness (Type)	~ 80D	~ 80A	~ 99D	~ 85D
Cured Density (gm/cc)	4.0	4.8	4.0	2.5
Thermal Conductivity	> 12.0 W/m-°K	> 12 W/m-°K	> 8 W/m-°K	> 12 W/m-°K
Coefficient of Thermal Expansion (ppm/°C)	40 (X-Y=Z, Isotropic)	90 (X-Y=Z, Isotropic)	26 (X-Y=Z, Isotropic)	45 (X-Y=Z, Isotropic)
Maximum Continuous Operation Temperature	> 180 °C	> 180 °C	> 250 °C	> 180 °C
TGA Decomposition Temperature (°C)	>450	>450	>500	>450
Recommended Curing Temperature /Time	>175°C/10 min	>175°C/10 min	>150°C/10 min	>175°C/10 min

EXTREME THERMAL ADHESIVE FOR MODULE MOUNTING

INSTANT BONDING COMPRESSIBLE PRESSURE SENSITIVE ADHESIVE PAD

MELT-TACKING AND IN-SITU CURABLE LOW THERMAL RESISTANCE FILM ADHESIVE

PROVEN LOWER JUNCTION AND DEVICE TEMPERATURE



METAL CORE THERMAL SPREADING INTERFACE LAMINATES FOR BATTERY PACKS

PROPERTY/PARAMETER	BPL-7156 (5, 10, 20)	BPL-7056 (5, 10, 20)
Aluminum Core Thickness	5mil (150μ), 10mil (250μ), 20mil (500μ)	
Dielectric Strength (Volts @ 5mil)	>2500	>2500
Dielectric Density (gm/cc)	2.5	2.5
Laminate Thermal Conductivity	> 8.0 W/m-°C	> 8.0 W/m-°C
Max. Continuous Op Temp. (°C)	150	150

MODULE SUB-MOUNTING THERMAL ADHESIVES

PROPERTY/PARAMETER	RTK 7555	RTK 7554	ME 7519-LB
Thermal Conductivity	> 0.2 W/m-°C	> 0.2 W/m-°C	> 0.2 W/m-°C
Dielectric Strength (Volts/mil)	>550	>300	>750
Device Push-off Strength (psi)	>1000	>1000	>1000
Cured Density (gm/cc)	2.5	2.5	2.5
Thermal Conductivity	> 3.0 W/m-°C	> 8.0 W/m-°C	> 12 W/m-°C
Maximum Continuous Operation Temp. (°C)	> 150	> 150	> 150
Electrical Resistivity	>10 ¹⁴ ohm-cm	>10 ¹⁴ ohm-cm	>10 ¹⁴ ohm-cm

Other AIT Thermal Interface Materials for HP LED Applications

FUNCTION	AIT PART #	THERMAL, ELECTRICAL AND OTHER RELEVANT PROPERTIES
Compressible Phase-Change	COOL-SILVER™ PAD CPR8850-LB	<ul style="list-style-type: none">Lowest thermal resistance, electrically non-conductive interface padCompressible, phase-change interface pad (US patented)
Compressible Phase-Change	COOL-SILVER™ G3 PAD	<ul style="list-style-type: none">Lower cost version of the lowest thermal resistance padCompressible, phase-change interface pad (US patented)
Compressible Phase-Change	COOL-PAD™ CPR7158	<ul style="list-style-type: none">Modified aluminum nitride filled with one of the lowest thermal resistanceCompressible, electrically insulating phase-change pad (US patented)
Compressible Phase-Change	COOL-PAD™ CPR7155-LB	<ul style="list-style-type: none">Modified aluminum oxide filled with one of the lowest thermal resistanceCompressible, electrically insulating phase-change pad (US patented)
Gap-Filling Thermal Pad	COOL-GAPFILL™ DT, TT	<ul style="list-style-type: none">Gap filling compressible thermal pad with the lowest thermal resistanceOne-side tacky (DT) or both side tacky (TT) for different applications
Compressible Gel-Film	COOL-GELFILM™ SZ	<ul style="list-style-type: none">Thin compressible gel like filmNon-curing thin bond-line thermal interface
Thermal Grease	COOL-SILVER™ G3 Grease	<ul style="list-style-type: none">Non-curing, electrically non-conductive interface greaseLowest thermal resistance, non-silicone, proven long-term stability
Thermal Grease	COOL-GREASE™ CGR7559-LB	<ul style="list-style-type: none">Lowest thermal resistance, electrically insulating interface greaseNon-curing, non-silicone, proven long-term stability
Thermal Gel	COOL-SILVER™ G3 Gel	<ul style="list-style-type: none">Non-curing, electrically non-conductive interface gel forming pasteNon-silicone grease, proven thermal stability similar to thermal pad
Electro-Grease	COOL-GREASE™ CGR8550	<ul style="list-style-type: none">Non-curing, electrically conductive interface grease for moving partsLowest thermal resistance non-silicone grease, proven long-term stability

Metal-Core Heat Spreading Interface Laminates

- For large area and high power battery packing applications
- Dielectric thermal interface material laminate over 5-10-20 mils aluminum cores
- Proven dielectric thermal interface layers
- Provide heat-spreading to the exterior instead of passing through the battery pack core

