MG ITALY

Pioneering Mechanics. Leading Innovation

INTRODUCTION FLAT HEAT PIPE (MG-FHP)

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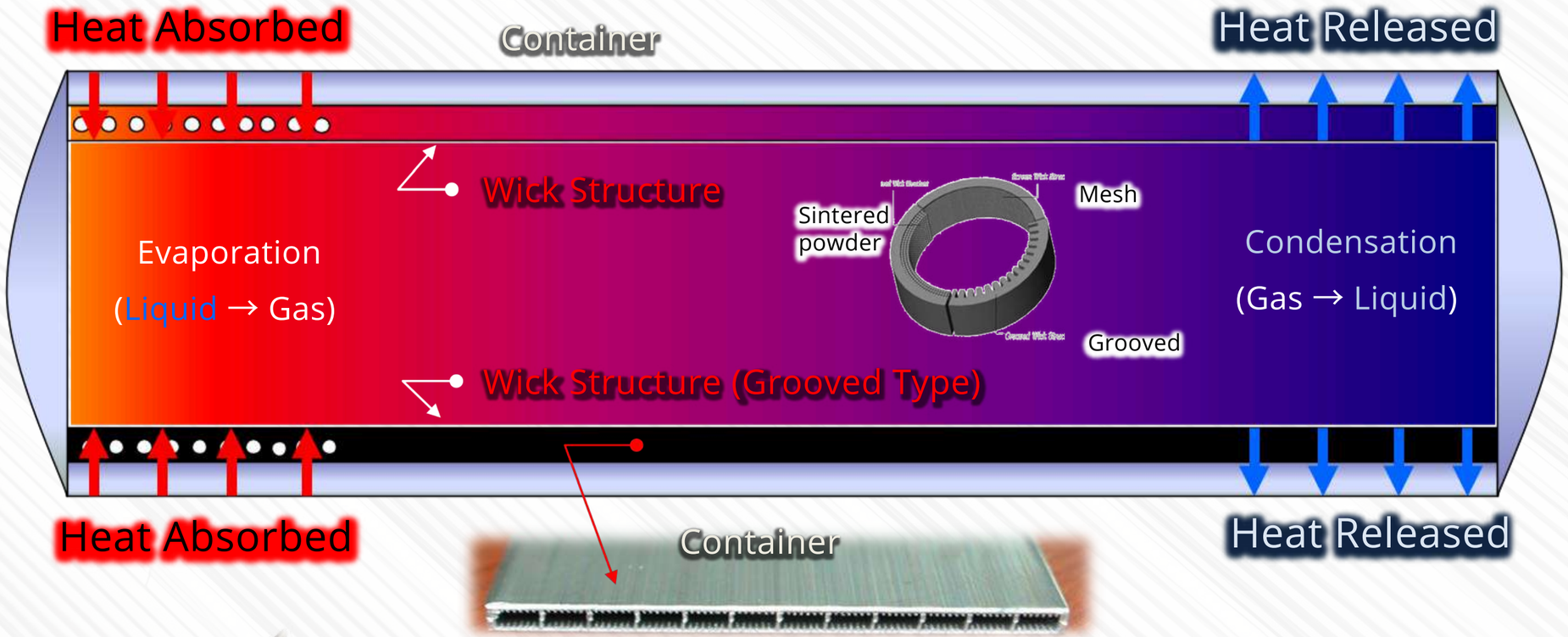
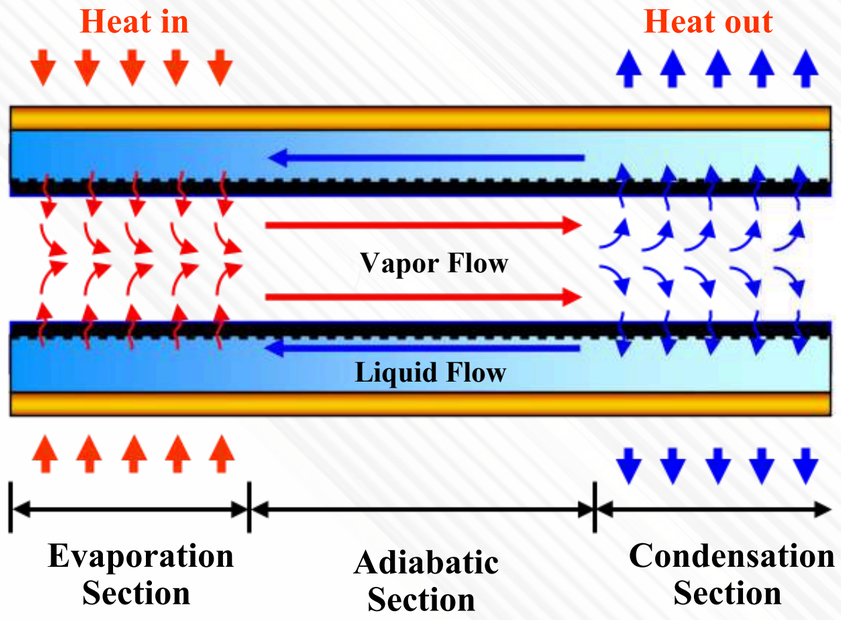
MG-FHP → FLAT MICRO HEAT PIPE



