

**THE EPOCHAL THERMAL SOLUTION PROVIDER****Company Introduction**

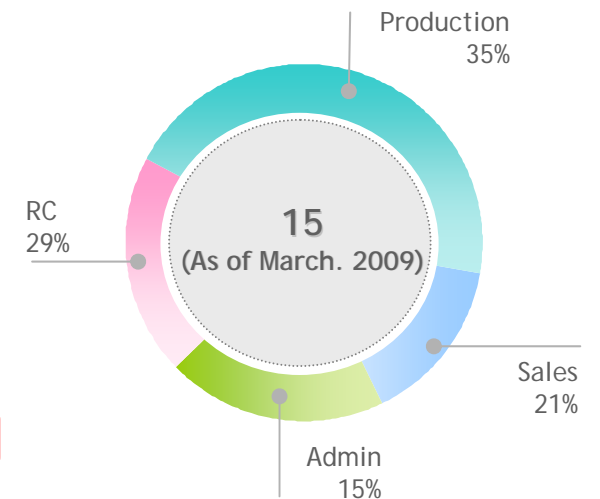
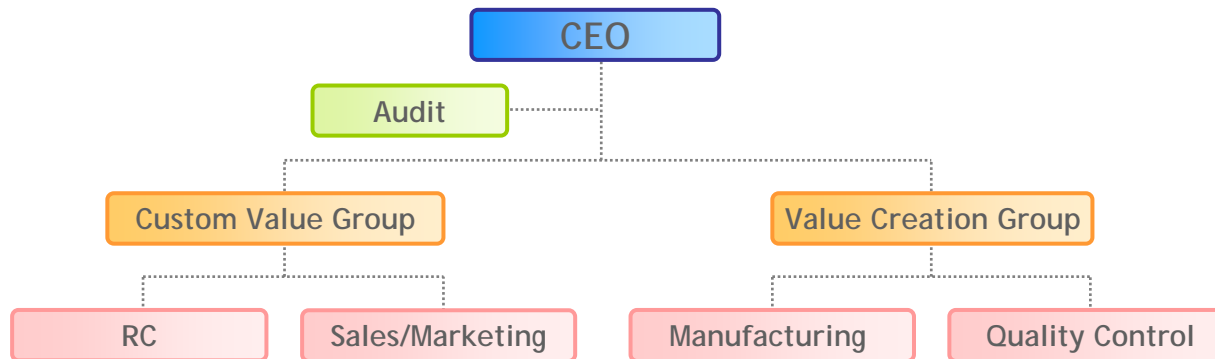
- Overview
- History
- Product
- Application

## CORPORATE OVERVIEW

### General Overview

Company Name	TTM Co., Ltd.
CEO/President	Eugene Choi
Established	November 14, 2003
Business Area	Epochal Thermal Solution for Electronics
Research Area	Thermal Interface Material with Nano Technology Thermal Management Device with Micro technology
Address	1F Venture Tower, 43-5 Chungnam Techno Park, Sameun-ri Jiksan-eup Chunan-si Chungnam Korea
Phone & FAX	HQ : 041-585-3755, FAX : 041-585-3756
E-Mail	<a href="mailto:ttm@coolttm.com">ttm@coolttm.com</a>
Web	<a href="http://www.coolttm.com">www.coolttm.com</a>

### Organization Structure



## CORPORATE HISTORY

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<b>2009 year</b>	Acquired Inno-Biz company
<b>2008 year</b>	Registered the special company for the parts and the material from Korea Government Selected the company of small enterprise technical innovation project in Korea Selected the company of the regional technical development project in Korea Selected the company of Technical Completion project in in Korea
<b>2007 year</b>	Certified partner of OSRAM's LLFY for APAC Launching MTRAN MM in domestic retail market Approved as 1 <sup>st</sup> Tier Supplier of Samsung Electronics Conclude distribution Agreement with Bothhand in Taiwan
<b>2006 year</b>	Investment from Venture Capital LG Conclude a MOU with LG Micron
<b>2005 year</b>	Selected as Korean Government Supported Display Thermal Solution Research Company Selected the company of small enterprise technical innovation project in Korea Selected as Korean Government Supported Conclude a MOU with Samsung Acquired ISO9001/ISO14001 Acquired Korean Good Technology Mark (KT Mark)
<b>2004 year</b>	Authenticated Venture Company with Innovative Technology by Korean Government Selected as The Center of Excellence by SIEMENS Authenticated Venture Company by 'Ministry of Commerce, Industry & Energy Korea' - Subject: Nano Hydraulic Fluid Cooling Apparatus Development Foundation of TTM Co., Ltd. Research & Development Center ETRI (Electronics & Telecommunications Research Institute) – Technology Transfer Agreement Contract
<b>2003 year</b>	TTM Co., Ltd. Foundation

## MTRAN®

### Feature

- Micro Technology
- Working Fluid : Acetone
- Thermal Performance : Up to 310W
- Ultra-Slim Flat HEATPIPE (Thickness:1.2 ~ 2.5mm)
- Light Weight, Great Uniformity
- Custom Size Available

