THE EPOCHAL THERMAL SOLUTION PROVIDER

NANOTIM ®

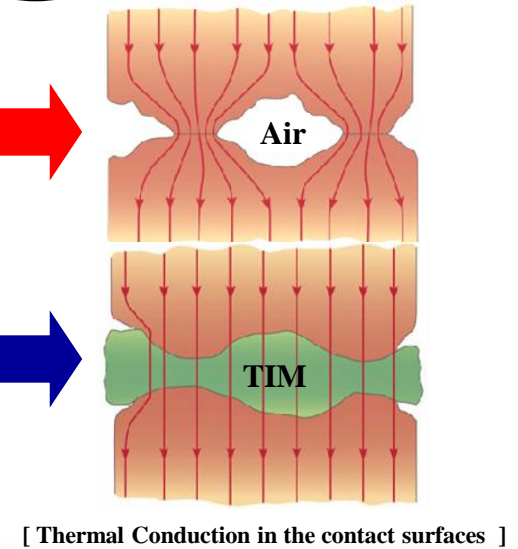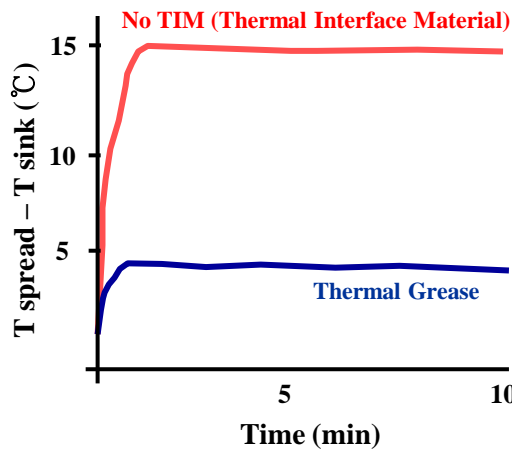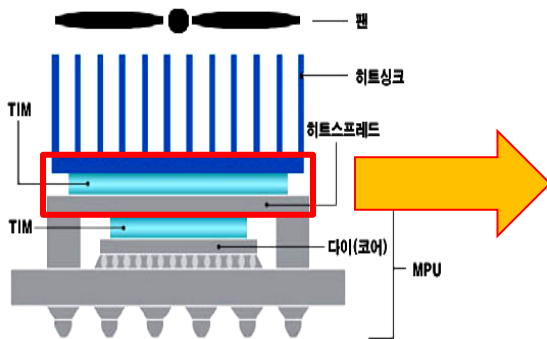*Application Note*

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COOLTTM

What is the thermal Interface Materials ?

Thermal Interface Material (T.I.M.) is used to fill the gap between heat sources and heat sinks, in order to increase thermal transfer efficiency. These gaps are normally filled with air which is a very poor conductor.

※ The contact area ratio between a heat sink (cooling unit) & a heat source is less than 5%.

Air (k=0.024W/m·K)

Cooling Unit
Heat Source

T.I.M. Function in Desktop PC

팬
히트싱크
TIM
히트스프레드
TIM
다이(코어)
MPU

No TIM (Thermal Interface Material)

T spread – T sink (℃)

15

10

5

Thermal Grease

5   10

Time (min)

Air

TIM

[Thermal Conduction in the contact surfaces]

2. T.I.M. Thermal Characteristics

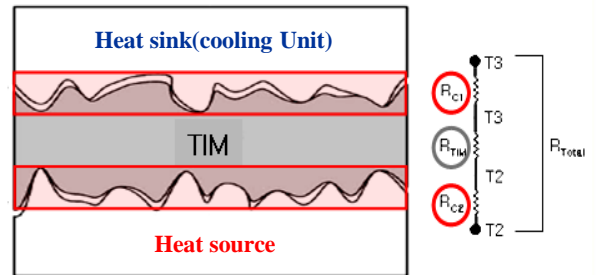## Thermal Resistance (R), Thermal Conductivity (k)

Thermal Resistance (R) is one of characteristics of the thermal interface materials.