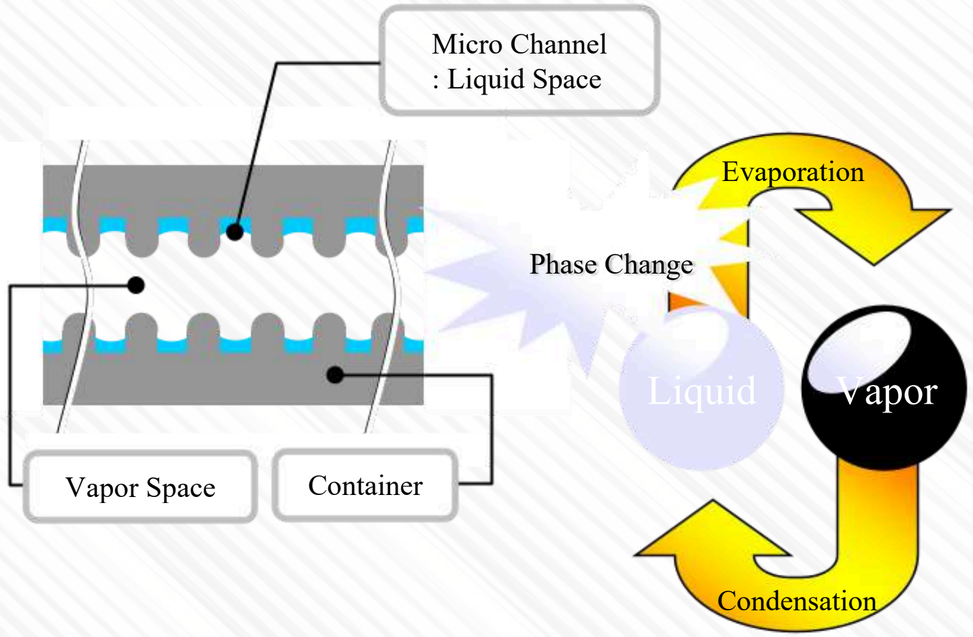
MG-FHP → WORKING MECHANISM

Phase Change Technology : Conduction & Convection Heat Transfer Mechanism Working Process :

1. Heat applied to the evaporator section by an external heat source is conducted through the MG-FHP wall.
2. Working fluids are vaporized then, working fluids through the vapor section to the condenser section.
3. Then releasing its latent heat of vaporization to the external cooler module of condenser section.
4. And working fluids return to the evaporator section in the liquid phase by the capillary pressure or gravitational force.



< Working Mechanism of MG-FHP >

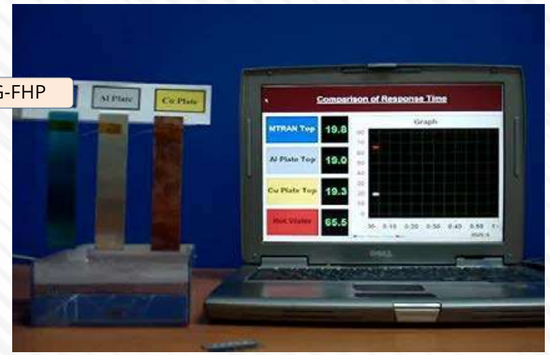


< Cross Sectional Area of MG-FHP >

MG-FHP → UNIQUE CHARACTERISTIC

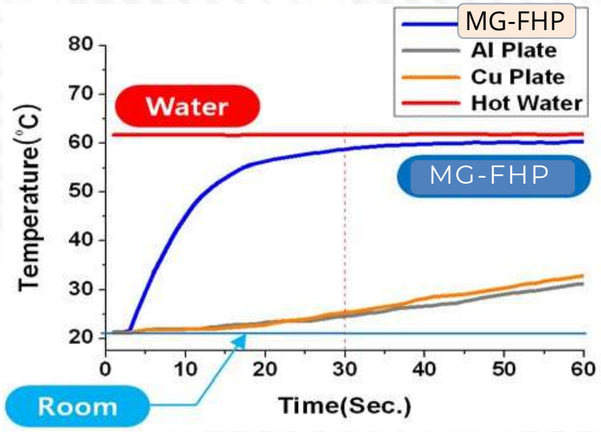
A. Thermal Responsibility

Unsteady State (=Transient)



※ MG-FHP, Cu Plate and Al Plate

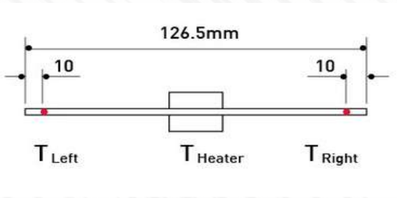
Dimension : T-1.2t, W-23mm, L-125mm

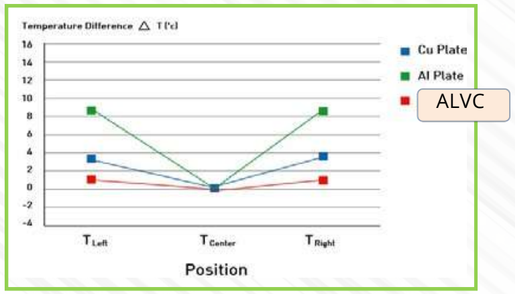


Superb Fastest
Heat Transfer Media

B. Uniform Thermal Equilibrium

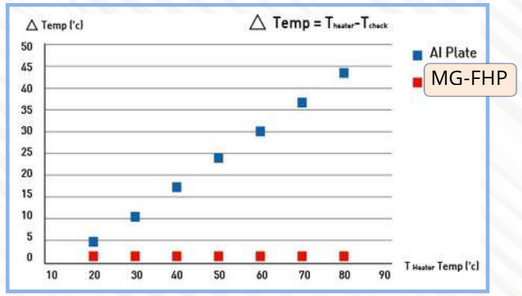
Steady State (=Saturation)