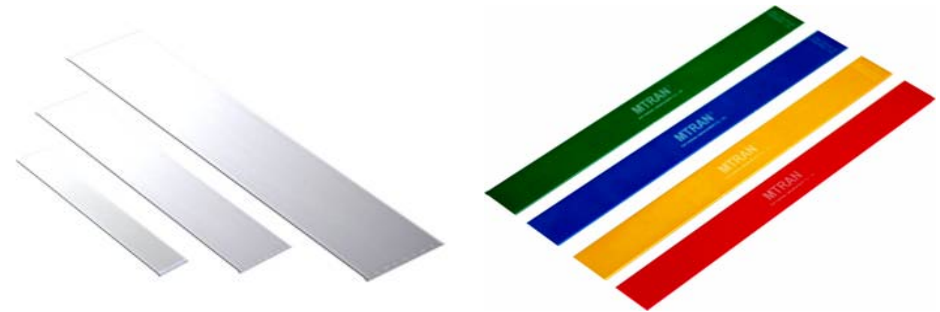
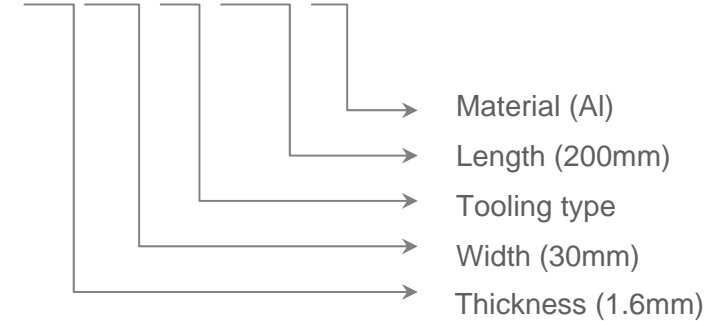
### Application

- Memory, CPU, GPU
- LED Lighting
- Optical Communication Module
- Telecommunications Network Test Equipment

### Specification

Part Name	Thickness [mm]	Width [mm]	Length [mm]	Heat Transfer Rate [W]	Material
TMT-1220B125A	1.2	20	125	5 ~ 18	Aluminum
TMT-1223A125A	1.2	23	125	5 ~ 18	
TMT-1630C200A	1.6	30	200	14 ~ 75	
TMT-2040A150A	2.0	40	150	35 ~ 120	
TMT-2550A150A	2.5	50	150	75 ~ 270	

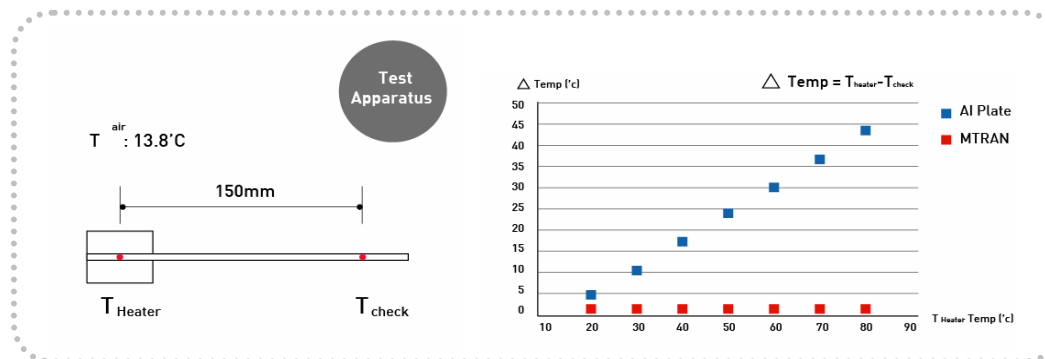
## TMT-1630C200A



## MTRAN®

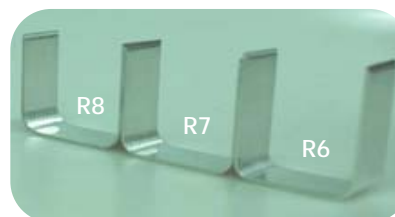
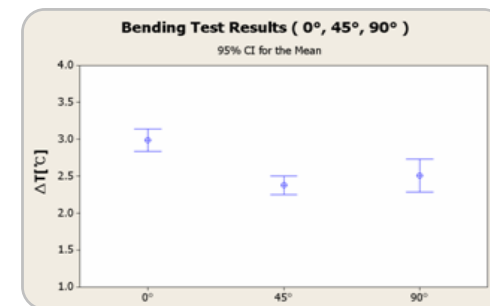
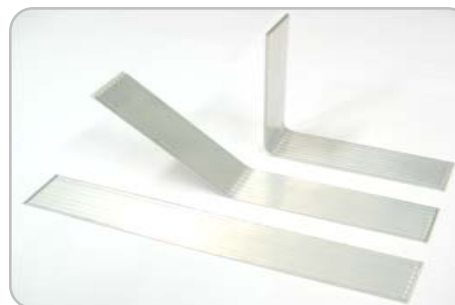
### Thermal Characteristic

