Thermal interface materials for next-generation electronics

Overheating is a critical concern for next-generation electronic assemblies. Moore's law states that the number of transistors on integrated circuit chips doubles every two years. Even with the anticipated deceleration of this doubling rate, the recent introduction of sub-10 nm semiconductor fabrication processes and current manufacturing trends have exacerbated the need for effective thermal managment. For example, with increased computing power and higher transistor density comes greater thermal loads.

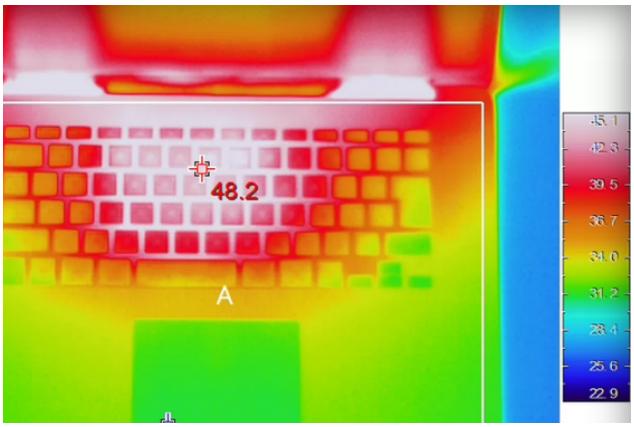

Figure 1. Heat map of a laptop. Source: Boyd Corporation

Overheating is one of the leading causes of electronic product failure and to overcome thermal limitations of next-generation electronics, design engineers require advanced materials and highly customized solutions.

Electronic component manufacturing trends have focused on device miniaturization and increased computing power. Thermal management is now an afterthought even though one of the leading causes of product failure is overheating. It is attributed as the cause of electronic component failure 55% of the time. Design engineers are best equipped to address the thermal limitations of advanced electronic components by leveraging the capabilities of carefully selected thermal interface materials (TIM).

TIMs play a vital role in addressing thermal limitations of new electronic assembly designs. They provide a heat path between heat-generating devices and cooling components, effectively helping to increase power capacity and reliability while also reducing the cost of the finished assembly. The ideal material conforms to mating surfaces, wets-out across the substrate and maintains a minimal thickness.

Boyd Corporation is one of the largest preferred converters of 3M's line of advanced TIMs, adhesives, films, and other specialty material. It sources and procures 3M's complete line of TIMs and converts these materials to address unique application requirements. Its precision converting services are also complemented by Boyd's high-performance thermal management components manufactured in-house . Boyd is a thermal solutions provider that supplies highly customized precision die-cut thermal interface pads, tapes and complete, ready-to-install thermal management solutions that meet or exceed the thermal requirements of specific OEM applications.

In Partnership With:

3M

3M TIMs help increase device reliability

3M Electronic Materials Solutions division's TIM product portfolio consists of acrylic and silicone thermal interface pads. These materials are available with fillers, in a range of thicknesses, dielectric strengths and thermal conductivities. They help improve device assembly time, reduce weight and extend component life. TIMs can also be designed with exceptional peel strengths, virtually eliminating the need for mechanical fastens and each product is engeerd to address specific application requirements.

3M TIMs help increase device reliability

3M's acrylic interface pads provide higher levels of conductivity than comparable products on the market. These materials are durable, highly conformable, have excellent wet-out characteristics and offer substantial cost=savings when compared to silicone materials. Reported thermal conductivity is tested in accordance with ASTM D5470 test methods. 3M also subjects their materials to aging test methods, verifying durability to effectively extend OEM component life.

Thermally conductive acrylic interface pads

Figure 2. 3M™ Thermally conductive interface pad. Source: 3M Electronics Materials Solutions Division

3M's acrylic interface pads provide higher levels of conductivity than comparable products on the market. These materials are durable, highly conformable, have excellent wet-out characteristics and offer substantial cost-savings when compared to silicone materials. Reported thermal conductivity is tested in accordance with ASTM D5470 test methods. 3M also subjects their materials to aging test methods, verifying durability to effectively extend OEM component life.

