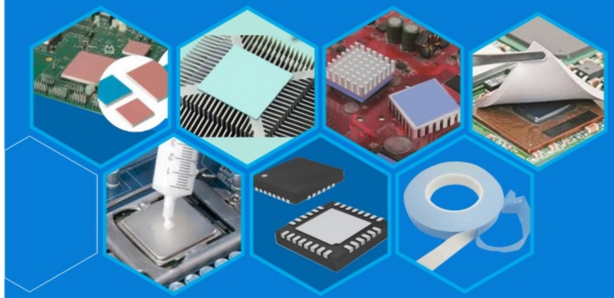
SinoGuide

The Global Leader In
Thermal Management
Technology



**THERMAL FAMILY**

- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

# OSRAM LLFY
# WORKSHOP OCT 26, 2015

## MCPCB's and Thermal Interface Material Considerations for High Power LED Lighting Applications


Justin.Li

Sr. Field Applications Manager
Thermal Substrates Division
The SinoGuide Technology



Acknowledgements:
John.Zhang – Sr. Development Engineer, SinoGuide Technology
Kevin.Hu – Director of Research & Development, SinoGuide Technology


SinoGuide™

SinoGuide

The Global Leader In
Thermal Management
Technology

# MCPCB's and TIM Considerations for High Power LED Lighting Applications

## Outline

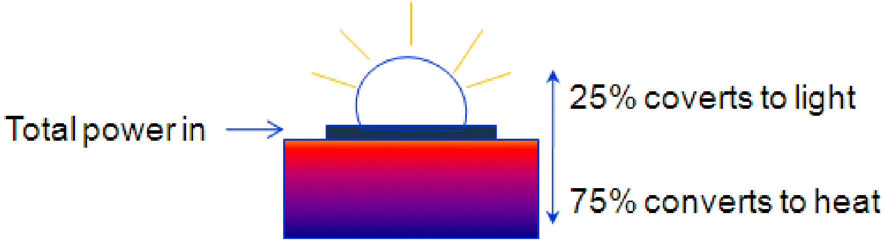
- **Thermal management is key to your design**
- **Thermal performance of high power LED's**
- **Understanding thermal performance (reference data)**
- **MCPCB material options and part geometry**
- **TIM selection considerations, options that are available**
- **Conclusions**

SinoGuide™



# Importance of Thermal Management of High Power LED’s

- Only ~15-30% of input power is converted to light
- The remaining 70-85% of input power is converted to heat
  - Excessive heat can cause a shift in color
  - Excessive heat can reduce light output
  - Excessive heat can shorten device life




IESNA Handbook    Osram Sylvania

Source: PNNL-SA-51901, February 2007

# SinoGuide

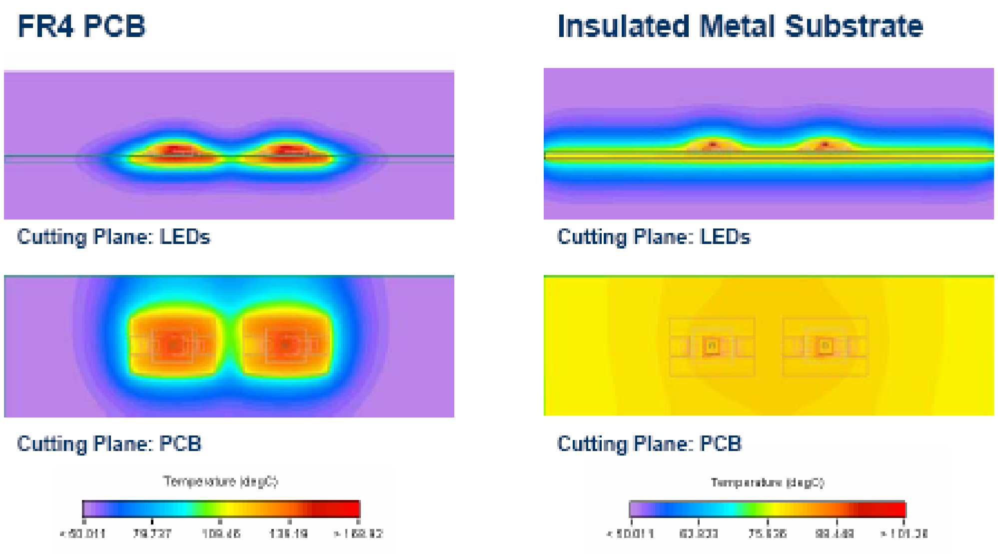
The Global Leader In Thermal Management Technology

**THERMAL FAMILY**

- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

# Model results

## Comparison of FR-4 to IMS




$T_{junc} = 168.9$ °C
$\Delta T = T_{junc} - T_{amb} = 118.9$ °C

-55%

$T_{junc} = 101.3$ °C
$\Delta T = T_{junc} - T_{amb} = 51.3$ °C

### Influencing Factors

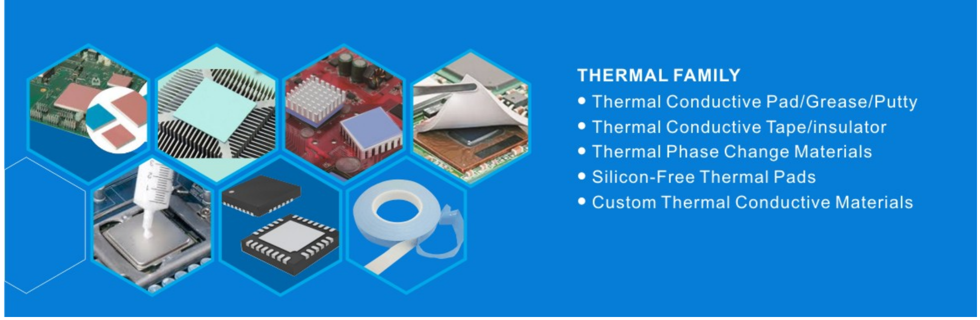
- Board material with higher thermal conductivity
- Attach to additional heat spreader (PCB on Aluminium)
- Solder pad layout and placement of other components
- Use of thermal vias

Good thermal management results in lower junction temperature

SinoGuide™

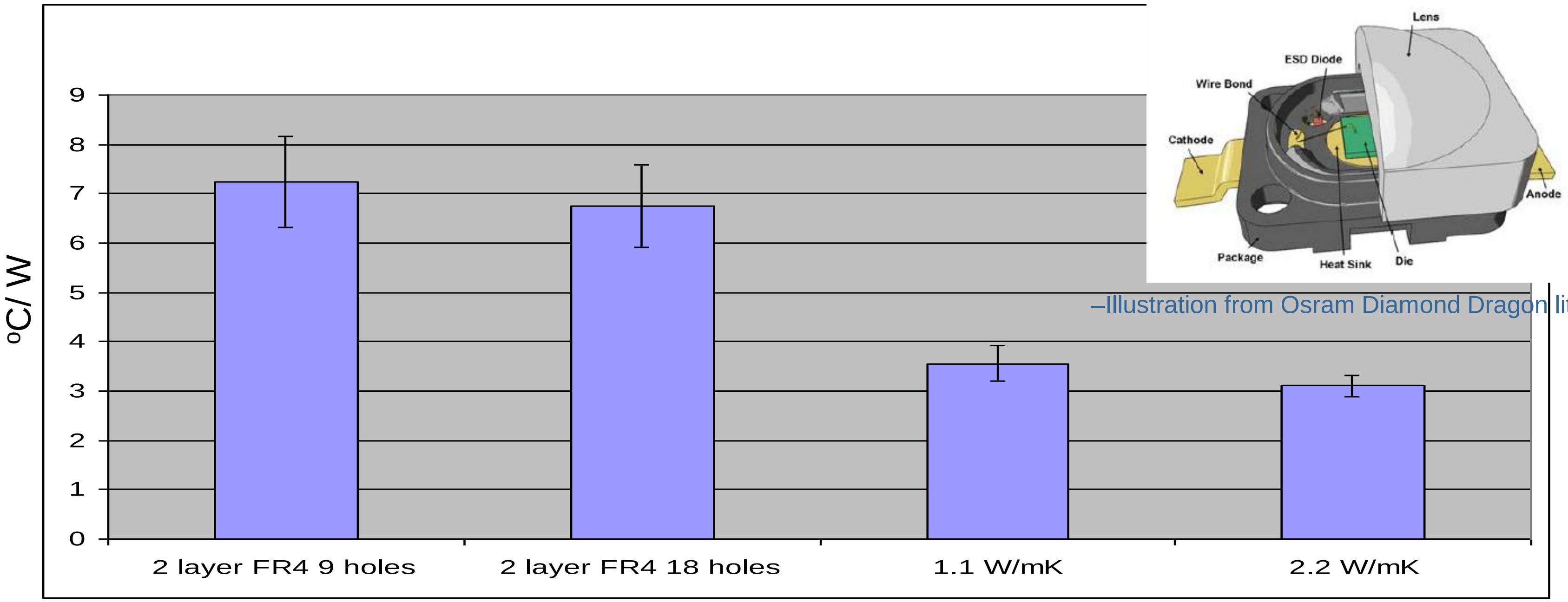
# SinoGuide

The Global Leader In
Thermal Management
Technology




## Case study results

### Thermal impedance of Osram Diamond Dragon on various substrates

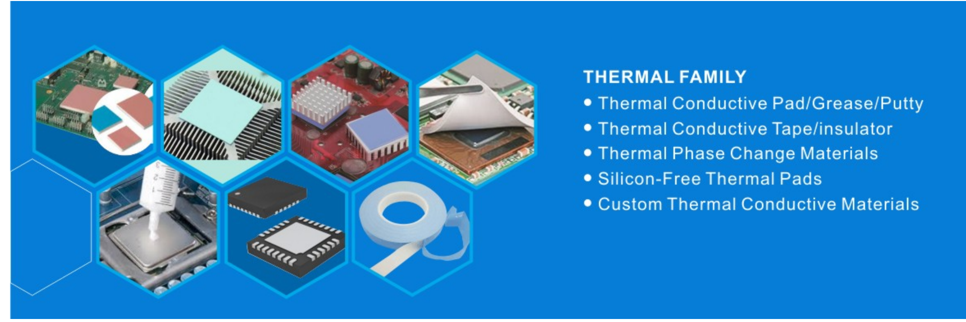



–Illustration from Osram Diamond Dragon literature

57% improvement from popular FR-4 configuration to 2.2 W/mK solution

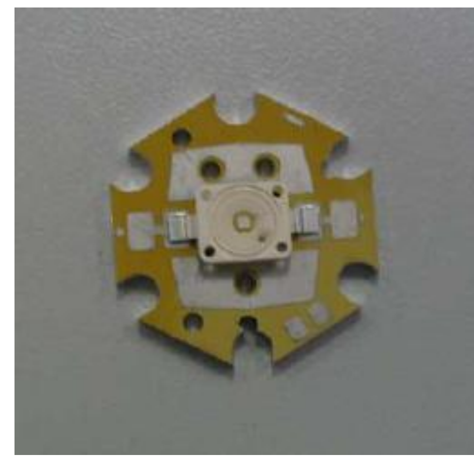
Note: the two FR-4 samples needed an insulator pad between the board and heat sink adding 0.2ºC/W

SinoGuide TM




# Comparison of thermal impedance of SinoGuide TCP150 and TCP100 dielectrics

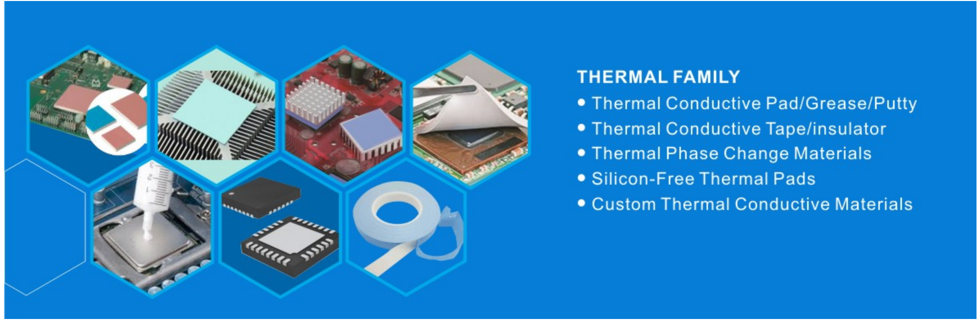
| | |
|---|---|
| Components: | LED Golden Dragon (chip 1sqmm)<br>(same wafer Lot) |
| MCPCB: | Al 1,57mm x Dielectric x 35µm cu |



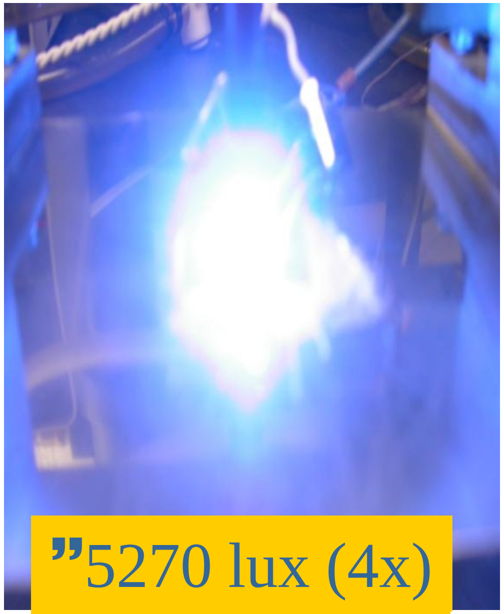
2 x improvement by increasing to 3W/mK dielectric from 1.1W/mK

# SinoGuide

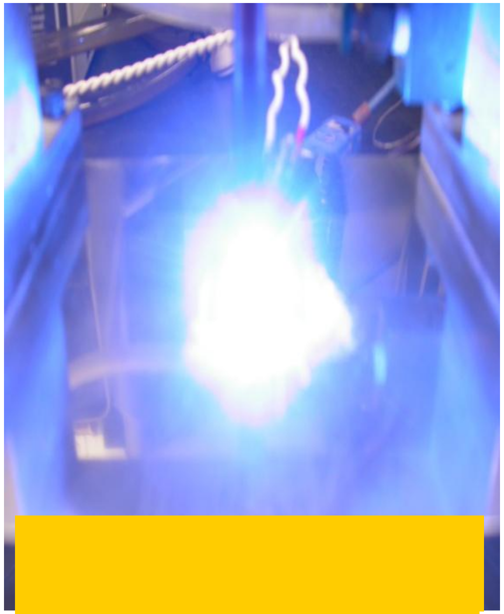
The Global Leader In
Thermal Management
Technology



