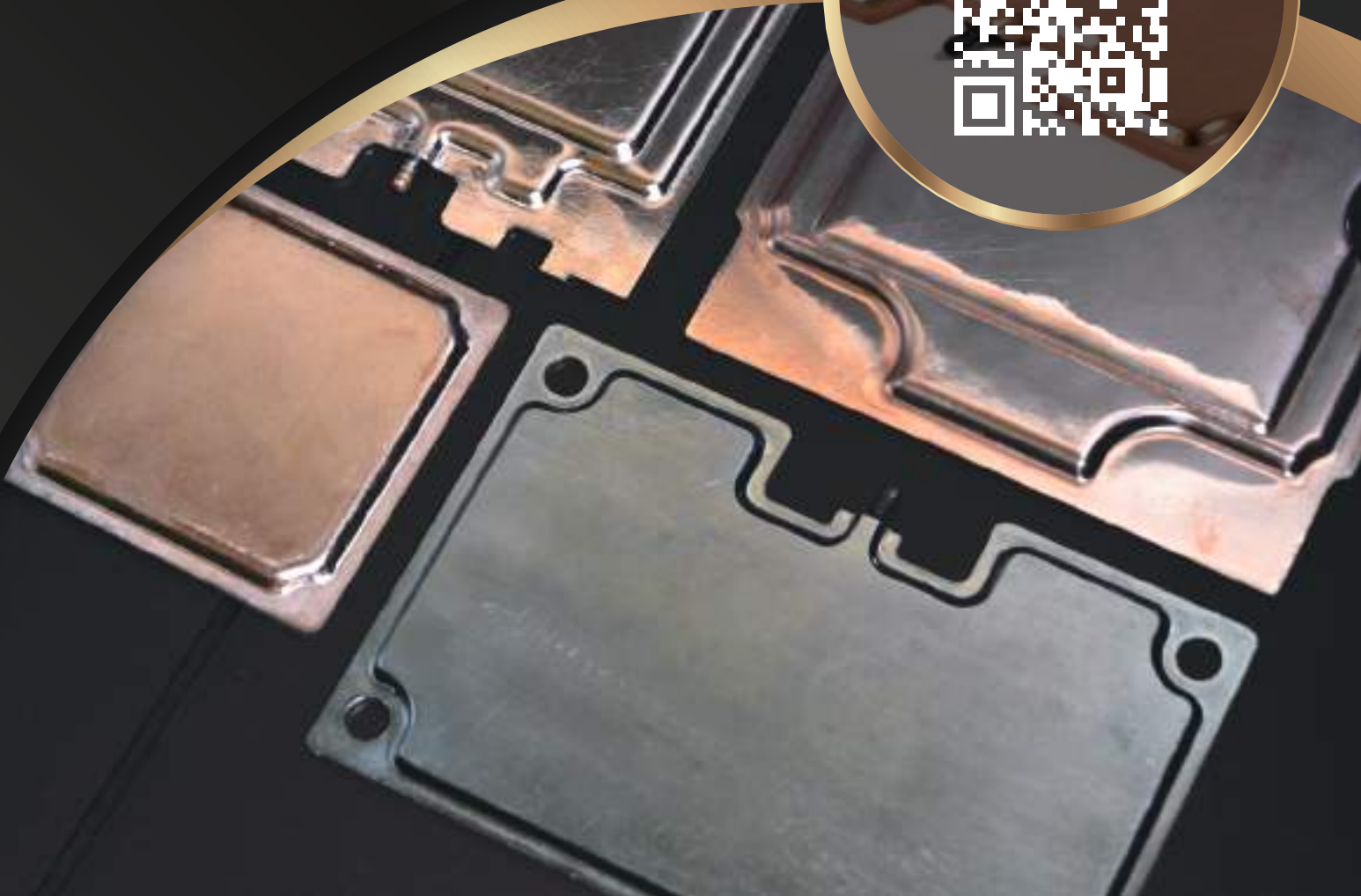


Thermal Engineering Revolution

# VAPOR CHAMBER

A vapor chamber (VC), also known as a planar heat pipe, is a flat device that spreads heat to a large area, and then the heat is removed by the device's fins or fans. It plays the role of temperature equalization and heat dissipation. It is a sealed cavity that is vacuumed and partially filled with working fluid. The cavity is equipped with a capillary structure to provide capillary force and promote fluid recirculation.