Compressible Thermal Gap and Interface Pad

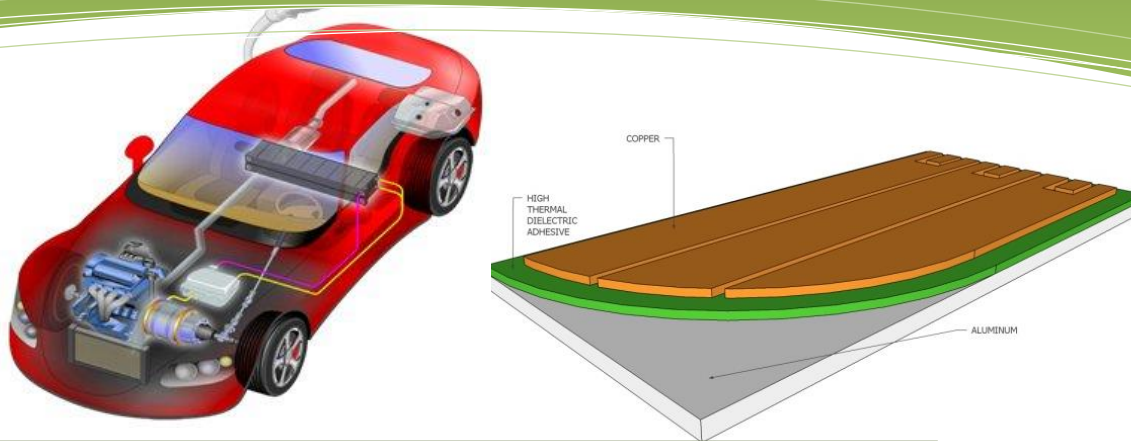
- Compressible and conformal
- Proven for large area requiring thermal filling into height gaps of different components
- Ideal for large area displays and module to enclosures
- Proven and used for the most critical thermal challenges with military grade reliability
- Non-silicone and non-contaminating
- Available in different thicknesses with one-side or both sides pressure sensitive

Compressible Phase-Change Thermal Interface

- Compressible and conformal coupled with phase change to allow elimination of voids
- Proven for most stringent applications including military applications
- US patented innovation
- Non-silicone and non-contaminating

INSULATED METAL THERMAL SUBSTRATE AND PRE-PREG THERMAL ADHESIVE FOR CAMBER-FREE MCPCB MODULES

MEASURED 2X THE THERMAL CONDUCTIVITY TO THAT OF TRADITIONAL INSULATED METAL SUBSTRATES
NOTABLE IMPROVEMENTS IN THE RELIABILITY OF POWER AND AUTOMOTIVE ELECTRONICS



INSULATED METAL THERMAL SUBSTRATE FOR SUB-MOUNTING

PROPERTY/PARAMETER	COUPLER™	PRE-PREG
Thermal Conductivity	> 3.2 W/m-°C	> 3.2 W/m-°C
Dielectric Strength (Volts/mil)	>750	>750 V
Linear Thermal Expansion Coefficient (ppm/°C)	35 (X-Y=Z, Isotropic)	40 (X-Y=Z, Isotropic)
Maximum Continuous Operation Temp. (°C)	> 175	> 175
Electrical Resistivity	>10 ¹⁴ ohm-cm	>10 ¹⁴ ohm-cm

About AI Technology, Inc.

Since pioneering the use of flexible epoxy technology for electronic packaging in 1985, AI Technology has been one of the leading forces in developing advanced materials and adhesive solutions for electronic interconnection and packaging.

Besides pioneering the use of "phase-change" materials (PCM) as thermal interface materials (TIM), AIT has also provided the electronic packaging industries with its flexible epoxy thermal adhesives. By managing interfacial stress induced by differential coefficient of thermal expansion between bonding adherents, AIT's thermal management materials have found extensive use and success in critical military and aerospace applications.

The same stress-free dielectric adhesives are now adapted for use in insulated metal substrates with copper and aluminum clad. The key advantage of these thermal management materials is their unparalleled long-term reliability attributed to their ability to withstand repeated thermal cycling and stress-free bonding between the heat-spreader plate and the circuit layer. AIT also offers the same flexible epoxy pre-preg with high thermal conductivity for more advanced multilayer insulated metal substrate circuits and modules. This novel class of thermal management materials provides a platform and infrastructure for large area thermal management of power modules such as solar cells, LED panels, etc.

AIT has a full line of die and substrate attach films and pastes, thermal interface materials, (EMI/RFI) mitigation material solutions, conductive caulks and adhesives and advanced flexible and Insulated Metal Circuit Substrates for camber-free modules. The company has an ISO9001:2000 certified manufacturing and R&D facility on a 16-acre campus in Princeton Junction, NJ. Sales support includes company direct offices in Shenzhen-HK China and sales reps in Europe and Asia.



AIT patented *thermal management technologies give unparalleled thermal and reliability performance and differ from traditional insulated metal substrates in the following ways:

- Instead of a rigid fiberglass thermally conductive epoxy laminate, we use our proprietary self-supporting thermal dielectric insulating layer resulting in stress-free and warp-free thermal copper-clad laminates.
- Unparalleled thermal conductivity in the insulating layer by eliminating the fiberglass fabrics.
- High temperature stability to withstand soldering at 300°C.
- Multi-layer capability with the same flexible dielectric copper-clad pre-preg that can be laminated at less than 15 psi pressure and at 125°C or higher.
- Thinner insulated metal substrate and pre-preg are available in rolls of 12-24-inch wide.
- Thicker insulated metal substrate and pre-preg are available in sheets of 24-inch or wider.
- Unparalleled adhesion to copper and aluminum even without chemical etching or treatment.
- Ideal for camber-free power and LED components, modules and panels.

*[US patent#: 7,154,046; 6,717,819; 6,580,035; 6,581,276; 6,108,210; 6,297,564; 6,665,193; 6,973,716]