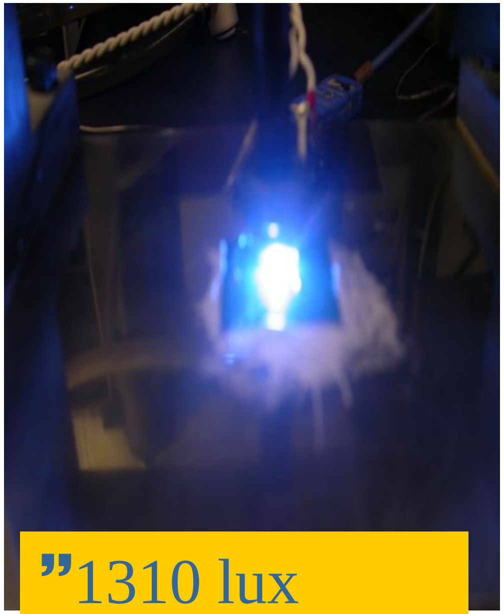

## Light Output of Die on Different Dielectric Materials at ΔT of 25C



”5270 lux (4x)
2.2 W/mK
SinoGuide HT



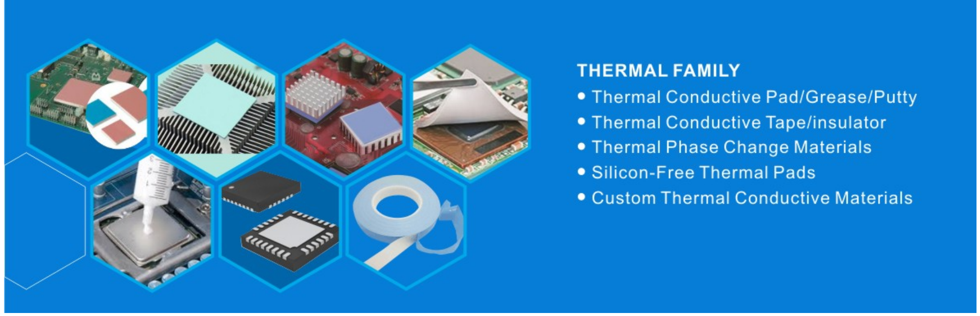
1.3 W/mK
SinoGuide MP



”1310 lux
0.30 W/mK
FR-4/Alu

# SinoGuide

The Global Leader In
Thermal Management
Technology




## Thermal T_Clad - IMS Insulated Metal Substrate

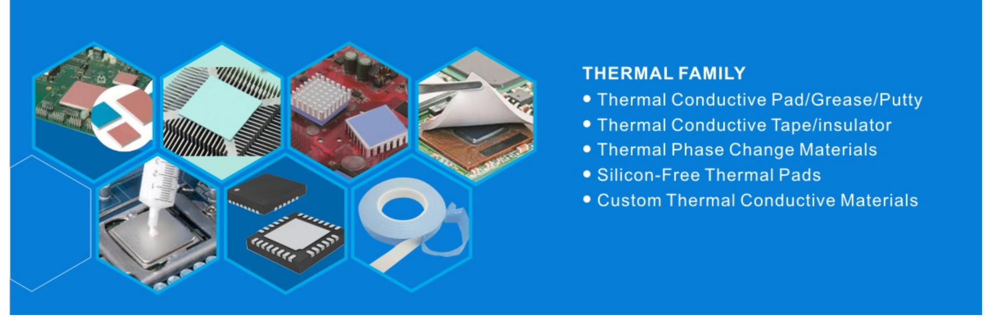
### KEY TAKE-AWAY POINTS

1. **Dielectric thermal impedance dominates** the conductive portion of the thermal path

2. Use of **MCPCB is critical to thermal management of high power LED's**

3. **Reducing the conductive portion** of the thermal budget, by using IMS, provide **more options for heat sink selection**.

SinoGuide™



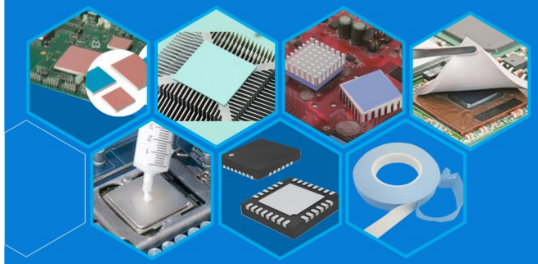

# MCPCB's and TIM Considerations for High Power LED Lighting Applications

## Outline

- Thermal management is key to your design
- **Thermal performance of high power LED's**
- Understanding thermal performance (reference data)
- MCPCB material options and part geometry
- TIM selection considerations, options that are available
- Conclusions

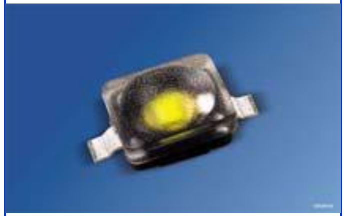
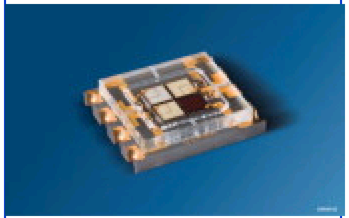
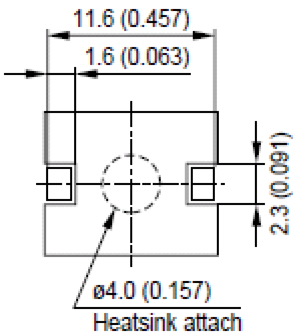
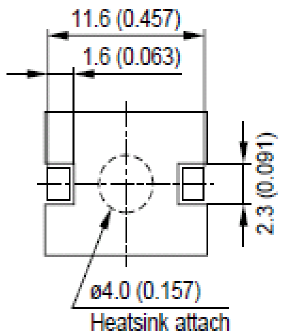
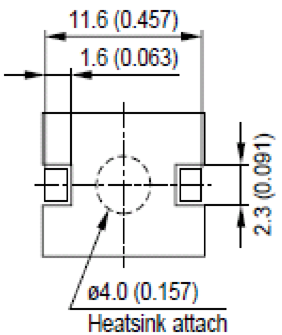
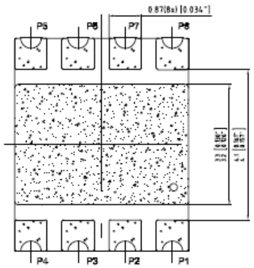
# SinoGuide

The Global Leader In
Thermal Management
Technology



**THERMAL FAMILY**
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

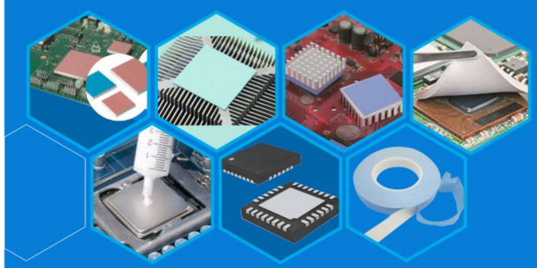
## LED's have different package styles & different $T_R$

| Golden DRAGON® | Platinum DRAGON | Diamond DRAGON | OSTAR - SMT |
|---|---|---|---|
|  |  |  |  |
| ZW W5SG | LR W5SM | LUW W5AP | |
|   |   |   |  |
| Heat Slug area 12.6mm$^2$ | Heat slug area 12.6mm$^2$ | Heat slug area 12.6mm$^2$ | Heat slug area 15.9mm$^2$ |
| $R_{th\ JS}$ 15 K/W | $R_{th\ JS}$ 11 K/W | $R_{th\ JS}$ 5 K/W | $R_{th\ JS}$ 30K/W |

SinoGuide™

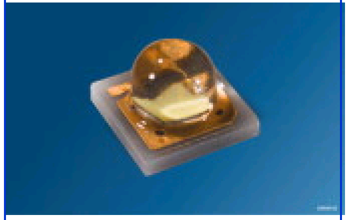
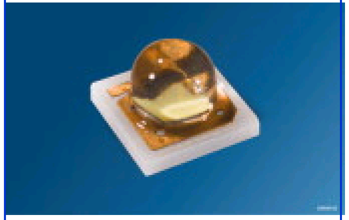
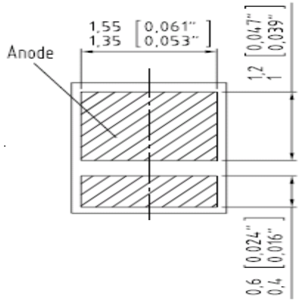
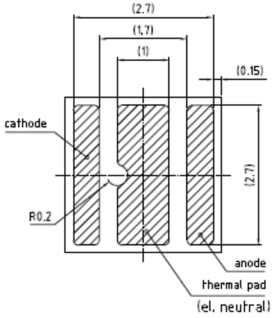
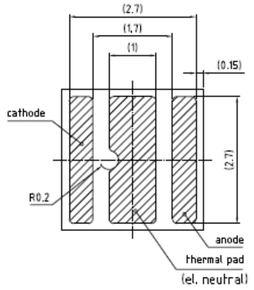
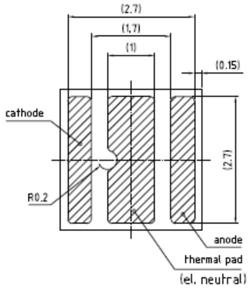
# SinoGuide

The Global Leader In
Thermal Management
Technology

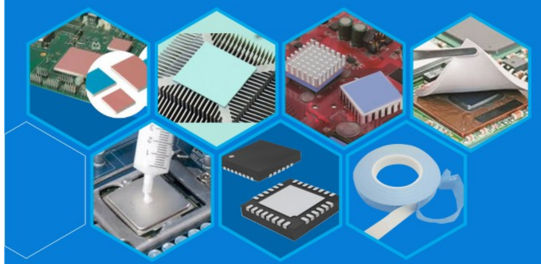


**THERMAL FAMILY**
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

## LED's have different package styles & different $T_R$

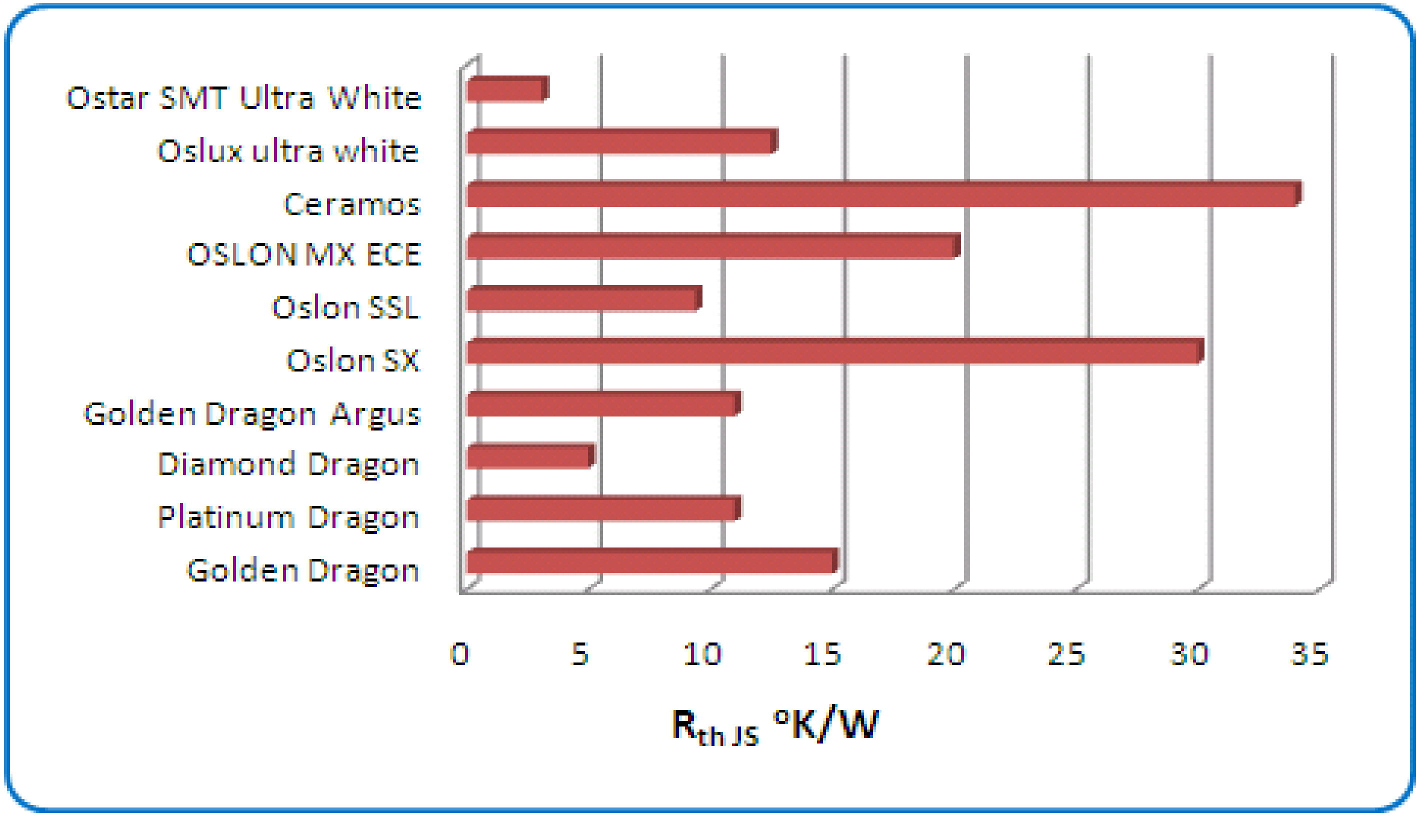
| CERAMOS™ | OSLON SSL | OSLON SX | OSLON MX ECE |
|---|---|---|---|
|  |  |  |  |
| **LUW C9SP**<br>**Ultra White** | **LUW CP7P** | **LUW CN5M**<br>**Ultra White** | **LUW CN7N**<br>**Ultra White** |
|  |  |  |  |
| Thermal Pad 1.86mm² | Heat slug area 2.7mm² | Heat slug area 2.7mm² | Heat slug area 2.7mm² |
| $R_{th\ JS}$ 34 K/W | $R_{th\ JS}$ 9.4 K/W | $R_{th\ JS}$ 30 K/W | $R_{th\ JS}$ 20K/W |