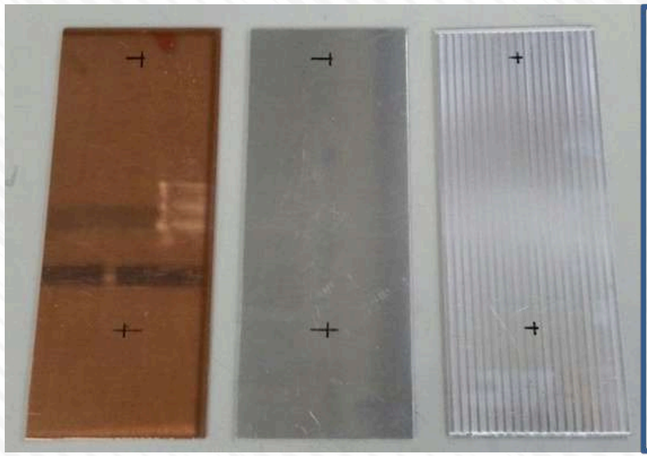
Uniform Temperature→ $T_{Heater} - T_{Side} \leq 1℃$

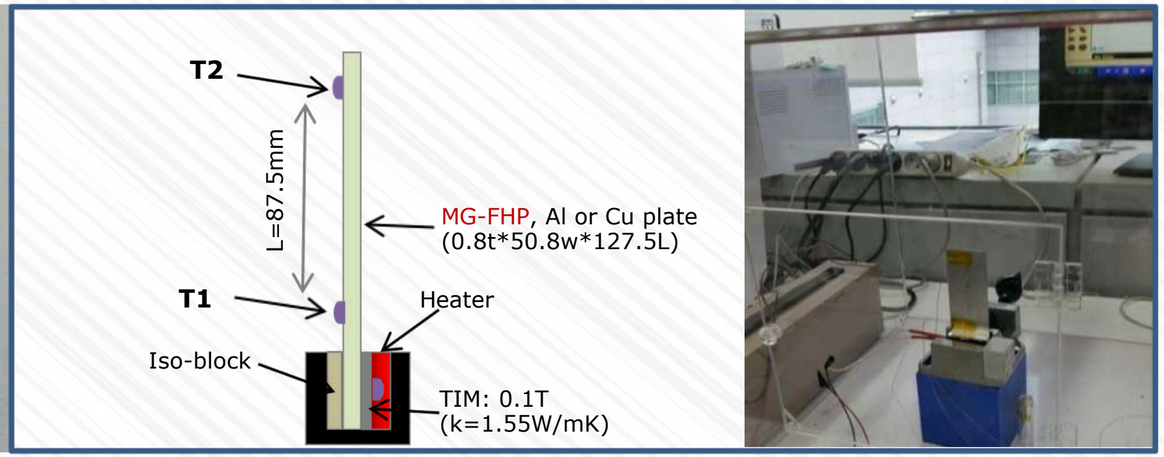
C. High Heat Treatment Capacity



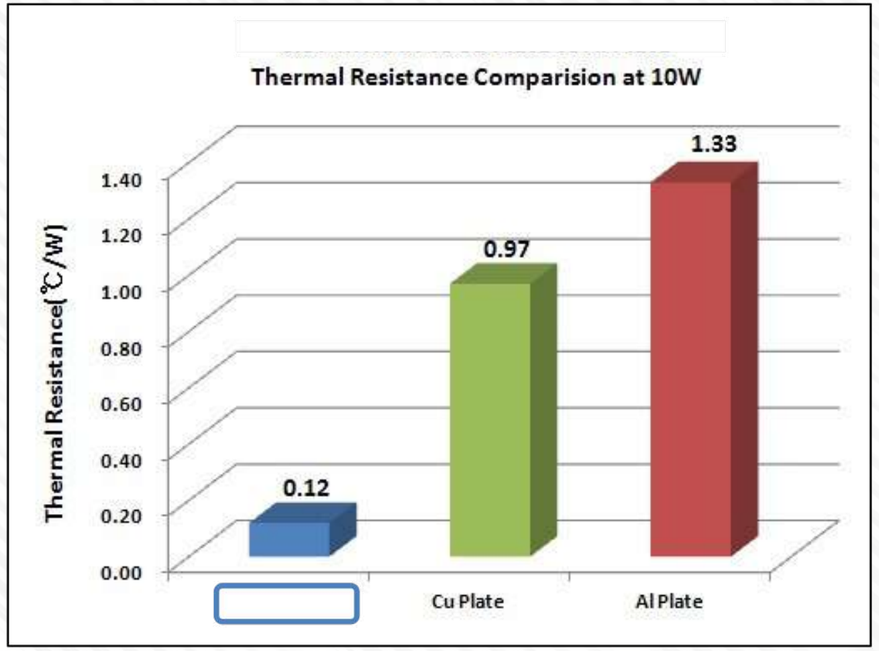
Even if the temperature is increased,
It maintains a small temperature difference.

MG-FHP → LOW THERMAL RESISTANCE (COMPARISON)





Material		MG-FHP	Al plate	Cu plate
Size(mm)		50.8W x 127.5L x 0.8T		
Weight(g)		10.8	13.7	46.1
ΔT (T1-T2)	10W	1.2℃	13.3℃	9.7℃



