



AAVID
THERMALLOY

Thermal Management Solutions for Cooling Electronics





OUR MISSION

Aavid Thermalloy will lead the electronics thermal management industry worldwide. We will be the first company customers call to enable their thermal designs anywhere in the world. We will respond with extraordinary speed and will provide them with timely and cost effective solutions because we understand their needs, their industry, and their culture.

About Aavid Thermalloy LLC

Aavid Thermalloy, LLC, a subsidiary of Aavid Thermal Technologies, Inc., is the world's leading provider of thermal management solutions. Founded in 1964 as Aavid Engineering, Aavid quickly established a reputation for excellence and in 1999 acquired Thermalloy, Inc. Today Aavid Thermalloy is the oldest and largest business devoted exclusively to thermal management of electronic systems. We have built an impressive track record by deploying world class engineering resources that work directly with our customers to remove damaging heat from electronic equipment.

Aavid Thermalloy is the partner of choice for electronics companies focused on introducing next generation products to market faster, with greater reliability, and increased functionality. Leading the way with the industry's broadest line of standard products, Aavid Thermalloy is the most recognized heat sink manufacturer in the world. Our design capabilities extend beyond standard products and use the most advanced thermal engineering resources available to design application specific products. Aavid Thermalloy solutions cool critical electronic components in computers, transportation, communications infrastructure, power supplies, motor controls, power conversion equipment, and more.

From our headquarters located in Concord, New Hampshire and locations around the globe, we develop and market innovative approaches to overcome the thermal challenges facing equipment designers in North America, Europe, and Asia. Our design resources and investment in advanced manufacturing technologies have positioned Aavid Thermalloy as *The Total Integrated Solution for Cooling Electronics.*®

Global Customer Service

Anticipate and meet customer needs with the highest quality products and services in a timely and cost effective manner

World Wide Sales and Distribution

Support product development cycles with dedicated sales engineering resources and distribution partners that deliver on time, anywhere in the world

Design Services

Guide our customers through thermal design issues at all stages of product development from concept to production with solutions that provide competitive advantage

World Class Manufacturing

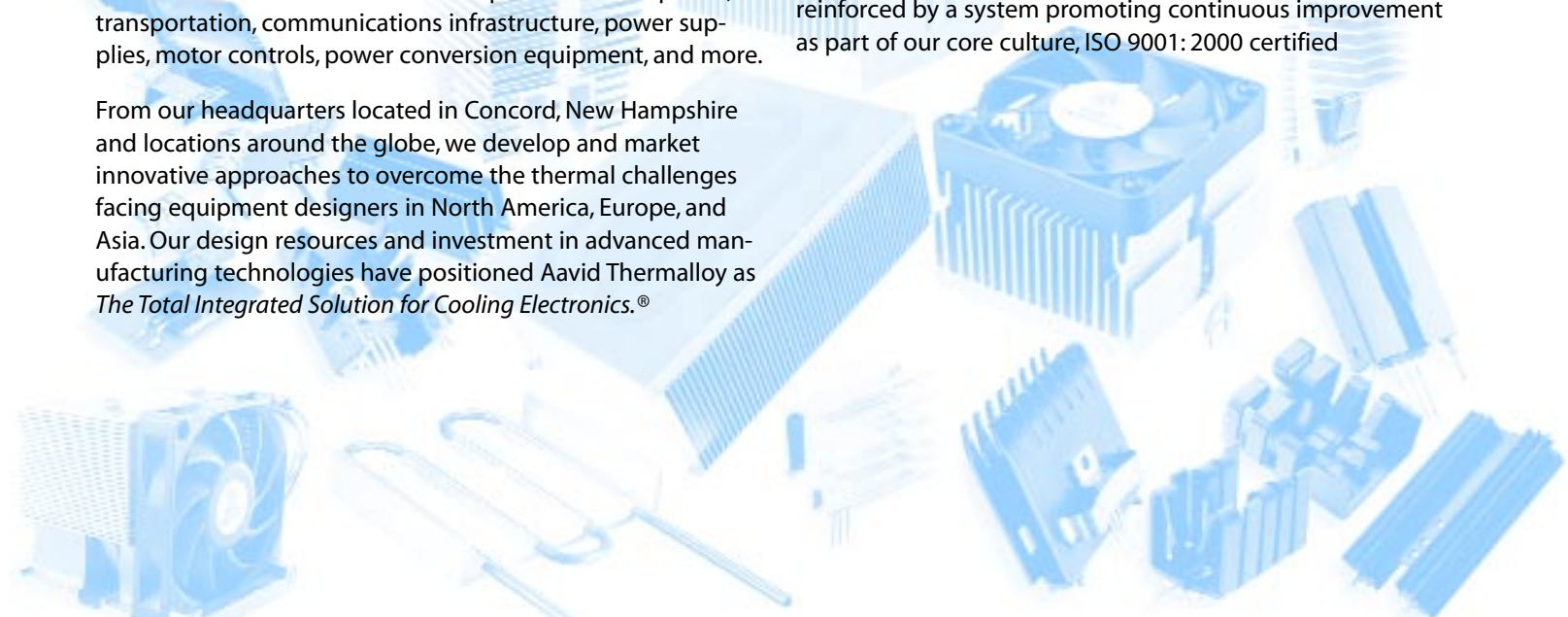
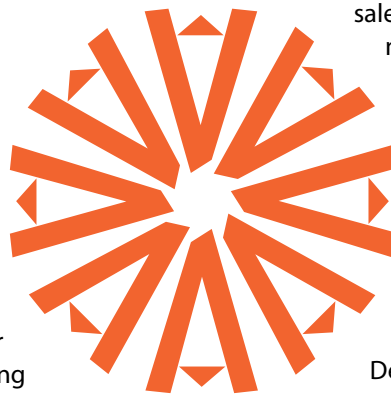
Deliver innovative, quality products to market cost effectively using global resources and a broad portfolio of manufacturing processes and capabilities