SinoGuide™



**THERMAL FAMILY**
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

# $R_{th\ JS}$ comparison of various LED's



# Thermal T_Clad - IMS Insulated Metal Substrate

## KEY TAKE-AWAY POINTS

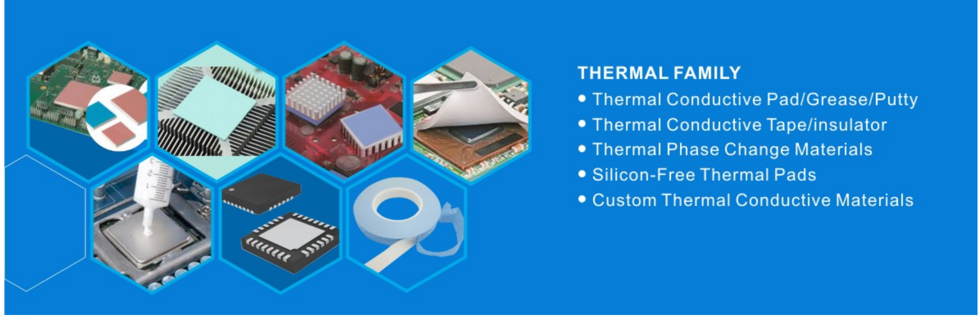
1. There are many **different LED package styles**

2. Even LED's with the **same package style can have different thermal resistance** from one part to another

3. **Lower the thermal resistance package can see greater benefit from lower thermal impedance MCPCB**

# SinoGuide

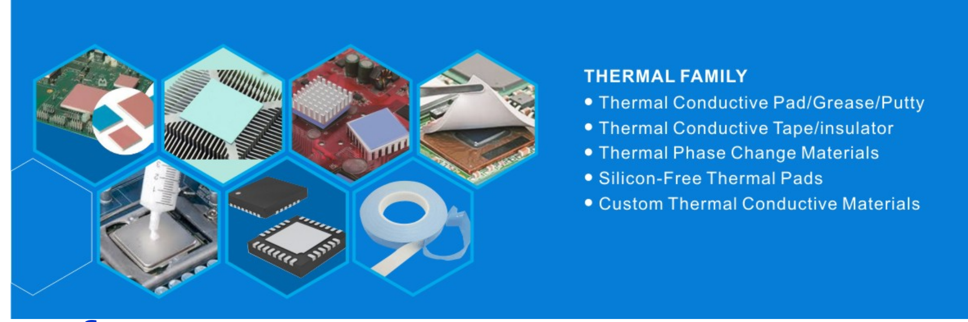
The Global Leader In
Thermal Management
Technology




## MCPCB's and TIM Considerations for High Power LED Lighting Applications

### Outline

- Thermal management is key to your design
- Thermal performance of high power LED's
- **Understanding thermal performance (reference data)**
- MCPCB material options and part geometry
- TIM selection considerations, options that are available
- Conclusions



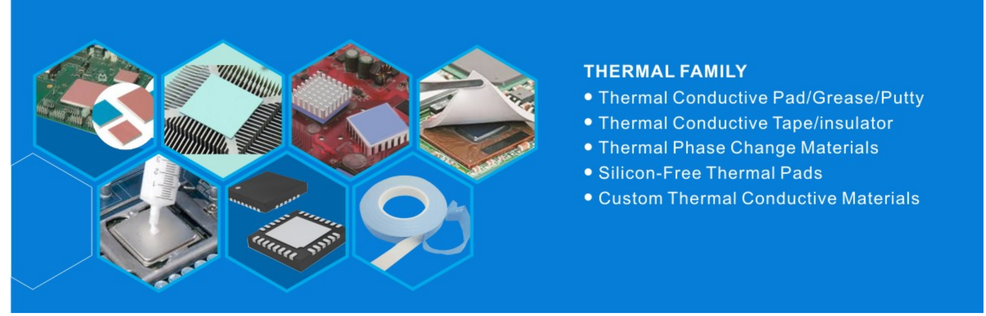

# Thermal Performance

## Understanding Thermal Conductivity

- Thermal Conductivity (*k*)
  - ✓ A material's ability to conduct heat
  - ✓ Inherent material property
  - ✓ Does not depend on thickness
  - ✓ $T_C$ unit is:

$$\frac{Watt}{meter \bullet Kelvin}$$

*For this purpose, the material is treated as isotropic.*




# Thermal Performance

- Fourier's Law of Heat Conduction
  - ✓ Steady-state uniform heat conduction through a thin sample:

$$\frac{q}{A} = -k\frac{dT}{dx}$$

q = heat flow rate, Watt

A = area of sample, square meter

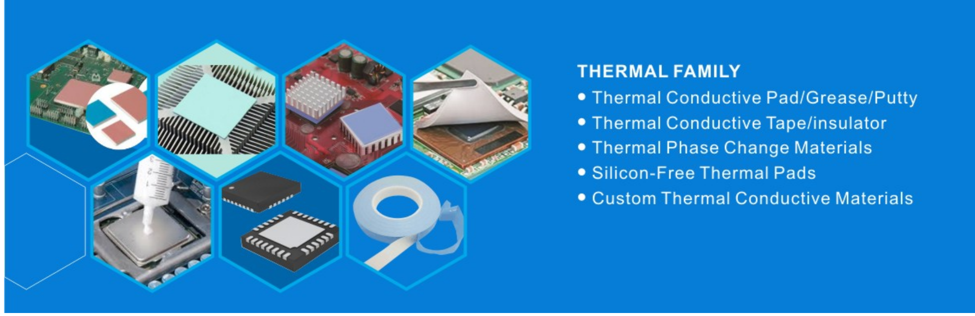
*k* = thermal conductivity, Watt/meter.Kelvin

x = thickness of specimen

dT/dx = temperature gradient through sample, Kelvin/meter

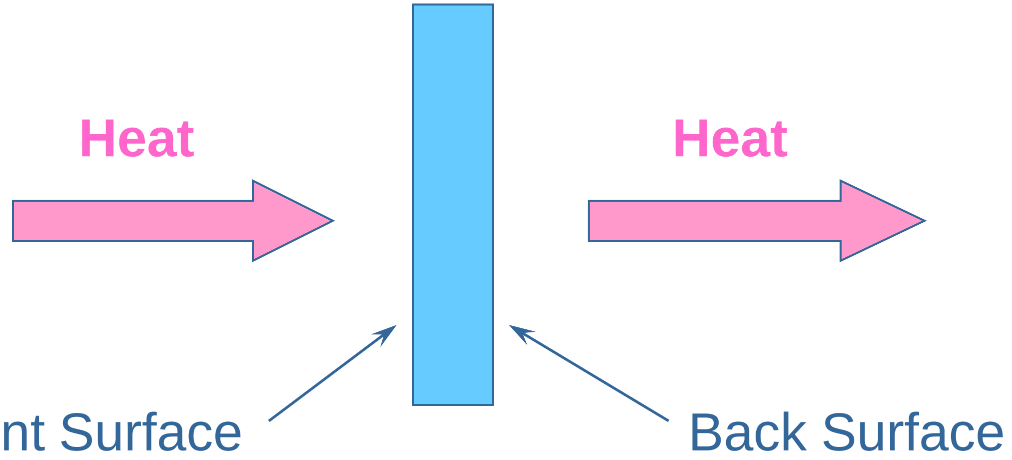
# SinoGuide

The Global Leader In
Thermal Management
Technology




## Thermal Performance

- Thermal Resistance, $R_{`e}$ (excludes interfacial resistance)

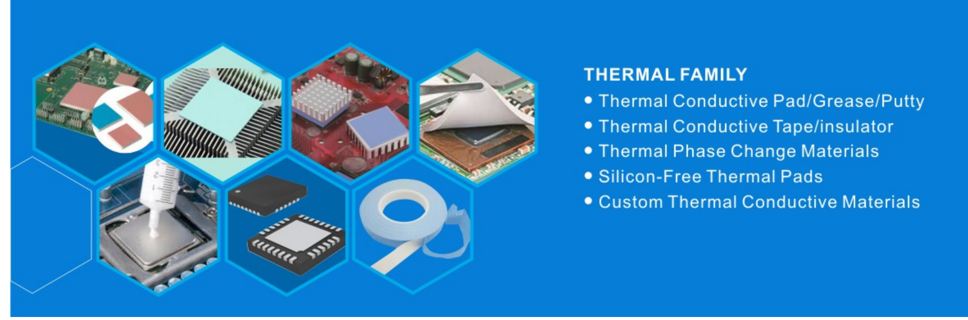



$$\text{Thermal Resistance} = \frac{\Delta T}{q/A} \qquad R_\theta = \frac{\Delta x}{k}$$

SinoGuide™

SinoGuide

The Global Leader In
Thermal Management
Technology




# Thermal Performance

## Understanding Thermal Resistance

- Thermal Resistance, $R_0$
  - ✓ A material’s resistance to heat flow
  - ✓ Defined as temperature drop across a unit area material subjected to a steady state heat flow rate
  - ✓ Does not include interfacial resistance
  - ✓ Proportional to ratio of material thickness to material thermal conductivity
  - ✓ $S_I$ unit is

$$\frac{meter^2 \bullet Kelvin}{Watt}$$

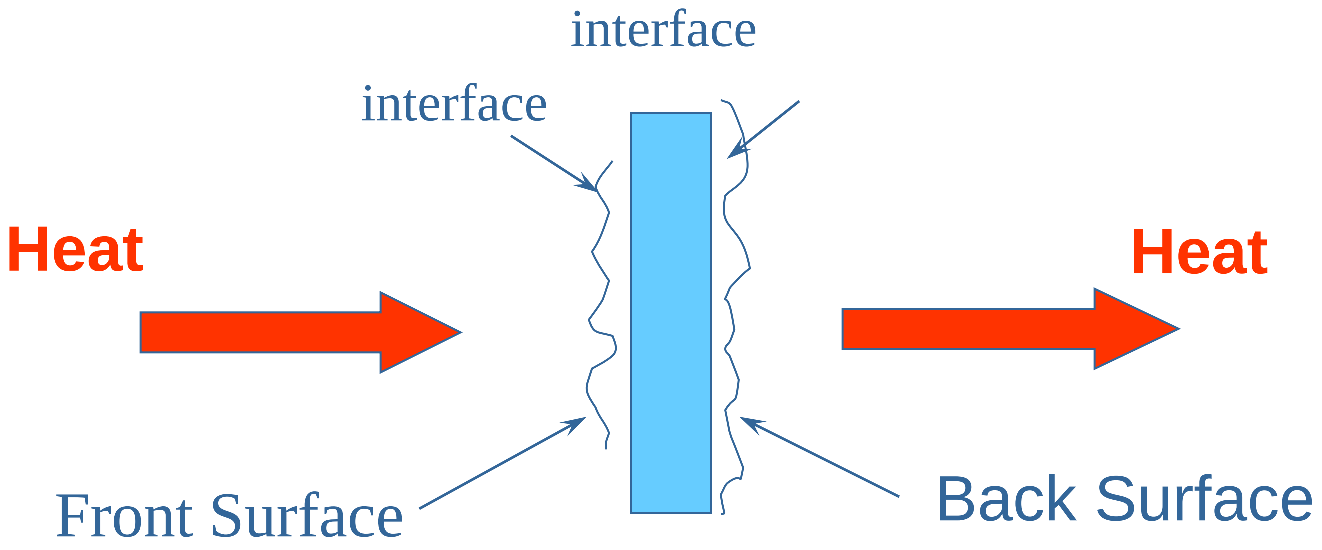
SinoGuide™



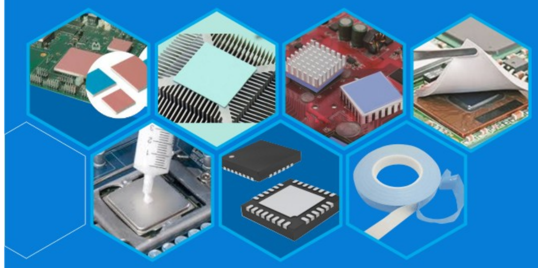
# Thermal Performance

## Understanding Thermal Impedance

- Thermal Impedance, $Z_0$ (includes interfacial resistance)




$$\text{Thermal Impedance} = \frac{\Delta T}{q}$$





# Thermal Performance

## Understanding Thermal Impedance

- Thermal Impedance, $Z_0$
  - ✓ The total opposition that an assembly (material and material interfaces) presents to the flow of heat.
  - ✓ Defined as temperature drop across one or more layers of materials subjected to a unit steady state heat flow rate
  - ✓ Interfacial thermal resistance (contact resistance) is highly variable and changes with pressure, texture, time and temperature
  - ✓ $S_I$ unit is: $\frac{Kelvin}{Watt}$

THERMAL FAMILY
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

# Thermal Performance

## Measurement Methods

- Thermal Conductivity (k) - ASTM D5470
- Thermal Resistance (Rq) - ASTM D5470
- Thermal Impedance ($Z_0$) - 1) ASTM D5470



# Thermal Performance

## KEY TAKE-AWAY POINTS

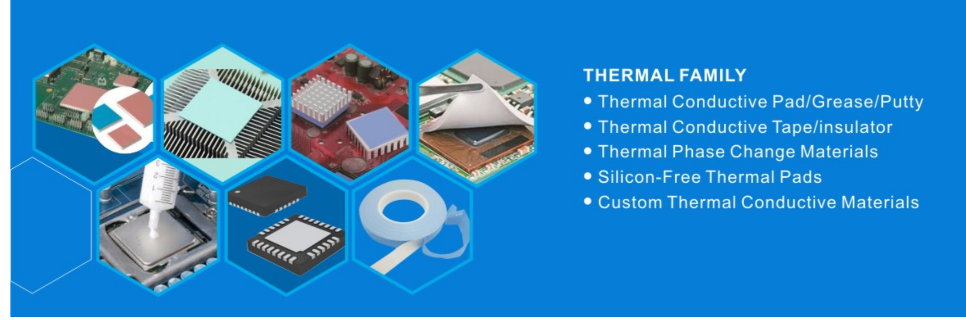
1. **Thermal conductivity** (k) is an **inherent property** of a material.
   – This property can be used for a sales agreement specification.

