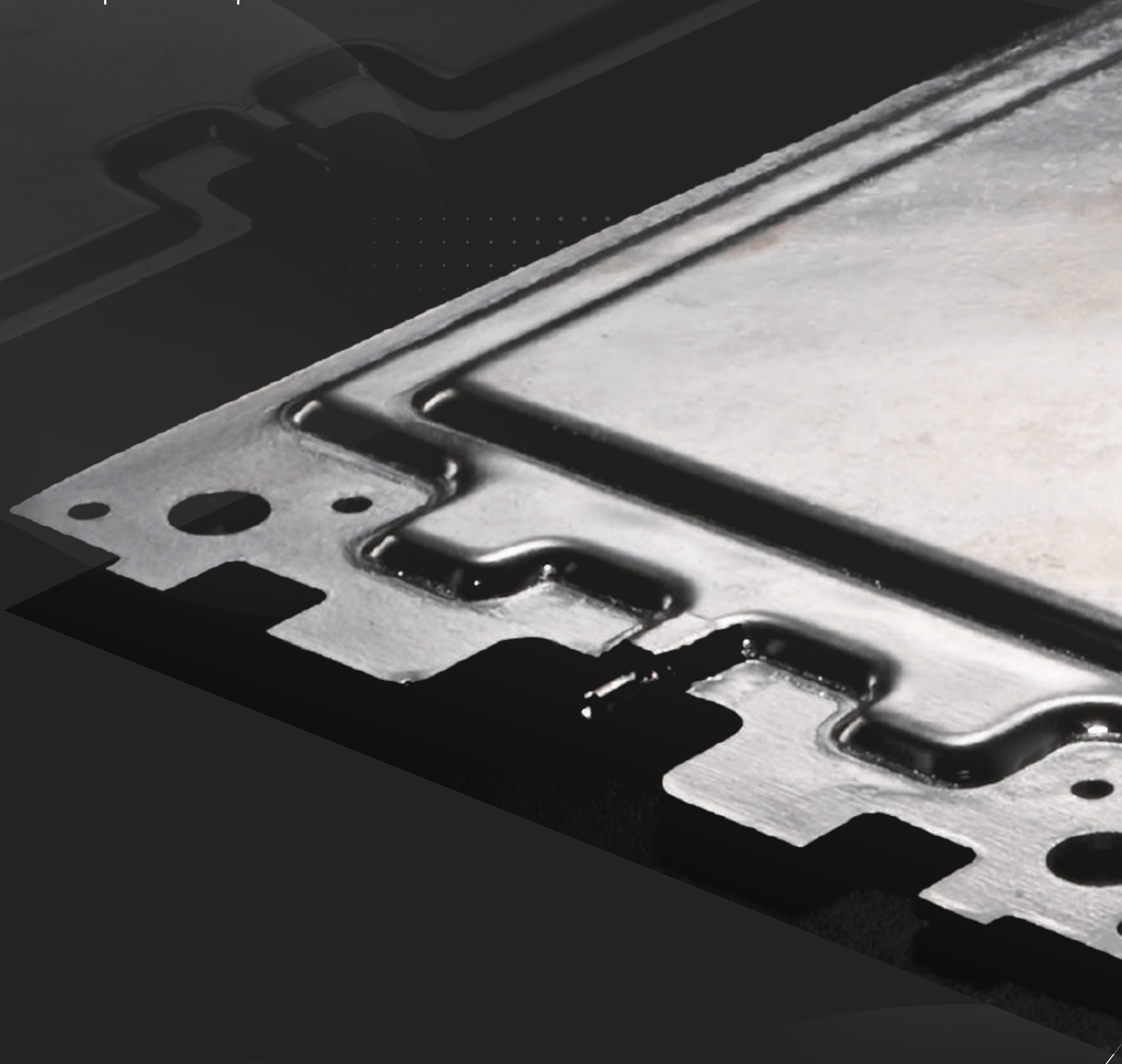
T-Global

Thermal Engineering Revolution

VAPOR CHAMBER

A Vapor Chamber (VC) is a flat device for heat spreading and dissipation, using fluid circulation for temperature equalization.