Global Logistics Support

Integrate seamlessly into our customers supply chain by leveraging our global footprint to supply product quickly

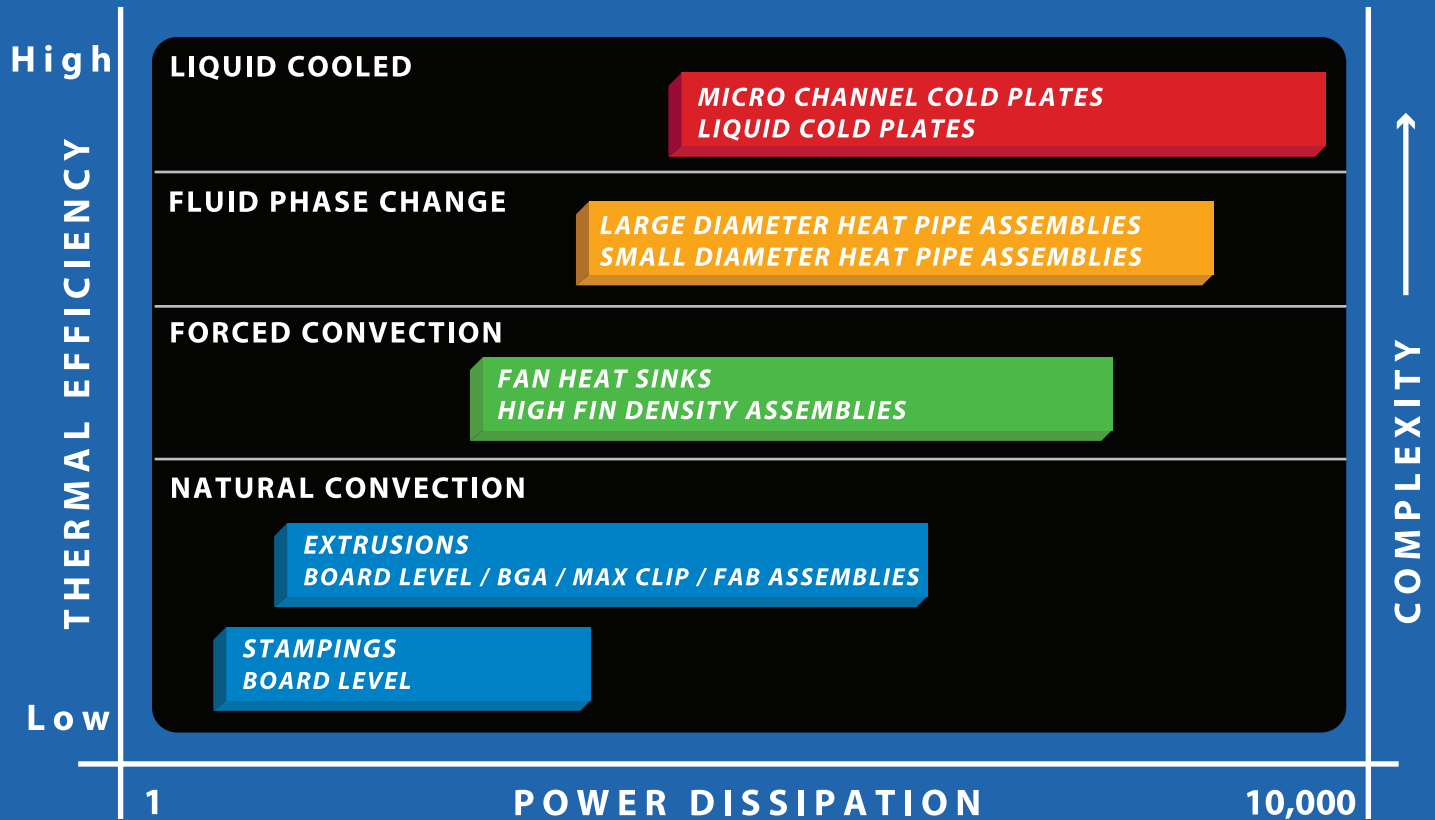
Quality Systems Management

Pursue an approach to quality and reliability that is reinforced by a system promoting continuous improvement as part of our core culture, ISO 9001:2000 certified





Technology Selection Guide



The graph illustrates the relationship between Power Dissipation of an application versus the Thermal Efficiency of a given solution. The X Axis indicates the total amount of power to be removed, while the Y Axis can be defined as the relationship of thermal resistance with respect to total power, unit volume, and heat flux density. This tool serves as the starting point for solving thermal problems by narrowing the field of available solutions. Suitable technologies for an application can be identified by plotting the expected Power Dissipation on the X Axis and considering the entire range of intersecting Aavid Thermalloy solutions along the Y Axis. Dependent upon the power used and the dynamics of the system configuration, there may be more than one appropriate cooling mechanism to solve your thermal problem.

Four Primary Cooling Mechanisms

NATURAL CONVECTION applications do not rely on a specified local air velocity for heat dissipation. Typical natural convection heat sinks are passive in nature and manufactured from copper or aluminum sheet, extruded aluminum, machined or cast alloys.

FORCED CONVECTION applications require forced air velocity generated through the incorporation of either a dedicated or system level fan(s) in order to increase thermal efficiency. Fan heat sinks, high fin density assemblies, as well as board level coolers are manufactured and configured for either impingement¹ or cross flow² environments.

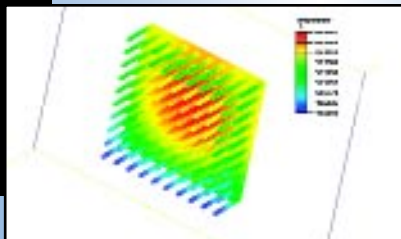