2. **Thermal resistance** (Rq) is an inherent property for each **thickness** of a material with a given thermal conductivity.
   – This property can be used for a sales agreement specification.

3. **Thermal impedance** (Zq) **varies** with thermal conductivity, thickness, area, interfacial thermal resistance, and test method used.

# SinoGuide

The Global Leader In
Thermal Management
Technology



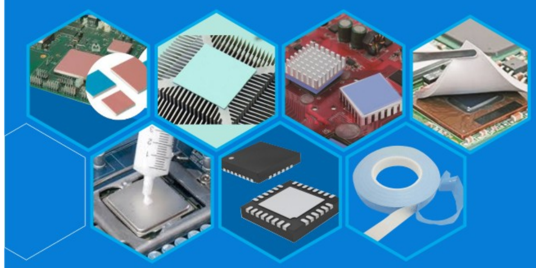

## Thermal Performance

### KEY TAKE-AWAY POINTS (cont)

4. **Interfacial thermal resistance** is **dependent** on heat source, time, texture, force and temperature

5. **Thermal impedance** (Zq) **cannot be used for a sales agreement specification due to interfacial resistance variables.** This variability has forced the thermal community to develop the methodology of D5470 measuring thermal resistance (Rq) and thermal conductivity (k).

SinoGuide™

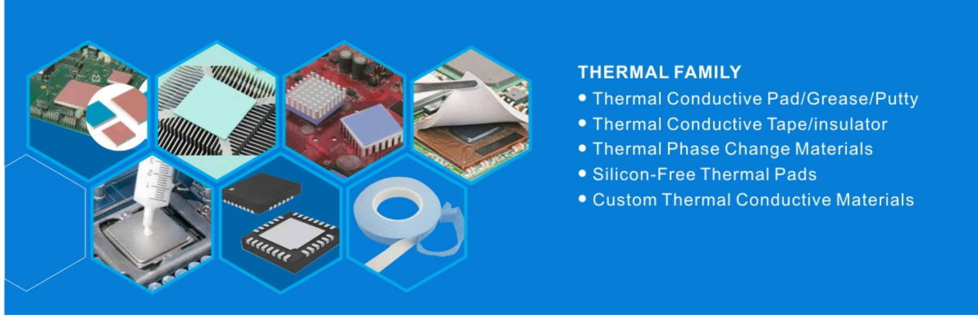


THERMAL FAMILY
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

# MCPCB's and TIM Considerations for High Power LED Lighting Applications

## Outline

- Thermal management is key to your design
- Thermal performance of high power LED's
- Understanding thermal performance (reference data)
- **MCPCB material options and part geometry**
- TIM selection considerations, options that are available
- Conclusions



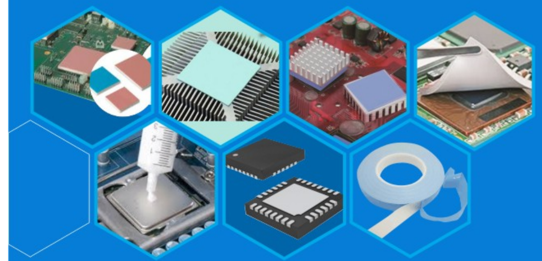

# Thermal Substrates (MCPCB) Intro:

## What is a Thermal Substrate?

- ✓ Metal clad printed circuit board used for surfacemount components and COB technologies
- ✓ Used to efficiently remove heat from the components, transfer and spread it in the metal substrate
- ✓ It gives a very good thermal / mechanical means of connecting to a heat sink
- ✓ It provides the best solution available to improve system performance and reliability by reducing component temperature

# SinoGuide

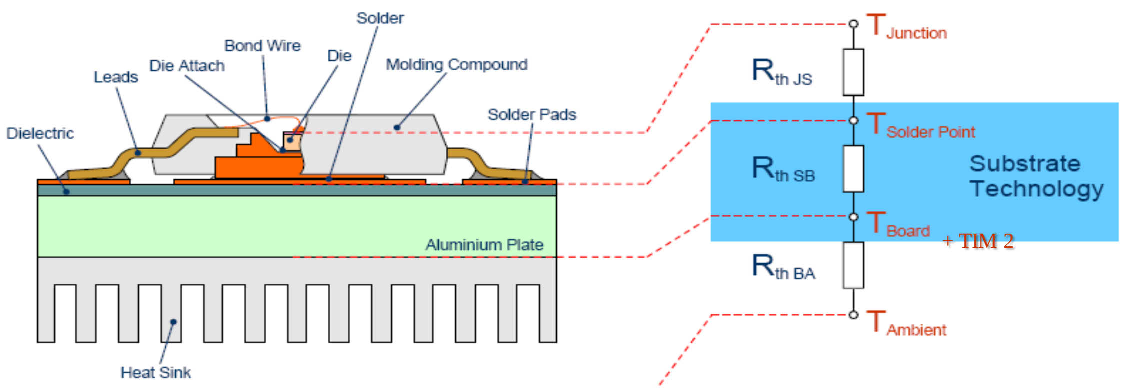
The Global Leader In
Thermal Management
Technology



**THERMAL FAMILY**
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

## The role of a MCPCB in an LED lighting system

- $R_T$ is the sum of all components within the thermal path
  - $R_T = R_{j-c} + R_{TIM1} + R_{MCPCB} + R_{TIM2} + R_{s-a}$




SinoGuide focus is in this area

**Thermal System Configuration** **Thermal Resistor Network**

Source: Osram Opto Semiconductor

Smaller package footprints and lower Thermal Resistance LED's is driving the need for lower thermal impedance MCPCB materials

SinoGuide™



# Choosing the appropriate MCPCB material stack up

Substrate material selection can vary with LED selection

- The lower the thermal resistance of the LED package the greater the need for a higher performing substrate material

  a) Copper circuit foil thickness is selected based on current carrying capacity needed and surface heat spreading objectives

  b) Dielectric thermal performance is selected based on LED's thermal resistance & power density

  c) Base metal is selected based on thermal performance and mechanical/structural requirements

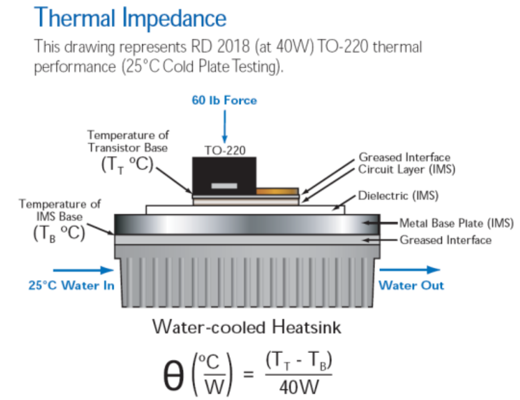
# SinoGuide

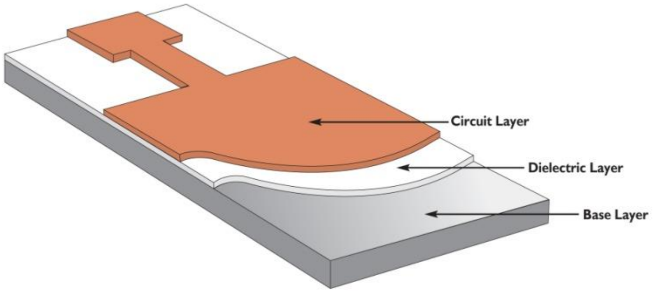
The Global Leader In
Thermal Management
Technology

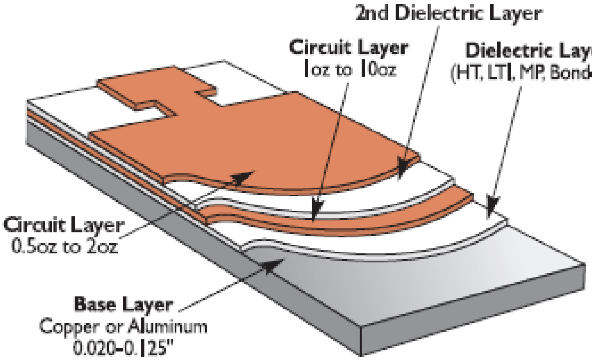
## MCPCB Substrate Technology

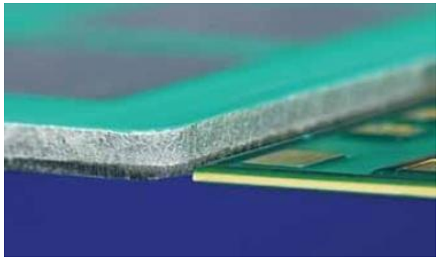
### Available Systems

- Single Layer – most common
- Double Layer – increased routing area
- Ultra Thin Substrate – can be formed



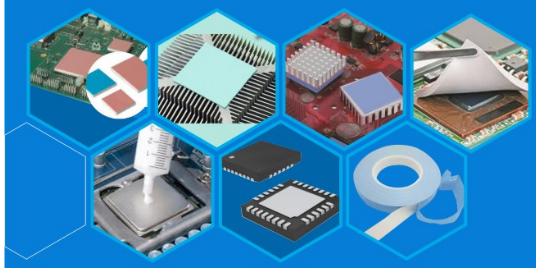



SinoGuide

The Global Leader In
Thermal Management
Technology



THERMAL FAMILY

- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

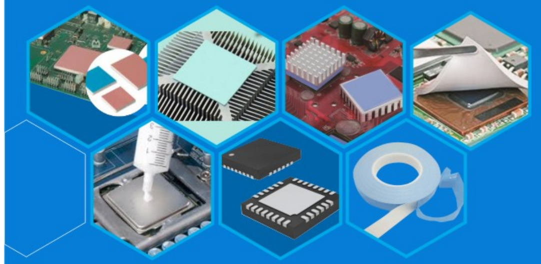
# Thermal Pad Standard Material Configurations

- **Available Panel Sizes**
  - **Thickness** 0.5mm (0.020”) – 5mm (0.190”)
    - most popular thicknesses 1mm ( 0.040”)  1.57 (0.062”)
  - 18” x 24” (457mm x 610mm)
    - usable area 17” x 23” (432mm x 584mm)
  - 20” x 24” (508mm x 610mm)
    - usable area 19” x 23” (482.6mm x 584.2mm)
  - 18” x 25” (457mm x 635mm)
    - usable area 17” x 24” (432mm x 610mm)
- **Aluminum**
  - 6061 T6 (easy to machine)
  - 5052 H34 (lower cost & bendable)
- **Copper**
  - C1100 FH (full hard)

SinoGuide™

# SinoGuide

The Global Leader In
Thermal Management
Technology

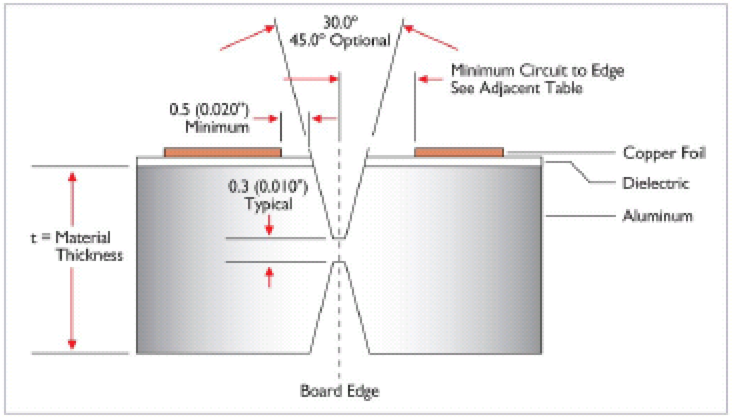


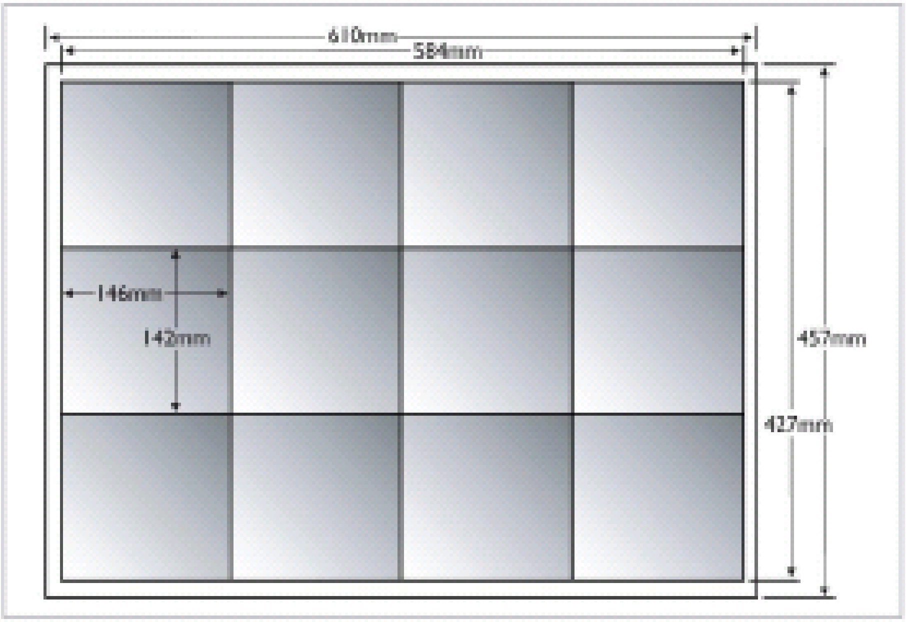
**THERMAL FAMILY**

- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

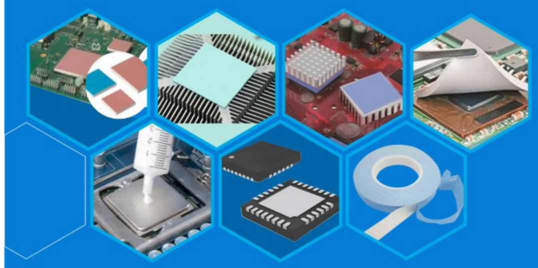
## Thermal Pad standard v-score

- V-scored parts tend to utilize the material most efficiently
- Eliminates the need for hard tooling required with a punched part
- Easy to separate from panel




