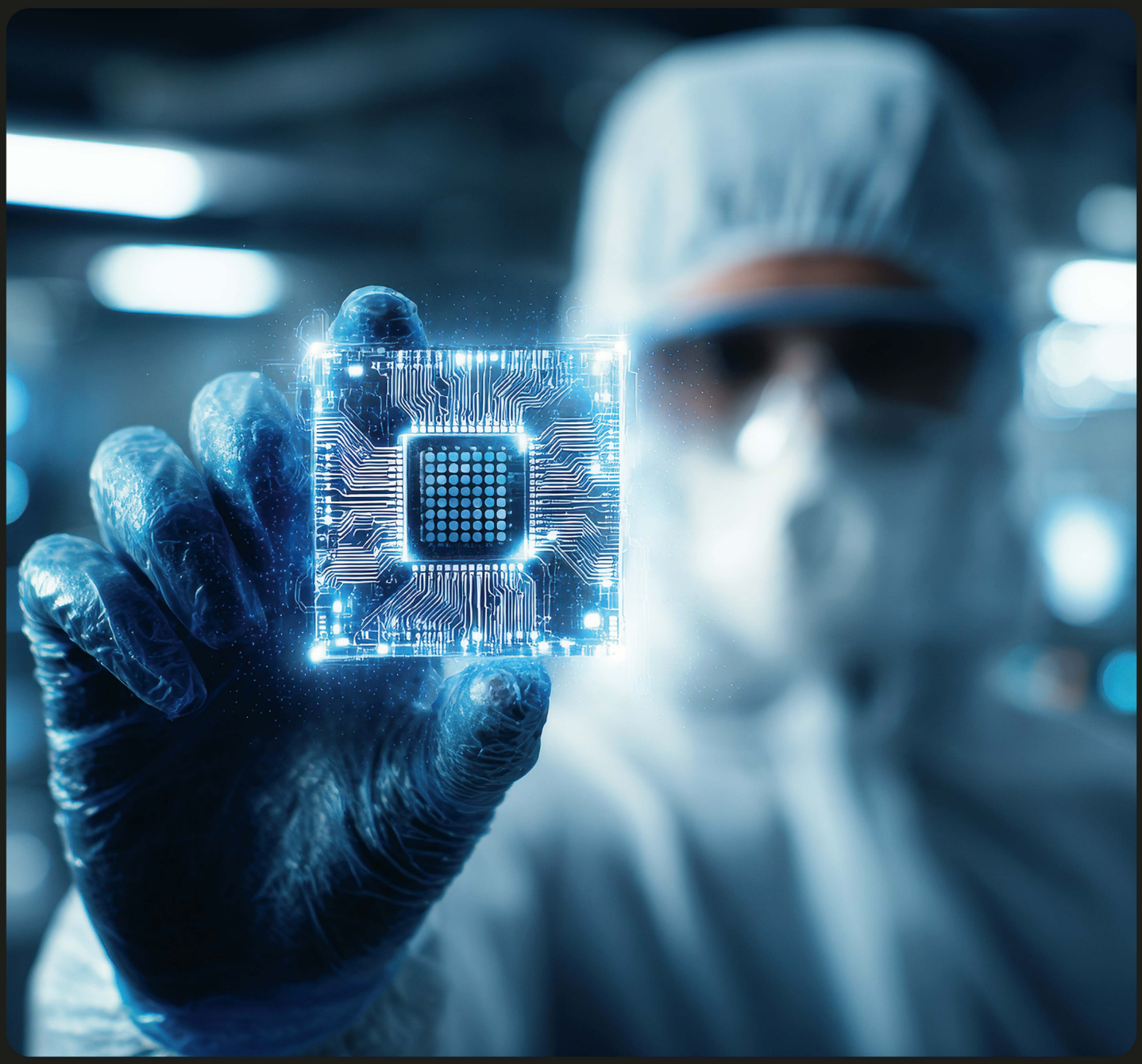


KEEP
COOL.

PERFORM
BETTER.

Solstice

CONTACT US

Solstice Advanced Materials offers an extensive range of Thermal Interface Materials (TIMs) designed specifically for semiconductor packaging and assembly applications. Our solutions combine advanced formulation technology with robust performance characteristics, ensuring optimal heat management for today's high-functioning electronics.

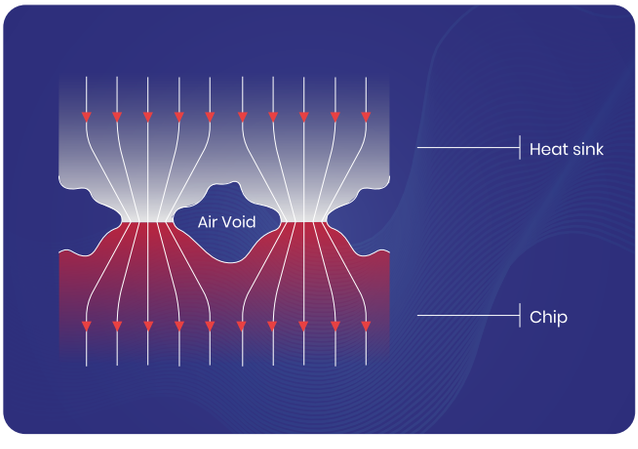
TIMs are essential components in modern electronics, enabling efficient heat transfer between surfaces that need to manage thermal loads effectively. As devices become increasingly compact and powerful, the demand for reliable TIMs has grown significantly. These materials play a crucial role in applications ranging from cloud computing to consumer electronics and automotive systems.