Slim MG-FHP has light weight compare to Aluminum and Copper at same size

MG-FHP → UNIQUE CHARACTERISTIC

- **Cost-effective Material: Aluminum**

- **Ultra Thin and Light**

  - Thickness: 1.5~6.0mm - Weight: only 1/3~1/2 of Solid Aluminum

- **Superior Thermal Performance**

  - Thermal Conductivity up to 10,000W/mK -

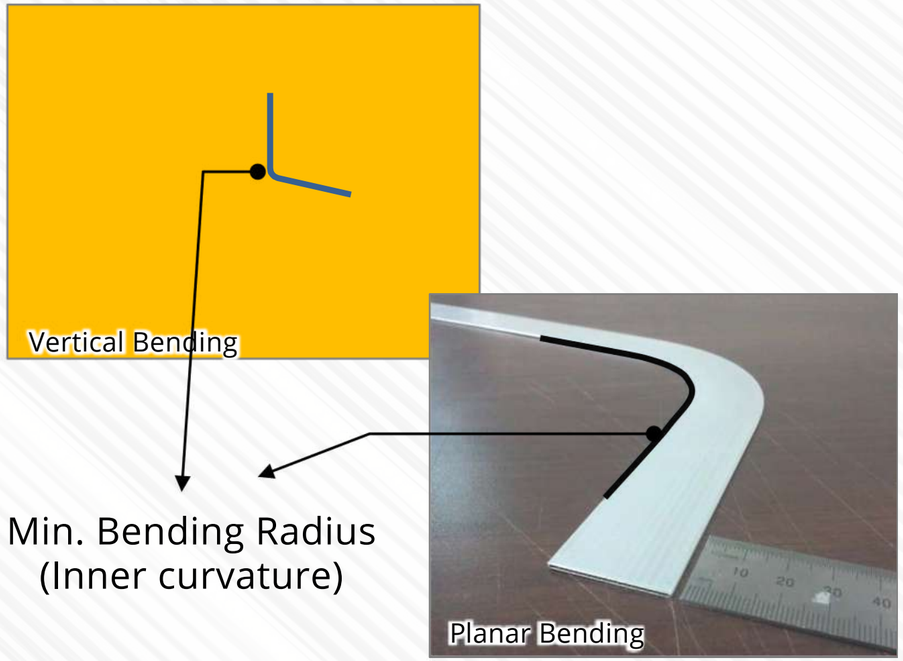
  Q_{max} : up to 250 W/unit

  - T (T_{evap} – T_{cond}) : lower than 1°C

- **Planner Bending Ability**

- **Wide Width**

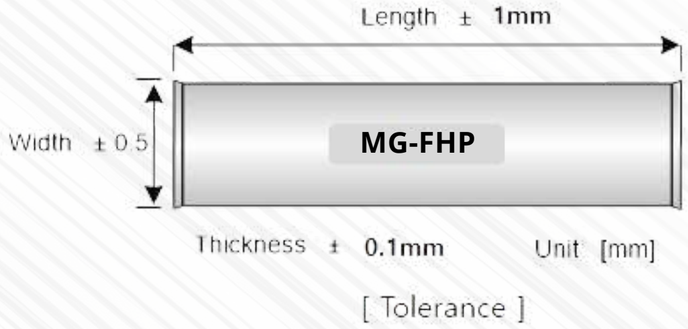
  -Normal Width : ≤ 30mm



MG-FHP → BASIC SPECIFICATIONS

▣ MG-FHP = Aluminum Vapor Chamber

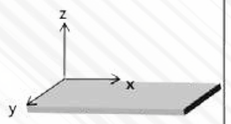
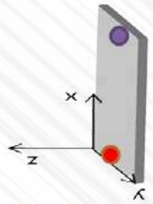
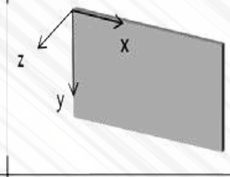
ITEM	Description
Material of Container	3003/1050/6061
Wick Structure	Grooved Wick
Working Fluids	Acetone etc.
Typical Thermal Resistance	< 0.4℃/W (Straight, No Bending)
Operating Inclination(θ)	0 ~ 90°
Leakage Temperature	~190℃ (Normal Thickness)
Vertical bending angle (Min)	2x Thickness
Planner bending angle (Min)	R35
Planner bending width (Min)	≤30mm
Theoretical life	17 years
Flatness (Min)	0.1mm
Withstand pressure	550psi Nickel plating,
Available surface treatment	anodizing, brushing, polishing
Installation method:	① low temperature solder paste welding ②epoxy resin bonding



[Tolerance]

MG-FHP → SPECIFICATIONS

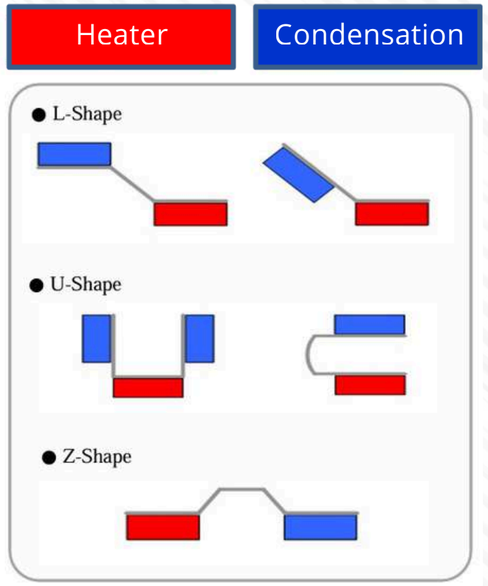
MG-FHP thermal conductivity

Thermal conductivity (W/mK)			
kx	5,000	Heat upside / Invalidation	Heat downside / 10,000
Ky	3,000	3,000	3,000
Kz	5,000	5,000	5,000

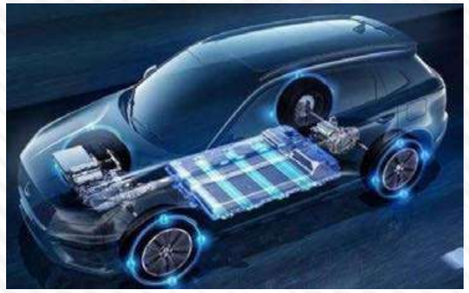
NOTE:

1. Different installation directionshave different thermal conductivity.
2. The heat source must be at the bottom and the condensation endmust be at the top
3. Ineffective use against gravity

[Various Shape of MG-FHP]