SinoGuide TM





# MCPCB surface finish options

- Soldermask
  - White
  - Black
  - Green
  - Red
  - Blue

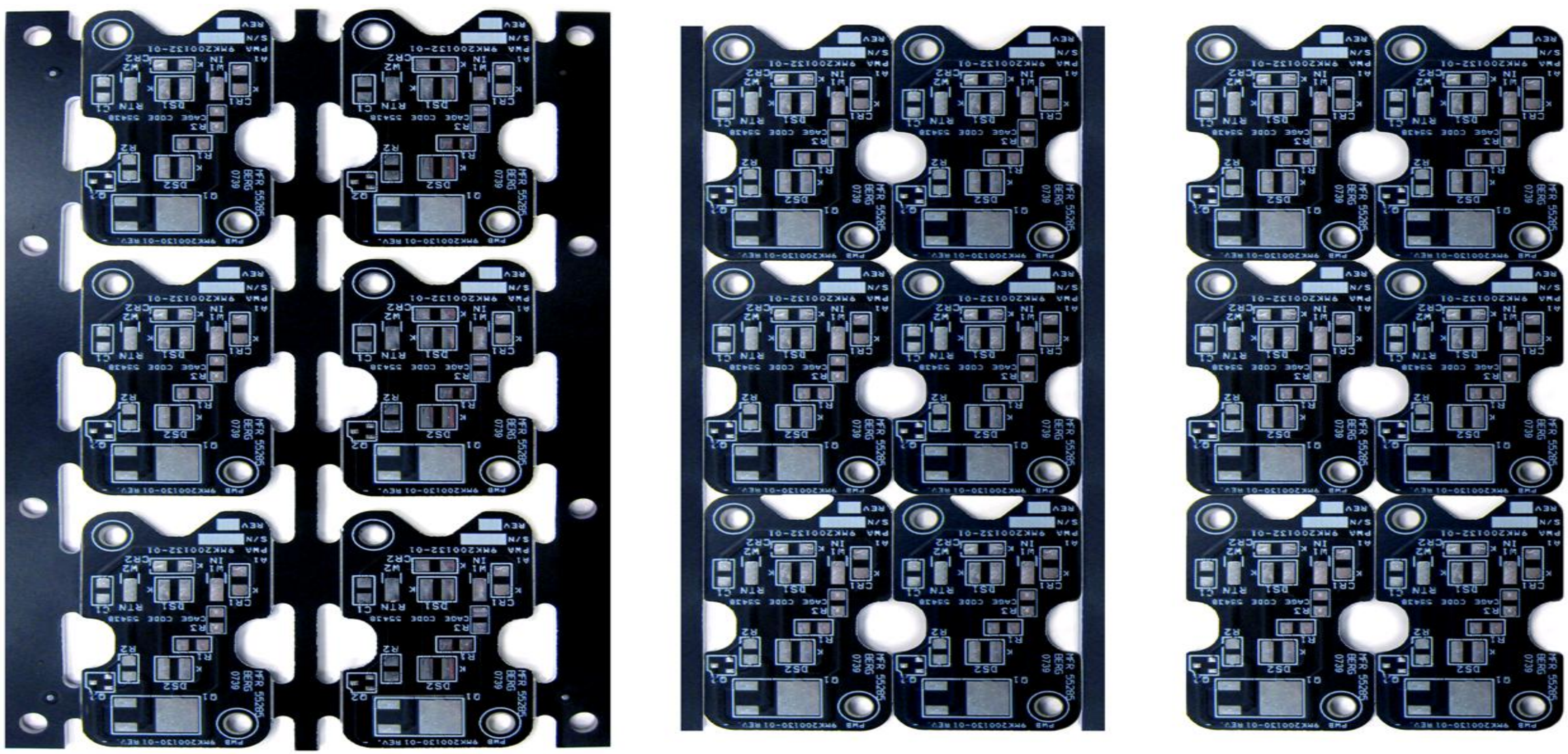
  Typically LPI (liquid photo imagable)

- Pad finishes
  - HASL (with lead) - solder with lead
  - HASL (lead free) – solder without lead
  - OSP – organic surface preservative
  - ENIG – electroless nickel immersion gold
  - ENEPIG – electroless nickel electroless palladium immersion gold

SinoGuide

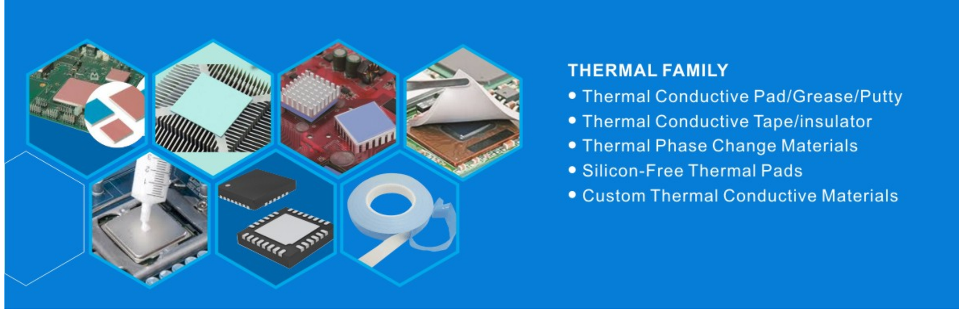
The Global Leader In
Thermal Management
Technology


# Standard punch / v-score combinations



Material utilization is key in reducing cost

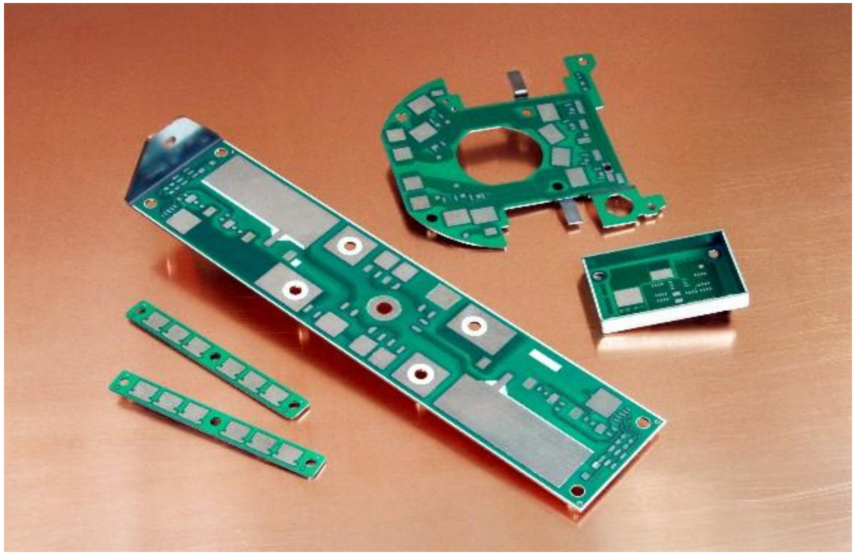
SinoGuide™




# Advanced Substrate Technology

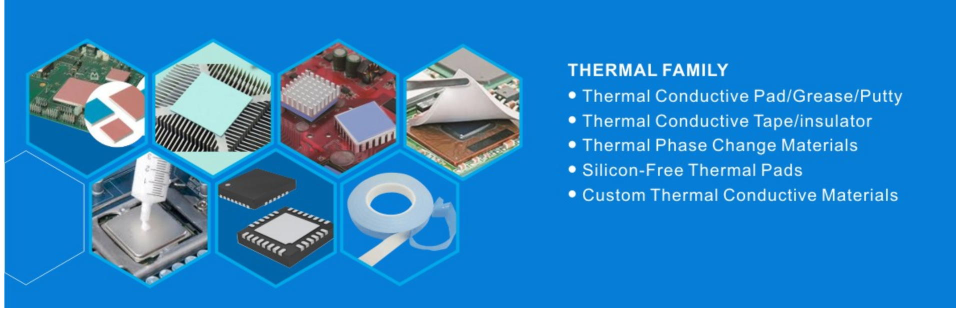
## Formed MCPCB

- Allows the substrate to be a part of the mechanical structure
- Can be single or two layer constructions
- Circuits cannot be routed around corners (yet)
- Base can be electrically active



# SinoGuide

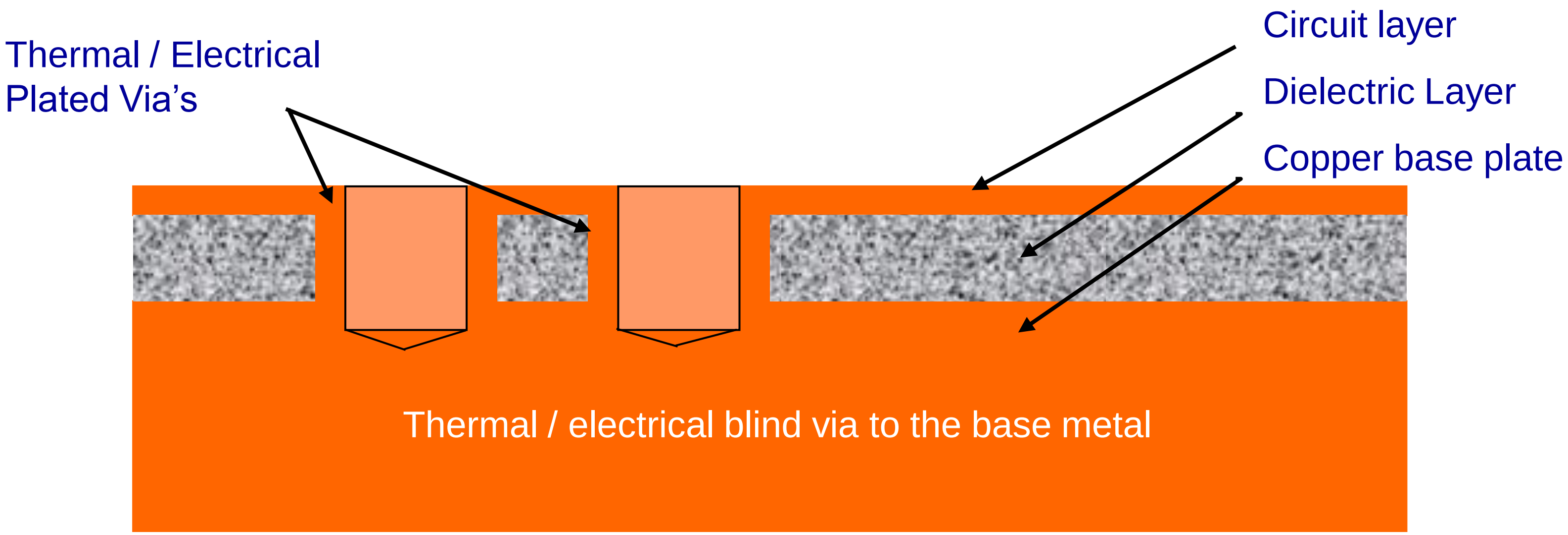
The Global Leader In
Thermal Management
Technology




## Advanced Substrate Technology

### Active Copper Base Plate

- ✓ Copper base with blind plated via's
- ✓ Can be a multilayer construction
- ✓ Laser drilling can enable the hole to stop at any copper layer

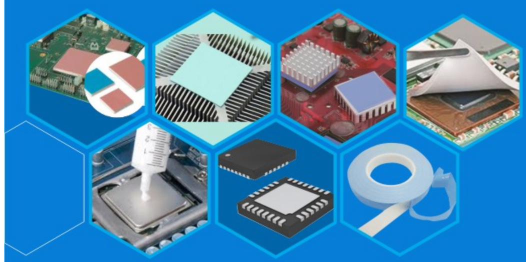




# Advanced Substrate Technology

## Active Copper Base Plate

- ✓ Copper base with blind plated via's

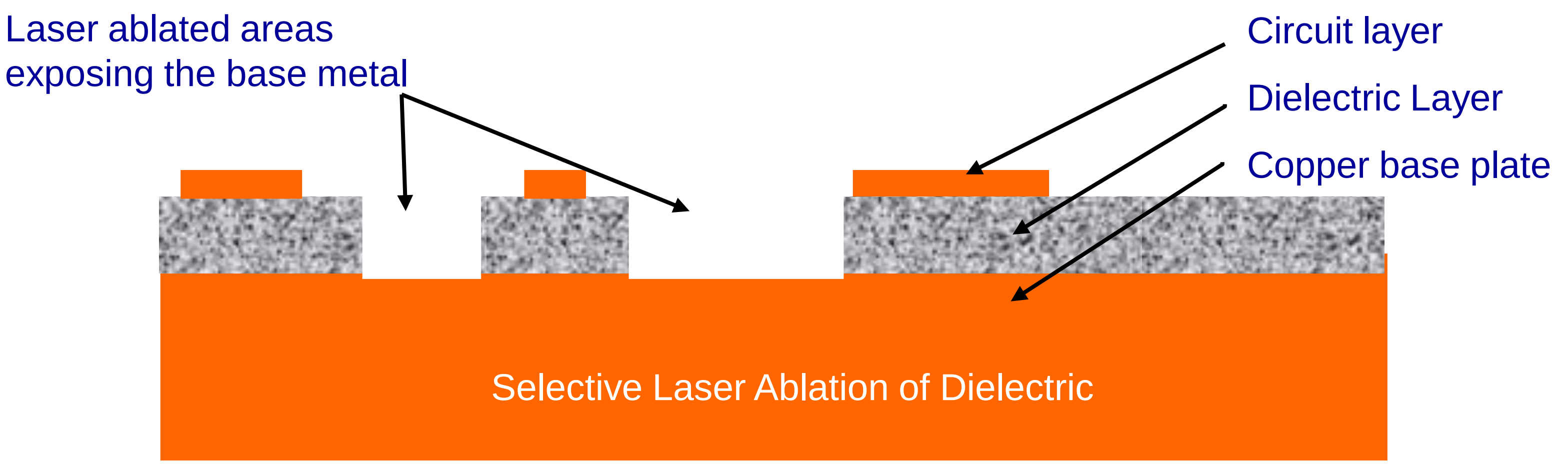




# Advanced Substrate Technology

## Selective Dielectric Removal

- Selective removal of dielectric - using a Co2 laser
- Tight tolerance capability - ± 0.05mm feature size and positional accuracy
- Reduce thermal resistance by mounting components directly to base metal