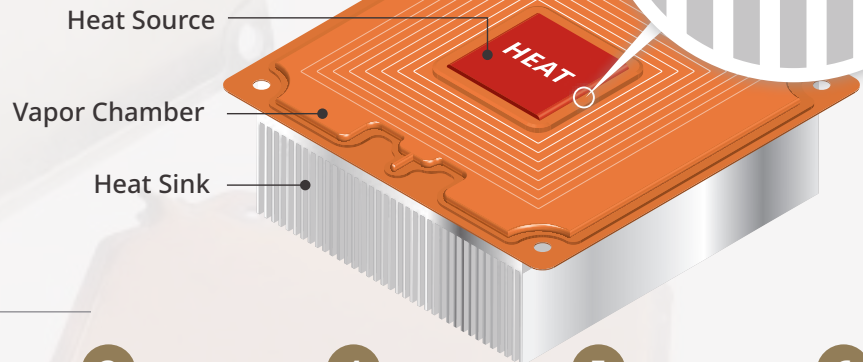
Information



## 01 Working Principle

When heat is transferred from the heat source to the evaporation zone of the vapor chamber, the working fluid in the chamber will absorb heat and vaporize. The vaporized working fluid will fill the chamber and flow to the cooler condenser surface in a two-dimensional manner, releasing latent heat. The condensed fluid then flows back to the heat source in the evaporation zone through capillary action.

This cycle will be repeated in the vapor chamber.



## 02 Product Process



## 03 Performance Testing

### Two-point temperature difference standard measurement method of TGP VC

$$Q_{\max} \sim R_{th,Z}$$

The TGP-VC two-point temperature difference measurement method is based on the standard <TTMA-VC-2020> set by the Taiwan Thermal Management Association. The performance indicators are the axial thermal resistance  $R_{th,Z}$  (or the axial temperature difference  $\Delta T_{JS,C}$ ) of the VC, the junction temperature  $T_{JS}$ , and the two-point temperature difference  $\Delta T_{C,X}=T_C-T_X$  and the maximum heat transfer rate  $Q_{\max}$ . Using a heated copper block to simulate IC chip heating, as shown in Figure 1. The hot plate of the VC is placed above the heated copper block. Measure the center temperature  $T_C$  of the cold plate of the VC, the second point temperature  $T_X$ , and the junction temperature  $T_{JS}$  of the heated copper block.  $T_{JS}$  is used to calculate the axial thermal resistance  $R_{th,Z}$  of VC. During measurement, the changes in axial thermal resistance  $R_{th,Z}$  of VC under different heating powers (W) are recorded. When the axial thermal resistance reaches the lowest value, the heating power is  $Q_{\max}$ . As shown in Figure 2, when the heating power is 8.5W, the axial thermal resistance reaches the minimum value, and the  $Q_{\max}$  of this VC is 8.5W.

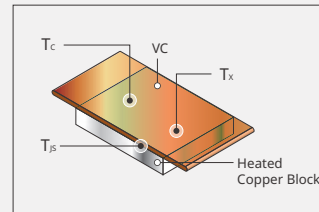


Figure 1. Schematic diagram of TGP-VC measured with two-point temperature difference.

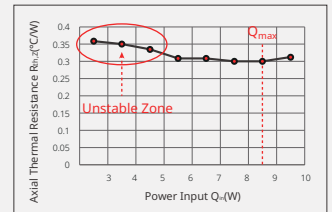


Figure 2. The trend curve of the axial thermal resistance  $R_{th,Z}$  versus the heating power  $Q_n$  by using the temperature difference between two points of VC

### VC performance standard measurement method

$$Q_{\max@Tc} \sim R_{th,Z@Tc}$$

The VC performance measurement method is based on the standard <TTMA-VC-2017> set by the Taiwan Thermal Management Association. The performance measurement of VC is to use the condensation water jacket to take away heat. The measured performance indicators of the VC at the set operating temperature  $T_C$  are the axial thermal resistance  $R_{th,Z@Tc}$  of the VC, the radial thermal resistance  $R_{th@Tc}$  of the VC, the junction temperature  $T_{JS@Tc}$  of the heated copper block and the maximum heat transfer of VC  $Q_{\max@Tc}$ . A high-power heated copper block is used to simulate IC chip heating. It is usually used to simulate and measure the usage of VC in computer CPUs, GPUs, and servers. As shown in Figure 3, the VC is heated from the bottom, and a water-cooling jacket is used on the upper of the VC to dissipate heat. The center temperature (operating temperature  $T_C$ ) of the VC at cold plate and the temperature  $T_{JS@Tc}$  of the contact between the surface of the heated copper block and the hot plate of the VC are used to calculate the axial thermal resistance  $R_{th,Z@Tc}$ . During measurement, record the changes in axial thermal resistance  $R_{th,Z@Tc}$  of VC at the set operating temperature  $T_C$  under different heating powers (W). When the axial thermal resistance reaches the lowest value, the heating power is  $Q_{\max@Tc}$  at operating temperature  $T_C$ . As shown in Figure 4, when the heating power is 350W, the axial thermal resistance reaches the minimum value, and the  $Q_{\max@Tc}$  of this VC is 350W.