Why are TIMs crucial for modern electronic devices?

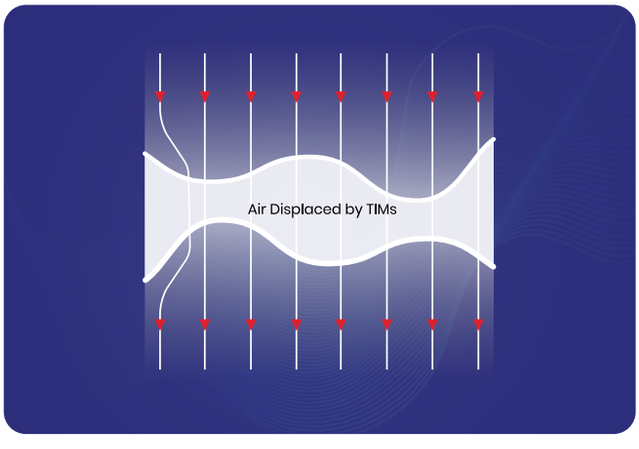
By acting as gap fillers between mating surfaces—like semiconductor devices and heat sinks—TIMs minimize thermal resistance, thereby enhancing the overall thermal management of the system.

Despite the appearance of flat surfaces, microscopic irregularities such as pores and tool marks create tiny air gaps that insulate against heat transfer. TIMs are designed to bridge these gaps with materials that exhibit much higher thermal conductivity, often surpassing air by nearly 100 times. This ensures that heat is dissipated effectively, which is critical for extending the operational lifespan and reliability of electronic components.

Air voids cause resistance to heat transfer

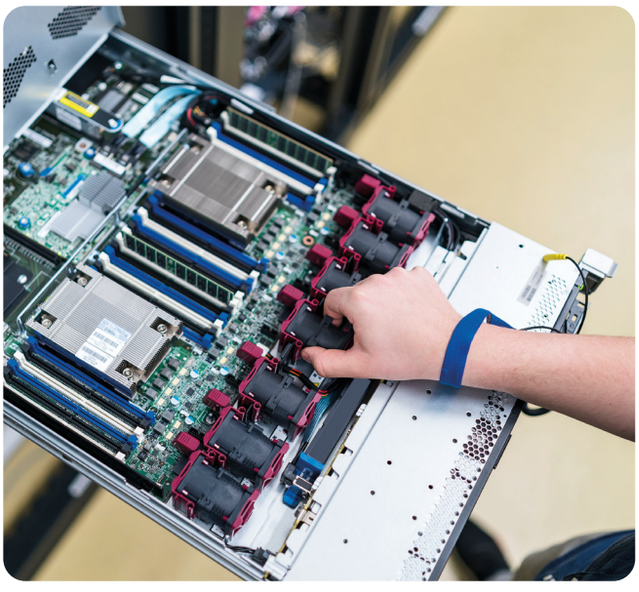


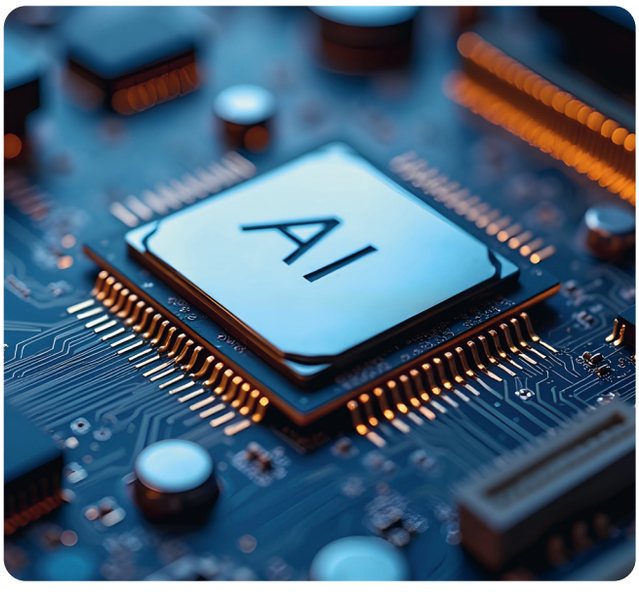
Phase Change Material (PCM) TIM squeezes out air voids and conforms to roughness of mating surfaces



FEATURED APPLICATIONS

1. Data Centers, HPC and Networking





In high-performance computing (HPC) and data centers leveraging AI chips, advanced thermal management solutions such as PCM and Thermal Gap Pads are essential for ensuring efficient operation and reliability.

- **PCM absorb thermal fluctuations** during peak AI processing loads, reducing the demand for active cooling and lowering energy costs.
- **The Gap Pads effectively transfer heat into densely packed server architectures,** ensuring that critical components remain stable and perform optimally under high thermal loads.
- **Both these materials provide exceptional thermal contact,** adapting to variable power loads typical of AI workloads, while maintaining long-term reliability.
- **Overall, Phase Change Materials (PCMs) and Gap Pads** maximize AI chip efficiency and scalability. These materials help mitigate risks associated with overheating, ensuring improved uptime and reduced operational costs.