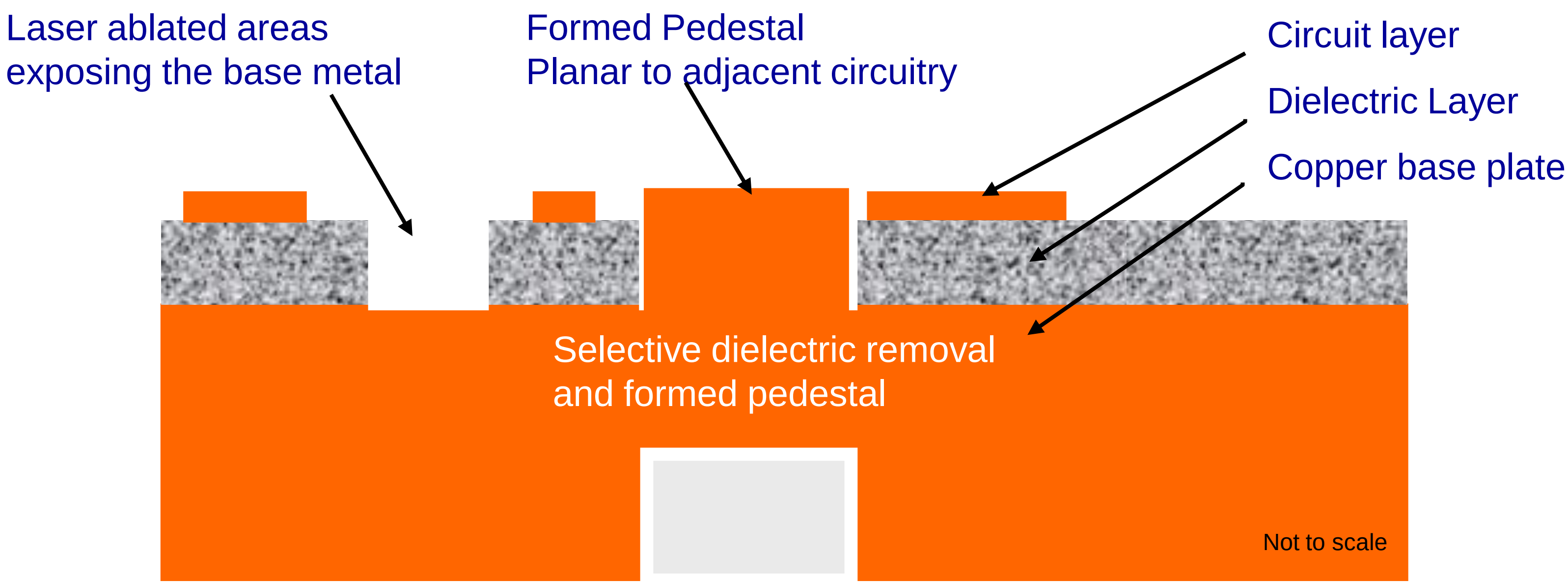
# SinoGuide

The Global Leader In
Thermal Management
Technology


## Advanced Substrate Technology

### Formed Pedestal

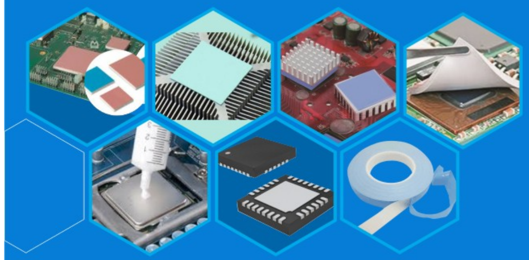
- Form base metal to be planar with adjacent circuits
- Minimizes solder bond line when component or die attach to base metal




SinoGuide™

# SinoGuide

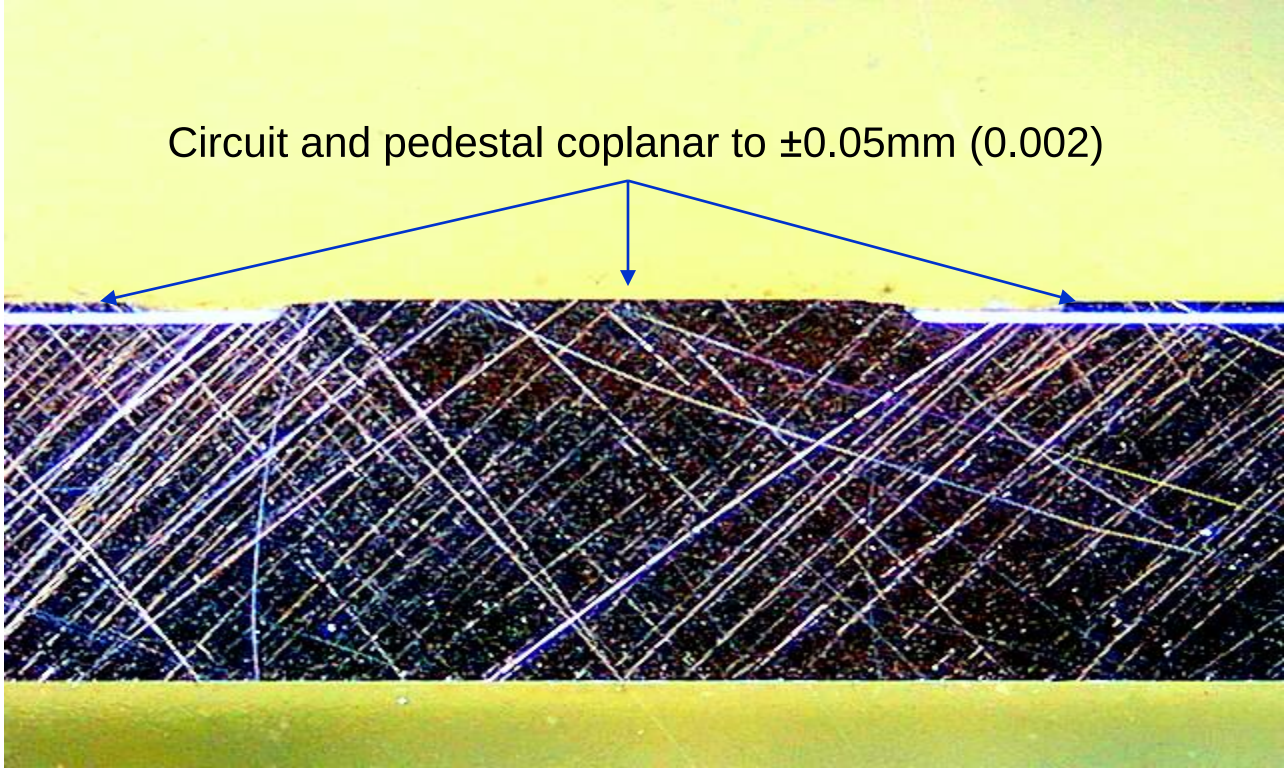
The Global Leader In
Thermal Management
Technology



**THERMAL FAMILY**
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

## Advanced Substrate Technology

### Cross Section of Pedestal Board



# SinoGuide

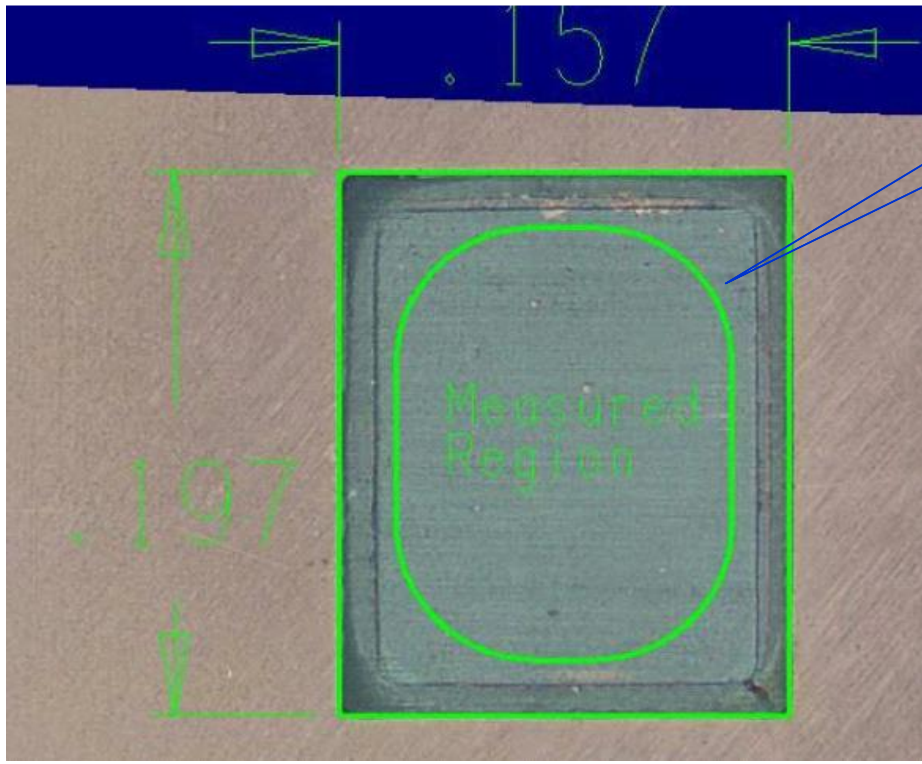
The Global Leader In
Thermal Management
Technology

**THERMAL FAMILY**

- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

## Advanced Substrate Technology

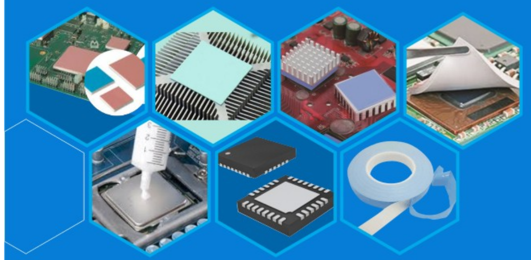
### Planar Solder Area inside line




Radius begins

# SinoGuide

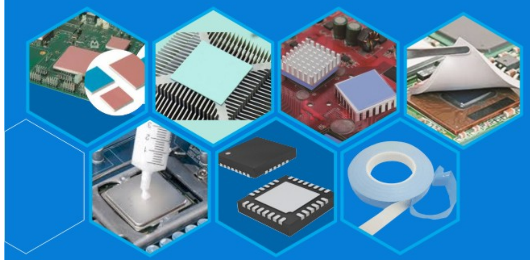
The Global Leader In
Thermal Management
Technology



**THERMAL FAMILY**
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

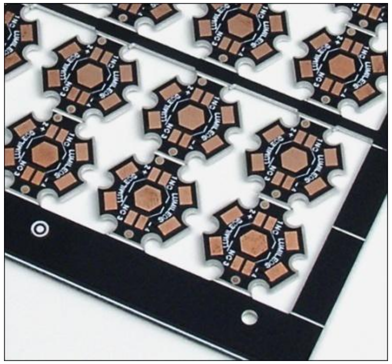
## Cost Drivers

- BOM
  - AL vs CU , & thickness
  - Circuit foil weight 1oz vs 10oz
  - Dielectric type and thickness
- Form Factor
  - Number of layers
  - Shape – round vs square
- Panel Utilization
  - What percentage of the panel is utilized
- Non Standard holes
  - c-sinks
  - Threaded
- Surface finishes
- Single piece or panelized array





# Key Advantages of the IMS Technology



- Measurable improvement in Watt-Density
- Simplified thermal design – due to IMS
- Reliability – dielectric and base plate integrity
- Array panelization available
- Structural rigidity which allows for features like threaded holes
- Variety of configurations available

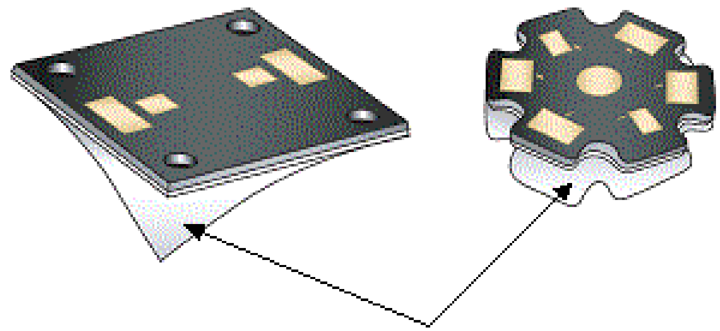
  - shape, dielectric & base plate

  - surface finishes for soldering and wire bonding

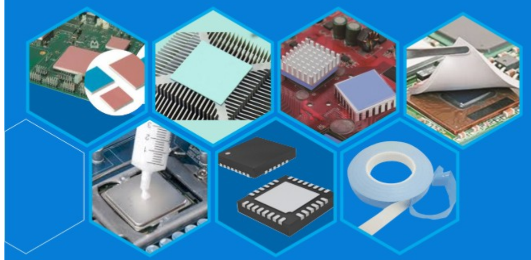
  - option for direct die bond to base plate

**THERMAL FAMILY**
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

# Combining IMS and Thermal Interface Materials




Bond Ply 450PA is pre-applied PSA thermally conductive tape withstands Reflow temperatures
> easy peel and place <