FLUID PHASE CHANGE applications, also known as re-circulating, typically employ closed loop heat pipes which allow the rapid exchange of heat transfer through evaporation and condensation. Heat pipes are integrated into other heat sink technologies to further increase the thermal efficiency when greater density is required or physical size restrictions exist.

LIQUID COOLED applications comprise channeled cold plates along with a heat exchanger and pump system in order to circulate fluids past a heat source. Generally, liquid cooled technologies are reserved for applications containing high heat flux density where forced convection or phase change systems are unable to dissipate the power demands.

¹ airflow directed at the base of a heat sink

² airflow directed across the fins

Natural Convection



STAMPED SOLUTIONS *for Low Power Board Level Cooling*

Stamped Heat Sinks provide an economical solution to low power density thermal problems in natural convection environments. Produced using high volume manufacturing techniques to ensure the lowest cost, copper or aluminum sheet metal is stamped into a desired shape. Attachment features and interface materials can easily be added during the manufacturing process, simplifying the bill of materials and reducing assembly costs.



SMT Power Semiconductors



Thru-Hole Power Semiconductors



Dual In-Line Package



Axial Lead Components

Why Use Aavid Stamped Heat Sinks?

- **Lowest cost thermal solutions**
- **Ideal for Printed Circuit Boards with tight component spacing**
- **Readily available from Aavid Thermalloy and its authorized distributors**
- **Variety of attachment methods and accessories to simplify assembly and reduce cost**
- **Several surface finishes to enhance durability and cooling efficiency**

EXTRUDED SOLUTIONS *for High Power Board and System Level Cooling*

Extruded Heat Sinks provide a greater range of natural convection solutions for higher power components and systems. Complex fin structures can be created by forcing raw aluminum through an extrusion die. These complex fin profiles allow greater heat dissipation through increased surface area while eliminating the cost and time associated with machining an equivalent shape from block aluminum.