- Horizontal Mode Test Result
- Superior Thermal Conductivity
- Superior Thermal Uniformity

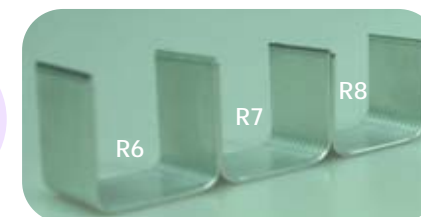
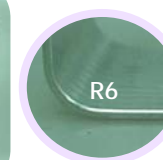


### Various bending angle

- Test Result under Bended Status
- Bending Angle: 0°, 45°, 90°
- Recommendable Bend Radius: R6
- No Performance Drop & Bulging Plane



<TMT-1220B>

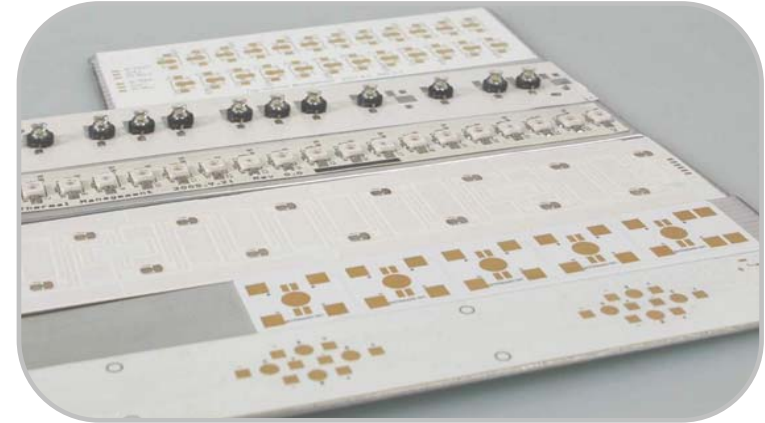


<TMT-1630C>

## MTRAN® PCB

### Feature

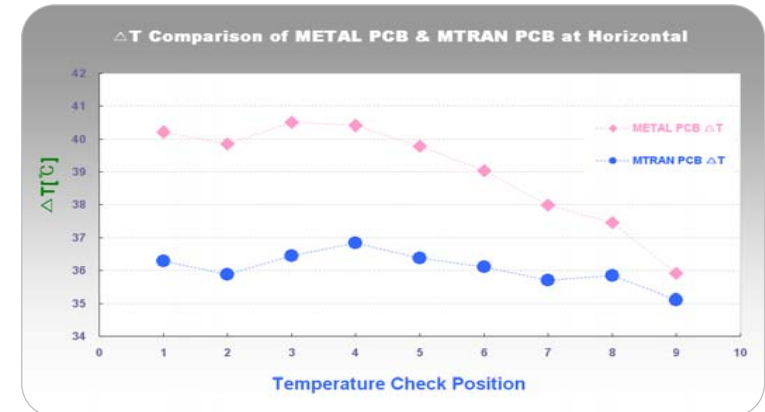
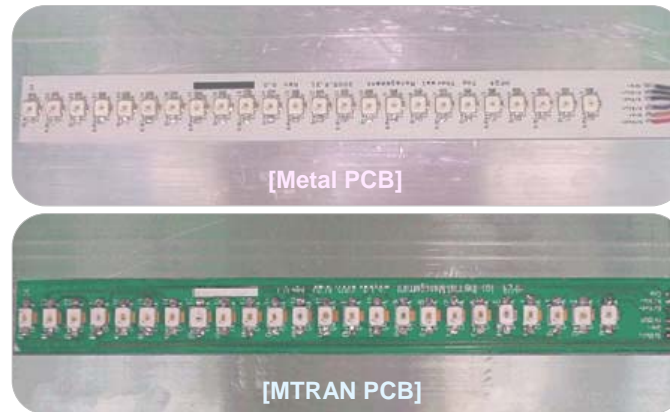
- Micro Technology
- Lower the junction temperature
- Make the temperature uniform over the LEDs
- Light Weight, Great Uniformity
- Custom Size Available
- Superior Performance than MCPCB



### Application

- Application for Display Cooling Module using LED Source
- Application for Cooling Module for Lighting System using LED
- Application for Electronics/Telecommunication Devices and other devices need cooling through PCB

### Test Result



## NANOTIM® TGS (Thermal Grease)

### Feature

- Nano Technology
- Great oxidization stability at high temperature
- Reduced thermal resistance
- RoHS Compliance