DATA CENTERS, HPC AND NETWORKING			
Segment	**Server**	**AI/HPC**	**Networking**
Applications	GPU/CPU/Memory	GPU/CPU	Base Station/Switches Optical Transceiver
Products	**PCMs** • PTM7900 **Two-part Thermally Conductive Gel** • TGP8000PT • TGP6000PT • TGP3500PT	**PCM** • PTM7950 • PTM7900 • PTM6880 • PTM6000	**PCMs** • PTM7950 • PTM7900 • PTM7000

2. Automotive Electronics

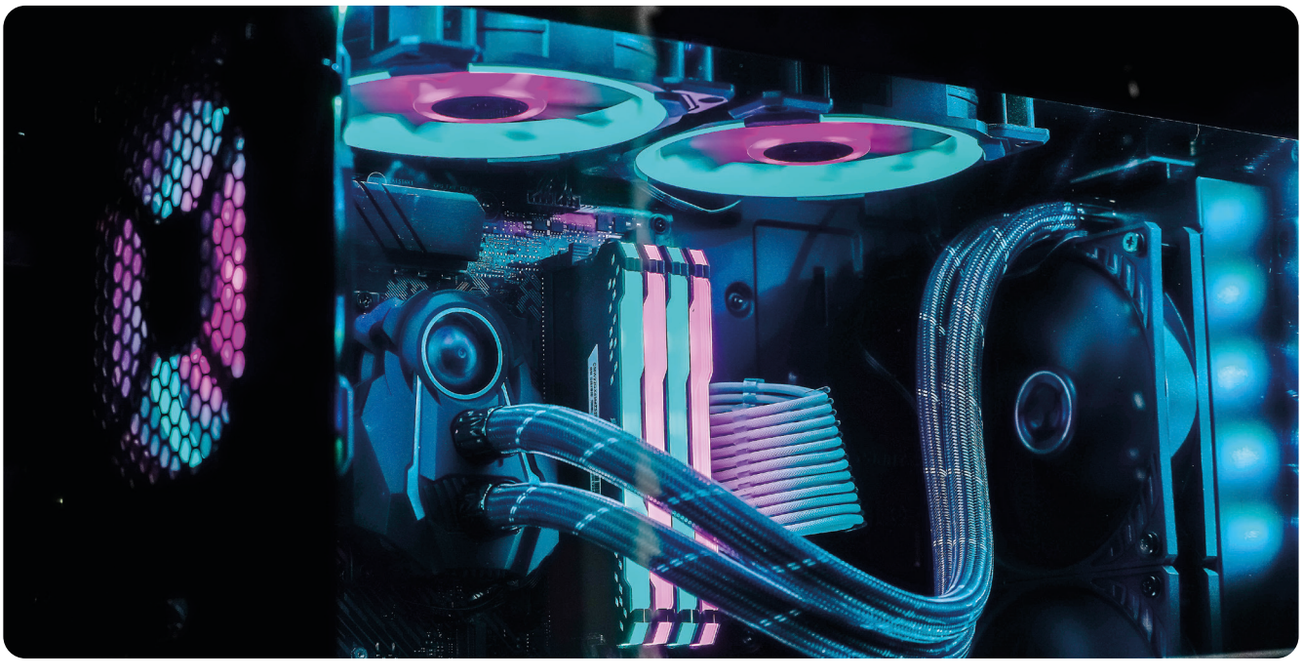
Solstice Phase Change Materials (PCM) and **Hybrid Gels** stand out as ideal solution for EV manufacturers to effectively dissipate heat, ensuring that vehicles remain efficient, reliable, and ready for the demands of modern driving.

- By choosing Solstice, you **gain a competitive edge through superior thermal management** for inverters, onboard charger (OBC) and advanced driver assistance systems (ADAS).
- After professional reliability testing in the new energy automobile industry, **Solstice PCMs have successfully passed various rigorous tests** including high- and low-temperature cycles, high- and low-temperature shocks, long term high-temperature baking, power cycles, HAST, vibration, shock and dripping test.
- Solstice thermal solutions offer **stable thermal impedance across accelerated aging tests** and do not display bleeding, pumping, or flow out.

The following thermal management solutions are designed to minimize thermal resistance at interfaces and maintain extremely stable performance through reliability testing required for long product life applications.