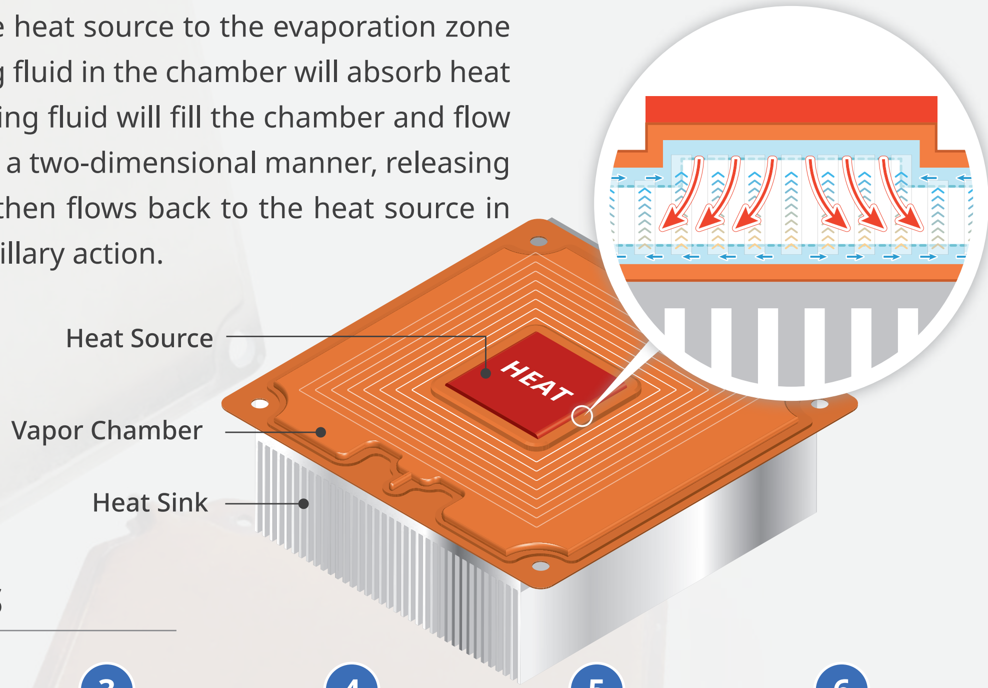


More information

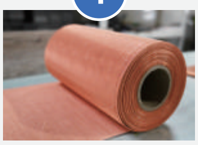
Version 02

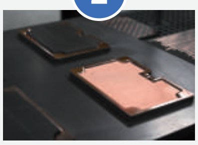
01 WORKING PRINCIPLE

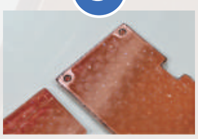
When heat is transferred from the heat source to the evaporation zone of the vapor chamber, the working fluid in the chamber will absorb heat and vaporize. The vaporized working fluid will fill the chamber and flow to the cooler condenser surface in a two-dimensional manner, releasing latent heat. The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

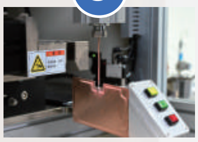
1

Materials Preparation and Cleaning

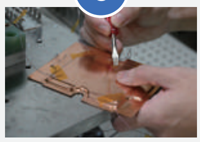
2

Powder/Net Sintering

3

Edge Brazing

4

Water Filling under Vacuum

5

Tail Pipe Removal

6

Performance Test

03 PERFORMANCE TESTING

Two-point temperature difference standard measurement method of TGP VC (Q_{max} ` $R_{th,Z}$)

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 $\triangle T_{JS,C}$) of the VC, the junction temperature T_{JS}, and the two-point temperature difference $\triangle T_{C,X}=T_C-T_X$ 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.

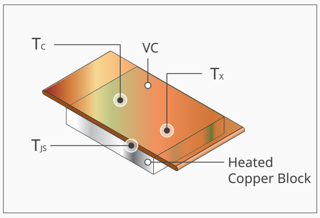


Figure 1. Schematic diagram of TGP-VC measured with two-point temperature difference.

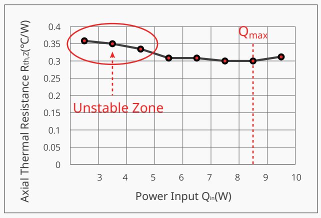


Figure 2. The trend curve of the axial thermal resistance $R_{th,Z}$ versus the heating power Q_{in} by using the temperature difference between two points of VC

VC performance standard measurement method ($Q_{max@Tc}$ ` $R_{th,Z@Tc}$)

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 TC 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.

