

TOTAL THERMAL MANAGEMENT MATERIAL SOLUTIONS

*RAPID CURING MODIFIED ELECTRO-THERMAL DIE-ATTACH
INSTANT BONDING THERMAL FILM ADHESIVE FOR MODULE SUB-MOUNTING
COMPRESSIBLE, CONFORMAL PHASE-CHANGE THERMAL INTERFACE PAD
INSULATED METAL THERMAL SUBSTRATE WITH 2X THERMAL CONDUCTIVITY*

Low LED Temperature for Higher Brightness:

Management of heat dissipation in LED is critical for high brightness and long-term performance. AIT has dedicated product developments with patented technologies that have proven to achieve the lowest thermal resistance from chip to heat-sink. The total material solutions yield the lowest LED device temperature from die-attach to module sub-mounting and heat-sink interface.

With over 30 years of experience in inventing and formulating specialty adhesives for electronic applications, AIT provides some of the most comprehensive thermal interface solutions that are engineered to facilitate manufacturability and throughput. Key features of AIT solutions include:

- Rapid curing electro-thermal die-attach pastes
- Compressible pressure sensitive thermal film that is the industry's best material to provide instant bonding and lowest thermal resistance for large area sub-mounting
- Melt-bonding thermal adhesive that can be pre-applied for module sub-mounting and achieve full curing in-situ without applied pressure
- Conformal compressible phase change or pressure sensitive thermal interfaces for modules to heat-sink for largest displays

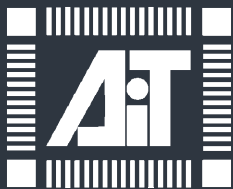


THERMAL MANAGEMENT FOR LED LIGHTING

What distinguishes AIT LED Total Thermal Management Material Solutions?

What distinguishes AIT LED total thermal management material solutions besides their unparalleled and proven low thermal resistance in the die-attach, sub-mount and heat-sink is long-term reliability and consistent performance after years of thermal shock and cycling with built-in stress relief and molecular structures that are engineered to prevent “drying” or cracking inside the materials and along the interface surfaces.

1. Ultra-low electrical and thermal resistance between LED dies and sub-mount or substrate. High mechanical strength and glass transition temperature to enable fast wiring bonding as high as 275°C.
2. 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 extend to below -55°C. Depending on the assembly process, pressure sensitive thermal adhesive or a melt-bonding thermal adhesive film can be used for LED sub-mounting.
3. 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 that need to be filled.
4. Ultra-low moisture absorption and sensitivity
5. RoHS, REACH and WEEE compliant that meets UL94V-0 rating.



ELECTRO-THERMAL & DIELECTRIC-THERMAL DIE-ATTACH

LOW THERMAL RESISTANCE FOR HIGHER BRIGHTNESS

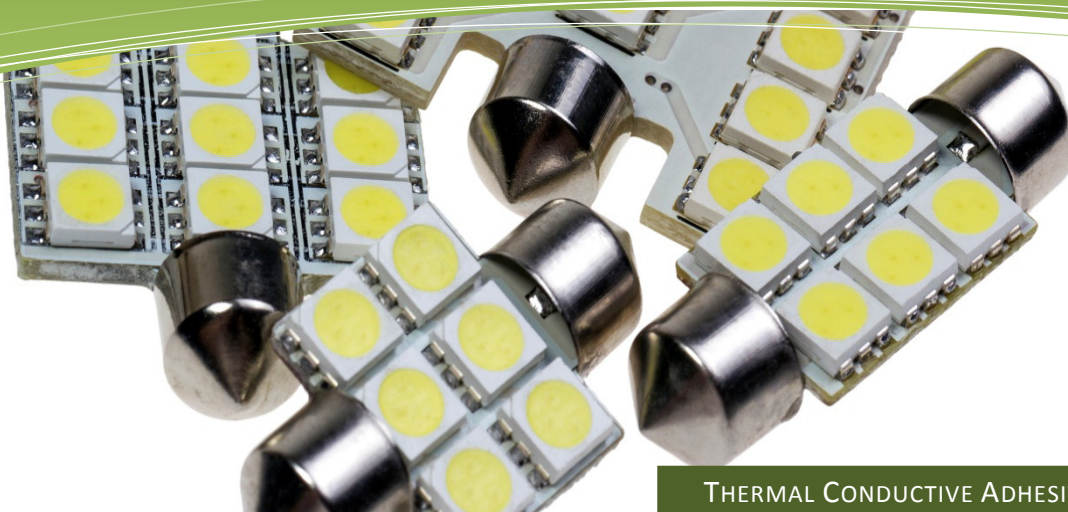
MODIFIED EPOXY FOR RAPID CURING AT TEMPERATURE OF 150-175°C