AUTO ELECTRONICS/ELECTRIC VEHICLES (EV)					
Segment	**ADAS**	**DC/DC Converter**	**On-board Charger**	**ECU**	**Inverter**
Applications	GPU/CPU/Memory/ Power Device	Power Module	Power Module	Lighting Device	IGBT Module
Products	**PCMs** • PTM7900 • PTM7000 **Two-part Thermally Conductive Gel** • HLT10000 • HLT8000 • HLT7000	**Thermal Insulator** • TIP5000 • TIP3500 **Thermal Grease** • TG5500	**PCMs** • PTM7000SPM • PTM6000SPM	**Two-part Thermally Conductive Gel** • HLT7000 • HLT2000 **Thermal Grease** • TG3010	**PCMs** • PTM7000 • PTM7000SPM

3. Consumer Electronics



Cutting-edge thermal management solutions play a vital role in enhancing the performance and longevity of consumer electronics by:

- **Efficiently absorbing and releasing heat during their phase transitions,** mitigating temperature spikes generated by compact, high-performance devices like smartphones and tablets. This ability to manage thermal loads improves energy efficiency and allows for slimmer designs, eliminating the need for bulky cooling systems like fans.
- **Providing effective heat transfer by bridging air gaps between components,** supporting both heat dissipation and mechanical stability in densely packed electronics.
- **Offering superior thermal conductivity and low thermal resistance,** adapting well to tight spaces and irregular surfaces, thereby enhancing reliability.

CONSUMER ELECTRONICS				
Segment	**Notebook/Tablet/PC**	**Gaming Console**	**XR**	**Camera/GPS**
Applications	GPU/CPU	GPU/CPU	SoC/Memory	CPU/Memory
Products	**PCMs** • PTM7950 • PTM7950SP • PTM7900 • PTM7900SP **Two-part Thermally Conductive Gel** • HLT3500	**PCM** • PTM5000	**PCMs** • PTM6000 • PTM7950 **Two-part Thermally Conductive Gel** • HLT6000	**Thermal Gap Pads** • TGP6000PT • TGP3500PT **Two-part Thermally Conductive Gel** • HLT3500

Solstice's Thermal Interface Material (TIM) offerings include:

- **Phase Change Material (PCM)**
- **Two-Part Hybrid Gel**
- **One-Part Hybrid Gel**
- **Thermal Gap Pad**

Phase Change Material (PCM)

Phase change thermal interface material, is a polymer-filler composition that softens at a defined temperature, allowing it to efficiently flow in the gap between the chip and the heat sink. Solstice PCMs designed to minimize thermal resistance at interfaces and maintain stable performance for long product life applications. Based on a robust polymer PCM structure, these materials exhibit effective wetting properties during typical operating temperature ranges, resulting in very low surface contact resistance. The proprietary material provides superior reliability and maintains low thermal impedance, making PCM desirable for high-performance integrated circuit devices.

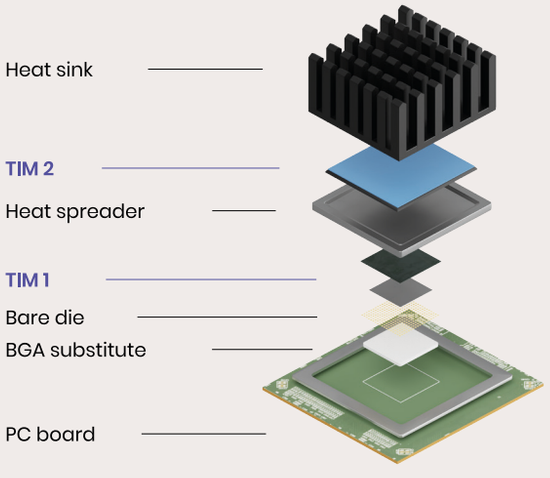
Shrink the stack with TIM 1.5 PCM

The increasing application of AI across sectors and industries is driving demand for TIM that supports the technology's performance and reliability. One application of TIM – called TIM 1.5 – can improve the efficiency and longevity of AI systems by reducing the risk of thermal-induced failure. Solstice advanced PCMs – PTM7950, PTM7900, PTM6800 and PTM6880 can be applied between a bare flip chip die and a heat spreader, heat sink, or heat pipe and are, therefore, referred to as TIM 1.5.

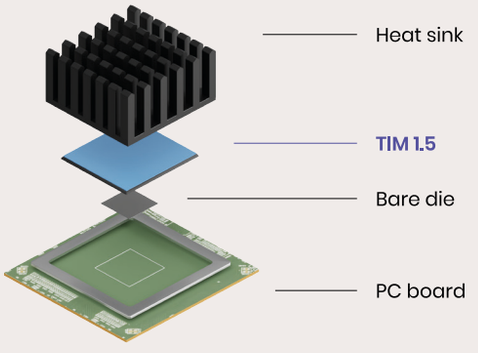
Solstice PCMs with TIM 1.5 application help you:

- **Achieve excellent thermal performance by reducing the stacking layers in a package and minimizing interface contact resistance**
- **Optimizing thermal conductivity by reducing interface contact resistance and allowing heat to move more freely and efficiently from the chip to the heat sink.**
- **Avoid component malfunctioning or premature failures while improving the reliability and efficiency of devices.**
- **Mitigate particle issues and achieve lower thermal impedance by maintaining thin bond-line thickness**
- **Improve reliability by reducing the likelihood of thermal-induced deformation**
- **Simplify assembly process**

Conventional thermal design involves both TIM 1 and TIM 2 with heat sink and heat spreader