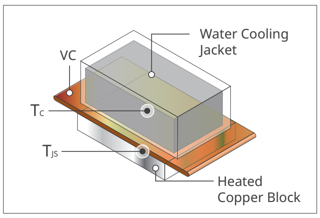


Figure 3. The schematic diagram of the water-cooling jacket VC and its heating copper block

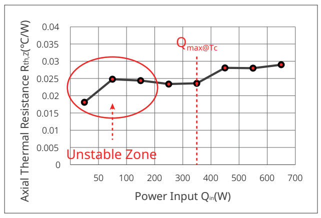


Figure 4. Trend curve of axial thermal resistance $R_{th,Z}$ versus heating power Q_{in} by using the water-cooling jacket

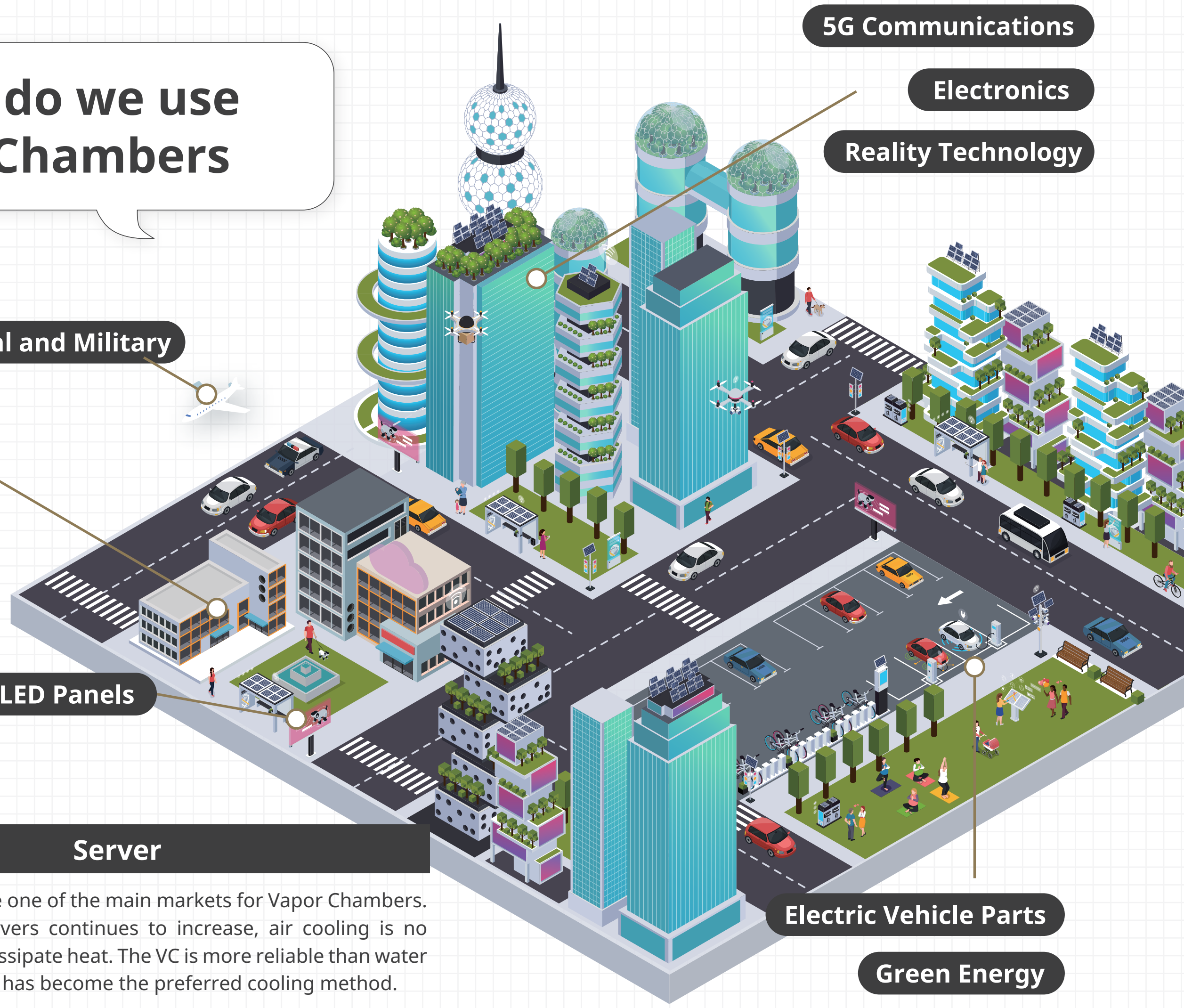
Full inspection before shipment

01 Size
Length and width tolerance ±0.1mm
Thickness 0.45±0.05mm

02 Appearance
Surface treatment, nickel-plated or anodizing

03 Other Testing
Aging test | Thermal Shock test
Salt Spray test

Where do we use Vapor Chambers



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.

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.

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.

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.