# Thermal Clad® - IMS Insulated Metal Substrate

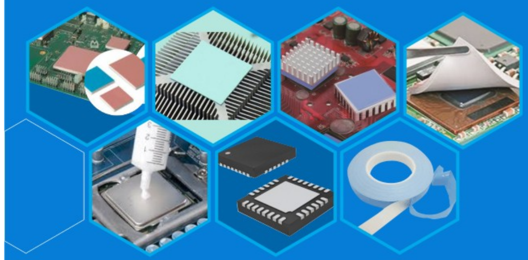
## KEY TAKE-AWAY POINTS

1. Three basic performance related decisions
   – **base metal** – type and thickness, **dielectric performance** and thickness and copper **circuit foil** thickness

**2.** **Soldermask** color and solder pad **surface finish**

**3.** **Part geometry** (shape) and format, single up or array

4. You may want to **consider a pre applied TIM** to improve performance and reduce cost





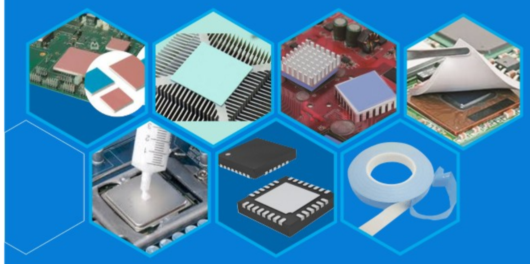
# MCPCB's and TIM Considerations for High Power LED Lighting Applications

## Outline

- Thermal management is key to your design
- Thermal performance of high power LED's
- Understanding thermal performance (reference data)
- MCPCB material options and part geometry
- Long term reliability concerns
- **TIM selection considerations, options that are available**
- Conclusions

# SinoGuide

The Global Leader In
Thermal Management
Technology



**THERMAL FAMILY**

- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

## Thermal Interface Materials (TIM) Intro:

### What is Thermal Interface Material?

- ✓ Used to optimize & achieve *consistent* thermal performance at component assembly interfaces
- ✓ Assembled interface surfaces do not align well due to planar mis-alignment (Micro & Macro)
- ✓ The consistent lowest cost solution

# SinoGuide

The Global Leader In
Thermal Management
Technology

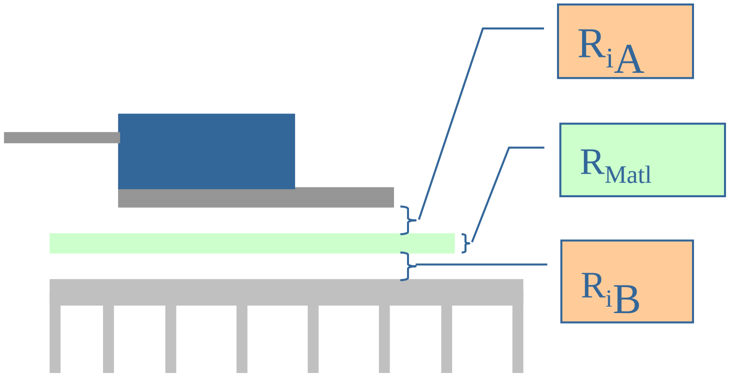
**THERMAL FAMILY**

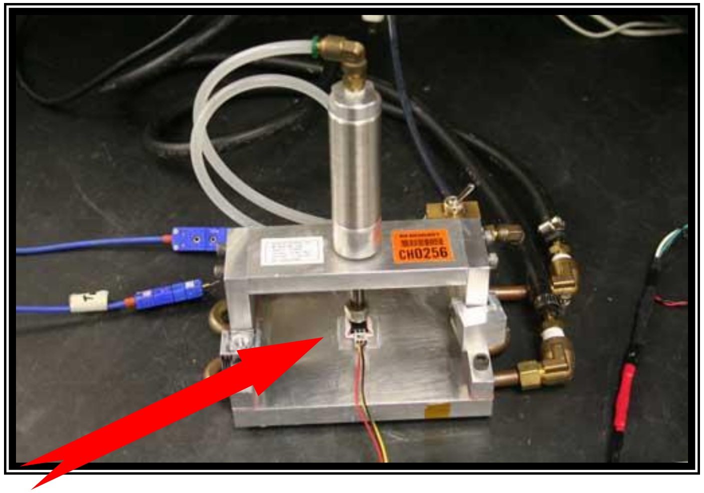
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

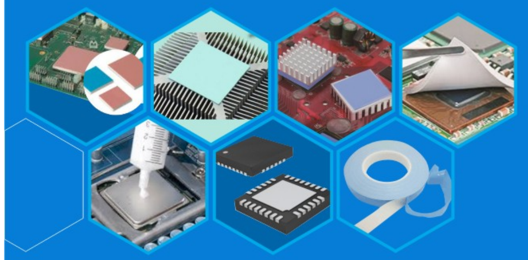
## Thermal Interface Materials (TIM) Intro:

TIM performance is typically optimized by:

- Maximizing thermal conductivity
- Maximizing wet-out (maintaining contact to adjacent surfaces)
- Minimizing bond line thickness



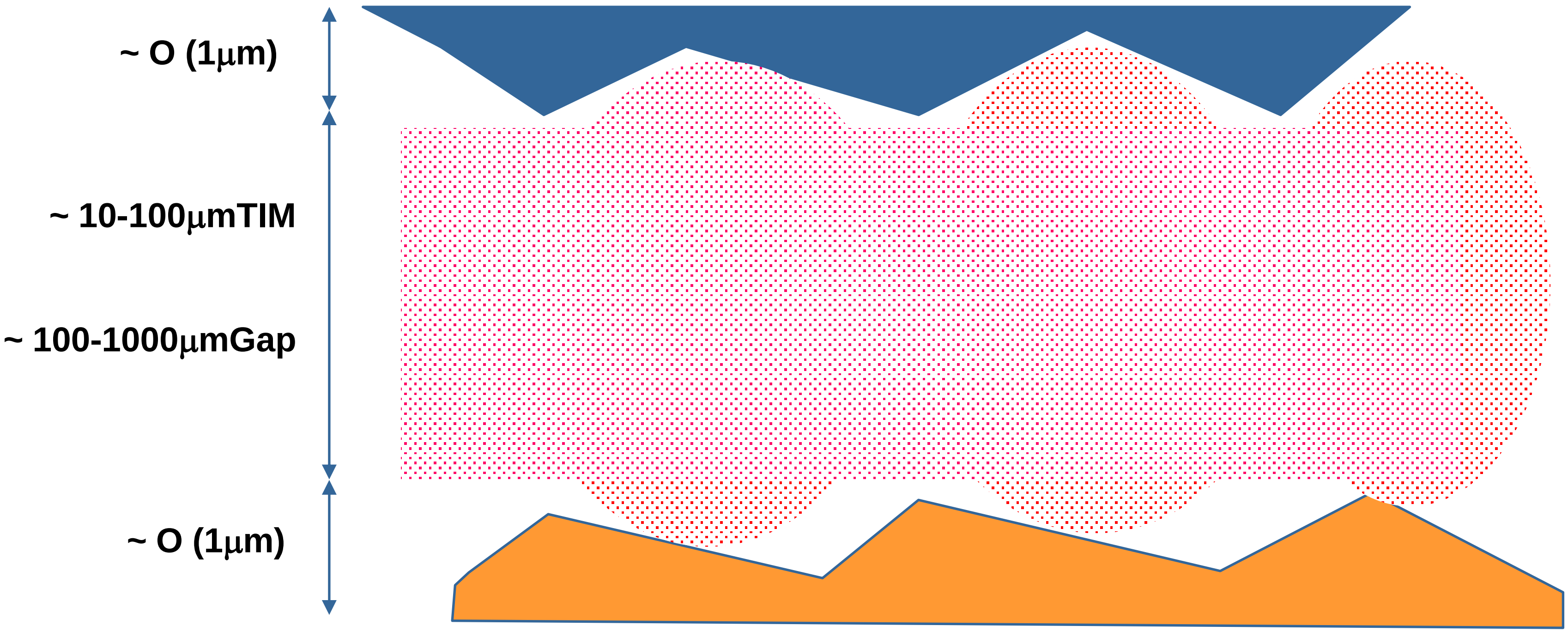



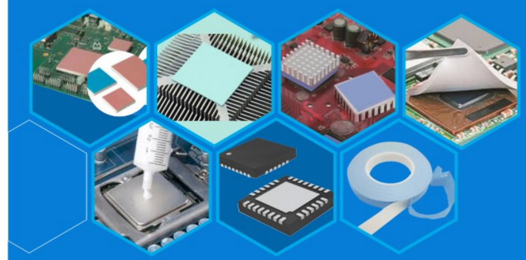




# Thermal Interface Materials (TIM) Intro:

## Typical Interface





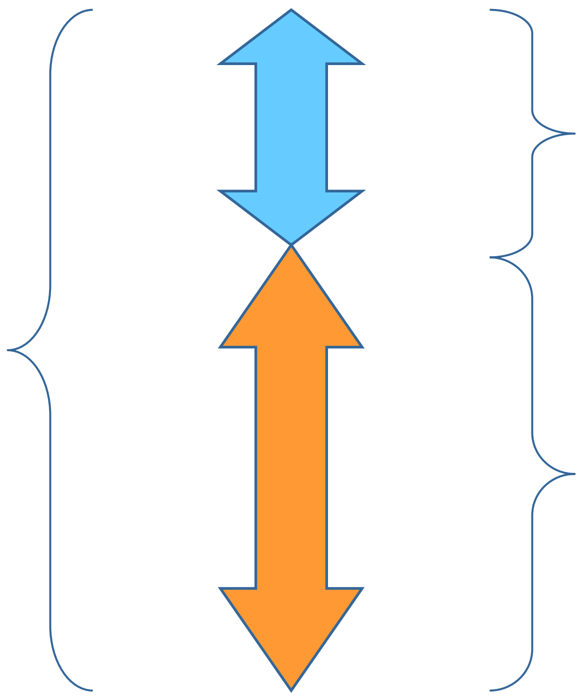
THERMAL FAMILY
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

# Thermal Interface Materials (TIM) Intro:

## Variables affecting Thermal Performance

$R_T$

Total Thermal Impedance Associated with TIM



$R_i$

**Contact Resistance**

- Complex to define-
- Surface Profile,
- Rheology
- Surface Tension
- Filler Attributes

$R_B$

**Bulk Resistance**

- L/k
- L is TIM thickness
- k is TIM Thermal Conductivity
- K depends on filler and concentration

# SinoGuide

The Global Leader In
Thermal Management
Technology

THERMAL FAMILY
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

## Thermal Interface Materials (TIM) Intro:

### Overview of TIM technologies today:

- Thermal Insulator Pads
- Thermal Gap Pads and Fillers
- Thermal Phase Change
- Thermal Adhesive Tapes
- Liquid Adhesives
- Compounds

# SinoGuide

The Global Leader In
Thermal Management
Technology

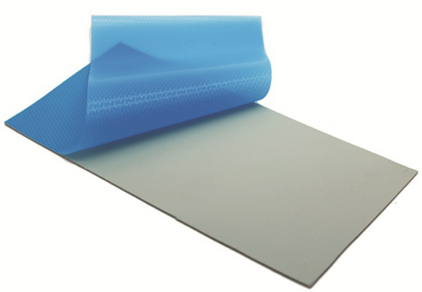
**THERMAL FAMILY**

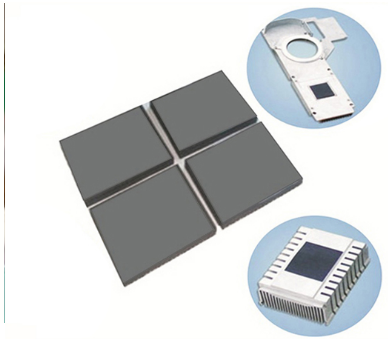
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

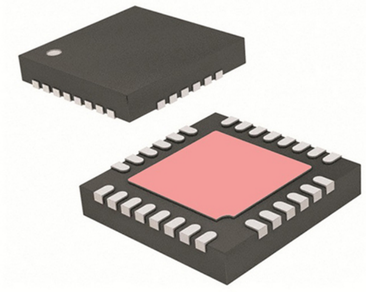
## Thermal Interface Materials (TIM) Intro:

### TIM construction and forms:

- ✓ Silicone & Sil-Free resin systems (Liquid or Pad Form)
- ✓ Thermally enhanced fillers (Al, BN, $Al_2O_3$, Al N…
- ✓ Carriers – pad form (Films, F/Glass, SP, Unsupported)
- ✓ Protective release Liners – Pad Form (PET, HDPE, LDPE…)
- ✓ Syringes, Tubes, Pails – Liquids (5 cc to 19k cc)

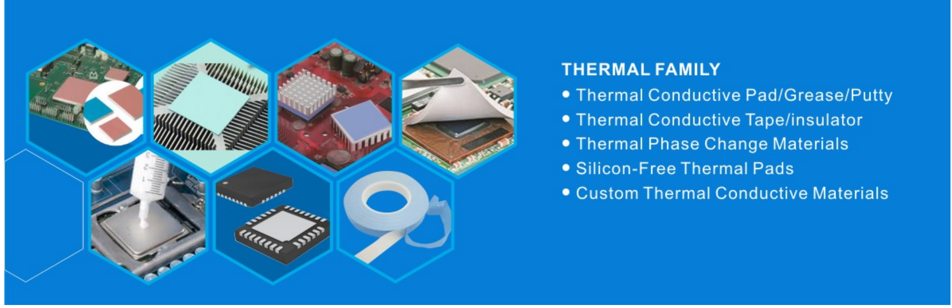






SinoGuide

The Global Leader In
Thermal Management
Technology




# Thermal Interface Materials (TIM) Intro:

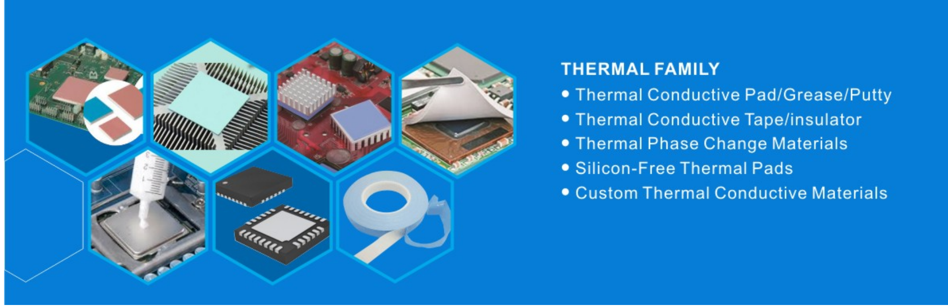
## Insulator Pads

- Insulator pads were the first thermally conductive insulators to replace mica and grease
- Insulator pads reduce the overall manufacturing costs of OEMs by reducing labor costs
- Insulator pads improve the overall quality and performance of electronic assemblies

