

DATASHEET – THERMA-BASE™ Vapor Chamber

Thermacore's Therma-Base™, or vapor chamber, is a two phase heat transfer device that allows spreading of heat in 3 dimensions. Vapor chambers are typically referred to as planar or flat heat pipes. Thermacore's vapor chambers incorporate various wick structures, including sintered powder wick structures that provides high-heat flux heat dissipation capability ($>300\text{W}/\text{cm}^2$). The Therma-Base™ product can offer thermal performance improvement of up to 30% when compared to a typical aluminum or copper base spreaders. This improvement is more evident in applications where the heat source is small relative to the allowable area for fins. Thermal architects can utilize this technology with a minimum design effort since it is possible to change a metallic base to a vapor chamber without changing the geometry of the heat sink.

Thermacore has developed a number of different options to thermally attach the vapor chamber to the cooling fins. In copper and nickel plated aluminum, Thermacore can directly solder (lead-free, high and low temperature) the fins to the Therma-Base to greatly reduce the fin to base thermal resistance. In applications that are more cost sensitive, Thermacore utilizes a thermally conductive adhesive film that ensures even coverage of the epoxy joint throughout the interface.

Applications

- Computer CPU and GPU Cooling
 - » Desktop, Server, and Mobile Computing
- Military and Power Semi-conductor Cooling
 - » IGBT's, MOSFETS, SGT's, Thyristers
- Telecom Applications – RF Amplifiers
- Low Profile Applications – Blade Servers
- High Temperature Applications ($>100^\circ\text{C}$)
- High Structural Strength Applications
 - » High Clamping Force Applications

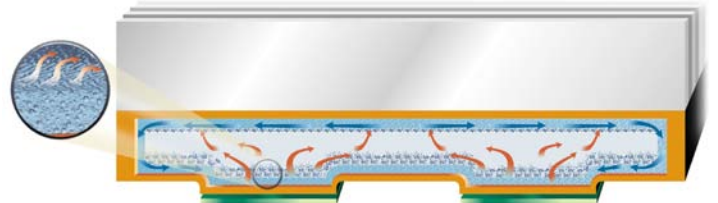


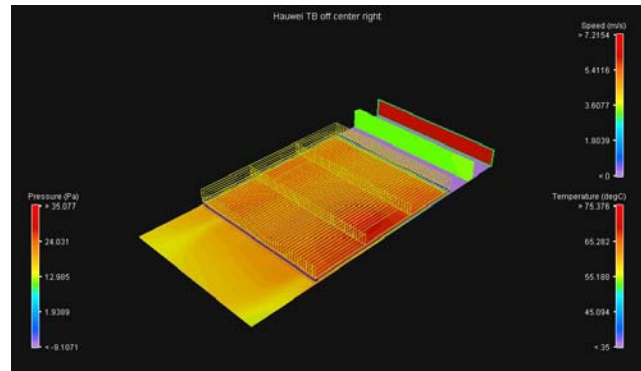
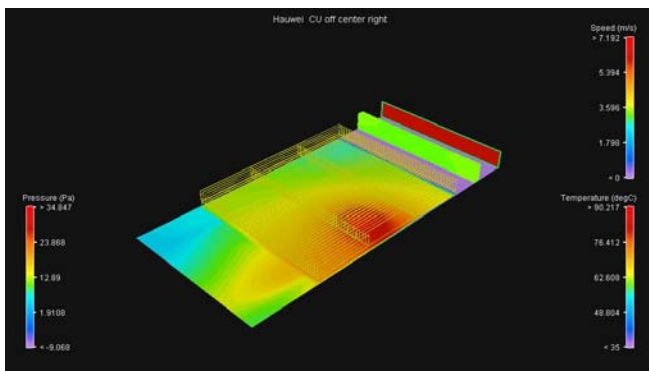
Figure 1. Vapor Chamber Heat Pipe Assemblies

| Technical Data – Vapor Chamber | |
|---|--|
| Thermal Resistance ($^\circ\text{C}/\text{W}$) ¹ | 0.10 - 0.25 $^\circ\text{C}/\text{W}\text{-cm}^2$ |
| Size: | Custom Sizes ranging from 1" x 1" x 0.04" to 14" x 12" x 0.1" |
| Options | Various Shapes (Square, L-shaped, Rectangular, with Pedestals, etc.) |
| Sealing Technologies | Brazed or Welded Assemblies |
| Wall Material | High Purity Copper |
| Working Fluid | Water |
| Wick | Sintered Copper Powder |
| Maximum Heat Flux | $>300\text{ Watts}/\text{cm}^2$ |

Thermacore Therma-Base™ Advantages

- Industry Leading Thermal Performance
- Highest Performing Heat Spreader in the Industry
- Manufactured over 300,000 vapor chambers in volume without a single field failure
- Application improvement of over 30% in high flux, poor spreading applications
- Can be engineered to withstand increase internal pressure (Working temperatures +150°C)
- Patented Thru-Hole Technology allows both straight and threaded holes through the highly conductive vapor space region for ease in design of attachment hardware
- Thermacore vapor chambers have been successfully thermally cycled from -40°C to +85°C
- Thermacore has over 24,000 hours of vapor chamber life testing

The following graphic represents an actual 1U application. It confirms a 27% thermal improvement performance gain using the exact same airflow, fin pitch, fin thickness and thickness of the base for both heat sinks. The only change is substituting the Therma-Base for the copper base.



All Copper Base Heat Sink = 0.423 °C/Watt vs. Therma-Base™ Heat Sink = 0.307 °C/Watt

Other References that can be found on the Thermacore Web Site:

- [Therma-Base Technical Datasheet \(Click Here\)](#)
- [CFD Modeling of Therma-Base Heat Sinks™, K. Grubb \(Click Here\)](#)
- [Use of Vapor Chambers for Thermal Management, K. Grubb, D. Mehl, P. Dussinger \(Click Here\)](#)
- [Therma-Base Vapor Chamber Heat Sinks Eliminate Semiconductor Hot Spots, D. Mehl \(Click Here\)](#)
- [Therma-Base™ Heat Sinks for Microprocessor Cooling, K. Grubb, D. Mehl, P. Dussinger \(Click Here\)](#)
- [Therma-Base™ Heat Sink Testing Guidelines \(Click Here\)](#)
- [Alleviating Thermal Spreading Resistance in Telecommunications Systems, G. Thyrum \(Click Here\)](#)
- [Analysis of Heat Pipe Assisted Heat Sinks, J. Thayer \(Click Here\)](#)
- [Vapor Chamber in Blade CPU Cooling, M. Connors](#)