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.

Electronics

Localized hotspots in electronic devices incur heat fluxes on the order of 100–1000 W/cm². 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.

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.

Green Energy

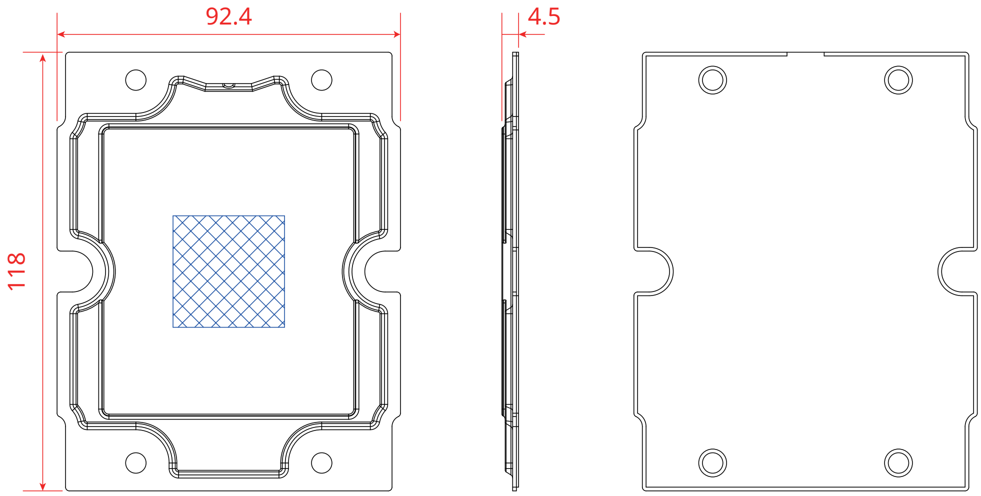
The public and the government are paying more and more attention to green energy and promoting the development of related energy storage equipment, the thermal solution of uniform temperature plate and heat dissipation module of VCs is an indispensable part of it.

05 STANDARD PRODUCT SPECIFICATION

AMD-1U

92.4 X 118 X 4.5 mm

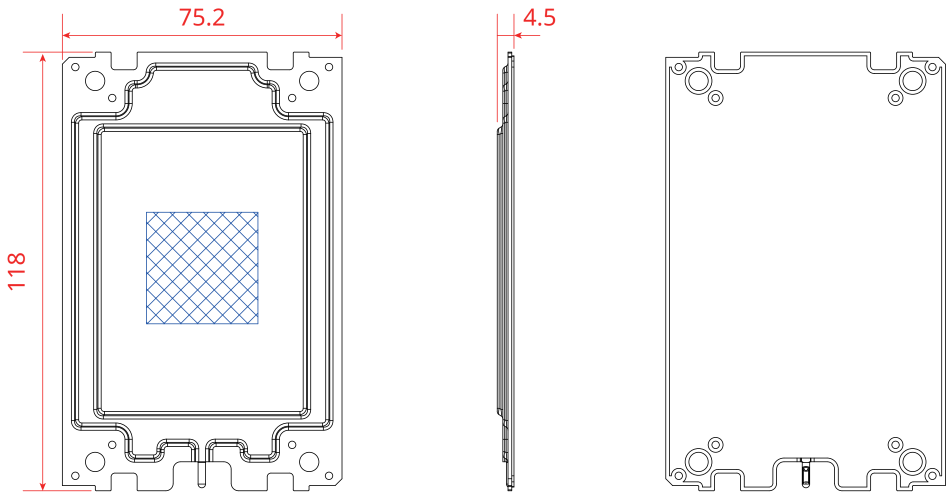
Material：Cu1020
Surface Finishing：Anti-oxidation
Recommended Power：270W