### Application

Thermal Interface Material between Heat Source and Heat sink

### Specification

Items	Unit	TGS-A300	TGS-C200
Color	-	Gray	White
Thermal Conductivity	W/m·K	4.0	1.7
Specific Heat	kJ/kg·K	0.8	0.9
Specific Gravity	-	2.6	2.8
Capacity Resistance	$\Omega \cdot m$	$2.0 \times 10^{13}$	$2.1 \times 10^{13}$
Usable Temp. Range	°C	0 ~ 150	0 ~ 150
RoHS	-	Not Detected	Not Detected

## NANOTIM® PCM (Phase Change Material)

### Feature

- High thermal conductivity
- Low thermal resistance
- Low phase change temperature
- Electrical stability & high reliability
- RoHS Compliance

### Application

- Memory module
- Micro processor unit
- Graphic processor unit
- Chipsets



### Specification

Items	Unit	NANOTIM PCM25C5	NANOTIM PCM25D5
Color	-	Gray	Gray
Thickness	mm	0.25	0.35
Thermal Conductivity	W/m·K	4.0	4.0
Specific Gravity	-	3.2	3.2
Specific Heat	kJ/kg·K	0.75	0.75
Phase Change Temperature	°C	45	45
Operating Temperature Range	°C	- 45 ~ 125	- 45 ~ 125
Volume Resistance	Ω·m	2.5X10 <sup>13</sup>	2.5X10 <sup>13</sup>
RoHS	-	Not Detected	Not Detected



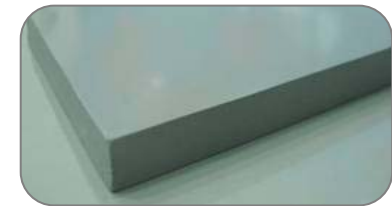
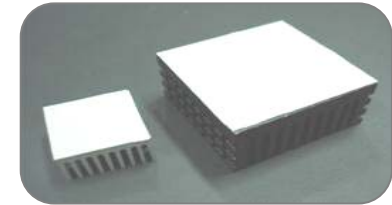
## NANOTIM<sup>®</sup> SPS (Silicon Thermal Pad)

### Feature

Conformable, low hardness  
 Isolated electrically  
 Minimized interfacial resistance  
 Superior Thermal conductivity  
 Superior self tacky

### Application

FPD like LCD TV, PDP TV  
 Computers  
 Telecommunications  
 Electronics equipment  
 Power Converter



### Specification

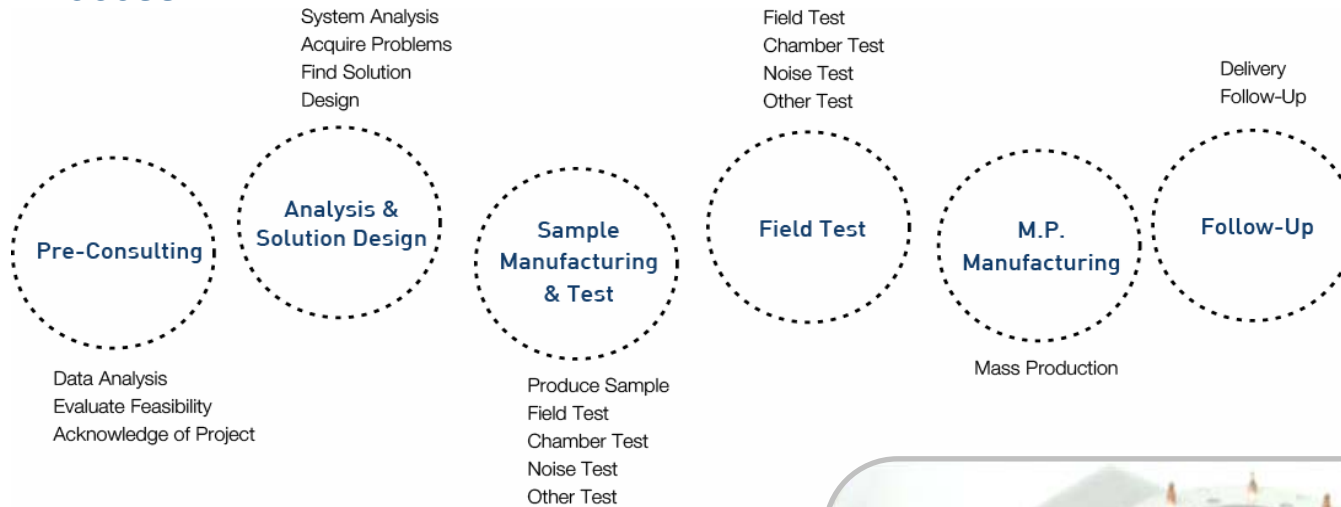
Items	Test Conditions	Units	Data	Note
Hardness	Shore 00	-	40±5	ASTM D2240
Density	25 °C, Gravimeter	g/cm <sup>3</sup>	2.5±0.1	ASTM D792
Thickness	Mitsutoyo	mm	(2.0~10) )±0.3	
Thermal Conductivity	QTM-500	W/m·K	1.55±0.1	ASTM D5470
Inflammability	Vertical Burning Test	-	V-0 suitable	UL94
Volume Resistance	-	Ω·cm	1.0X10 <sup>14</sup>	ASTM D257
Breakdown Voltage	-	kV	> 15	ASTM D149
Thermal Stability	- 40 ~ 150 °C	-	No Change	
Part Name	Dim. [mm]	Note		
SPS-1620NA-A0	215X215X2	Self Tacky		
SPS-1660NA-A0	215X215X6	Self Tacky		
SPS-1503SAP-A2	1000X1000X0.3	One side Adhesive		