It is defined as the reciprocal of thermal conductivity (k) or temperature drop($\triangle$T) in the thermal power (q).

$$R = \frac{\Delta T \times A}{q} = \frac{t}{k} \quad (^{\circ}Cm^2/w) \qquad q = kA\frac{\Delta T}{t}(w)$$
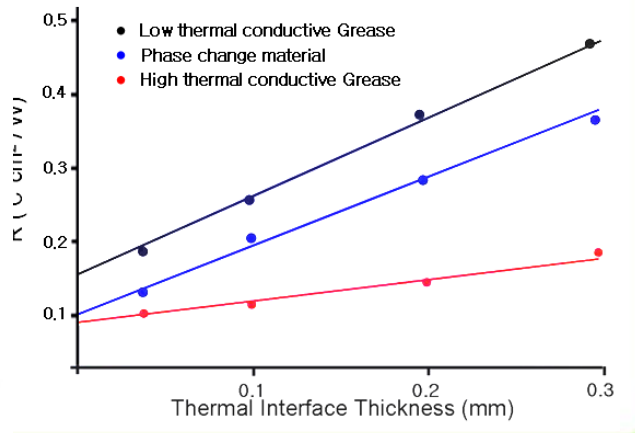
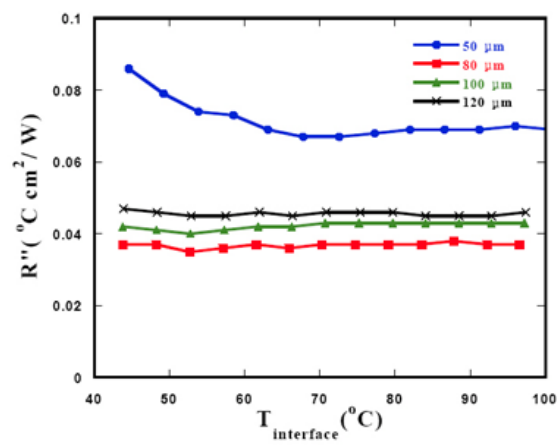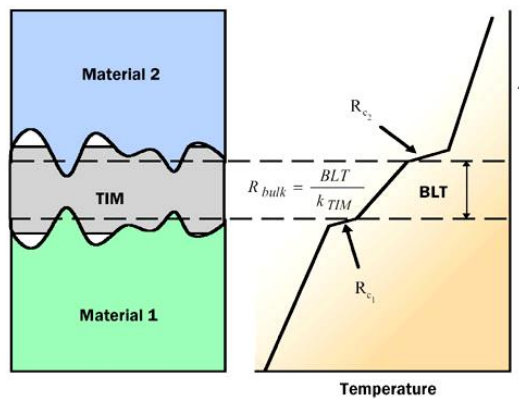Total thermal resistance generated in surfaces between a heat source & a heat sink (cooling unit) is called the Thermal Impedance (Rt). The following formula can be used to estimate the performance.

$$R_t(^{\circ}Cm^2/w) = R_{C1} + R_{TIM} + R_{C2} = R_{TIM} + R_C = \frac{t}{k} + R_C \quad (R_C = R_{C1} + R_{C2})$$

Heat sink(cooling Unit)

TIM

Heat source

[Thermal Resistance Circuit of T.I.M]

BLT (Bond Line Thickness)

COOLTTM
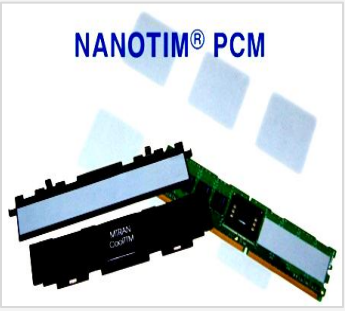
Material	Advantages	Disadvantages	Thermal Conductivity
Phase Change	- Conforms to surface irregularity - No cure, easy handling, film form - Low thermal resistance	- Lower thermal conductivity than grease -Technology limitations	0.5~5 W/m·K
Thermal Grease	- High bulk thermal conductivity - No cure, conforms to surface irregularity - Low thermal resistance	- Pump out, Separation - Difficult to apply	2~5 W/m·K
Silicone Pad	- Good hand-ability, film form - Provide surface protection	- High thermal contact resistance - Need high clamping force	0.5~3 W/m·K
Adhesive Pad	- Double-sided adhesive system replaces - Mechanical fasteners	- High thermal contact resistance - Low thermal conductivity	0.5~3 W/m·K
Solder	- High thermal conductivity - Easy handling	- High stress at Interfaces - Reflow needed	30~50 W/m·K

4. NANOTIM® Series

COOLTTM

NANOTIM® Series Characteristics.