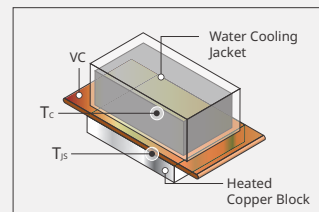


Figure 3. The schematic diagram of the water-cooling jacket VC and its heating copper block

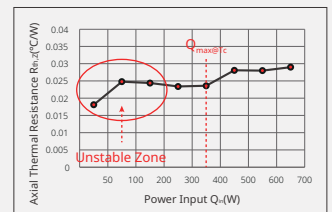


Figure 4. Trend curve of axial thermal resistance  $R_{th,Z}$  versus heating power  $Q_n$  by using the water-cooling jacket

## Full inspection before shipment

01

### Size

Length and width tolerance  $\pm 0.1\text{mm}$   
Thickness  $0.45 \pm 0.05\text{mm}$

02

### Appearance

Surface treatment, nickel-plated or anodizing

03

### Other Testing

Aging test | Thermal Shock test  
Salt Spray test

# Why do we need Vapor Chambers?

Separate Medical and Military

Server

Netcom

LED Panels

5G Communications

Electronics

Reality Technology

Electric Vehicle Parts

Green Energy

### Server

Servers and GPUs are one of the main markets for Vapor Chambers. As the power of servers continues to increase, air cooling is no longer sufficient to dissipate heat. The VC is more reliable than water cooling systems, and has become the preferred cooling method.

### 5G Communications

With the development of 5G, related applications such as mobile phones and other electronic devices, their instantaneous heat may reach more than 10W, a thin VC is an ideal solution for heat dissipation.

### Electric Vehicle Parts

Electric vehicles are driving demand for power semiconductors and modules, and insulated gate bipolar transistor (IGBT) modules are now key components. Due to its excellent temperature uniformity, IGBTs use VCs in their designs for temperature equalization and fit word on one line devices.

### LED Panel

Around 20% of the energy provided by the LED is converted into optical output power, and the rest is transformed into wasted heat, causing dominant luminescence wavelength drift and optical efficiency decline. Effective heat dissipation of the VC can improve the overall performance of the LED.

### Reality Technology

The reality industry has products that combine high-end technology in various fields, with many of them being wearable devices. Therefore, the operating temperature ranges are very strict. The VC can quickly diffuse the heat from the heat source and increase the heat dissipation area.

### Netcom

Communications and network equipment have many heating elements in them. In the case of limited space, the VC can still quickly transfer the heat to the casing, which is an excellent choice for both heat transfer and space constraints.

### Medical/Military Industry

In these industries, there is often a need for components that can reduce the temperature difference or accurately control the temperature. The rapid response of using temperature control components such as refrigeration chips with vapor chambers has become the preferred choice.

### Electronics

Localized hotspots in electronic devices incur heat fluxes on the order of 100–1000 W/cm<sup>2</sup>. Space limitation and high heat dissipation capacity are the main issues. The excellent heat transfer capability and lower thickness of the Vapor Chamber on one line are the best solution.

### Green Energy

The public and the government are paying more and more attention to green energy and promoting the development of related energy storage equipment, the thermal solution of uniform temperature plate and heat dissipation module of VCs is an indispensable part of it.