MG-FHP → MAJOR APPLICATION FIELDS



TV / Monitor

LED & SOLAR

Automotive Industr y

Thermal Solution

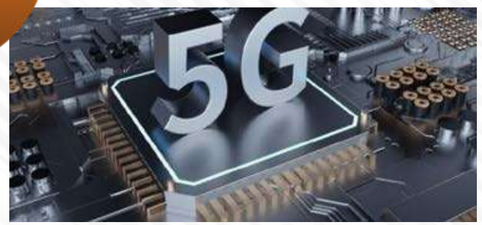
IGBT Communicatio n Medical

Head Lamp

Motor

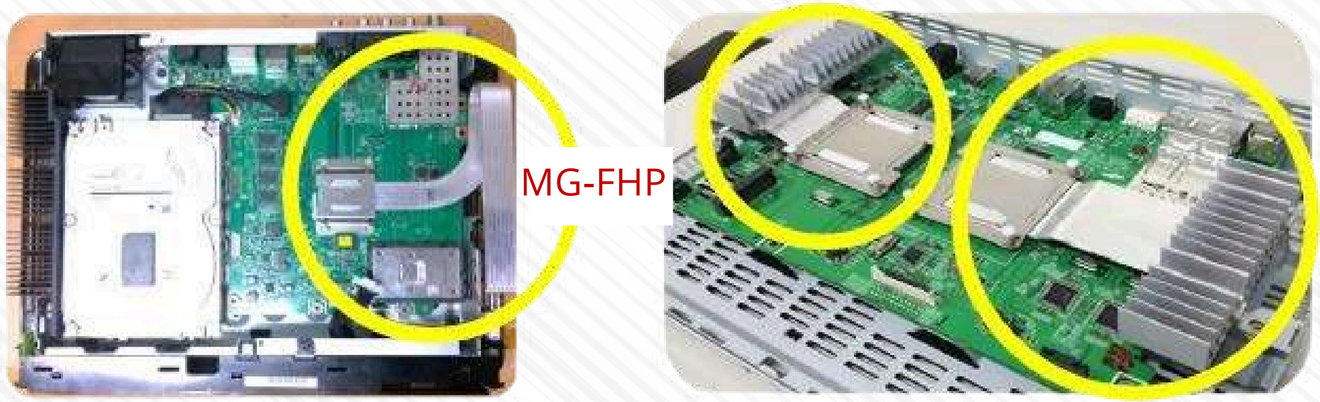
Battery

Inverter/Converter

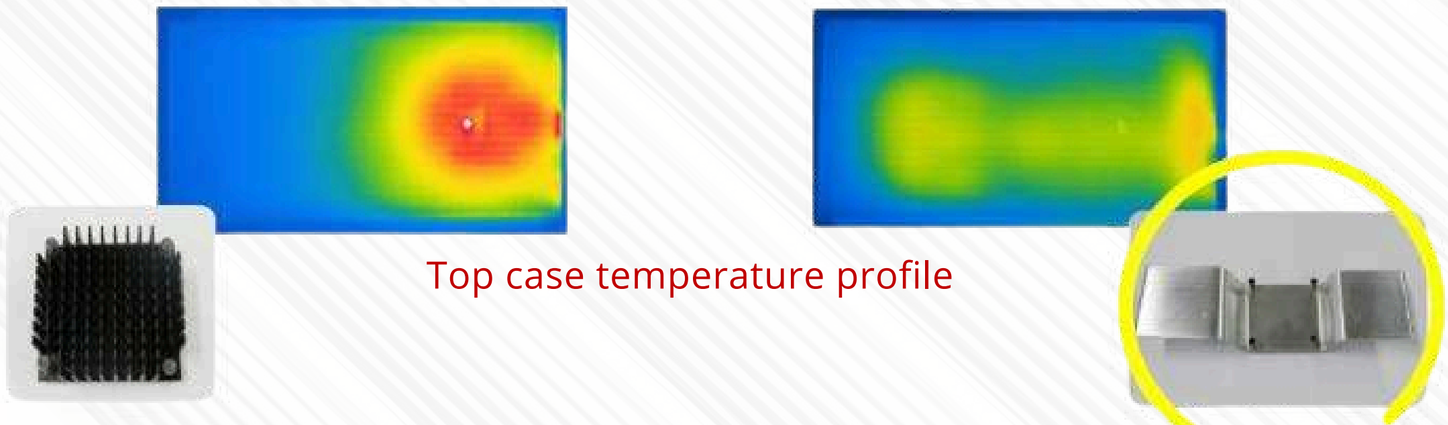


MG-FHP → APPLICATION ACTUAL OPERATION

MG-FHP → APPLICATION FOR SET-TOP BOX

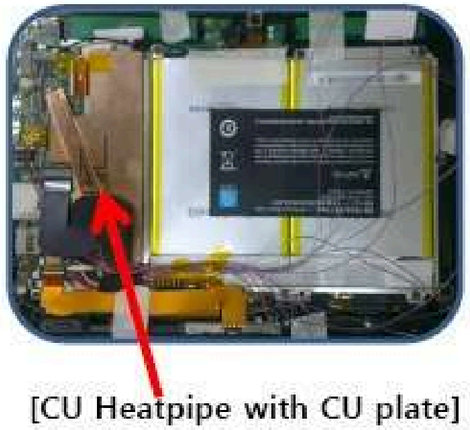


Low number of parts assembled MG-FHP module
drops device temperature as well as case temperature



MG-FHP → APPLICATION FOR TABLET PC

MG-FHP Solution VS Cu Heat pipe Solution


[CU Heatpipe with CU plate]

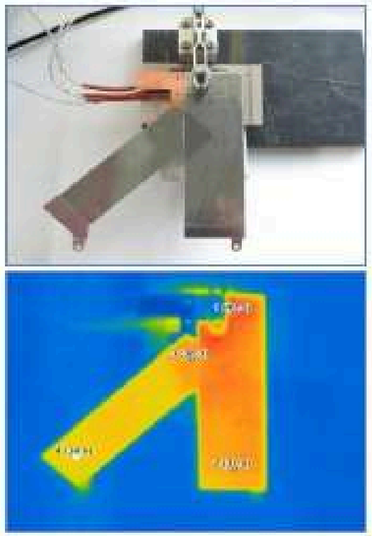
- ❖CPU: Tegra 4 (6.65W)
- ❖3G / LTE stem memory is 2GB
- ❖Built-in storage is 16GB
- ❖Main camera is 13MP & Front camera is 1.2MP.
- ❖resolution panels: WQXGA (2,560 x 1,600)
- ❖Thickness 8.8mm
- ❖Weight 600g
- ❖34Wh battery official estimate can use WiFi 8.5 hours.