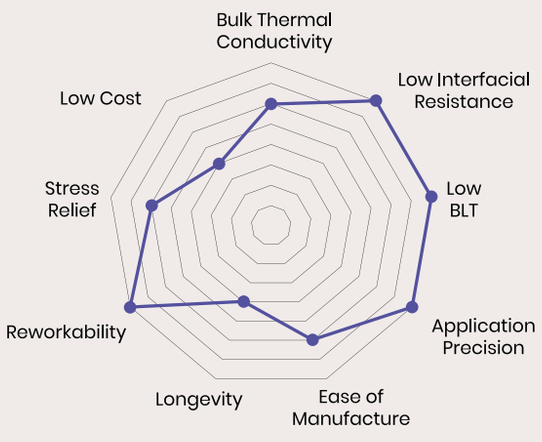
Thermal design with TIM 1.5 enables robust thermal interface between bare die and heat sink



Relative performance of TIMs

Over the years, the industry has seen evolution of different thermal interface materials, ranging from gap pads to liquid metals.
When compared across a set of performance attributes critical to efficient heat transfer and manufacturing, these thermal interface material offerings have their advantages and disadvantages as shown in the table.
Overall, TIMs based on phase change materials offer the much-needed balance between performance, usability, and reliability.

	PRODUCTS OFFERED BY SOLSTICE		
Properties	**Phase Change Materials (PCM)**	**Gap Pads**	**Gap Fillers**
Bulk Thermal Conductivity	Good	Excellent	Good
Low Interfacial Resistance	Excellent	Fair	Good
Low BLT	Excellent	Poor	Good
Application Precision	Excellent	Excellent	Poor
Ease of Manufacture	Good	Good	Fair
Longevity	Fair	Fair	Fair
Reworkability	Excellent	Excellent	Good
Stress Relief	Good	Good	Excellent
Low Cost	Fair	Good	Good



Solstice offers a range of phase change TIMs which offer a wide range of thermal properties. Furthermore, each of these products are available in different forms, such as pads, sheets, screen printable and dispensable pastes to fit the multiple assembly needs.

Pad | Sheet | Roll | Can | Cartridge

The choice of PCM is largely dictated by the application, namely the power density of the device, the bond line thickness, and the thermal performance needed for a safe and reliable operation.

PHASE CHANGE MATERIALS

Material	Specific Gravity	Viscosity (Pas)	Thermal Conductivity (W/mK)	Thermal Impedance no shim (°C cm²/W)	Format	Liner Color	Supplied Thickness (mm)	Extend Drying Type	Fast Drying Type
	ASTM D374	Rehometer HON	ASTM D5470	ASTM D5470 Modified					
PTM7950-SP	2.5	100	8.5	0.04–0.08	Paste/Printable	N/A	N/A		✓
PTM7950	2.8	151	8.5	0.04–0.08	Pad	Light	0.2/0.25/0.3 /0.4/0.5		
PTM7900-SP	2.5	177	8	0.04–0.08	Paste/Printable	N/A	N/A		✓
PTM7900	2.8	N/A	8	0.04–0.07	Pad	Light Blue	0.2/0.25/0.3 /0.4/0.5		
PTM7000-SPM	2.3	120	6.5	0.04–0.08	Paste/Printable	N/A	N/A	✓	
PTM7000-SP	2.3	120	6.5	0.04–0.08	Paste/Printable	N/A	N/A		✓
PTM7000	2.7	N/A	6.5	0.04–0.08	Pad	Light Blue	0.2/0.25/0.3 /0.4/0.5		
PTM6880	2.7	101	6	0.056	Pad and Paste	Grey	N/A		
PTM6000HV-SP	2.6	200–460	5.7	0.04–0.07	Paste/Printable	N/A	N/A	✓	
PTM6000-SPM	2.2	222	5.7	0.04–0.07	Paste/Printable	N/A	N/A	✓	
PTM6000-SP	2.2	222	5.7	0.04–0.07	Paste/Printable	N/A	N/A		✓
PTM6000	2.3	N/A	5.7	0.04–0.07	Pad	Yellow	0.2/0.25/0.3 /0.4/0.5		
PTM5000-SPM	2.2	82	4.4	0.06–0.08	Paste/Printable	N/A	N/A	✓	
PTM5000	2.3	N/A	4.4	0.06–0.08	Pad	Pink	0.2/0.25/0.3 /0.4/0.5		
PCM45F-SPM	1.7	100	2.4	0.09–0.12	Paste/Printable	N/A	N/A	✓	
PCM45F-SP	1.7	100	2.4	0.09–0.12	Paste/Printable	N/A	N/A		✓
PCM45F	2.2	N/A	2.4	0.09–0.12	Pad	Pink	0.2/0.25/0.3 /0.4/0.5		

Material	Specific Gravity	Viscosity (Pas)	Thermal Conductivity (W/mK)	Thermal Impedance no shim (°C cm²/W)	Volume Resistivity	Phase Change Temp	Operating Temp Range	Typical Bondline Thickness	Minimum Bondline Thickness	Format	Appearance	Liner Color	Supplied Thickness	Extend Drying Type	Fast Drying Type
	ASTM D374	Rehometer Honm													
LTM 6300-SP	1.8	150	2.0	0.4	3×1015	45°	–55 to 120	0.025	0.038	Paste / Printable	Grey	N/A	N/A		