Custom Fabricated To Specification



Standard IC Packages (BGA/PGA)



Thru-Hole Power Semiconductors



DC/DC Converters



MAX CLIP® Clip & Rail System for Power Semiconductors

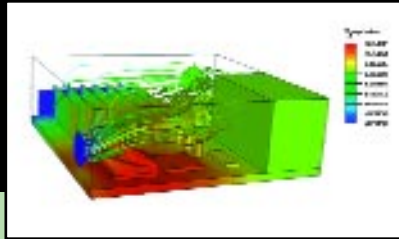
Why Use Aavid Extruded Heat Sinks?

- **More efficient than stamped heat sinks**
- **Lower cost than fully machined assemblies**
- **Many standard shapes and sizes assure availability**
- **Easily customized for any application**
- **Significant weight advantage over copper**
- **MAX CLIP® system eliminates mounting hardware and tools**

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Try Aavid's easy to use extrusion search tool which allows users to quickly select the extrusion that best fits an application. The product coding system makes it simple to identify an extrusion that is normally stocked at Aavid.

Forced Convection



HIGH FIN DENSITY HEAT SINKS *for High Power Cooling*

High Fin Density Heat Sinks provide increased efficiency for high power applications under forced convection by creating greater volumetric surface area and are classified into two types: High Aspect Ratio Extrusions and Fabricated Fin Assemblies. Although both types offer considerable performance gains over standard extrusions, Fabricated Fin Assemblies are constructed from a base and have independent fins, which allow greater aspect ratios¹ than current extrusion processes. These heat sinks can be assembled using a variety of fin types such as stamped, folded, or zipper which are attached to a base using epoxy bonding, swaging, brazing, or soldering.



Folded Fin, Optifin & Zipper Fin

Why Use Aavid High Fin Density Heat Sinks?

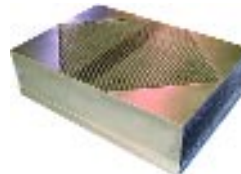
- *Overcome high heat flux in space constrained areas*
- *Standard and custom offerings available*
- *Engineering expertise to design the most economic solutions*
- *Broad range of fin designs to match thermal requirements*
- *Expertise in copper and aluminum joining technologies*



Epoxy Bonded & Augmented Fin



High Aspect Ratio Extrusion



Brazed Fin

FAN HEAT SINKS *for High Power Cooling*

Fan Heat Sinks provide significant component cooling benefits over system level fans by incorporating a dedicated fan with a heat sink base increasing localized airflow and improving thermal efficiency. These active fan heat sinks allow for much greater thermal performance than can be achieved with an equivalent size passive solution. By matching fan performance to a variety of extrusion or other fabricated fin bases, fan heat sinks can be designed to meet specific application requirements.



Microprocessor and Chipset Coolers

Why Use Aavid Fan Heat Sinks?

- *Enhanced performance in less space*
- *Increased life and reliability of critical high power components*
- *System airflow restricted or just not possible*
- *Impingement designs cool adjacent components*
- *Skilled design engineers utilizing latest CFD design software*



POLAR CAP™ Augmented Fin Coolers



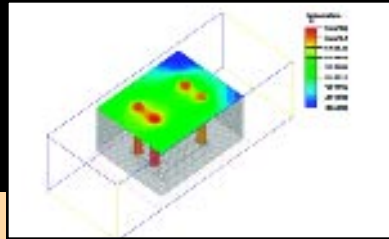
BRAZEDGAIN™ Cross-Cut Fabricated Fin Coolers



POWERGAIN™ Extruded Pin Fin Coolers

¹ Ratio of fin thickness versus fin height.

Fluid Phase Change



SMALL DIAMETER HEAT PIPE SOLUTIONS *for High Power Cooling*

Small Diameter Heat Pipe Assemblies provide greater thermal efficiency by embedding heat pipes into an assembly to transport heat away from a concentrated source. Heat pipes passively facilitate this transfer by employing an evaporator and condenser in a closed loop mechanism, spreading heat evenly within a base or transporting it to peripheral fins. A variety of basic heat sink technologies benefit from integrating heat pipes which improve conduction paths, reduce overall weight, and raise thermal performance without increasing volume.



Optifin Heat Pipe Towers

Why Use Aavid Small Diameter Heat Pipe Assemblies?