	Air	CPU(1)	SKIN(13)	SKIN(14)
MG-FHP Solution	24.6	69	45.8	34.5
CU Heatpipe Solution	24.8	88.3	53.5	36.3

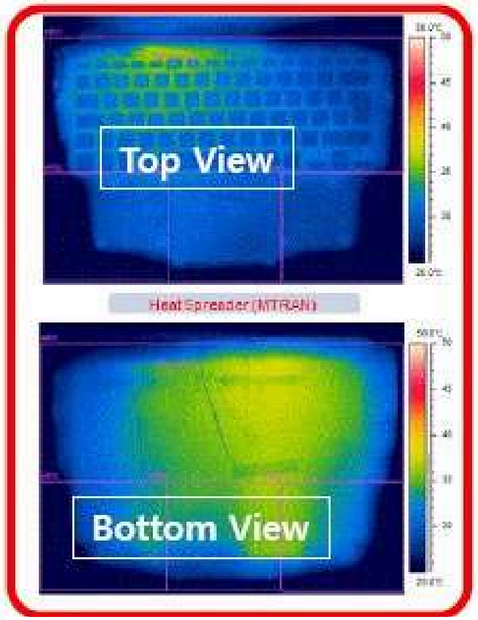
MG-FHP → APPLICATION FOR TABLET ULTRA BOOK

Model	Picture	Condition	Specification
ATIV 9 Lite NT915S3G-KSQT		Total Set Power : 13.3W CPU Power : 5.64W Environment : 25 °C	OS : Window 8 (64bit) CPU : Quad-Core (1.4GHz) Memory : 4GB (DDR3 1066, on-BD) SSD : 128GB Graphic : Radeon ™ HD 8250 Resolution : 1,366 X 768 **Thickness : 17.4mm** **Weight : 1.58 kg**

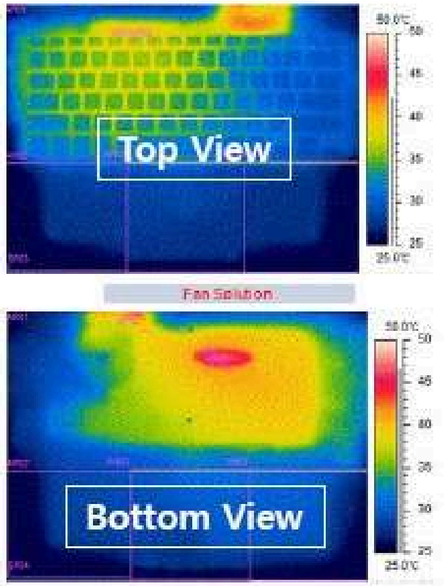
MG-FHP Module drops CPU temperature well as case temperature!



[MTRAN Solution]

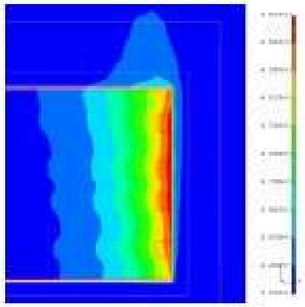


[MG-FHP solution (no fan)]

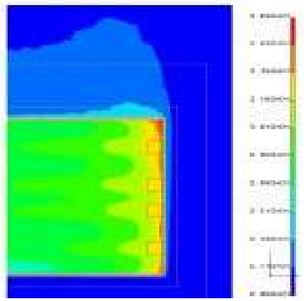


[Heat Pipe+Fan Solution]

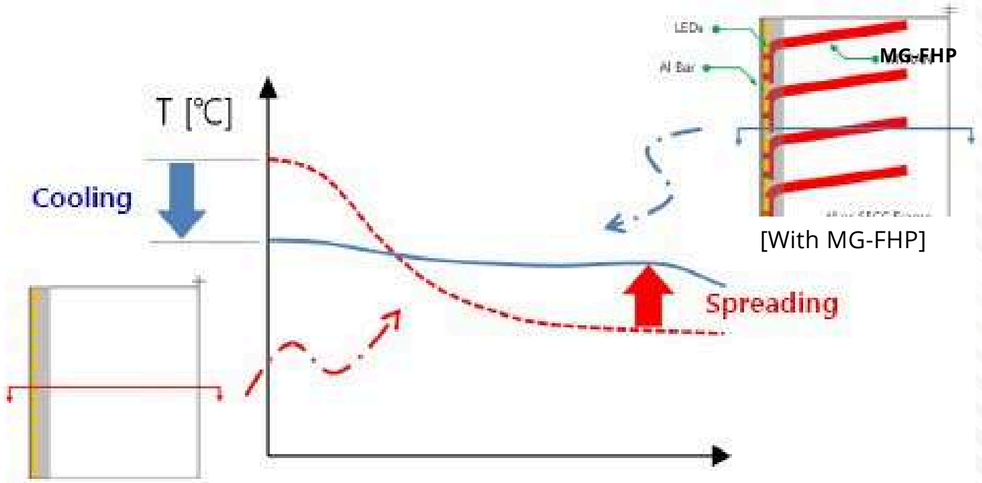
MG-FHP → APPLICATION FOR DISPLAY



[Without MG-FHP]



[With MG-FHP]

