

Therma-Base® Vapor Chamber

Aavid, Thermal Division of Boyd Corporation's Therma-Base® Vapor Chamber (Figure 1) is a two-phase heat transfer device that spreads heat in three directions. Vapor chambers are typically referred to as planar flat heat pipes, which are used as the base of a heat sink. The vapor chamber incorporates sintered powder wick structures that provide high-heat flux heat dissipation capability (>350 Watts/cm²) (Figure 2), and improves thermal performance of up to 30%, compared to a solid aluminum or copper-based heat spreader (Figure 3). Its smaller size improves system packaging and provides quieter operation through less air flow. Minimal design effort is required because a metallic-based heat spreader can be changed to a vapor chamber without altering the geometry of the original design.

Methods to Attach Vapor Chamber Base

Aavid developed two options to thermally attach the vapor chamber base to a heat sink's cooling fins to greatly reduce the fin-to-base thermal resistance. With copper and nickel plated aluminum heat sinks, the vapor chamber can be directly soldered to the fins. In more cost-sensitive applications, Aavid uses a thermally conductive adhesive film, which covers the epoxy joint evenly throughout the surface.

Performance

The graphs (Figures 3 and 4), which represent a 1U application, show that the Therma-Base® Vapor Chamber thermal performance is 27% better than a copper-based heat spreader, using the same airflow, fin pitch and thickness, and thickness of the base.

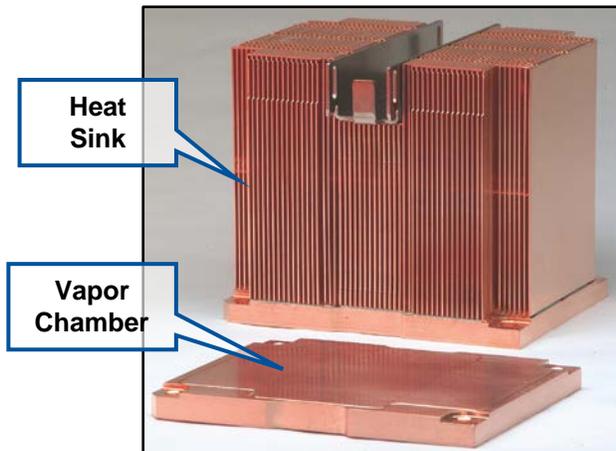


Figure 1 – Therma-Base® Vapor Chamber

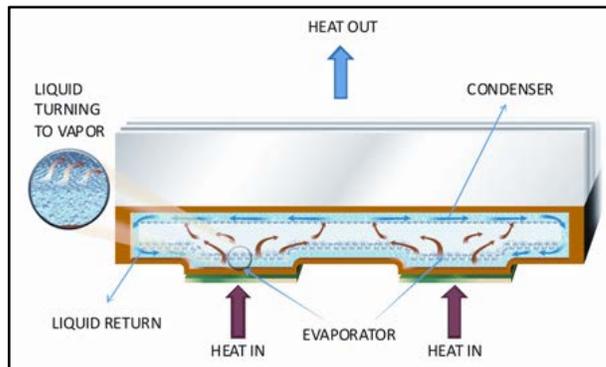


Figure 2 – Vapor Chamber Operation

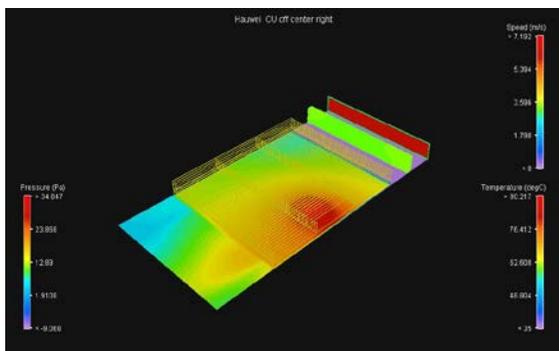


Fig. 3 – Copper-Based Spreader = 0.423° C/W-cm²

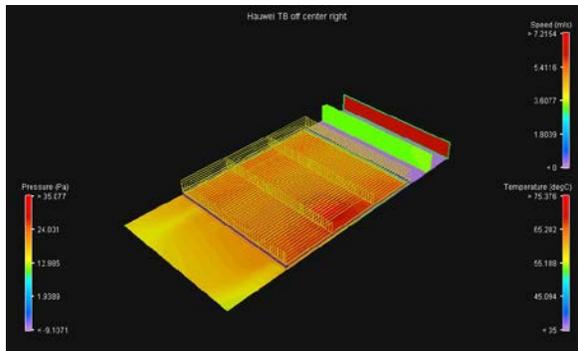


Fig. 4 – Therma-Base® Heat Spreader = 0.307° C/W-cm²

Key Features and Benefits

- ▶ Highest performing heat spreader in the industry
- ▶ Effective thermal conductivity over 5,000 W/m·K
 - » vs. Pure copper (401 W/m·K) & Graphite (1,200 W/m·K)
- ▶ Can be engineered to withstand increased 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*
- ▶ Successfully thermally cycled from -40°C to +85°C
- ▶ More than 50,000 hours of vapor chamber continuous life and reliability testing
- ▶ Shipped more than 500,000 vapor chamber assemblies
- ▶ Compatible with advanced thermal technologies

Critical Application Need

- ▶ Computer CPU and GPU Cooling:
 - Desktops, Laptops, Tablets, and Servers
- ▶ Low-Profile Applications: Blade Servers
- ▶ Military, Power Electronics Cooling:
 - IGBTs, MOSFETs, TWTs, and SGTs
- ▶ Telecom Communications: RF Amplifiers
- ▶ High Temperature Applications (>100°C)
- ▶ High Strength and Clamping Force Applications

Options – Therma-Base® Vapor Chamber	
Thermal Resistance (°C/W-cm ²)	0.01 to 0.25 typical
Maximum Heat Flux	350 Watts/cm ²
Sizes	Any size made custom to given application
Thickness	1mm to 10mm (3-4mm typical)
Shape Options	Various Shapes (Square, L-shaped, Rectangular)
Evaporator Surface	Custom “Skyline”
Sealing Technology	Brazed or Welded
Wall Material*	OFE Copper (typical) Titanium Copper/Moly/Copper Other CTE Matching
Working Fluid*	Water
Wick	Sintered Copper Powder, Screen, or Combination

*Note: Wall and Working Fluid must be compatible