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. The highest thermal conductivity possible with a thin and void-free bond-line of the die-attach adhesive is critical to dissipate the heat quickly to the broader sub-mount and eventually to the heat-sink.

- ME8960-UT is a popular choice of void-free die attach with low electrical and thermal resistance.
- ME8950-SA 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.
- M3669-DA is diamond filled thermally conductive and electrically insulating die-attach adhesive. M3669-DA is a white color that is non-yellowing.
- For more standard LED power dielectric die-attach, ME3665-DA has been engineered to have both high thermal conductivity and dielectric strength. ME3665-DA is white in color and non-yellowing.



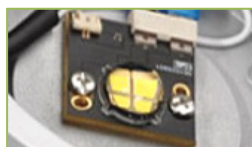
THERMAL CONDUCTIVE ADHESIVES

Properties of Cool-Bond™ Die-Attach for LED Applications

PROPERTY/PARAMETER	ME8960-UT	ME8950-SA	ME3665-DA	ME3669-DA
Electrical Resistivity	<0.0001 ohm-cm	<0.0001 ohm-cm	>10 ¹⁴ ohm-cm	>10 ¹⁴ ohm-cm
Viscosity @5.0 rpm/Thixotropic Index	30,000 cps/3.3	30,000 cps/3.0	20,000 cps/>3	20,000 cps/>3
Glass Transition Temperature (°C)	80	30	60	60
Device Push-off Strength (psi)	>3000	>3000	>2000	>2000
Hardness (Type)	~ 80D	~ 60D	~ 90	~ 90
Cured Density of Conductive Adhesive Portion (gm/cc)	6.5	6.6	2.5	2.5
Thermal Interface Resistance	<0.002°C-in ² /W	<0.002°C-in ² /W	<0.006°C-in ² /W	<0.003°C-in ² /W
Thermal Conductivity	> 23.0 W/m-°K	> 52.0 W/m-°K	> 2.0 W/m-°K	> 12.0 W/m-°K
Linear Tab-Composite Thermal Expansion Coefficient (ppm/°C)	40(X-Y=Z, Isotropic)	48(X-Y=Z, Isotropic)	40 (X-Y=Z, Isotropic)	40 (X-Y=Z, Isotropic)
Maximum Continuous Operation Temperature (°C)	> 150	> 150	> 150	> 150
Decomposition Temperature @5% weight loss (°C)	>400	>400	>400	>400
Recommended Curing Temperature/Time (°C/min.)	175/30	175/30	175/30	>175/30
Color (Cured)	Silver white	Silver white	White, Non-Yellowing	White, Non-Yellowing