SinoGuide™

SinoGuide

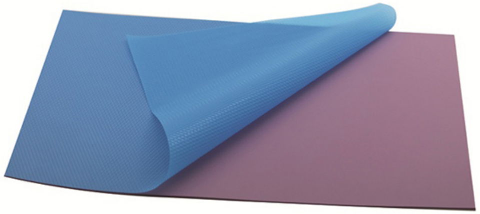
The Global Leader In
Thermal Management
Technology




# Thermal Interface Materials (TIM) Intro:

## Thermal Gap Pad and Gap Fillers

- Fill gaps created with different component topology and irregular heat sink surfaces
- Originally designed to cool digital components and eliminate costly “active” cooling solutions and reduce the overall cost of the OEM
- Now are commonly used in most all electronic applications
- Often times, the gap between the component and the heat sink is large as compared to that of a thermal pad application



SinoGuide™

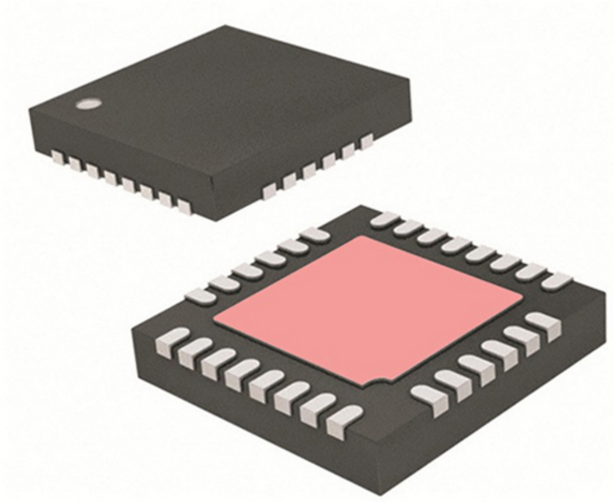


# Thermal Interface Materials (TIM) Intro:

## Thermal Phase Change

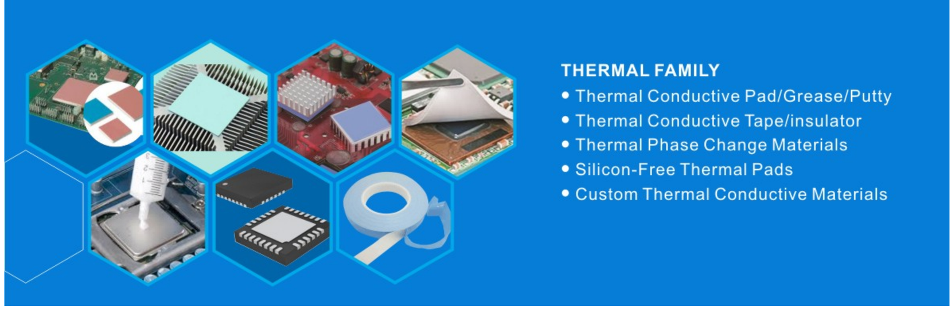
### Alternative to thermal grease

- Phase change materials change from a solid at specific temperatures and flow to assure total wet-out of the interface without overflow. (phase change)
- Can easily be automated
- Offers the best thermal performance of a pad type product
- Was originally design for high end processor applications



SinoGuide

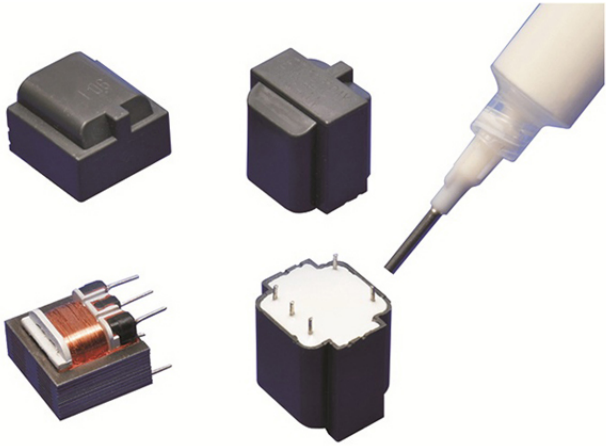
The Global Leader In Thermal Management Technology

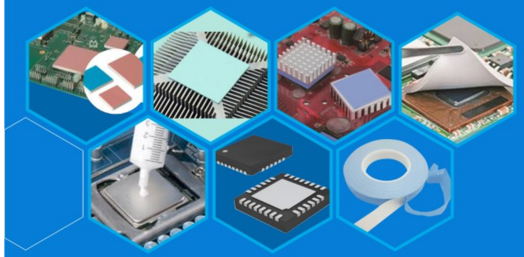



# Thermal Interface Materials (TIM) Intro:

## PSA and Liquid Adhesives

- PSA can adheres materials with mismatched CTE strong enough to bond, yet soft enough to let materials expand and contract at their own rate.
- Liquid adhesives are high performance, thermally conductive, bonding materials. They tend to be less forgiving with CTE mismatch.





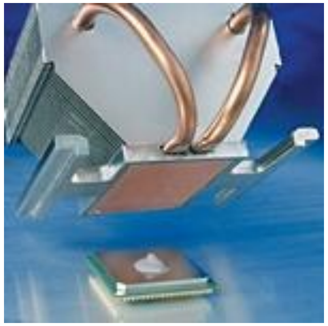
**THERMAL FAMILY**
- Thermal Conductive Pad/Grease/Putty
- Thermal Conductive Tape/insulator
- Thermal Phase Change Materials
- Silicon-Free Thermal Pads
- Custom Thermal Conductive Materials

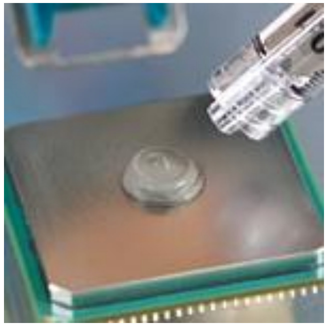
# Thermal Interface Materials (TIM) Intro:

## Thermal Interface Compounds

- High performance thermal greases are designed for use between a heat generating device or MCPCB and a heat sink

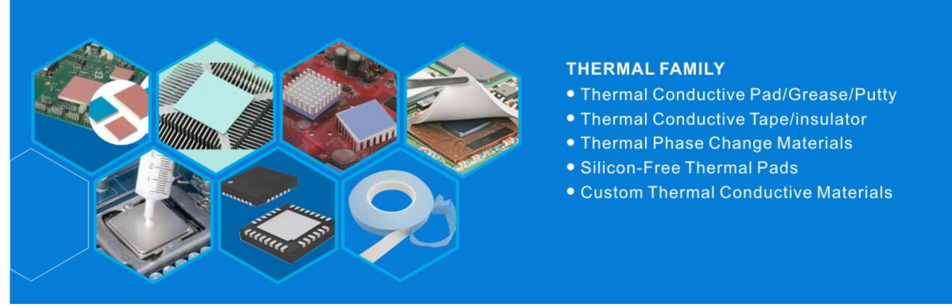
- Low performances greases can be used in place of high performance greases and thermal pads to reduce cost but be aware of potential long term performance issues





SinoGuide

The Global Leader In
Thermal Management
Technology




# MCPCB's and TIM Considerations for High Power LED Lighting Applications

## Outline

- Thermal management is key to your design
- Thermal performance of high power LED's
- Understanding thermal performance (reference data)
- MCPCB material options and part geometry
- Long term reliability concerns
- TIM selection considerations, options that are available
- **Conclusions**

SinoGuide™



# Conclusions

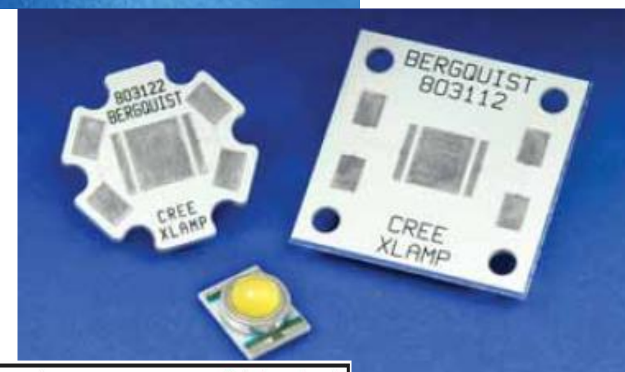
1. Understand the LED that you want to use
   - maximum operating temperature
   - Thermal resistance of the LED
2. Calculate the thermal stack-up
   - Considering all materials and interfaces
   - Model if can, try substituting various materials to determine best cost vs performance
3. Choose the appropriate dielectric material
   - Lower thermal resistance does not always mean lower $T\text{-}_{Rise}$
4. Choose the appropriate TIM material
   - Consider mechanical requirements
   - Try to minimize thermal resistance
5. Make sure you have an exit path for waste heat

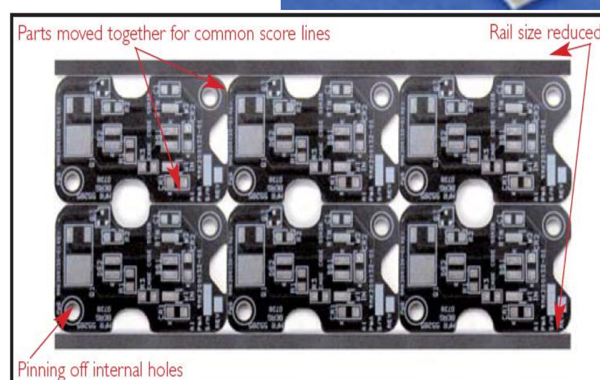
# SinoGuide

The Global Leader In
Thermal Management
Technology

## SinoGuide known for

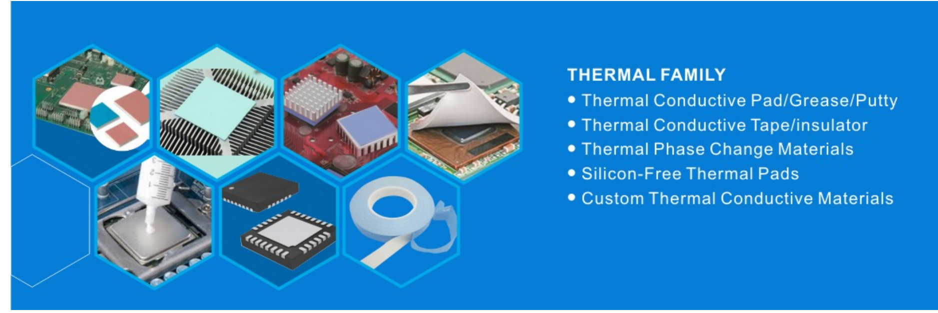
- Materials Manufacturer
  - ✓ Thermal Interface Materials
  - ✓ IMS Materials
- Circuit Provider for IMS
  - ✓ IMS circuits supplier
    - Component and COB level
    - Piece Part and Array´s
  - ✓ Active Base Plate Solutions
    - Electrical / Thermal Vias to Base
    - Selective Dielectric Removal
    - Pedestal Forming
  - ✓ Special Processes – 3D circuits



SinoGuide

The Global Leader In
Thermal Management
Technology




# Thank you!

For more information on The Sinoguide Technology, please visit our website at:

www.sinoguide.com

SinoGuide™

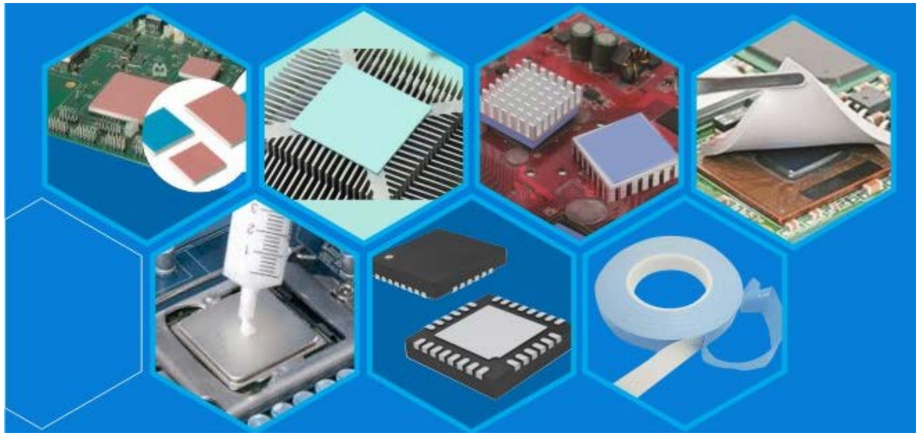
# SinoGuide

The Global Leader In
Thermal Management
Technology

**The SinoGiude Technology** designs and manufactures high performance thermal management materials used to dissipate heat and keep electronic components cool. Our Thermal T_Clad is a metal core printed circuit board (MCPCB) providing complete thermal management for COB, surface mount components, High Power LED's applications. Available in standard and custom configurations, SinoGuide Thermal T_Clad solutions provide better thermal management resulting in lower operating temperatures thus allowing extended LED life and increased light output. SinoGuide Thermal Interface Materials are some of the best-known brands in the industry including: Thermal Pad TCP, Gap Pad, Thermal Gap Fillers, TCG Series, and Thermal phase change grease replacement materials

SinoGuide is your total thermal management supplier

Please visit our web page at www.sinoguide.com



SinoGuide™