## T-SET (Customized Design Module)

### Feature

Customized design module by distinguished heat flow analysis consult  
 Suggest cooling solution methodical thesis appropriate for characteristics of various systems

### Process



### Application

LED Lighting Module  
 Network Switching Equipment  
 Computer & Telecommunication Equipment

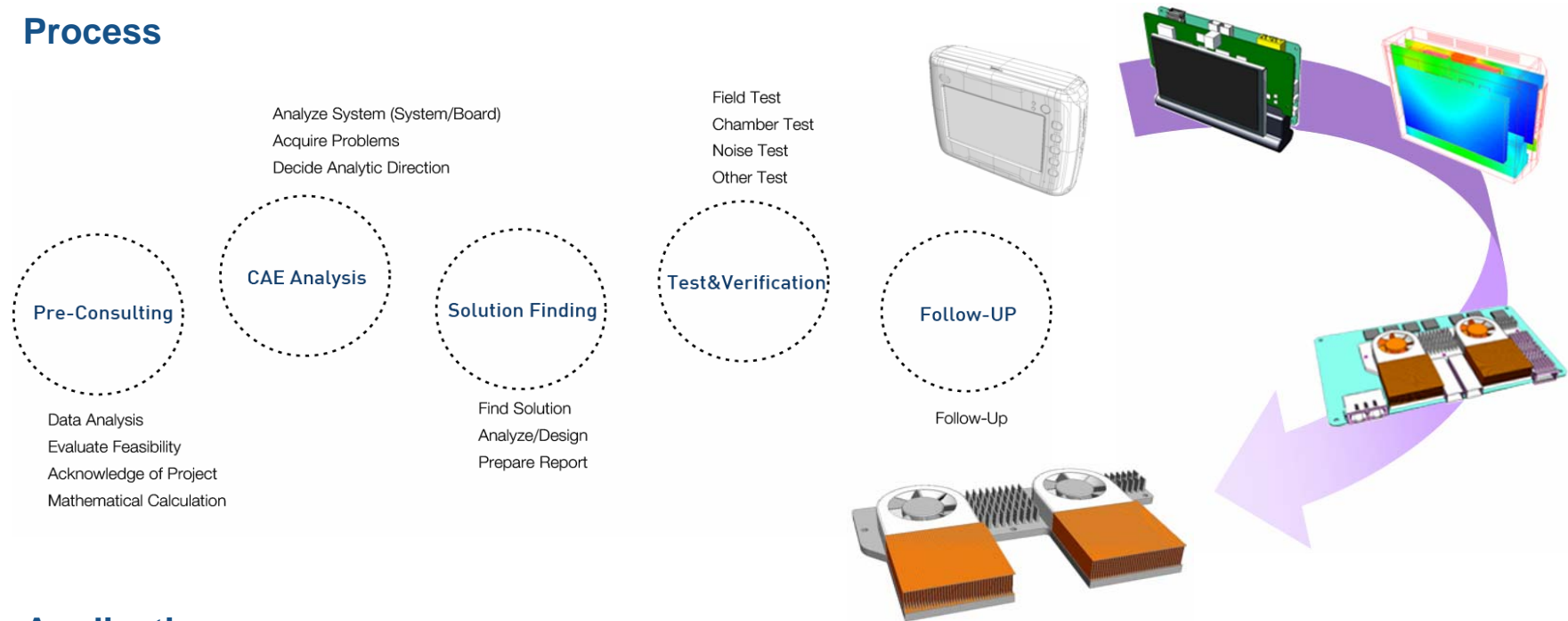


## T-SPOT (Thermal Consulting Service)

### Feature

- Overall heat flow analysis consult
- Suggest cooling solution methodical thesis appropriate for characteristics of variable systems