Intel-1U

75.2 X 118 X 4.5 mm

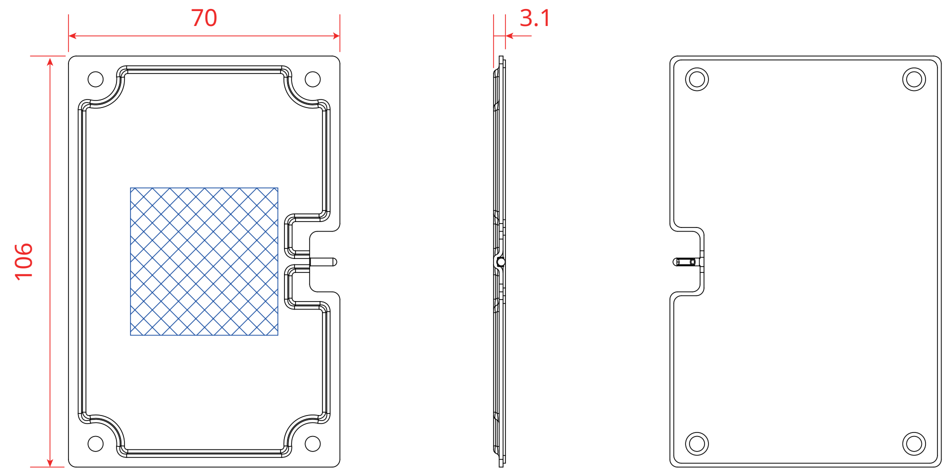
Material：Cu1020
Surface Finishing：Anti-oxidation
Recommended Power：270W



EOS

70 X 106 X 3.1 mm

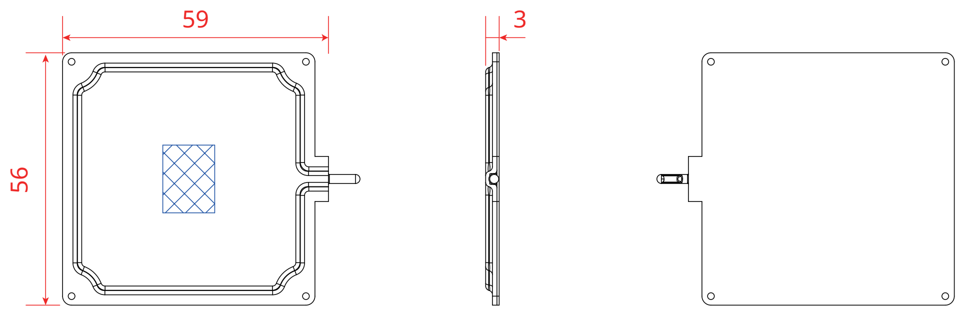
Material：Cu1020
Surface Finishing：Anti-oxidation
Recommended Power：150W



OB

59 X 56 X 3 mm

Material：Cu1020
Surface Finishing：Anti-oxidation
Recommended Power：150W



06 EQUIPMENT


Cold Press Machine


Plasma Cleaning Machine


Spot Welder


Automatic 6-Groove Ultrasonic Cleaning Machine


Oven


Semi-finished VC Helium Leak Detector


Three-Axis Automatic Gluing Machine


High Frequency Spot Welding Machine


Semi-finished VC Helium Leak Detector Machine


Water Filling Machine


Ultra-pure Water Machine


Vacuum Deaerator


Secondary Vacuum Heating Deaerator


High Power Resistance Welder


VC Tube Trimming Machine


Finished VC Helium Leak Detector


Inkjet Printer


Laser Engraving Machine


Two-Stop VC Qmax Measuring Machine


Nitrogen Cabinet

07 FAQ

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.

08 PROJECT PROCESS

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

09 DESIGN GUIDE

Size(mm) \ Q-Max	Thickness (mm)		
	2.0	3.0	4.0
60X80	50	70	90
90X90	80	120	160
100X100	140	200	260
120X80	130	200	250
180X150	160	250	300
200X120	200	300	400
350X100	220	350	450

21+
Years of experience in thermal engineering solutions

7500+
Chosen by thousands of companies worldwide

100M+
Delivery of more than 100 million pieces from T-Global

1K+
Experience in thousands of thermal projects

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