3M™ Thermally Conductive Acrylic Interface Pad 5590H is a highly conformable, slightly tacky acrylic elastomer filled with thermally conductive ceramic particles. It provides for improved handling and forms an effective heat path when bonding irregular IC surfaces and electric vehicle batteries to heat spreaders and heat sinks.

3M™ Thermally Conductive Acrylic Interface Pad 5571 has a similar chemistry to 3M™ Thermally Conductive Acrylic Interface Pad 5590H, but is available in roll format for use in rotary die-cut conversions. It is a soft compliant acrylic interface pad that allows for pressure relaxation, helping prevent high-pressure zones when joining non-flat IC surfaces and heat spreading blocks.

3M™ Thermally Conductive Interface Tape 8926-05 is a 0.5 mm acrylic polymer pressure-sensitive adhesive tape with a thin PET carrier. This tape has a rated thermal conductivity of 1.5 W/mK, excellent dielectric properties and good substrate compatibility. It is also available in multiple thicknesses for bonding or joining a range of different surfaces.

Thermally conductive silicone interface pad

3M's silicone interface pads address the requirements of high-temperature applications. These materials exhibit excellent dielectric properties and are available with thermal conductivities of up to 4.9 W/mK.

3M™ Thermally Conductive Silicone Interface Pad 5516 is a highly conformable, slightly tacky silicone elastomer pad with a rated thermal conductivity of 3.1 W/mK. The soft silicone pad is conformable at low pressures. It provides high-temperature resistance and good dielectric properties providing an effective heat transfer path between heat-generating components and heat sinks, heat spreaders or other cooling devices.

3M™ Thermally Conductive Silicone Interface Pad 5519 provides for thermal conductivities of up to 4.9 W/mK. It has a Shore 00 hardness of 70 and is conformable at moderately low pressures.

Boyd Corporation — A preferred converter and thermal solutions partner

Figure 3. Rotary die cutting conversions. Source: Boyd Corporation

Boyd Corporation provides cooling solutions across all major electronics industries. As a preferred thermal solutions provider, it maintains strategic alliances with highly qualified supply chain partners, such as 3M. Critical thermal performance criterion is addressed through a holistic design approach and is supported by a breadth of precision converting and in-house manufacturing capabilities. Procured custom converted materials and complete thermal solutions are developed that meet or exceed the requirements of the intended application while addressing target costs.

Precision conversion capabilities

Boyd's high-precision material converting capabilities address unique application requirements. Boyd provides prototyping services as well as low-to-high volume production runs on a wide range of materials and material thicknesses. From highly automated rotary die cutting, high precision flat-bed die cutting to CNC lathes, laser cutting, and water jetting, its extensive capabilities address the exact requirements of almost any thermal design.

Rotary die cutting

- High production runs and handling of roll materials for increased productivity.
- Ideal for thin materials and dimensionally stable materials.
- Highly automated process with in-line video inspection and self-adjustment capabilities.
- Use of intermediate rollers to align materials and eliminate material waste.

Flatbed die cutting

- High-precision, large-format die-cutting method
- Eliminates concerns with concavity that may be present in rotary processes when dealing with thick materials.
- Available for medium-to-high production runs.
- Exerts a high force for piercing thick materials and complex profiles.
- Ideal for pic k-and-place assembly.

CNC Milling

- Prototyping and low-volume runs of sheet materials.
- Converting of materials up to an inc h thick.
- No tooling required.
- Ability to produce complex shapes.
- Low cost, low waste.

Laser cutting

- Prototyping and low-volume production run of sheet materials and roll formats.
- Slightly limited in thickness range, as high power to the workpiece enlarges the heat-affected zone.
- Ability to produce intricate, complex designs.
- Water-jetting
- Prototyping and low-volume production run of sheet materials and roll formats.
- Slightly limited in thickness range.
- Accuracy within 0.004 in to 0.010 in.