Feature	Application
High Thermal Conductivity *Low Thermal Resistance* *Safety with electric* *RoHS-Compliant*	*Display (LED, LCD, PDP etc)* *LED Lighting* *Digital Mobile Convergence, Memory, CPU,* *GPU, ASICS Chips*

NANOTIM® PCM

■ **Phase Change Material**

❖ Easy Handling/Re-workability
❖ High Thermal Conductivity
❖ Low Thermal Resistance

■ **Product Category**

PCM25, PCM25-SP
PCM-L

NANOTIM® TGS Series
Thermal Interface Material

■ **Thermal Grease**

❖ Stability in high temperature
❖ High Thermal Conductivity
❖ Low Thermal Resistance

■ **Product Category**
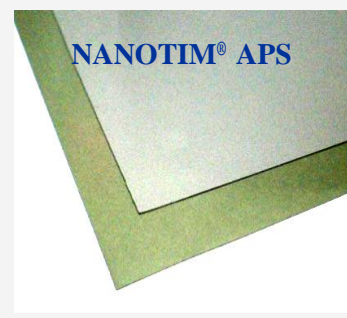
A300, C200

NANOTIM® SPS

■ **Silicon Pad(Low hardness)**

❖ Superior Self-adhesion
❖ Cushion function
❖ Various thickness

■ **Product Category**

SPS, SPS S025
0.3~10mm

NANOTIM® APS

■ **Adhesive Pad**

❖ Mechanical Fasteners
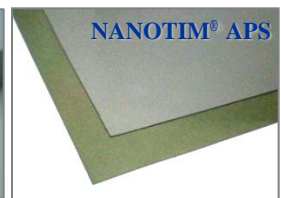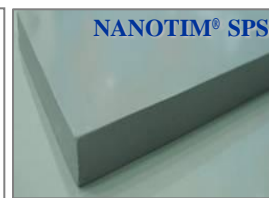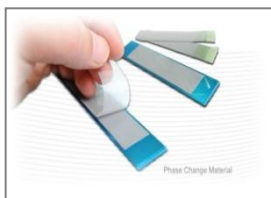❖ Superior Self-adhesion
❖ High Thermal Conductivity

■ **Product Category**

APS-S, APS-T

5. NANOTIM® Spec. Sheet

Items	Unit	PCM25			TGS		SPS		APS	
		PCM25	PCM25-SP	PCM-L	A300	C200	SPS	SPS025	APS-S	APS-T
Color	-	Gray	Gray	Gray	Gray	White	Gray	Gray	Gray	Gray
Thickness	mm	0.25	-	0.25	-	-	0.3~10	0.25	0.25	0.25
Density	-	3.2	2.2	2.8	2.6	2.4	2.5	2.4	2.2	1.8
Thermal Conductivity	W/m·K	4.0	3.0	2.0	4.0	1.7	1.55	1.55	1.0	1.8
Phase Change Temperature	℃	45	45	45	-	-	-	-	-	-
Operating Temperature Range	℃	~ 125	~ 125	~ 125	~ 150	~ 150	~ 150	~ 150	~ 150	~ 150
Volume Resistivity	Ω·cm	2.5×10^{13}	2.5×10^{13}	1×10^{14}	1×10^{14}	2.1×10^{13}	3.4×10^{11}	1×10^{12}	1×10^{12}	7.5×10^{12}
Breakdown Voltage	kV	2	2	4	4.5	4.0	> 5.8	> 5.8	6.0	6.5
180° Peel Test (SUS 304. RT/15min)	g/cm	-	-	-	-	-	-	-	82	560
RoHS	-	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D