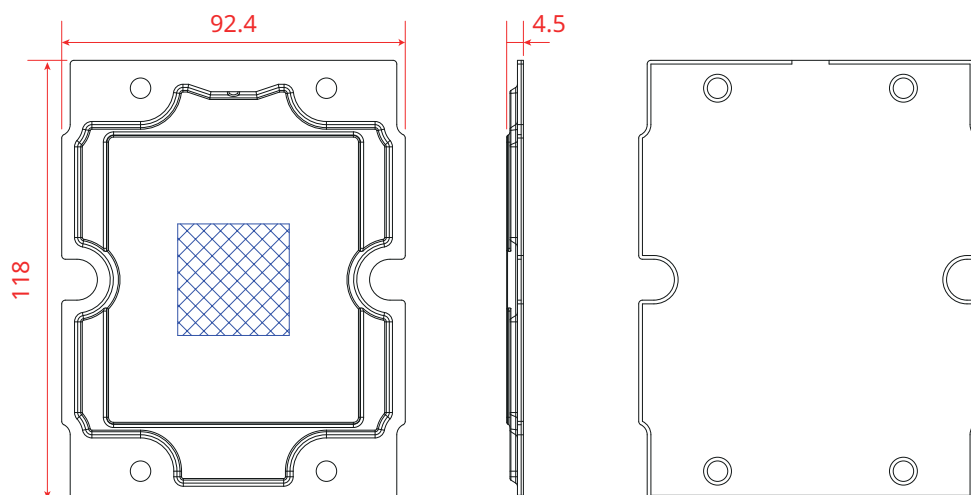
## AMD-1U

92.4 X 118 X 4.5 mm

Material : Cu1020

Surface finishing : anti-oxidation

Recommended Power : 270W



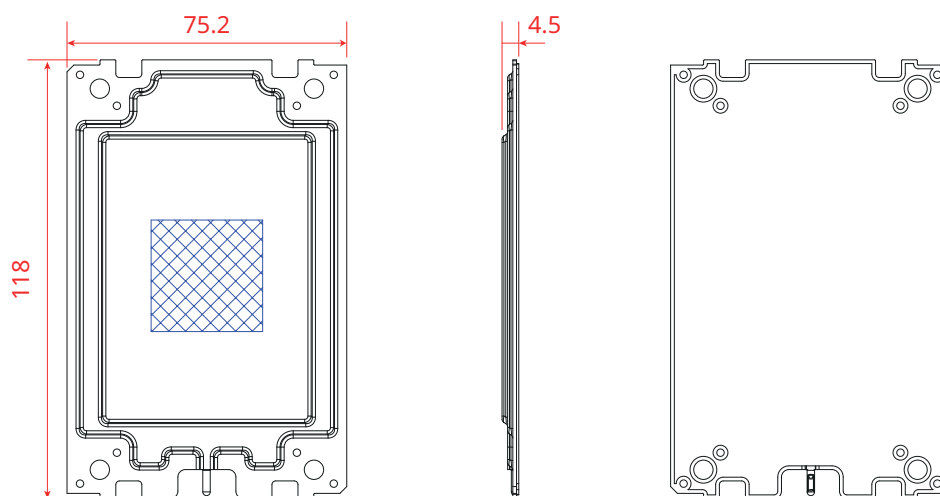
## Intel-1U

75.2 X 118 X 4.5 mm

Material : Cu1020

Surface finishing : anti-oxidation

Recommended Power : 270W



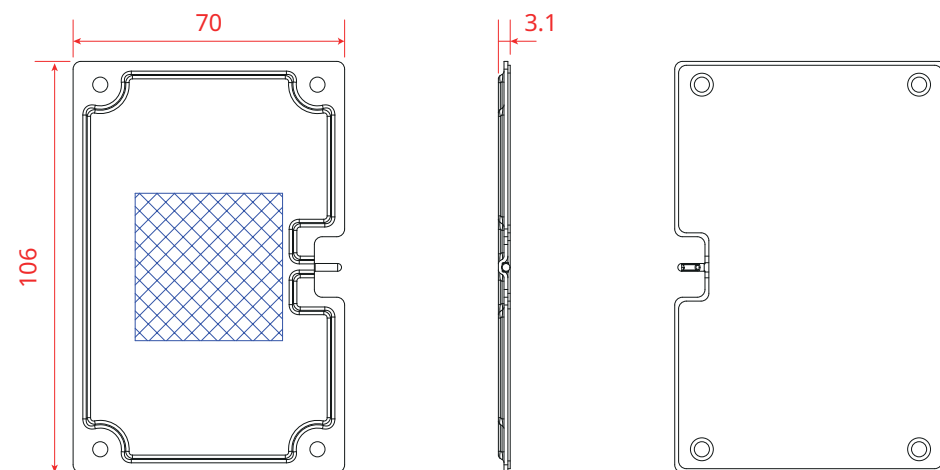
## EOS

70 X 106 X 3.1 mm

Material : Cu1020

Surface finishing : anti-oxidation

Recommended Power : 150W



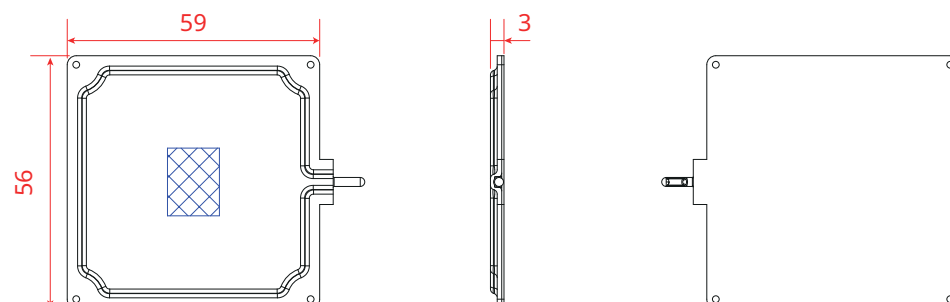
## OB

59 X 56 X 3 mm

Material : Cu1020

Surface finishing : anti-oxidation

Recommended Power : 150W





Cold Press Machine



Plasma Cleaning Machine



Spot Welder

Automatic 6-Groove  
Ultrasonic Cleaning Machine

Oven

Semi-finished VC  
Helium Leak DetectorThree-Axis Automatic  
Gluing MachineHigh Frequency Spot  
Welding MachineSemi-finished VC Helium  
Leak Detector MachineWater  
Filling Machine

Ultra-pure Water Machine



Vacuum Deaerator

Secondary Vacuum  
Heating DeaeratorHigh Power  
Resistance WelderVC Tube  
Trimming MachineFinished VC Helium  
Leak Detector

Inkjet Printer

Laser Engraving  
MachineTwo-Stop VC  
Qmax Measuring Machine

Nitrogen Cabinet

### Q What are the factors affecting thermal conductivity of Vapor Chamber?

There are many factors that affect the thermal conductivity of the Vapor Chamber including degree of vacuum, working fluid, capillary structure, porosity, wetting area, capillary radius and processing quality.

### Q How to determine the dimension and thickness of a Vapor Chamber?

Customers need to provide the size and thickness of the vapor chamber according to the available space, length and width of the heat source, and power.

### Q What is the working principle of a Vapor Chamber?

The inside of a Vapor Chamber is a vacuum chamber with a wick structure. After the working fluid absorbs heat, it will vaporize rapidly and flow to the cooling zone, where the vaporized fluid exchanges heat with the outside and condenses to fluid to flow back to the heat zone. This constitutes one circulation of the Vapor Chamber.