Rapid Curing Electro-thermal Die-Attaches



Sub-Mount Melt-Bonding or Pressure Sensitive Thermal Adhesives



Conformal & Compressible Phase-Change or Pressure Sensitive Thermal Interface



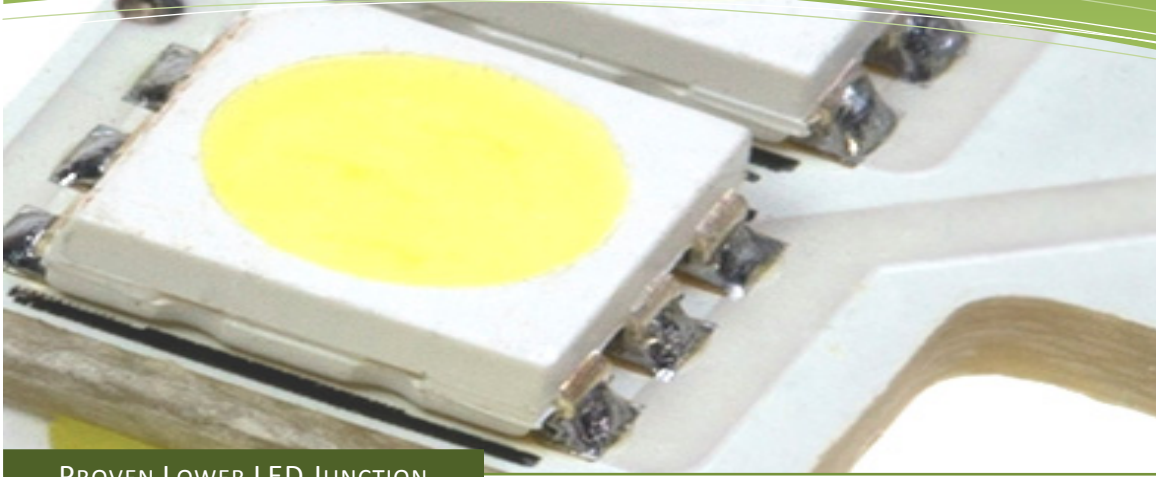
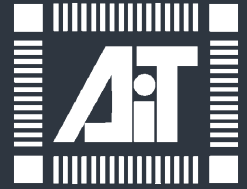
Insulated Metal Thermal Substrate for Large Area LED

EXTREME THERMAL ADHESIVE FOR MODULE SUB-MOUNTING

INSTANT BONDING COMPRESSIBLE PRESSURE SENSITIVE ADHESIVE PAD

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

PROVEN LOWER LED JUNCTION AND DEVICE TEMPERATURE FOR HIGHER BRIGHTNESS



PROVEN LOWER LED JUNCTION

Module Sub-Mounting Thermal Adhesives

PROPERTY/PARAMETER	RTK7555	RTK7554	ME7155-M	ME 7159-M
Thermal Interface Resistance	<0.05°C-in ² /W	<0.05°C-in ² /W	<0.01°C-in ² /W	<0.005°C-in ² /W
Dielectric Strength (Volts/mil)	>550	>300	>750	>750
Device Push-off Strength (psi)	>1000	>1000	>1000	>1000
Cured Density (gm/cc)	2.5	2.5	2.5	2.5
Thermal Conductivity	> 3.0 W/m-°C	> 8.0 W/m-°C	> 2 W/m-°C	> 12 W/m-°C
Max. Continuous Operation Temp. (°C)	> 150	> 150	> 150	> 150
Electrical Resistivity	>10 ¹⁴ ohm-cm	>10 ¹² ohm-cm	>10 ¹⁴ ohm-cm	>10 ¹⁴ ohm-cm
Material Format	Flexible Pressure Sensitive Tape	Flexible Pressure Sensitive Tape	Smooth Paste, Flexible Adhesive	Smooth Paste, Flexible Adhesive

AIT Thermal Interface Materials for HB LED Applications

FUNCTION	AIT PART #	THERMAL, ELECTRICAL, and other RELEVANT PROPERTIES
Pressure-Sensitive Tape Adhesive	COOL-BOND™ NC PSA-3NC	<ul style="list-style-type: none"> Non-curing pressure sensitive thermal tape with lowest thermal resistance for same class Compressible to bond at <10 psi with bonding of 100 psi at 25°C - 75°C
Pressure-Sensitive Tape Adhesive	COOL-BOND TC PSA-3TC	<ul style="list-style-type: none"> Industry only in-situ curable pressure sensitive thermal tape with lowest thermal resistance Compressible to bond at <10 psi with bonding of >200 psi at 25°C and >500 psi at 75°C
Compressible Phase-Change	COOL-PAD™ CPR7159-LB	<ul style="list-style-type: none"> Lowest thermal resistance, electrically insulating interface pad Compressible, 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 pad Compressible, phase-change interface pad (US patented)
Compressible Phase-Change	COOL-PAD™ CPR7154	<ul style="list-style-type: none"> Modified aluminum nitride filled for one of the lowest thermal resistance Compressible, electrically insulating phase-change pad (US patented)
Compressible Phase-Change	COOL-PAD™ CPR7155-LB	<ul style="list-style-type: none"> Modified aluminum oxide filled for one of the lowest thermal resistance Compressible, electrically insulating phase-change pad (US patented)
Gap-Filling Thermal Pad	COOL-GAPFILL™ DT	<ul style="list-style-type: none"> Gap filling compressible thermal pad with the lowest thermal resistance One-side tacky (DT) with thickness from 0.005" to 0.1" or thicker for different applications
Gap-Filling Thermal Pad	COOL-GAPFILL™ TT	<ul style="list-style-type: none"> Gap filling compressible thermal pad with the lowest thermal resistance Both side tacky (TT) with thickness from 0.005" to 0.1" or thicker for different applications
Compressible Gel-Film	COOL-GELFILM™ SZ	<ul style="list-style-type: none"> Thin compressible gel like film Non-curing thin bond-line thermal interface
Thermal Grease	COOL-SILVER™ G3 Grease	<ul style="list-style-type: none"> Non-curing, electrically non-conductive interface grease Lowest thermal resistance, non-silicone, proven long-term stability
Thermal Grease	COOL-GREASE™ ZX	<ul style="list-style-type: none"> Non-curing, electrically non-conductive interface grease Lowest 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 grease Non-curing, non-silicone, proven long-term stability
Thermal Gel	COOL-SILVER™ G3 Gel	<ul style="list-style-type: none"> Gel-forming, electrically non-conductive interface gel forming paste Non-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 parts Lowest thermal resistance non-silicone grease, proven long-term stability