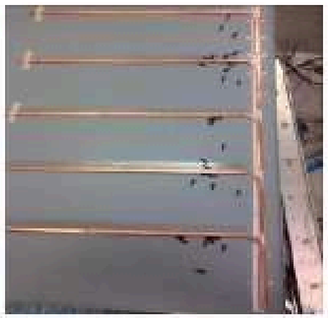


[With MG-FHP]

[Without MG-FHP]

MG-FHP Solution VS. Cu Heat pipe Solution

[MG-FHP]

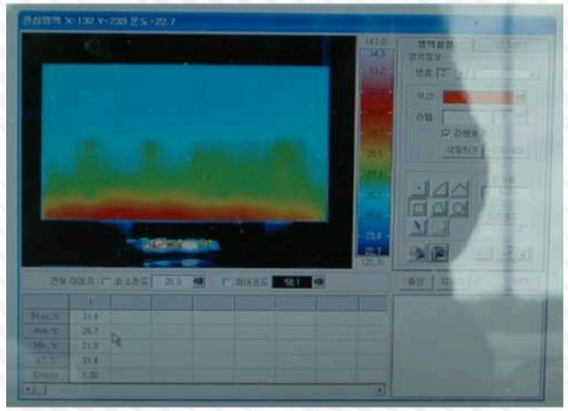


[CU Heatpipe]

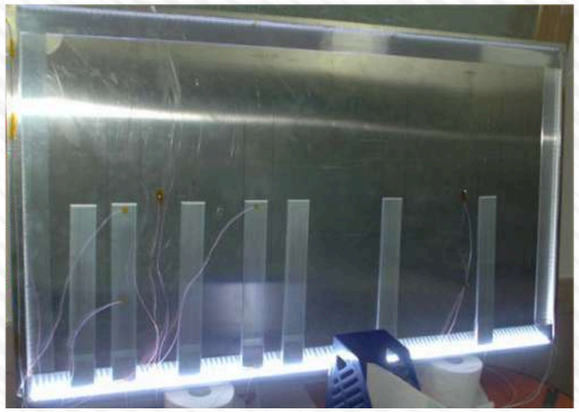
	Air	Light Bar	Bazel
MG-FHP Solution (Average)	25	68.8	46
CU Heatpipe Solution (Average)	25	74.1	49

MG-FHP → APPLICATION FOR DISPLAY

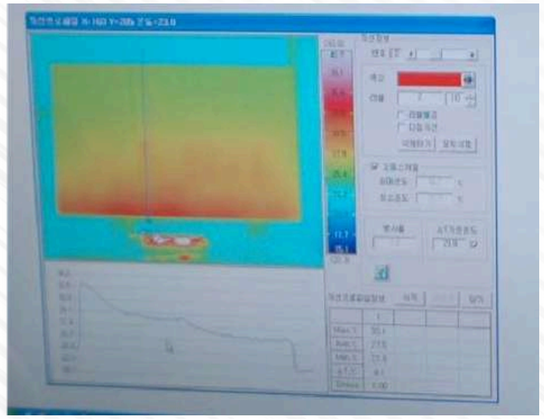
MG-FHP Solution for Blue LED TV.



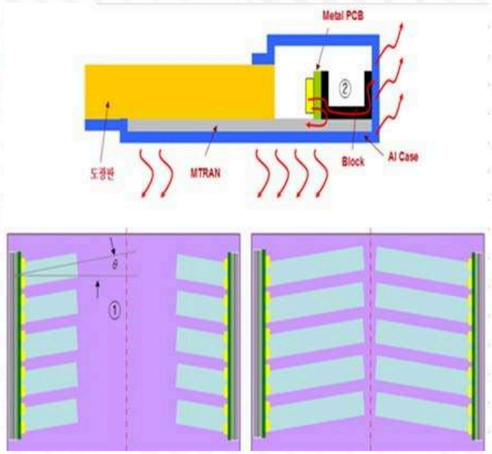
[Without MG-FHP]

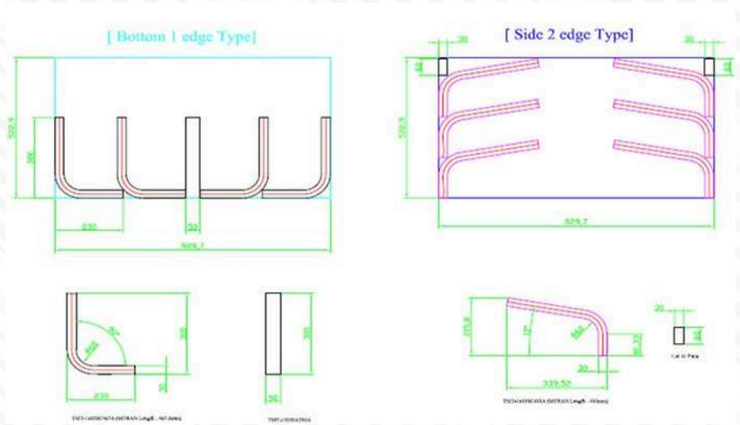


[With MG-FHP]



[Test result down 8-22℃]