### Process

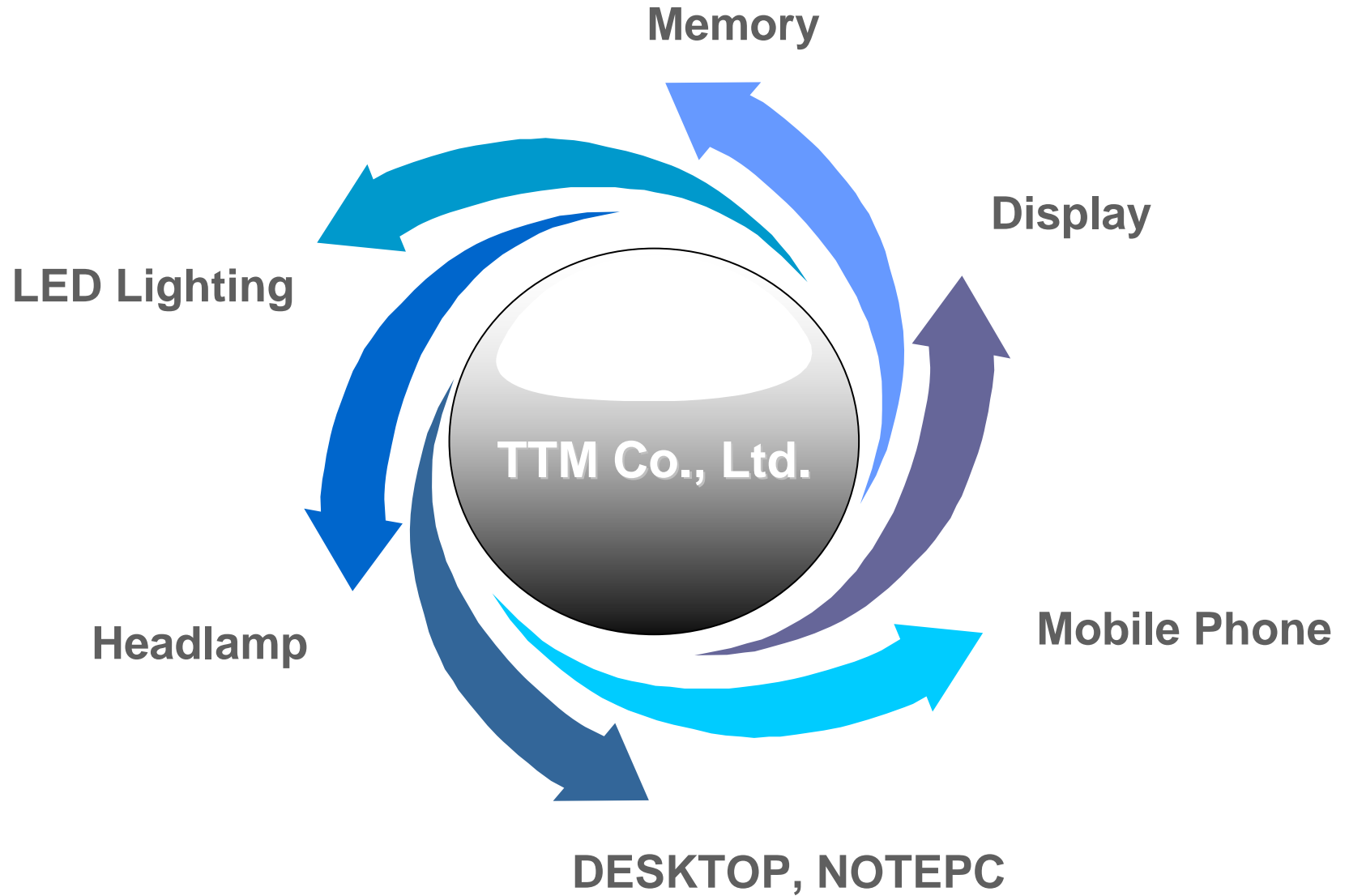


### Application

- SFT Module / LED BLU System / Home Sever / DVR System / 1U Server System
- Burn Wet Scrubber System / 300mm Dryer

**APPLICATION FIELD**

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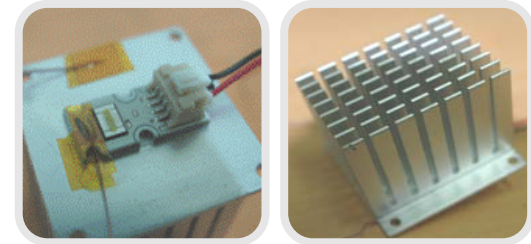
## High Power LED Temperature Difference

### 10W LED Cooling Test



- Thermal Test Apparatus -

- H/W : Personal Daq/56
- S/W : DasyLab 9.0
- Thermocouple : T - type



- Temperature Check Points -

Case	Check Point	Ambient	$\Delta T$
1	93.7	24.4	69.3
2	76.3	24.2	52.1
3	68.4	25.1	43.3

17°C ↓  
9°C ↓

- Result

- 1) Case 2 : Only applied MTRAN → About 17 Degree C dropped
- 2) Case 3 : Applied MTRAN with additional heat sink at the right side and left side on MTRAN → Drop 9 Degree C Additionally

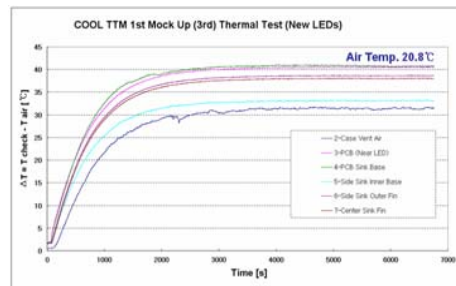
## APPLICATION – LED Electric-Light Bulb