AI Technology, Inc. (© 2013, Rev 3.2) | 70 Washington Rd., Princeton Junction, NJ 08550
Tel: 609-799-9388 | www.aitechnology.com | ait@aitechnology.com

Compressible Thermal Gap Pad Thermal Interface

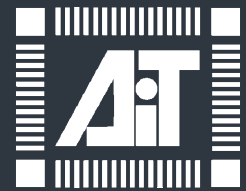
- Compressible and conformal
- Proven for large areas requiring thermal filling into height gaps of different components
- Ideal for large area display and module to device enclosure
- Proven and used for most critical thermal challenges with military grade reliability
- Non-silicone and non-contaminating
- Available in different thicknesses with one or two sided pressure sensitive

Compressible Phase-Change Thermal Interface Pads

- Compressible and conformal pads couple with phase change pads 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 & PRE-PREG THERMAL FILM ADHESIVE FOR LED SUB-MOUNTING & MODULE:

MEASURED 2X THERMAL CONDUCTIVITY OVER TRADITIONAL INSULATED METAL SUBSTRATE
NOTABLE IMPROVEMENTS IN THE RELIABILITY OF LARGER AREA LED PANEL



UNPARALLELED ADHESION

About AI Technology, Inc.

Since pioneering the use of flexible epoxy technology for microelectronic 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 provided the microelectronic packaging industry with its flexible epoxy thermal adhesives. By managing interfacial stress induced by differential coefficient of thermal expansion between bonding adherents, these 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 the unparalleled long-term reliability attributed to its 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 the 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. 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.

Insulated Metal Thermal Substrate for Sub-Mounting

PROPERTY/PARAMETER	COOL-CLAD™ CXP	PRE-PREG
Thermal Conductivity	> 3.2 W/m-°C	> 3.2 W/m-°C
Dielectric Strength (Volts/mil)	>1000 V	>1000 V
Dielectric Constant and Loss (@1 MHz)	4.5/0.01	4.5/0.01
Glass Transition Temperatures (°C)	250/80	250/80
Linear Thermal Expansion Coefficient (ppm/°C)	23 (X-Y=Z, Isotropic)	23 (X-Y=Z, Isotropic)
Thickness of Dielectric	20-30 Micron	35 Micron
Maximum Continuous Operation Temp. (°C)	> 250	> 250
Electrical Resistivity	>10 ¹⁴ ohm-cm	>10 ¹⁴ ohm-cm

AIT patented thermal management technologies (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) give unparalleled thermal and reliability performance. AIT's thermal management materials differ from traditional insulated metal substrates in the following ways:

- Instead of a rigid fiberglass thermally conductive epoxy laminate, AIT uses a 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 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.
- Base metal plates in aluminum or copper and in select thicknesses.
- Thinner insulated metal substrate and pre-preg are available in rolls of 12-24-inch width.
- 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 power and LED components, modules and panels.