COMMON PROPERTIES

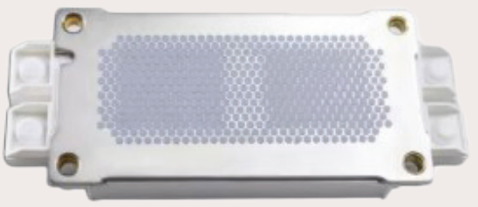
Volume Resistivity (Ω·m): **2.1×10^{14}**
Phase Change Temperature (°C): **45°**
Operating Temperature Range (°C): **–55 to 150°**

Typical Bond Line Thickness @30psi/60°C (mm): **0.025**
Minimum Bond Line Thickness for Best Performance (mm): **0.038**
Appearance: **Grey**

Featured product:
PTM7950

PTM7950 is a highly thermally conductive PCM designed to minimize thermal resistance at interfaces, maintain excellent performance through reliability testing, and provide scalable applications at a competitive cost.

PTM7950 exhibits excellent interface wettability during typical operating temperature ranges, resulting in extremely low surface contact resistance.
The PTM7950 is clearly the best choice for thermal impedance, with the lowest value among all materials tested. This makes it an excellent option for electronic devices that require exceptional thermal management.



AVAILABLE VERSIONS:

- **PTM7950 Pad:**
  Easy application and no drying steps
- **PTM7950-SP:**
  Paste version for automatic stencil printing
- **PTM7950-SPS:**
  Paste version with slow-drying solvent

Featured product:
PTM6880

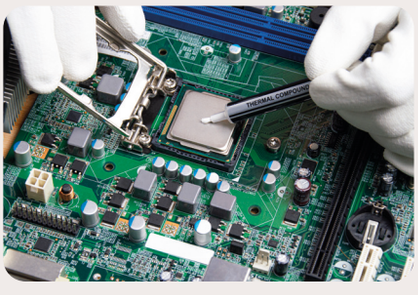
As a category leader in the PCM space, Solstice is proud to introduce PTM6880, an advanced PCM that provides superior reliability (pass 150˚C baking 1000 hours, thermal shock 1000 cycles, and maintains low thermal impedance (<0.06˚C.cm2/W@ no shim), making it an ideal choice for high-performance integrated circuit (HPC) devices.

- **Improve thermal resistance against pump out/vertical flow at interfaces** - PTM6880 provides a reliable solution by maintaining consistent flatness between the chip and heatsink, even in tight applications needing less than 0.1mm tolerance.
- **Maintain stable thermal performance required for long product life applications** - wWith PTM6880, you can achieve efficient heat dissipation, ensuring optimal performance for your chips while minimizing the risks associated with overheating.
- **Enhance production efficiency, streamlining automated processes** while drastically reducing the risk of damage to the bare die.
- **Decrease the need for rework and repairs**, making it the ideal choice for modern high-performance applications:
  - AI Servers GPU/CPU, Supercomputing
  - EV Inverter, onboard charger (OBC), DC/DC converters
  - Switches, routers, base stations
  - IGBT Power Module

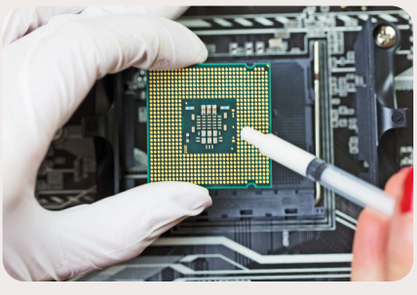
Thermal Two-Part Hybrid Gel

The Thermal Two-Part Hybrids products are two-component, dispensable thermally conductive gels that offer long-term reliability and superior softness. The enhanced bonding force between the polymer base and the filler minimizes oil separation issues in storage.

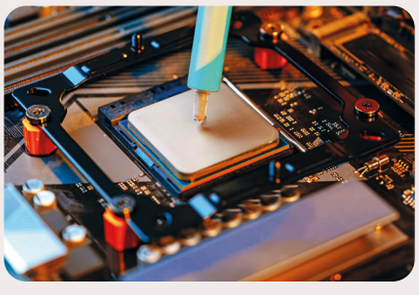
Thermal hybrid gels require very low compression force and can be used for vertical mounting. Before curing, the materials maintain good thixotropic characteristics and low viscosity to be easily dispensed. Additionally, they show minimal post-cure oil bleeding/separation and no pump-out or cracking. Two component hybrid thermal gels can be cured in a short time after two-component mixing at room temperature. HLT series thermal gels require curing but very little pressure during installation (5-10psi or the weight of a heatsink is sufficient). You can speed up the process by curing at elevated temperatures (80 -100°C). The high compressibility minimizes thermal resistance at interfaces, making hybrids ideal for low stress applications while maintaining excellent performance during reliability testing.



Hybrid thermal interface materials offer a variety of options for dispensing methods, depending on the application.



State-of-the-art two-part hybrid with high thermal conductivity for high power density applications.



The recommended modified viscosity and cure schedule meets large-scale application requirements

Featured product:
HLT10000

HLT10000 Hybrid TIM has a thermal conductivity of 10 W/mK, high reliability, and ease of dispensing. It can be cured after two-component mixing and faster under higher temperatures. Its high compressibility minimizes interface thermal resistance while maintaining excellent performance during reliability testing.