### General Specification

Items	Unit	Value
MTRAN Dimension	mm	TMT-1630C100A (U-Bending)
Outside Dimension	mm	φ 51 X 42
Weight	g	84.3
Power Capability	W	6
LED Base Temp.	°C	65
Amb. Temp.	°C	21
Thermal Resistance	°C/W	7.33



### Test Results



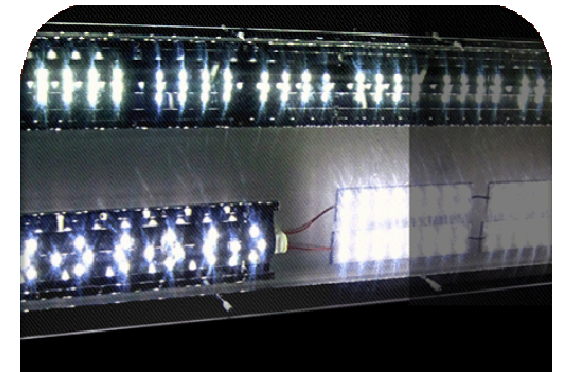
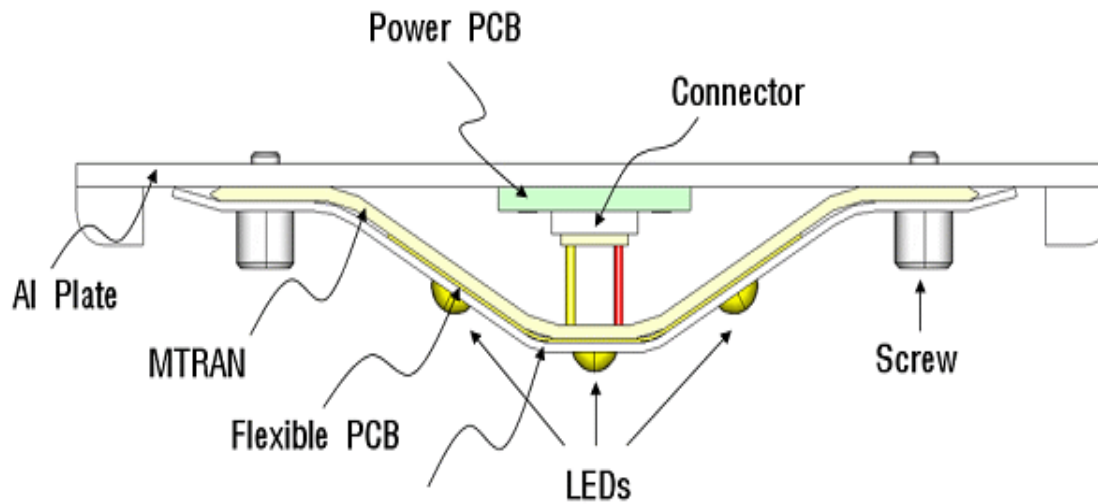
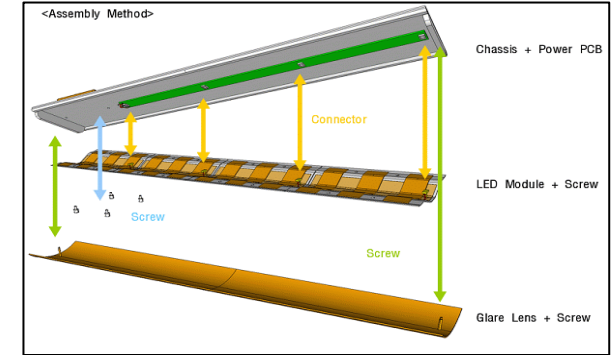
ΔT [°C]	Inner Sink	Side Sink	PCB (Near LED)
<b>Original Module (Al Sink+Other)</b>	66.6	55.3	<b>68.0</b>
Simulation (Original)	69.0	68.3	70.2
Simulation (Cu Sink)	75.9	-	76.8
Simulation (MTRAN Concept 1)	63.9	62.1	65.4
<b>Simulation (MTRAN Concept 2)</b>	55.9	54.7	<b>56.6</b>
<b>New Module (original LEDs)</b>	46.2	45.5	<b>44.5</b>
<b>New Module (New LEDs)</b>	40.7	38.6	<b>40.5</b>

- Performance improvement : 27.5°C

## APPLICATION – LED Fluorescent Lamp

### Feature

- Energy Efficient Lamp – Energy Save
- Environmental-Friendly Products
- MTRAN Used (Maximize the Thermal Performance)
- Excellent Optical Efficiency



## MTRAN<sup>®</sup> MM

### Feature

- MTRAN Embedded Memory Cooler
- MEMS Technology
- Rapid acceleration of heat dissipation
- Light Weight
- Great Thermal Uniformity

### Application

- Various Memory type Supported
  - Unbuffered DIMM
  - Registered DIMM
  - Fully Buffered DIMM