NANOTIM® PCM

NANOTIM®
Thermal Interface Material
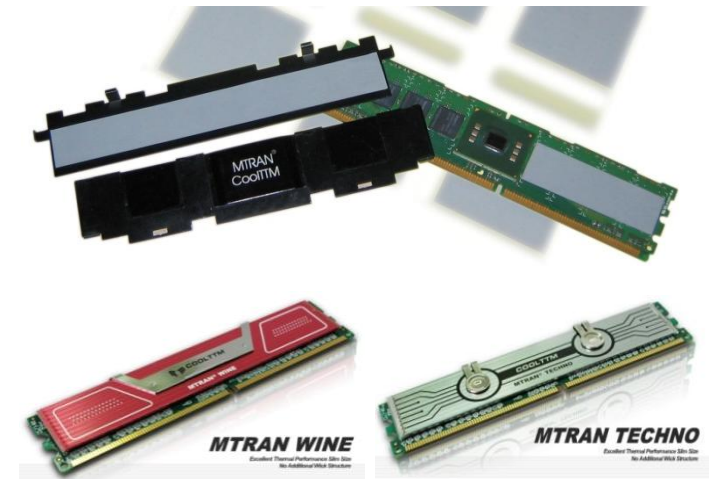TGS Series

NANOTIM® SPS

NANOTIM® APS

COOL TTM

Handling

❖ **Clean the contact surface of heat source to remove particles and pollutants.**

❖ **Remove the release-paper of the PCM .(NANOTIM® PCM)**

❖ **Attached the PCM to the contact surface.**

❖ **After Adhesion, remove another release-paper**

NANOTIM® PCM

Storage & Directions

❖ **Avoid contact with eyes & skins**

❖ **Avoid prolonged high temperature.**

❖ **Use in well-ventilated place**

❖ **Avoid intake or inhale.**

❖ **Store in a cool dry location with adequate ventilation. (less than 25℃)**

❖ **Keep out of reach of children.**

❖ **Avoid to use by the other purposes for thermal transfer**

[NANOTIM® PCM Application]

Handling

❖ Clean the contact surface of heat source to remove particles and pollutants.

❖ Remove the release-paper of the Silicone Pad. (NANOTIM® SPS)

❖ Attached Silicon Pad to the contact surface.

❖ After Adhesion, remove another release-paper.

NANOTIM® SPS

Storage & Directions

❖ Avoid contact with eyes & skins

❖ Avoid prolonged high temperature.

❖ Wash thoroughly body exposed to product after handling

❖ Avoid intake or inhale.

❖ Store in a cool dry location with adequate ventilation. (less than 25℃)

❖ Keep out of reach of children.
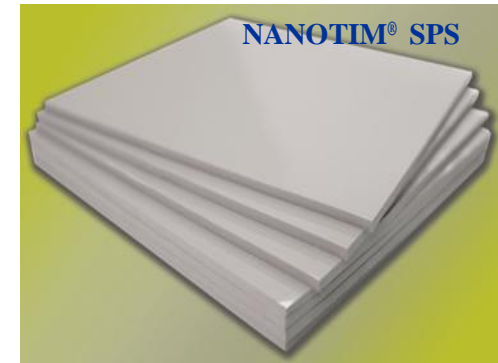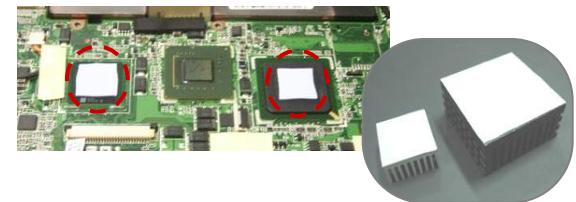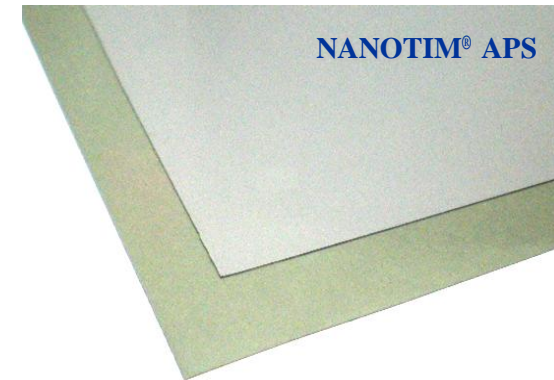
❖ Avoid to use by the other purposes for thermal transfer