This product is engineered for the most demanding and delicate applications on the market. It starts with a very low thickness and compresses just as easily, reaching its final thickness at a remarkable rate. It is also easy to dispense and rework, making it ideal for high volume manufacturing. To add to that, it offers reduced oil separation and doesn't exhibit pump out or cracking.

Property chart of Solstice Two-Part Hybrid Gels

TYPICAL PROPERTIES					
PROPERTY	**HLT 10000***	**HLT 7000***	**HLT 2000**	**HLT 3500**	**TEST METHOD**
		PROPERTIES			
Color	Dark Grey Part B: Light Grey	Part A: Dark Red Part B: Grey	Part A: Yellow Part B: White	Part B: Blue Part A: White	Visual
Viscosity (cps)	*	1040	200,000– 350,000	300,000– 450,000	ASTM D2196**
Hardness (Shore00)	*	*	50	50	ASTM D2240
Specific Gravity	3.3	3.5	2.8	3.2	ASTM D792
		THERMAL PROPERTIES			
Thermal Conductivity (W/m·K)	10.0	7.0	2.0	3.5	ASTM D5470
Thermal Impedance (°C·in2/W) (1mm@10psi, typical value)	0.042	0.2	0.66	0.44	ASTM D5470
Curing Schedule/Curing Time	<24hrs@23°C 0.5hrs@80°C	12 hrs @23°C 30 mins @100°C	10 hrs @25 °C 30 mins @100 °C	12 hrs @25 °C 30 min @100 °C	-

Thermal One-Part Hybrid

Thermal conductivity liquid gap fillers not only have the benefits of shape recovery, strong material cohesion, and good long-term thermal stability — they also offer a very low thermal resistance comparable to thermal grease and can fill gaps at interfaces.

One-part, dispensable, very low compression force, thermal hybrid

Hybrid is a substance between liquid and solid, combining the advantages of thermal grease and thermal gap pad, without the potential problems of either. Thermal Hybrid is prepared as a silicone polymer, with low molecular siloxane, and mixed with high thermal conductivity particles (such as alumina, aluminum nitride powder, etc.).

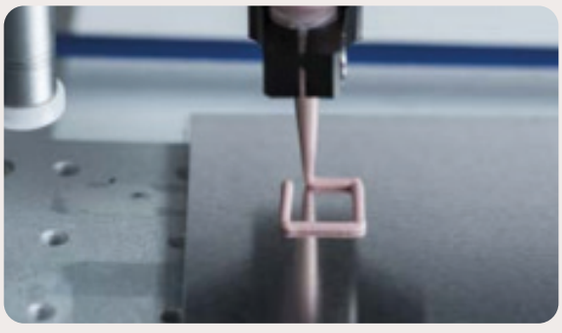
Compared with thermal grease, thermal Hybrid does not present oil separation issues while in storage, and the Hybrid can be torn off and reused. Thermal Hybrid needs relatively low working pressure when connected with heat sink and chip and has a wide working temperature range.

The HT series, our one-part Gap Filler, provides effective thermal properties and high conformability along with its high compressibility. It is formulated to deliver high dispense rates for improved productivity, long-term reliability performance and easy re-workability. It is designed to minimize thermal resistance at interfaces, maintain its performance through reliability testing, and provide scalable application at a competitive cost.

All HT series products are available in 280cc aluminum cartridge, and 1 and 5-gallon pail.

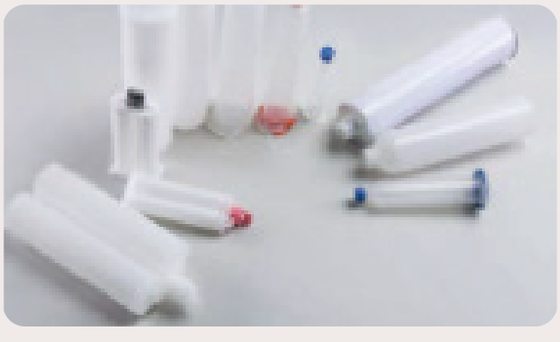
Key features

- High thermal performance and low contact resistance
- Easily dispensable and reworkable
- High compressibility for low stress applications
- Long-term reliability
- No pump-out or cracking risk
- Reduced oil separation
- Requires no mixing, additional curing or low temperature storage



One-part thermal Hybrid offers good dispensing and thixotropy properties for automated assembly processes.

Thermal Hybrid materials provide good surface wetting without slumping after dispensing.



A large selection of packaging options is available for our one-part and two-part thermal Hybrid products.