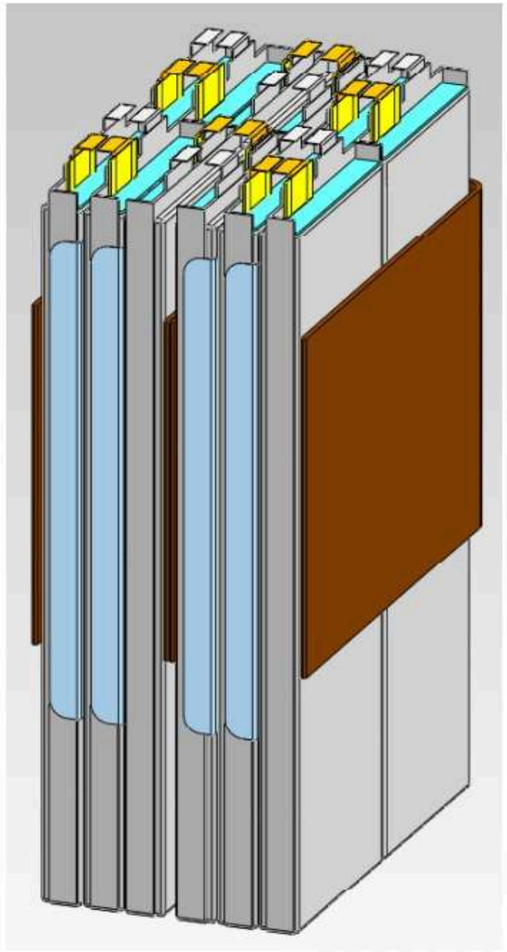


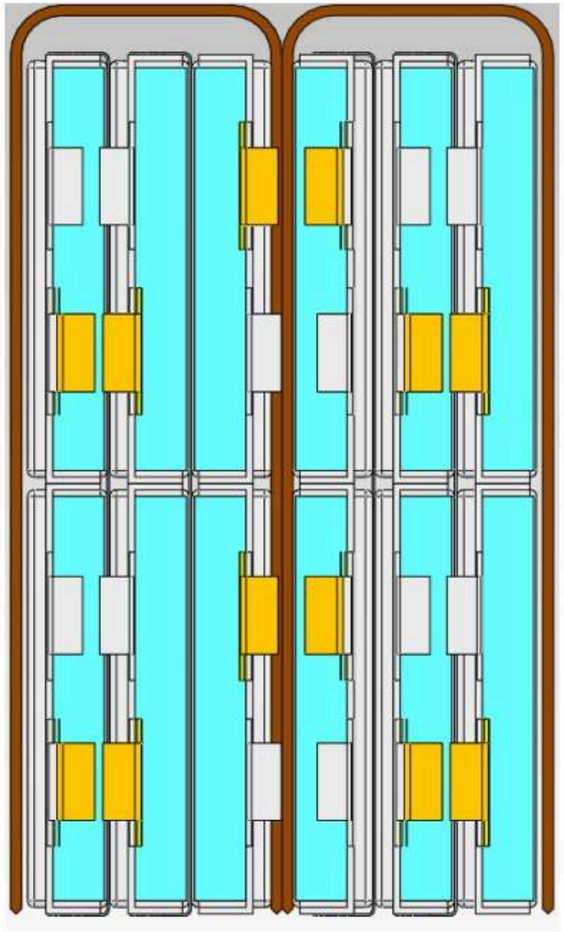


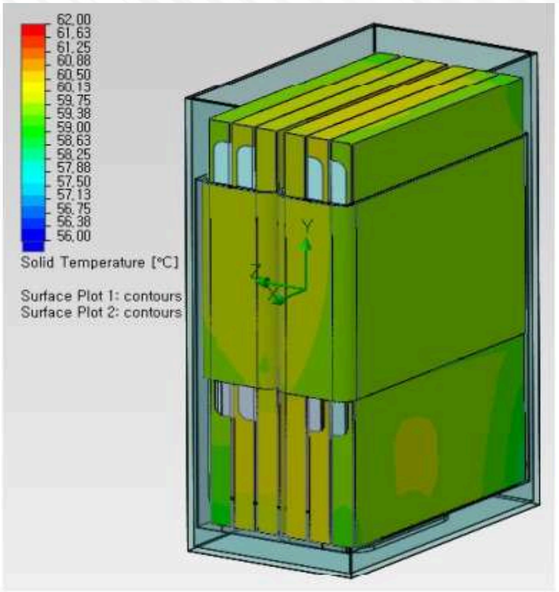
[Concept design]

MG-FHP → APPLICATION FOR DRONE

- MG-FHP Used for drone battery-DJI







Battery No.	Min.	Max.	Avg.
1	57.98	60.26	59.70
2	58.01	60.36	60.00
3	58.45	60.39	60.11
4	58.38	60.58	60.15
5	57.86	60.57	60.25
6	58.54	60.41	59.65

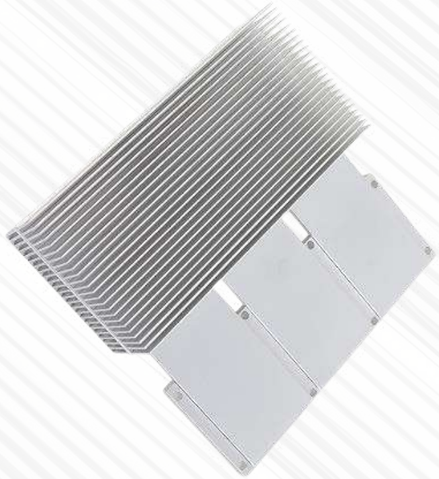
MG-FHP → APPLICATION FOR 5G POWER STATION

- MG-FHP 5G power station

- Thermal conductivity: >5000W/(m·K),
- Operating temperature: -40-150℃, temperature difference <2℃
- The working liquid does not freeze, low ignition temperature
- Connection: nickel-plated tin welding, epoxy resin bonding, brazing
- Surface treatment: nickel plating/oxidation/spraying

MG-FHP → APPLICATION FOR IGBT

- MG-FHP Module for IGBT, Up to 2000watt



- Thermal conductivity: >5000W/(m·K),
- Operating temperature: -40-190℃, temperature difference <2℃
- The working liquid does not freeze, low ignition temperature
- Maximum temperature: >190℃
- Connection: nickel-plated tin welding, epoxy resin bonding, brazing Surface
- treatment: nickel plating/oxidation/spraying

- Application: IGBT Electrical appliances/communications/industry/rail transit