Global sourcing and supply chain services

Boyd provides its customers with access to cutting-edge materials. It is a thermal solutions provider that maintains a strategic collaboration with 3M, as well as other highly qualified supply chain partners. It sources and procures high-performance acrylic and silicone interface pads and tapes along with a complete portfolio of thermal interface materials. This allows the company to address unique applications and target costs. Whether designing a highly compact flexible circuit for next generation wearable devices or seeking a cost-effective thermal solution for a battery pack, Boyd is well equipped to address specific design requirements.

Thermal Management by Boyd

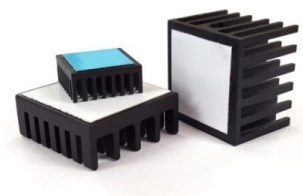

Figure 4. Thermal interface material and heat sink assembly. Source: Boyd Corporation

In 2017, Boyd acquired Aavid Thermalloy, now part of Boyd. Boyd develops, designs, tests and fabricates highly reliable, high-performance thermal management solutions, including two-phased, air-cooled and liquid systems. In-house manufacturing allows Boyd to produce complete, ready-to-install, thermal management solutions inclusive of converted TIMs.

Boyd solutions include:

- Advanced conduction cooling and two-phase heat transfer systems.
- Immersion-cooling boiler plates, ultra-thin vapor chambers, thermosiphons and complex heat pipe assemblies.
- Ability to produce lightweight, high-performance thermal straps, heat spreaders, c hassis and enclosures and CTE-matched surfaces.
- Fabrications composed of unique materials, including titanium and graphite.
- Reduced assembly time and costs with a complete thermal product developed for standard or high heat flux applications.

Holistic design approach

Modeling and design challenges associated with next-generation electronic assemblies include the need to develop compact, intricate thermal solutions while supporting short design cycles. Time to market is an essential aspect of an effective electronic component design, and Boyd addresses these requirements globally with more than 30 facilities worldwide, 300 highly qualified thermal design engineers, its own proprietary software, Boyd SmartCFD, and a holistic design approach.

Features of Boyd SmartCFD include:

- Streamlined model and design process by moving the iterative process forward in the design cycle.
- Improved modeling accuracy of complex components with decades of empirical data, complex algorithms, swept geometry tools and enhanced meshing capabilities such as heat pipe and vapor chamber dry out modeling, complete liquid cooling system simulation including heat exchangers and cold plates.
- Increased power, improved functionality and reliability.
- Reduced cost and size of electronic components

Conclusion

Overheating is one of the leading causes of electronic product failure and to overcome thermal limitations of next-generation electronics, design engineers require advanced materials and highly customized solutions.

Boyd Corporation is a preferred converter of 3M thermal interface materials. Boyd sources gap pads and thermal tapes that are tested in accordance with ASTM D5470 test methods and converts these reliable materials into a usable format to optimize productivity and ease of integration. It provides highly effective thermal solutions that reduce assembly time, improve yield rates and extend component life at the lowest total cost of ownership. The company's value-added services include engineering design, product development and the ability to produce complete, ready-to-install, thermal management solutions.

To receive more information regarding thermal interface material, please visit www.boydcorp.com.

BOYD CORPORATION

5960 Inglewood Dr., Suite 115
Pleasanton, CA 94588 USA
Tel: (888) 244-6931

3M

2501 Hudson Rd,
Maplewood, MN 55144
Tel: (888) 364-357

ABOUT BOYD CORPORATION

Boyd Corporation has over 90 years of customer-focused performance success and is a global leader in advanced sealing, thermal management and protection solutions. From humble beginnings as an industrial fabricator in the Bay Area of California in 1928, Boyd has evolved into a dynamic global innovator. Empowering human curiosity through the safe exploration of space. Enhancing the safety and flexibility of medical care and transportation. Enabling faster, brighter, more functional technology with greater power density. From self-driving cars to brain surgery, space stations to smart farming, high powered computing devices to wearable medical technologies. As our customers redefine their markets and technology – unique solutions from Boyd empower them to be possible.

BC102020