### Specification

Part Name	MTRAN Dim. [mm]	COLOR	CLIP Dim. [mm]	TIM	WEIGHT [g]
MTRAN TANK	125.5X23.0X1.2 (2pcs)	Green	50.3X25.0X8.0 (2pcs)	PCM25D5	27.3
MTRAN WINE	125.5X23.0X1.2 (2pcs)	Wine	66.0X17.6X7.5 (1pcs)	PCM25D5	19.2
MTRAN TECHNO	125.5X23.0X1.2 (2pcs)	Cobalt	6.8X8.8X18.4 (2pcs)	PCM25D5	18.7

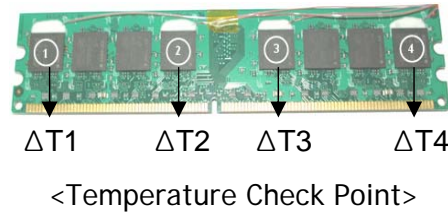




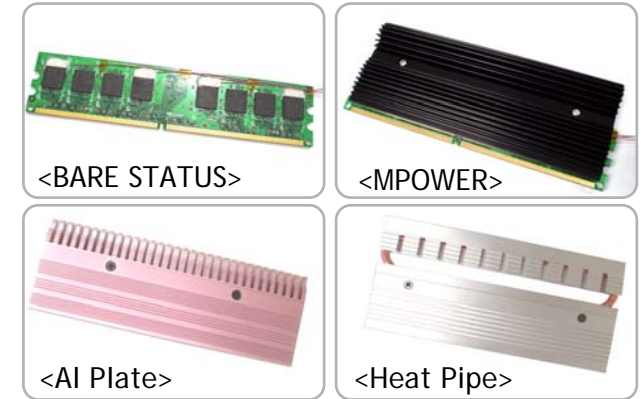
## MTRAN<sup>®</sup> MPOWER

### Test Environment & Condition

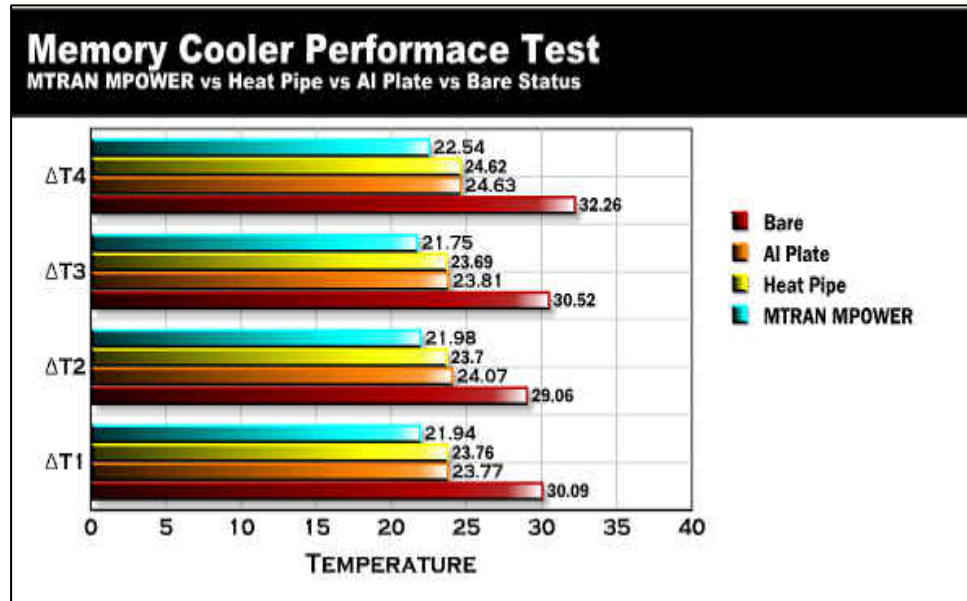
- Board : ASUS P5B-V STCOM
- CPU : Intel Core2Duo Conroe E4400
- Memory : Cynex DDR2 1G PC2-6400
- HDD : SATA 7200rpm 160GB HDD



### Test Sample Used



### Test Result



		Bare	Al Plate	Heat Pipe	MTRAN MPOWER
1	ΔT <sub>1</sub>	30.09	23.77	23.76	21.94
2	ΔT <sub>2</sub>	29.06	24.07	23.7	21.98
3	ΔT <sub>3</sub>	30.52	23.81	23.69	21.75
4	ΔT <sub>4</sub>	32.26	24.63	24.62	22.54

## SUMMARY

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### EPOCHAL THERMAL SOLUTION PROVIDER

#### MTRAN®

- MTRAN Basic
- MTRAN PCB – MTRAN Embedded PCB
- MTRAN MM – TANK, WINE, TECHNO

#### NANOTIM®

- NANOTIM TGS – Thermal Grease
- NANOTIM PCM – Phase Change Material
- NANOTIM SPS – Silicon Thermal PAD

#### T-SET

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

#### T-SPOT

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