### Q How to determine the working fluid in the Vapor Chamber?

The outer shell used to make the vacuum chamber of a Vapor Chamber can be made of different materials. Purified water is adopted as a working fluid for copper, stainless steel, and titanium shell materials, and acetone is chosen as a working fluid to be compatible with aluminum material.

### Q What are the heat conduction and heat dissipation components of common Vapor Chamber modules?

A heat dissipation module is mainly composed of two parts: heat conduction part and heat dissipation part. The heat conductive components include Heat Pipes, Vapor Chambers and Thermal Interface Materials, metal sheets, graphite and ceramic sheets which are selected according to the requirements of each project. Heat dissipation components can be divided into air cooling and water cooling. Air cooling often use parts such as fins and graphene to increase the contact area with the air, while water cooling uses water as a medium to transfer heat.



### 01 | Inquiry

The customer provides the design requirements and specifications, various parameters or design drawings of the vapor chamber and its related cooling modules to T-Global Technology



### 02 | Design and Sampling of VC

Draw VC designs based on customer information, confirm mechanism design and internal parameters, and make samples



### 03 | Sample Confirmation

T-Global provides samples to customer for confirmation to ensure the designs meet the requirements



### 04 | Trial & Mass Production

Integrate T-Global product lines to provide customers with Vapor Chambers, thermal modules and related products on time



Q-Max Size(mm)	Thickness (mm)		
	2.0	3.0	4.0
60X80	50	70	90
90X90	80	120	160
100X100	140	200	260
120X80	130	200	260
180X150	160	250	250
200X120	200	300	300
350X100	220	350	450

# 20<sup>+</sup>

Years of experience in thermal engineering solutions

# 3500<sup>+</sup>

Chosen by thousands of companies worldwide

# 100M<sup>+</sup>

Delivery of more than 100 million pieces from T-Global

# 1K<sup>+</sup>

Experience in thousands of thermal projects

## CONTACT US



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