- *Extends thermal range of both natural and forced convection cooling*
- *HiContact™ heat pipe embedding process improves thermal transfer*
- *Pioneer with nearly 10 years experience*
- *Over 10 million high quality units shipped*
- *Rapid design and prototype capability*



Embedded Heat Pipes



Laptop PC Heat Pipe Solutions



Heat Pipe Towers With Fan

LARGE DIAMETER HEAT PIPE SOLUTIONS *for High Power Cooling*

Large Diameter Heat Pipe Assemblies function in the same manner as small diameter heat pipes but are capable of transferring much greater power loads because of increased interior volume and circumferential surface area. Due to the diverse nature of the applications, most large diameter heat pipes are custom fabricated and may employ different combinations of wick structures, fluid types, liquid volumes, and construction methods in order to maximize performance.



Large Scale Heat Pipe & Extrusion Assembly

Why Use Aavid Large Diameter Heat Pipe Assemblies?

- *Best passive cooling system available*
- *In house heat pipe design and fabrication*
- *High reliability and long service life*
- *Experts in heat pipe design, construction, and integration*
- *Advanced thermal modeling and testing capabilities*

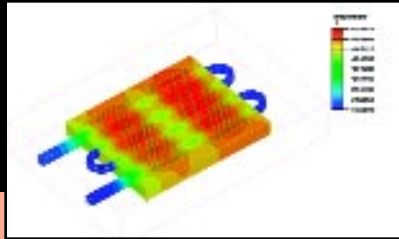


Embedded Heat Pipes
with Fabricated Fin Assembly



Powerpipe Solutions

Liquid Cooled

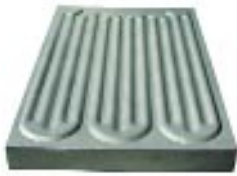


LIQUID COLD PLATES *for High Power Cooling*

Liquid Cold Plate Heat Sinks provide the best thermal performance per unit volume and counter nearly every drawback associated with air cooling by dissipating more heat with considerably less flow volume, better temperature consistency, and less local acoustic noise. Cold plates take advantage of the increased thermal conduction properties of liquid by actively circulating fluids past a heat source through a closed loop system. These liquid passageways are formed by sealing machined channels or adding copper or other tubing to a metal base plate



HiContact™ Cold Plates



Brazed Blister Cold Plate



Extruded Channel Cold Plate



Complex Custom Solutions

Why Use Aavid Liquid Cold Plates?

- **Most compact and efficient cooling method available**
- **HiContact™ process improves thermal transfer**
- **Quiet, reliable and leak free**
- **Compatible with water, glycol, or other cooling fluids**
- **Standard models and custom designs available**

MICRO CHANNEL TECHNOLOGY *for High Power Cooling*

Micro Channel Cold Plates provide the superior performance of traditional liquid cooling in a much smaller footprint by forcing fluid through a network of miniature passageways in a cold plate mounted directly above a heat source. These compact, active solutions are suitable for high performance microprocessors and other high heat flux density applications. The major advantage of micro channel heat sinks is the high heat transfer coefficients, up to 60 times higher than conventional heat exchangers. Micro channel heat sink technology will have a major impact on the future of electronic packaging and design.



Multilayer Micro Channel Technology

Why Use Aavid Micro Channel Cold Plates?

- **Small, quiet and efficient**
- **Innovative technology**
- **Leaders in design and manufacturing**
- **Flexible, scalable solutions**
- **Advanced thermal modeling and testing capabilities**



AAVID THERMALLOY

Aavid Thermal Technologies, Inc. The Total Integrated Solution for Cooling Electronics®

Aavid Thermal Technologies, Inc., operates through its subsidiaries in three business areas - Thermal Management Solutions, Computational Fluid Dynamics (CFD) Software and Customized Computer-Aided Engineering. Each of these businesses has an established reputation for high product quality, service excellence and engineering innovation.

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Fluent Inc. is the worlds largest provider of commercial CFD software and services. The company offers general purpose CFD software for a wide range of industrial applications, along with highly automated, application focused packages including ICEPAK® for cooling electronics. CFD consulting services are also available worldwide. Its staff includes CFD engineers, plus experts in computational methods, mesh generation, and software development.

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Applied Thermal Technologies is the leading thermal engineering company specializing in system, board, and component level design and analysis using CFD/FEA and experimental techniques. Applied can analyze and solve all your thermal challenges. With US offices in Santa Clara, California and, Richardson, Texas, as well as international offices in the Pacific Rim, Applied assists companies globally. Dedicated thermal engineers characterize your system and provide the most advanced and effective cooling solutions, saving thousands in engineering resources, thermal modeling software, and test hardware.

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