Property chart for Solstice One-Part Hybrid

TYPICAL PROPERTIES					
PROPERTY	**HT10000**	**HT7000**	**HT5000**	**HT3500**	**TEST METHOD**
Feature	Silicone-based Pre-cured	Silicone-based Pre-cured	Silicone-based Pre-cured	Silicone-based Pre-cured	- -
Color	Light Grey	Pink	Grey	Dark Red	Visual
Specific Gravity	3.2	3.45	3.4	3.2	ASTM D792
Thermal Conductivity (W/m·K)	10.0	7.0	5.0	3.5	ASTM D5470
Thermal Impedance (°C·cm2/W)	*	0.21	<0.25	<0.35	ASTM D5470 at BLT
Minimum BLT (mm)	0.2	*	0.05	0.10	-
Dispense Rate (g/min)	*	>14	>10	>10	90psi, 30cc EFD syringe
Out Gassing (TML)	*	*	<0.5%	<0.5%	ASTM E595
Storage Condition	*	*	RT	RT	-
Shelf Life (months)	12 months at 0-35°C, <65%RH	6	12	12	-

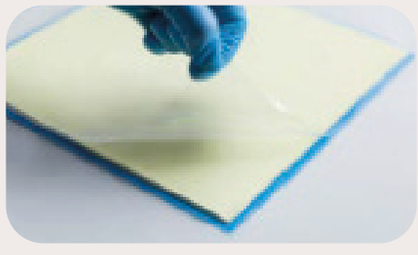
Thermal Gap Pads

Solstice Thermal Gap Pads are designed for thick bond line applications with large variances in gap dimensions between heat sources and heat sinks. Where the heat source is comprised of multiple microprocessors soldered onto a printed circuit board, the gap filler pads need to fill spaces between the chips and the heat sink.

In the consumer electronics industry, Thermal Gap Pads must be simultaneously soft, elastic and thermally conductive. For manufacturers operating at the current technological level, a balance must be struck between high rebound resilience and low hardness.
Solstice Thermal Gap Pads provide exceptional thermal conductivity, exert limited pressure onto the chip and PCB to avoid damage, and ensure the rebound necessary to enable sustainable surface contact – all while minimizing outgassing and oil bleeding to maintain long-term device reliability.

Solstice TGP model gap pads are available in standard sheets and also custom die-cut parts, and in a range of thicknesses.

The low oil-bleeding property protects components from contamination.



Two surface liners enable easier handling with less contamination risk

Featured product:
HGP10000

Solstice HGP10000 thermal gap pad provides high thermal performance with ease of use across multitude of applications.
Its ultra-high compressibility enables low stress and excellent conformity to mating surfaces. It is designed to minimize thermal resistance at interfaces and maintain excellent performance through reliability testing.

Key features

- 10 W/m·K thermal conductivity
- Ultra-high compressibility for low stress applications
- High residual stress after relaxation
- Excellent surface wetting for low contact resistance
- High reliability
- Electrically insulating
- Available in thickness range from 1mm to 5.0mm with 0.25mm incremental

Featured product: **HGP14**

HGP14 is a high-performance thermal interface material designed for efficient heat transfer in demanding electronic applications. It offers a thermal conductivity of 14.0 W/m·K, making it well-suited for systems requiring high thermal dissipation across varying bond line thicknesses.

The material is soft and conformable, allowing it to fill gaps between components and heat sinks without introducing significant mechanical stress. This makes it suitable for use with fragile components or assemblies where minimizing stress during installation is critical.

HGP14 also maintains material integrity over time, with low volatility and minimal oil bleed, reducing the risk of contamination or pump-out under thermal cycling. Its stability makes it a strong choice for applications sensitive to oil migration or where long-term performance is required.

Solstice HGP14 is well-suited for high-power electronics, automotive systems, and telecommunications equipment, where superior heat dissipation and long-term stability are essential.

TGP1200 – TGP8000 TYPICAL PROPERTIES

PROPERTY	TGP8000	TGP6000	TGP5000	TGP3000	TGP1500	TGP1200	TEST METHOD
PROPERTIES							
Color	Grey	Grey	Blue	Yellow	Grey	Blue	Visual
Thickness (mm)	0.5-5	0.5-5	0.5-5	0.5-5	0.5-5	0.5-5	ASTM D374
Hardness (Shore00)	30	40	45	40	40	30	ASTM D2240
Specific Gravity	3.4	3.3	3.3	3.1	1.8	1.7	ASTM D792
THERMAL PROPERTIES							
Thermal Conductivity (W/m·K)	8.0	6.0	5.0	3.0	1.5	1.2	ASTM D5470
Thermal Impedance (°C·in2/W) (1mm@10psi) [1]	0.2	0.25	0.3	0.65	0.94	1.03	ASTM D5470
ELECTRICAL PROPERTIES							
Dielectric Constant @1MHz	8.3	8.5	5.0	6.6	5.5	4.5	ASTM D150
Volume Resistivity (ohm·cm)	6.47 x 1015	3.79 x 1015	8.0 x 1013	4.8 x 1013	2.0 x 1013	4.0 x 1012	ASTM D257
ELECTRICAL PROPERTIES							
Flammability Rating	V-0	V-0	V-0	V-0	V-0	V-0	UL94

[1] Typical Value

Conclusion

As we've explored, TIMs play a pivotal role in the performance and reliability of modern electronic devices. By effectively managing heat dissipation, TIMs contribute to the longevity and efficiency of a wide array of applications, from consumer electronics to advanced automotive systems. Understanding the significance of these materials allows engineers and designers to make informed choices that enhance their products' functionality and lifespan.

Whether you're looking to optimize thermal performance in your devices or seeking innovative solutions for emerging technologies, we invite you to connect with our team today to discuss how our advanced TIM solutions can meet your specific needs and elevate your projects to the next level.