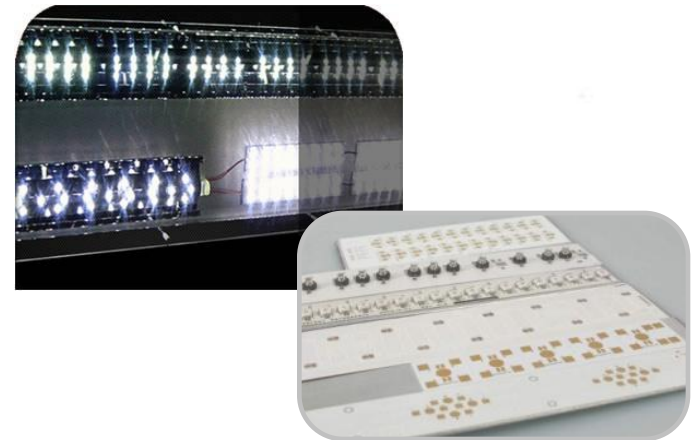[NANOTIM® SPS Application]

6. NANOTIM® Guide Line - APS

Handling

❖ **Clean the contact surface of heat source to remove particles and pollutants..**

❖ **Remove the release-paper of the Adhesive Pad. (NANOTIM® APS).**

❖ **Attached Adhesive Pad to the contact surface.**

❖ **Press with the roller or fingertips not to generate bubbles between interfaces.**

❖ **After Adhesion, remove another release-paper.**

❖ **Attach cooling unit (ex. Heat sink) to adhesive pad surface removed the release-paper.**

❖ **Bond the NANOTIM ® APS & cooling unit (ex. Heat sink) by some pressure.**

NANOTIM® APS

Storage & Directions

❖ **Avoid contact with eyes & skins**

❖ **Avoid prolonged high temperature.**

❖ **Use in well-ventilated place**

❖ **Avoid intake or inhale.**

❖ **Store in a cool dry location with adequate ventilation. (less than 25℃)**

❖ **Keep out of reach of children.**

❖ **Avoid to use by the other purposes for thermal transfer**
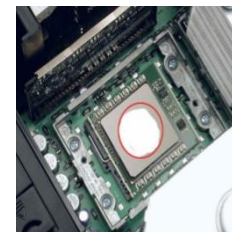

[NANOTIM® APS Application]

Handling

❖ Clean the contact surface of heat source to remove particles and pollutants.

❖ Dispense suitable quantity of Grease on exposed surfaces of CPU/Heat sources.

❖ After dispense uniformly by the spreader and toolkit, attach cooling unit (ex. Heat sink)
   to the contact surface.

❖ If the surface temperature of CPU or heat sink is high(40~45℃), handling on
   the surfaces is easy.

Storage & Directions

❖ Avoid contact with eyes & skins

❖ Avoid prolonged high temperature.

❖ Use in well-ventilated place

❖ Wash thoroughly body exposed to product after handling

❖ Avoid intake or inhale.

❖ Cover tightly & Store in a cool dry location with adequate ventilation.
   (less than 25℃)

❖ Keep out of reach of children.

❖ Avoid to use by the other purposes for thermal transfer

[NANOTIM® TGS Application]

Summary

COOLTTM

EPOCHAL THERMAL SOLUTION PROVIDER

MTRAN®
- MTRAN Basic – Flat Micro Heat Pipe
- MTRAN PCB – MTRAN Embedded PCB
- MTRAN MM – TANK, WINE, TECHNO
- MTRAN RHP – Round Heat Pipe

NANOTIM®
- NANOTIM PCM – Phase Change Material
- NANOTIM SPS – Silicone Thermal PAD
- NANOTIM APS – Adhesion PAD
- NANOTIM TGS – Thermal Grease

TSET
- Customized Design Module
- Heat sink Module, Heat pipe applied Module, Fan

TSPOT
- Thermal Consulting Service
- Thermal and Fluid Flow Analysis by I-DEAS ESC